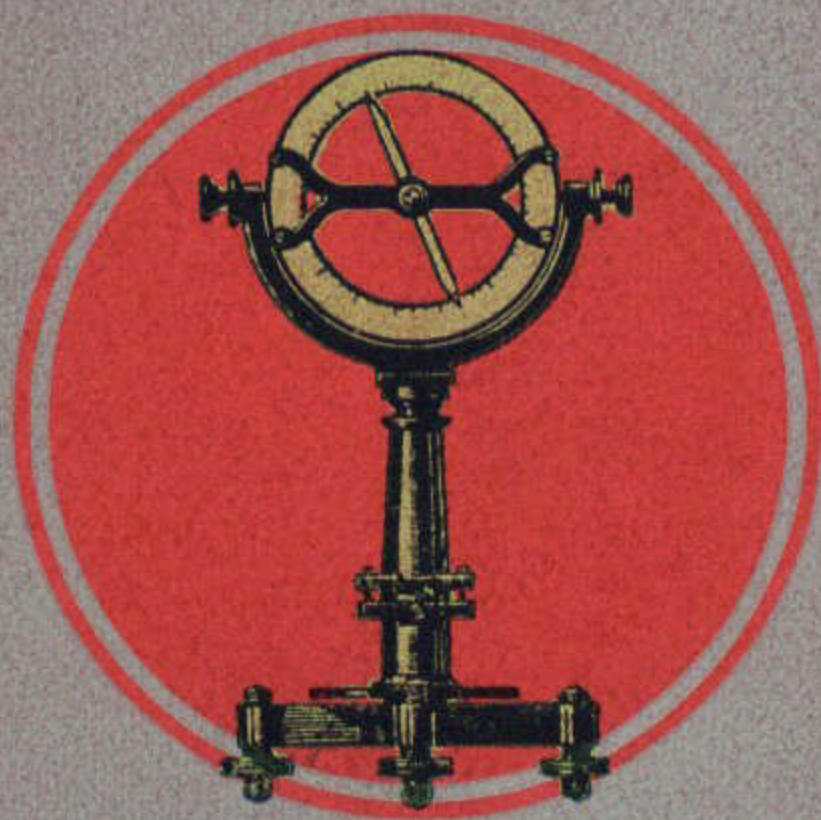


 Catalog M 

PHYSICAL &  
CHEMICAL  
APPARATUS

May 1912



Manufactured & Imported by  
**CENTRAL SCIENTIFIC  
COMPANY**  
CHICAGO, U.S.A.

**PHYSICAL *and* CHEMICAL  
APPARATUS**

MANUFACTURED AND IMPORTED BY

**CENTRAL SCIENTIFIC CO.,**

412 to 420 Orleans Street,

**CHICAGO**

U. S. A.

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May, 1912.

Reprinted March, 1915.

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**Established**  
1889

A. H. McCONNELL, Pres.  
H. C. ARMS, Vice-Pres.  
J. M. ROBERTS, Secy.  
A. H. STANDISH, Treas.

**Incorporated**  
1900

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**CATALOGUE M**

51680

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## Notice to the Trade.

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CENTRAL SCIENTIFIC COMPANY.

March 1, 1915.



## To Science Teachers.

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We present this catalog to Science Teachers, believing that it is in many respects superior to any catalog in our line heretofore issued in this country, and with it our assurance on the following important points:—

1. The illustrations represent faithfully the apparatus offered for sale,
2. The descriptions are drawn with all the detail and accuracy that space will permit,
3. The statements as to efficiency, sensibility, etc., of the apparatus are based upon actual tests, and may be relied upon.

We have endeavored to eliminate the obsolete and less efficient types of apparatus, and have made our selections only after a careful study of all the standard Text Books and a thorough examination of the various types of instruments in the market.

A helpful feature of this catalog is the method we have employed to aid the teacher in selecting instruments for demonstrations of a particular nature. To do this we state what the instrument is designed to do, how it is operated and the special structure that makes the attainment of desired results possible. In extension of these helpful features we supplement the brief catalog descriptions by furnishing detailed instructions with each instrument when shipped, where it is considered by us at all helpful and advisable.

CENTRAL SCIENTIFIC COMPANY.

# To Our Customers.

This edition of Catalog M thoroughly revises our prices. Many new pieces are added; a few pieces have been omitted and others materially modified. All future sales and quotations will be based hereon.

We are desirous of avoiding mistakes and misunderstandings in our dealings and therefore make the following suggestions, the careful observance of which will be to our mutual advantage.

Former editions, if used, will cause you and us much inconvenience and possible annoyance, to avoid which we ask you to DESTROY ALL FORMER EDITIONS OF OUR CATALOG M.

**CORRESPONDENCE** should plainly indicate State, Town, and NAME OF SCHOOL and should be OFFICIALLY SIGNED.

**SUGGESTIONS** regarding improvements in our apparatus and the making of new and useful instruments are desired at all times.

## **CHANGES IN DESIGN.**

In order to keep pace with the advancement of science and improved laboratory methods, we may find it necessary to ALTER THE DETAILS OF CONSTRUCTION of apparatus from catalog illustration. Where such modification does not meet the approval of the purchaser, he is at liberty to return the apparatus.

## **SPECIAL APPARATUS.**

We are prepared to build special apparatus to order from original drawings and specifications.

## **ORDERS AND LISTS FOR QUOTATION.**

1. When possible, specify our catalog number, name of article, and dimensions. Further specification is not necessary. We furnish conveniently ruled order sheets upon request.

Note: Lists made from catalogs of other dealers will be transposed by us into our own numbers when possible, with our guarantee that the articles will equal in efficiency and finish those originally specified.

2. Specify date when shipment is desired, with route and method of shipment, i. e., by express or freight.

**DUTY FREE IMPORTATIONS**, see page 313.

## **REPAIRS.**

Our manufacturing facilities and skilled workmen enable us to repair instruments of any make. Our charge therefor is based upon the actual number of hours consumed. Apparatus for repair or exchange should be carefully packed and addressed, and should have TAGS ATTACHED, showing NAME AND ADDRESS OF OWNER. LETTER OF ADVICE SHOULD BE SENT US THROUGH THE MAILS.

## **SHIPMENTS.**

Unless otherwise ordered, shipments are made by us AT ONCE, by such route as will insure earliest delivery. Large shipments are made by freight and smaller shipments by express or mail, as seems expedient to us.

## **PRICES.**

Prices herein are subject to a discount of TEN PER CENT, except on items marked NET or DUTY FREE; the latter will be quoted upon application. NO CASH DISCOUNT for prepayment allowed.

NO CHARGE FOR BOXING AND CARTAGE except on orders of \$10.00 or less; then a nominal charge will be made if the boxing expense exceeds five per cent of the value of the shipment.

## **TERMS.**

Thirty days after delivery unless special terms are arranged for.

NOTE: Unless otherwise directed, invoices and statements will be mailed to the person placing the order, upon whom we rely to O. K. THE BILLS PROMPTLY and thus EXPEDITE PAYMENT.

## **REMITTANCES.**

Remittances should be in exchange at par in Chicago, as we are obliged to pay exchange upon all private checks, except from a few of the largest cities.

NOTE: School Warrants tendered as payment, the funds for which are not immediately available, should, if possible, be registered before sending.

CENTRAL SCIENTIFIC COMPANY.

## UNIVERSAL PHYSICAL LABORATORY SUPPORTS.



Nos. 1-6.



Nos. 16-18.

Unless otherwise stated the supports and clamps listed on the following pages are of iron or steel, the bases and clamps being nicely finished with two coats of japan. They can, however, be furnished in brass at an increased price. Prices will be quoted on application.

## TRIPOD BASES.

A tripod base is a most essential part of any system of laboratory supports, and must therefore be very carefully made. We call attention to features which our experience has suggested for improvement over the bases already on the market. Each base is made as heavy as practicable with the center of mass low. In addition, we have made the legs as long as each individual base would allow, which insures stability. Each one of our bases is faced, drilled and threaded by lathe operations and we guarantee that a rod will stand perpendicular to the table or floor. The English thread is used, the pitch and the diameter being given below.

1. Tripod Base, length of leg 11 cm. Tapped to receive 10 mm. rod. Diameter of thread, $\frac{1}{4}$ inch. Number of threads to the inch, 20...	\$ 0.33
2. Tripod Base, length of leg 13.5 cm. Tapped to receive 13 mm. rod. Diameter of thread, $\frac{3}{8}$ inch. Number of threads to the inch, 16...	.40
3. Tripod Base, length of leg 15.8 cm. Tapped to receive 13 mm. rod. Diameter of thread, $\frac{3}{8}$ inch. Number of threads to the inch, 16...	.67
3A. Tripod Base, length of leg 15.8 cm. Tapped to receive 19 mm. rod. Diameter of thread, $\frac{1}{2}$ inch. Number of threads to the inch, 12...	.67
4. Tripod Base, length of leg 20 cm. Tapped to receive 19 mm. rod. Diameter of thread, $\frac{1}{2}$ inch. Number of threads to the inch, 12...	1.00
5. Tripod Base, length of leg 22 cm. Tapped to receive 30 mm. rod. Diameter of thread, $\frac{3}{4}$ inch. Number of threads to the inch, 10...	1.50
6. Tripod Base, length of leg 40.8 cm. Tapped to receive 30 mm. rod. Diameter of thread, $\frac{3}{4}$ inch. Number of threads to the inch, 10...	5.75
7. Tripod Base, No. 1, with three nickel plated leveling screws.....	1.33
8. Tripod Base, No. 2, with three nickel plated leveling screws.....	1.40
9. Tripod Base, No. 3, with three nickel plated leveling screws.....	1.67
10. Tripod Base, No. 3A, with three nickel plated leveling screws.....	1.67
11. Tripod Base, No. 4, with three nickel plated leveling screws.....	2.00
12. Tripod Base, No. 5, with three nickel plated leveling screws.....	2.50
13. Tripod Base, No. 6, with three nickel plated leveling screws.....	7.00

## ROUND BASES.

The description of tripod bases given above applies in general to the round bases listed below. Special attention is given to facing these bases on both top and bottom so that the rod will stand perpendicular to the table.

16. Round Base, 8.5 cm. diameter, tapped to receive 10 mm. rod.....	.22
17. Round Base, 11.5 cm. diameter, tapped to receive 10 mm. rod.....	.30
18. Round Base, 14.3 cm. diameter, tapped to receive 13 mm. rod.....	.35

## SUPPORT RODS.

These rods are made of Bessemer steel, copper plated to prevent rusting, and nickel plated. The shoulders of these rods are made so that they fit the facing of the base closely.



Nos. 20—23.

20. **Support Rod.** Diameter 10 mm. Threaded to fit Nos. 1, 7, 16 and 17 Bases.  
Length above shoulder..10 cm. 15 cm. 20 cm. 30 cm. 40 cm.  
Each ..... \$0.16 .18 .20 .25 .30
21. **Support Rod.** Diameter 13 mm. Threaded to fit Nos. 2, 3, 8, 9 and 18 Bases.  
Length above shoulder..20 cm. 40 cm. 60 cm. 80 cm. 100 cm.  
Each ..... .25 .35 .50 .60 .70
22. **Support Rod.** Diameter 19 mm. Threaded to fit Nos. 3A, 4, 10 and 11 Bases.  
Length above shoulder.. 30 cm. 40 cm. 60 cm. 80 cm. 100 cm. 125 cm.  
Each ..... .40 .50 .66 .85 1.00 1.25
23. **Support Rod.** Diameter 30 mm. Threaded to fit Nos. 5, 6, 12 and 13 Bases.  
Length above shoulder.. 60 cm. 80 cm. 100 cm. 120 cm. 160 cm.  
Each ..... 1.50 1.75 2.10 2.45 3.35
24. **Support Rod.** Diameter 19 mm. For use as horizontal cross rod in connection with No. 39 Clamp and No. 22 Support Rod. Rounded ends. Not threaded.  
Length above shoulder..... 100 cm. 125 cm. 185 cm.  
Each ..... 1.00 1.25 2.00

25. **Support Rod, square.** One end is turned for 2.5 inches to a diameter of 19 mm. with threading to fit Nos. 3A, 4, 10 and 11 Bases.



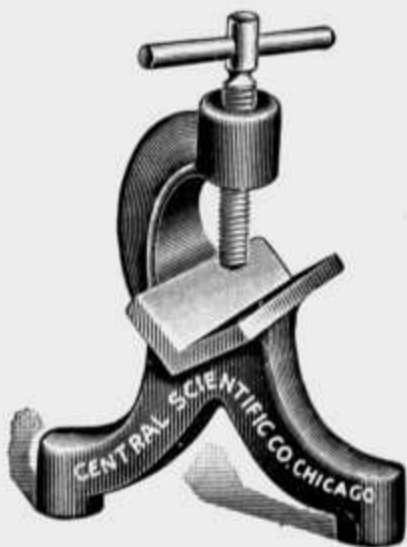
No. 25.

- Length above shoulder..40 cm. 60 cm. 80 cm. 100 cm. 150 cm. 200 cm.  
Each ..... 1.15 1.55 2.00 2.35 3.60 4.50
- 25A. **Support Rod.** Same as No. 25, but graduated in millimeters.  
Length above shoulder..... 120 cm. 220 cm.  
Length of graduated portion..... 100 cm. 200 cm.  
Each ..... 6.65 10.00

## CLAMPS AND SUPPORTS.

In all our Clamps with V openings, we have modified the old designs so that the screws are long enough to reach to the apex of the V.

Instead of thumb nuts we use a nickel plated T-screw, as shown in the illustrations. All V's are accurately milled.

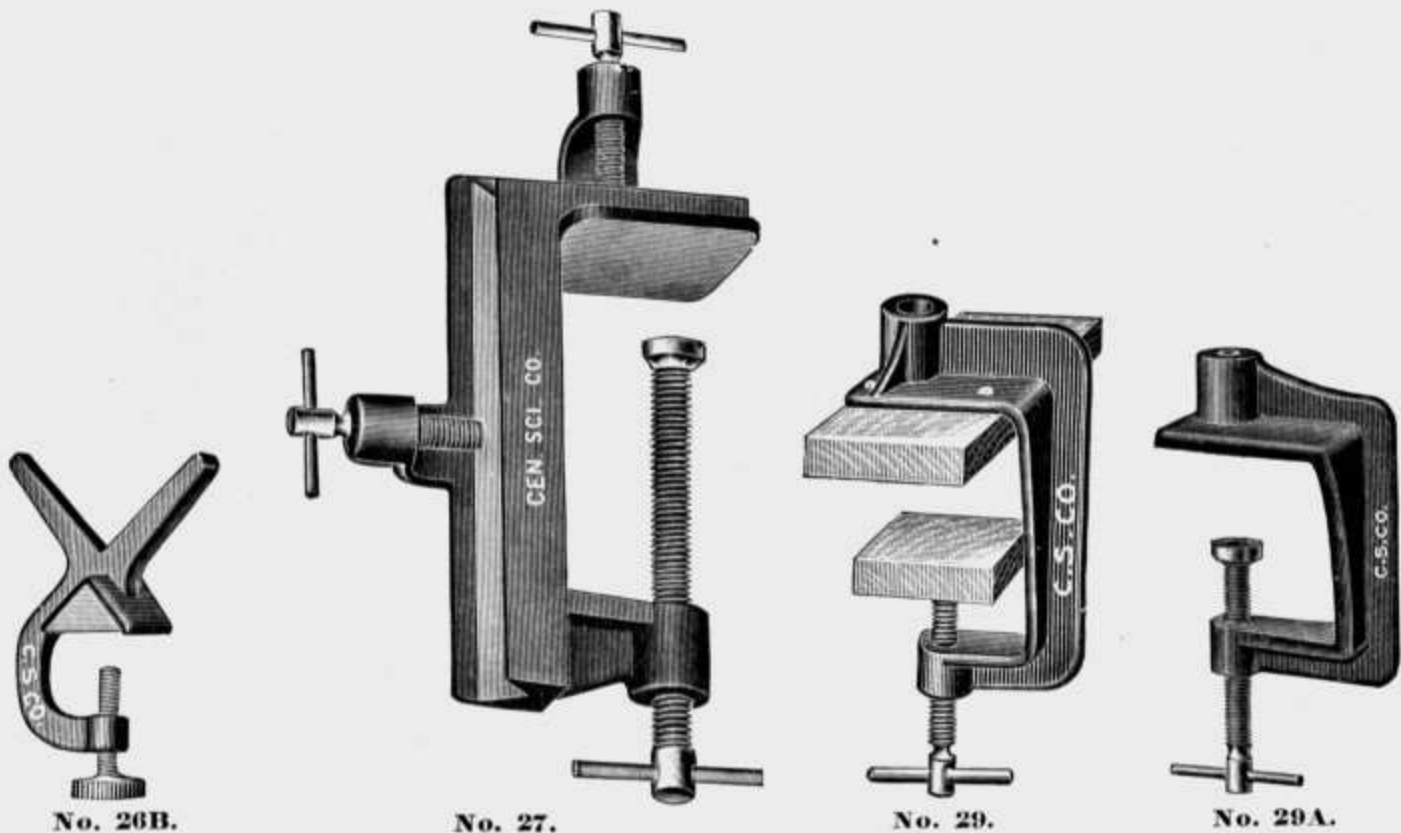


No. 26.

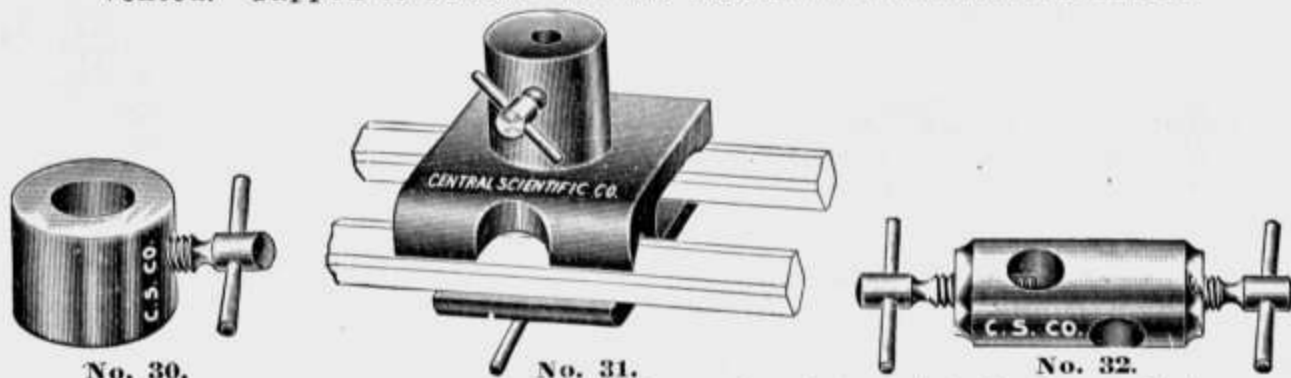


No. 26A.

26. **End Support,** for holding rods in a horizontal position (19 mm. is advised). The increased length of the V in our support is advisable, since it offers a more rigid support in the horizontal plane. The base of the support is milled so that it will stand upright. These clamps are essential in building up the Optical Bench illustrated on pages 249 to 252..... \$ 0.55
- 26A. **End Support,** same as above, to hold two rods 7.5 cm. apart and 15 cm. above the supporting base. One support is supplied with a leveling screw. Per pair..... 2.30

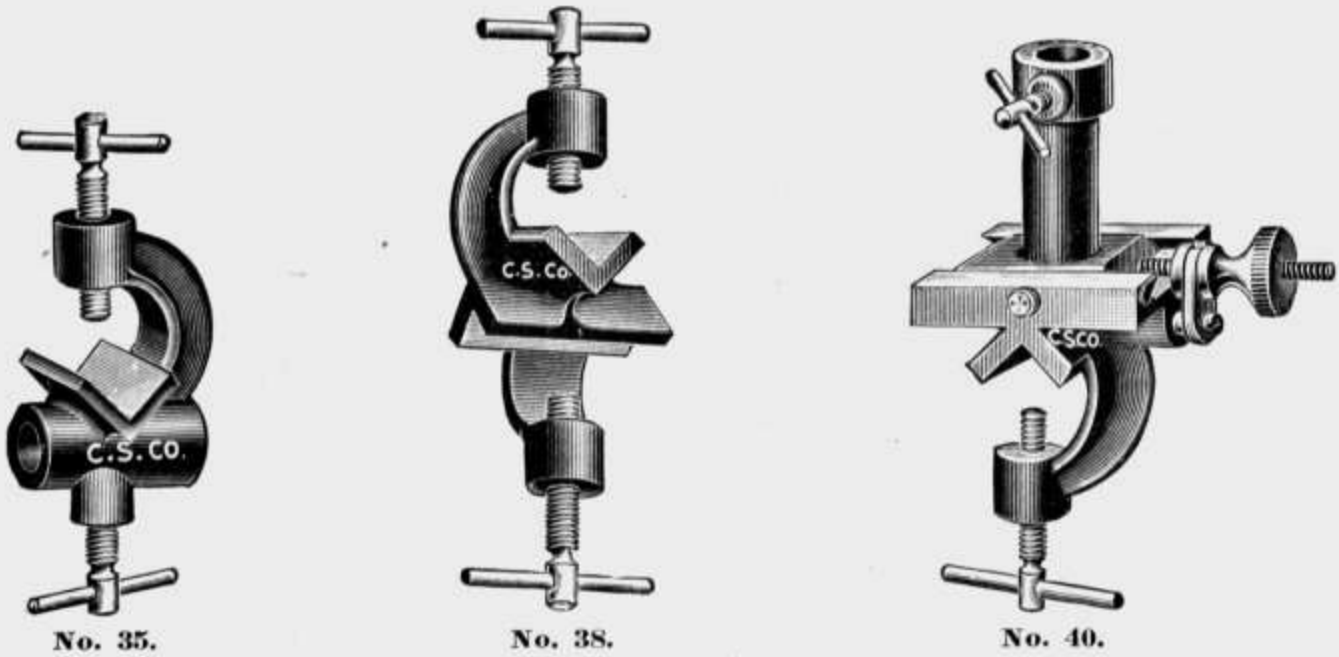


- No. 26B.**  
**26B. V Support**, of brass. Useful for supporting objects of various sizes and forms in a horizontal position, for building telescope holders, level testers, etc. V arms will support an object up to 6 cm. in diameter. To clamp on either 10 or 13 mm. rod..... \$ 0.50
- 26C. V Support**, of brass. Similar to No. 26B, but the V arms will support an object up to 15 cm. in diameter. To clamp on 19 mm. rod or smaller ..... .60
- 27. Table Clamp**, of iron, for a table 8 cm. thick or less, with accurately milled V's at right angles to each other. To be attached to the edge of the table for holding 10 to 19 mm. round or square rods, either horizontally or vertically. The broad flange is carefully milled and insures stability..... 1.40
- 28. Table Clamp**, same as No. 27. For a table 11 cm. thick or less..... 1.60
- 29. Table Clamp**, wooden jaws, for a table 8.5 cm. thick or less. Designed for use where there is danger of injury to the table top. The large surface of jaws gives increased stability. Tapped to receive 19 mm. rod..... 1.65
- 29A. Table Clamp**. Similar to No. 29, but without the wooden jaws. The flange at the top is broad so that injury to the table top is prevented. Tapped to receive 13 mm. rod..... .65

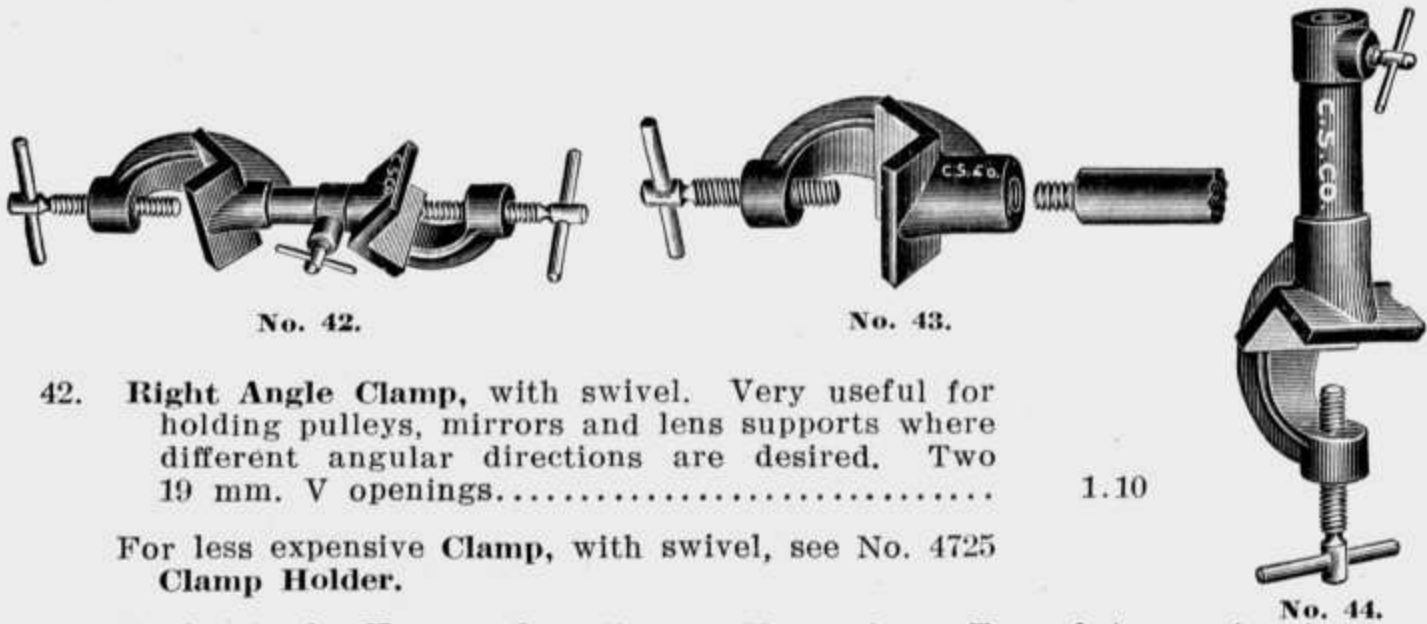


- No. 30.**  
**30. Collar**, with set screw, allowing a clamped rod to rotate freely, and at the same time preventing motion along the axis.  
 For rods .....10 mm. 13 mm. 19 mm. 30 mm.  
 Each ..... .33 .40 .55 .65
- No. 31.**  
**31. Bridge Clamp**, to be used with optical bench or photometer made up of No. 26A End Supports and a pair of 19 mm. square rods. The clamp has an index line in the same plane with the vertical hole, for use with the graduated rods. A slight movement of the handle is sufficient for firm clamping. Hole 10 mm. diameter..... 3.00
- No. 32.**  
**32. Right Angle Clamp**, of brass, nickel plated. To hold two 10 mm. rods accurately at right angles to each other..... .50
- 30A. Hook Collar**, page 487.





- |      |  |    |      |
|------|--|----|------|
| 35.  | Right Angle Clamp, of iron, neatly japanned. V opening 6 to 13 mm. Hole 10 mm.....   | \$ | 0.45 |
| 36.  | Right Angle Clamp, same as No. 35, but V opening 19 mm. Hole 13 mm. ....   |    | .55  |
| 36A. | Right Angle Clamp, same as No. 36, with zero line for use with optical bench accessories .....   |    | 1.00 |
| 36B. | Right Angle Clamp, same as No. 36A, except hole is 6 mm.....   |    | .55  |
| 37.  | Right Angle Clamp, same as No. 35, but V opening 30 mm. Hole 19 mm. ....   |    | .90  |
| 38.  | Right Angle Clamp, of iron, neatly japanned. Two V openings, 13 mm., at right angles.....  |    | .45  |
| 39.  | Right Angle Clamp, same as No. 38. V openings 19 mm.....   |    | .55  |
| 40.  | Right Angle Clamp, with screw adjustment. This clamp is designed to give a very fine adjustment in a plane perpendicular to the V. Range of adjusting screw, 25 mm., V opening 19 mm., hole 10 mm. |    | 5.55 |



- |   |  |      |
|---|--|------|
| 42.   | Right Angle Clamp, with swivel. Very useful for holding pulleys, mirrors and lens supports where different angular directions are desired. Two 19 mm. V openings.....  | 1.10 |
| For less expensive Clamp, with swivel, see No. 4725 Clamp Holder. |  |      |
| 43.   | Right Angle Clamp. One 19 mm. V opening. Tapped to receive 10 mm. rod .....  | .45  |
| 44.   | Right Angle Clamp, for lens holders, telescope supports, pulleys, etc., with zero line for photometer and optical bench accessories. Carefully made so that the rod will be held perpendicular to the V. V opening 19 mm., hole 10 mm..... | .55  |
| 44B.  | Right Angle Clamp, same as No. 44, with addition of spring. Can be moved along the rod without loosening the set screw. Convenient for carrying photometer box.....  | 1.35 |
| 45.   | Right Angle Clamp, same as No. 44. V opening 19 mm., hole 13 mm. For Stone's Tension Clamp, see No. 723.   | .90  |



No. 46.



No. 47.



No. 47A.

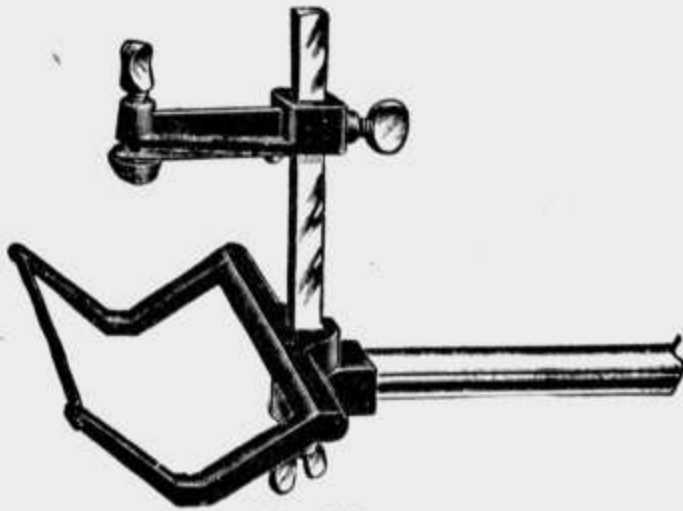


No. 48.

- |      |   |         |
|------|---|---------|
| 46.  | <b>Pulley</b> , of steel, white nickel plated. 45 mm. diameter. Adjustable cone bearing, mounted on nickel plated rod 15 cm. long by 10 mm. diameter .....  | \$ 0.75 |
| 47.  | <b>Knife Edge Clamp</b> . For use in experiments on elasticity of flexure or any other experiments in which a knife edge support is desired. The knife edge extends over the edge of the table so that a weight pan can be suspended without cutting through the table top..... | .55     |
| 47A. | <b>Square Rod</b> . For use as a knife edge support in connection with No. 27 or No. 28 Table Clamp. 13 mm. square by 10 cm. long, with half of the length turned to 13 mm. in diameter.....  | .30     |
| 48.  | <b>Mirror Support</b> , with mirror 30 mm. in diameter. Mirror adjustable about a horizontal axis. Mounted on nickel plated rod 15 cm. long by 10 mm. diameter.....   | 2.00    |
| 49.  | <b>Mirror Support</b> , same as No. 48, but 60 mm. in diameter and mounted on nickel plated rod 10 cm. long by 10 mm. diameter.....   | 2.75    |



No. 50.



No. 52.

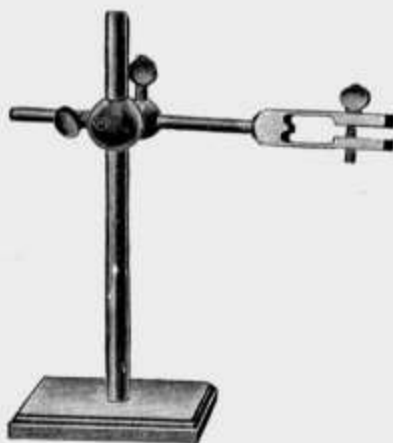


No. 53.

- |     |  |      |
|-----|--|------|
| 50. | <b>Lens Holder</b> , for holding lenses 25 mm. to 50 mm. in diameter; easily adjustable. Mounted on nickel plated rod 15 cm. long by 10 mm. in diameter....  | 1.00 |
| 51. | <b>Lens Holder</b> . Same as No. 50, for lenses 50 to 100 mm. in diameter...   | 1.35 |
| 52. | <b>Holder</b> , for telescopes, lenses and cylinders of any form and size as well as irregular objects up to 8 cm. in diameter. Mounted on nickel plated rod 20 cm. long by 13 mm. in diameter.....              | 2.25 |
| 53. | <b>Stand Tube</b> , of brass, nickel plated, used in connection with rods, tripods and stand tops for building up tables or stands. Will fit Bases Nos. 2, 3, 8, 9 and 18 and hold 13 mm. rod. Length, 20 cm.... | 1.10 |
| 54. | <b>Stand Tube</b> , same as No. 53, but 30 cm. long.....   | 1.35 |
| 55. | <b>Stand Tube</b> , same as No. 53. Will fit Bases Nos. 3A, 4, 10 and 11 and hold 19 mm. rod. Length, 30 cm.....   | 2.00 |
| 56. | <b>Stand Tube</b> , same as No. 55, but 40 cm. long.....   | 2.25 |
- 51A. Lens Holder, page 487.



No. 5341.



No. 5343.



No. 5345.

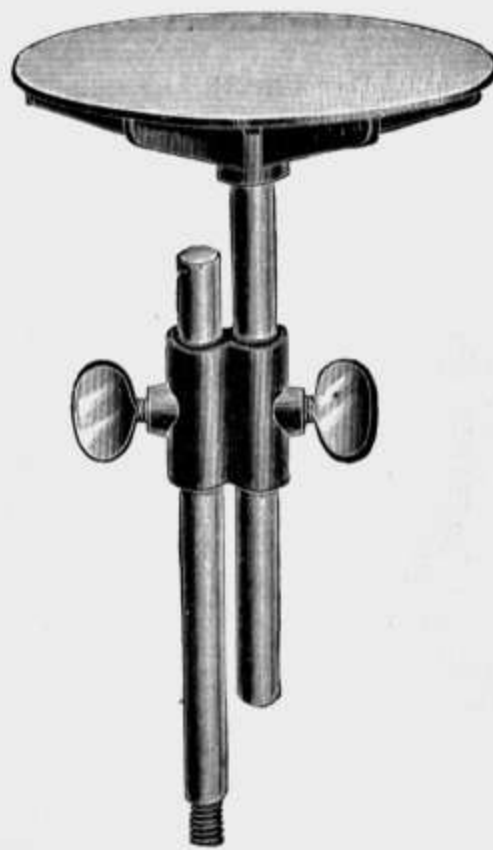
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|-------|---|---------|
| 5341. | Support, Hardwood, Gay-Lussac's. Clamp cork lined, movable in three ways .....  | \$ 1.33 |
| 5343. | Support, Hardwood. Improved form of Gay-Lussac's, with extension rod 22 inches long.....  | 1.33    |
| 5344. | Wooden Clamp with 1/2-inch rod, same as in No. 5343, for use with clamp holders, etc., in connection with iron supports. Clamp only ..... | .75     |
| 5345. | Support, Hardwood, Schellbach's. Clamp cork lined, universal movement .....   | 1.33    |



No. 57.



No. 58.



Nos. 61, 66A, 21.

- |      |  |      |
|------|--|------|
| 57.  | Clamp. A condenser clamp of improved construction mounted on a 10 mm. nickel plated rod 30 cm. long. Will hold objects up to 55 mm. in diameter..... | .65  |
| 58.  | Clamp, of brass, nickel plated, for holding square objects, mirrors, scales, screens, etc. Jaws open 4 cm.; rod 20 cm. long, 10 mm. diameter .....   | 1.65 |
| 59.  | Clamp, same as No. 58, but rod 10 cm. long, 10 mm. diameter.....   | 1.55 |
| 60.  | Extension or Parallel Clamp (illustrated in connection with two rods and iron table top). For two 10 mm. rods.....                                   | .45  |
| 61.  | Extension or Parallel Clamp, same as No. 60, but with openings 13 mm. diameter .....   | .55  |
| 62.  | Extension or Parallel Clamp, same as No. 60, but with openings 19 mm. diameter .....   | .65  |
| 62A. | Extension Clamps, page 487.  |      |



No. 63.



No. 64.



No. 773.

- |  |    |      |
|--|----|------|
| 63. Extension Clamp, for holding two rods in line. Lower end reamed for 13 mm. rod; upper end tapped for 13 mm. rod.....   | \$ | 0.50 |
| 63A. Extension Clamp, same as No. 63, but for two 19 mm. rods .....  |    | .60  |
| 63B. Extension Clamp, same as No. 63, but lower end reamed for 13 mm. rod and upper end tapped for 10 mm. rod.....   |    | .50  |
| 63C. Extension Clamp, same as No. 63, but lower end reamed for 19 mm. rod and upper end tapped for 13 mm. rod.....   |    | .60  |
| 64. T Clamp, for holding two round rods at right angles to each other in the same plane. Reamed for two 13 mm. rods.....   |    | .65  |
| 64A. T Clamp, same as No. 64, but reamed for two 19 mm. rods.....  |    | .90  |
| 773. Pendulum Clamp. Can be clamped to any vertical or horizontal support rod 19 mm. or less in diameter. Upon the arm are three removable clamps, each consisting of a flat brass plate with guide pin and held (by means of a thumb screw) against the plane face of the arm and flush with its lower edge. This gives exact points of suspension. Finished in japan and white nickel plate..... |    | .75  |

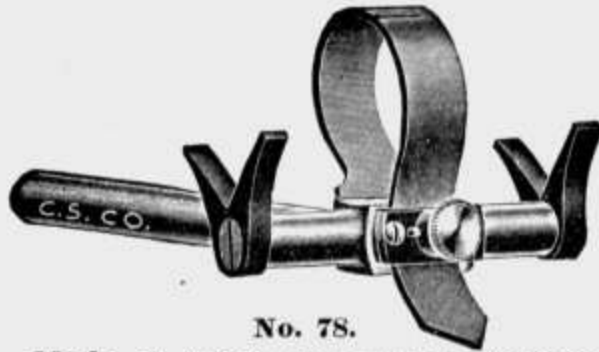


No. 66.



No. 70.

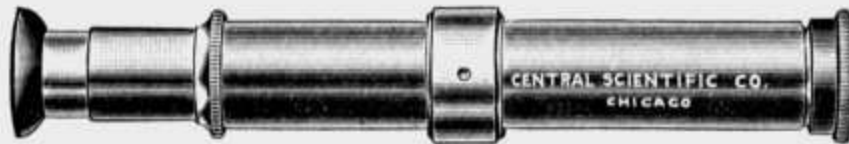
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|---|------|
| 66. Stand Top, of well seasoned wood, three-ply to prevent warping. Diameter of top, 15 cm. Nickel plated boss, tapped for 13 mm. rod.....    | 1.00 |
| 66B. Stand Top, same as No. 66, but tapped for 10 mm. rod.....  | 1.00 |
| 66C. Stand Top, same as No. 66B, with nickel plated rod 10 cm. long.....  | 1.16 |
| 67. Stand Top, same as No. 66, but diameter of top 20 cm.....   | 1.25 |
| 68. Stand Top, same as No. 67, but tapped for 19 mm. rod.....   | 1.45 |
| 69. Stand Top, same as No. 68, but diameter of top 30 cm.....   | 1.65 |
| 66A. Stand Top, of iron turned true on top. Diameter of top, 15 cm. Tapped for 13 mm. rod. (See illustration in cut of No. 61, page 10.)..... | 1.00 |
| 67A. Stand Top, same as No. 66A, but diameter of top 20 cm.....   | 1.25 |
| 68A. Stand Top, same as No. 67A, but tapped for 19 mm. rod.....   | 1.45 |
| 69A. Stand Top, same as No. 68A, but diameter of top 30 cm.....   | 1.65 |
| 70. Table Platform, of cast iron. Top surface planed true and at right angles to the opening. Top 6x9 cm.; for 10 mm. rod.....                | .50  |
| 71. Table Platform, same as No. 70. Top 9x14 cm.; for 13 mm. rod.....   | .80  |
| 72. Table Platform, same as No. 70. Top 12x19 cm.; for 19 mm. rod.....  | 1.00 |
| 75. Meter Stick Clamp, page 487.  |      |



No. 78.

78. **Telescope Clamp.** Made of brass, for holding telescopes from 2 to 5 cm. in diameter. The telescope is held in place by a leather strap and is therefore not liable to injury as is the case when metal clamps are used. A No. 21 Support Rod, 20 cm. in length, is included, which may be placed either as shown in the illustration or in a position at right angles to this. The clamp is also tapped to receive a No. 20 Support Rod for carrying a scale as shown in illustration of No. 2435 below..... \$ 2.20

**READING TELESCOPES.**



No. 80.

80. **Reading Telescope,** simple form, without rack and pinion. Eyepiece fitted with cross hairs. Objective 16 mm. diameter with brass cap. For galvanometer distances of from 45 cm. up. Magnification 6 to 7 times. This Telescope is well made and the objective is achromatic ..... 6.00



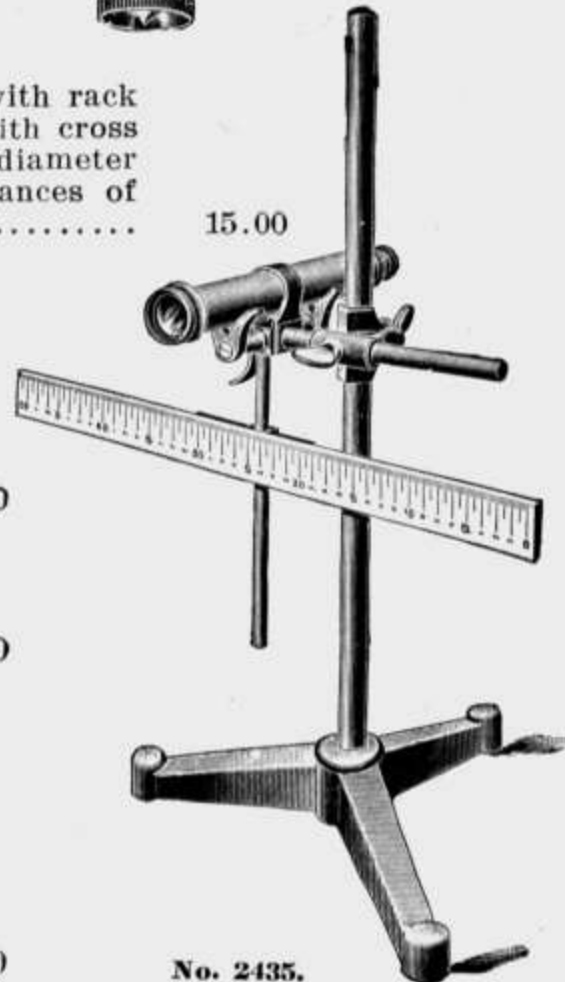
No. 82.

82. **Reading Telescope,** superior construction, with rack and pinion movement. Eyepiece fitted with cross hairs. Achromatic objective 25 mm. in diameter with brass cap. For galvanometer distances of 75 cm. up. Magnification 10 times..... 15.00

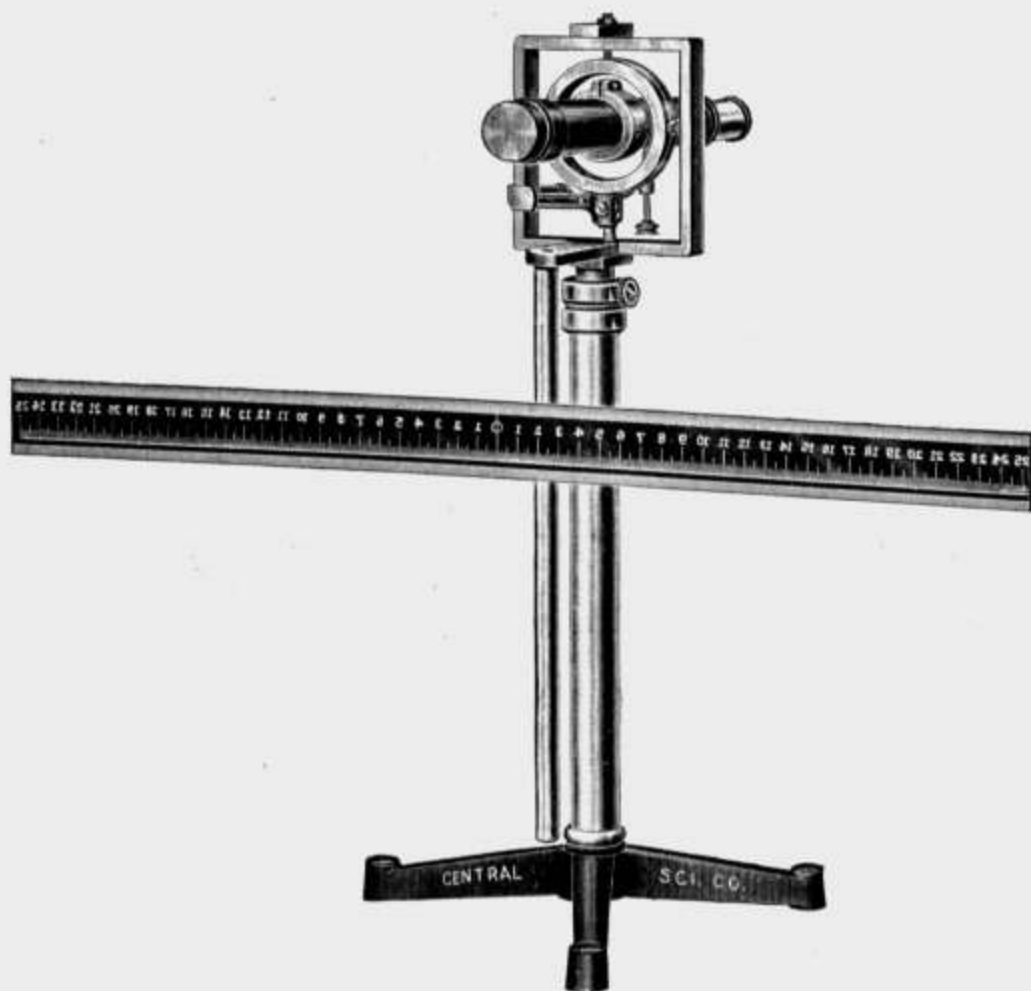
2435. **Reading Telescope and Support.** The support is built up from our laboratory support pieces and allows adjustment of telescope and scale in every direction. Height of upright rod, 40 cm. Complete with No. 80 Telescope and No. 85 Scale ..... 11.00

2436. **Reading Telescope and Support.** Same as No. 2435, but fitted with No. 82 Telescope in place of No. 80 ..... 20.00

2437. **Reading Telescope and Support.** The support is similar to No. 2435 but made entirely of brass, so as to be non-magnetic for use with Magnetometer. Allows adjustment of the telescope and scale in every direction. Complete with No. 82 Telescope and No. 85 Scale..... 30.00



No. 2435.

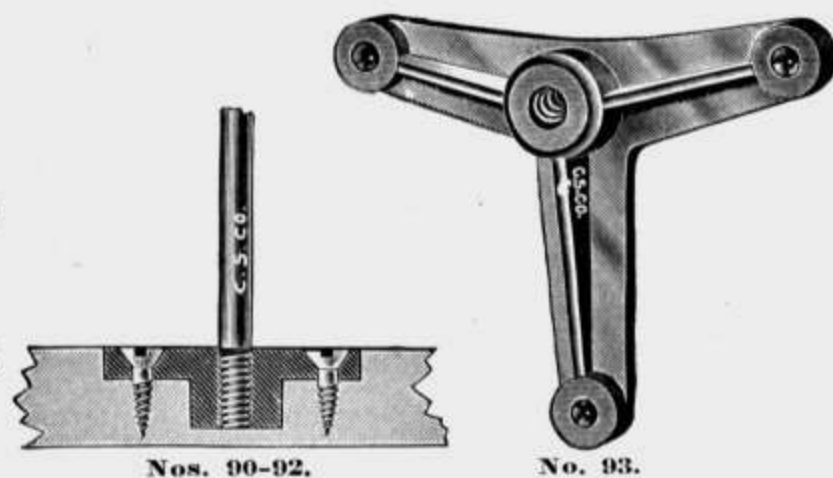


No. 2438.

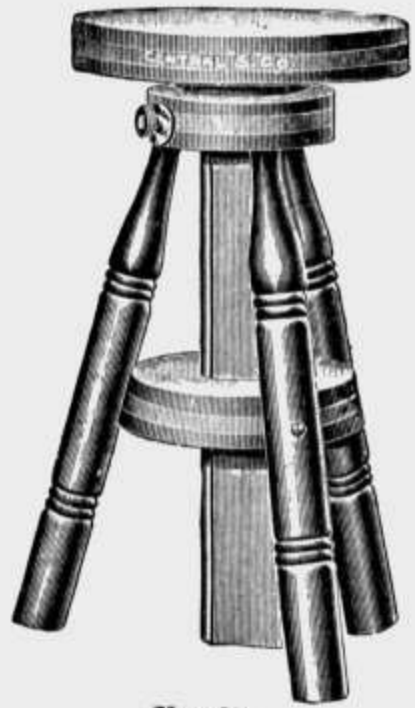
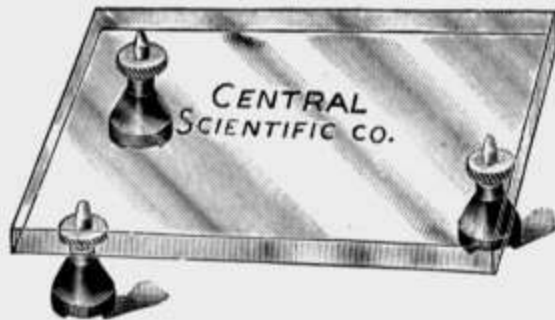
2438. **Reading Telescope.** Consists of No. 82 Telescope with an adjustable support of our own improved design. The telescope has a vertical range of 22 cm. and is provided with slow motion screws for changing its position either in altitude or azimuth. The rod on which the scale is mounted may be placed either below the telescope as shown in the illustration or above the telescope. The scale is a bichrome scale 50 cm. long, so mounted that it can be used either vertically or horizontally or in any intermediate position. A special spring device holds the scale in any position in which it may be placed. The telescope and support are constructed entirely of non-magnetic materials ..... \$ 33.35
85. **Reading Telescope Scale,** printed on glazed cardboard 50 cm. long in millimeter divisions, figures inverted and printed in red on half of the scale and in black on the other half. Scale is mounted on hardwood strip with clamp for 10 mm. rod. (See illustration in cut of No. 2435, page 12.) ..... 1.00

For Transparent Glass Scale, see No. 2433C.

90. **Flush Plate,** of brass, nickel plated, to be fitted into laboratory table flush with the top. Diameter  $1\frac{3}{8}$  in. Tapped for 10 mm. rod..... .30
91. **Flush Plate,** same as No. 90, but diameter  $1\frac{7}{8}$  inches, tapped for 13 mm. rod. .40
92. **Flush Plate,** same as No. 90, but diameter  $2\frac{3}{4}$  inches, tapped for 19 mm. rod..... .65



93. **Wall Bracket,** 9 cm. x 10 cm. spread; tapped for 13 mm. rod..... .45
- 93A. **Wall Bracket,** 12.5 cm. x 16 cm. spread; tapped for 19 mm. rod..... .65

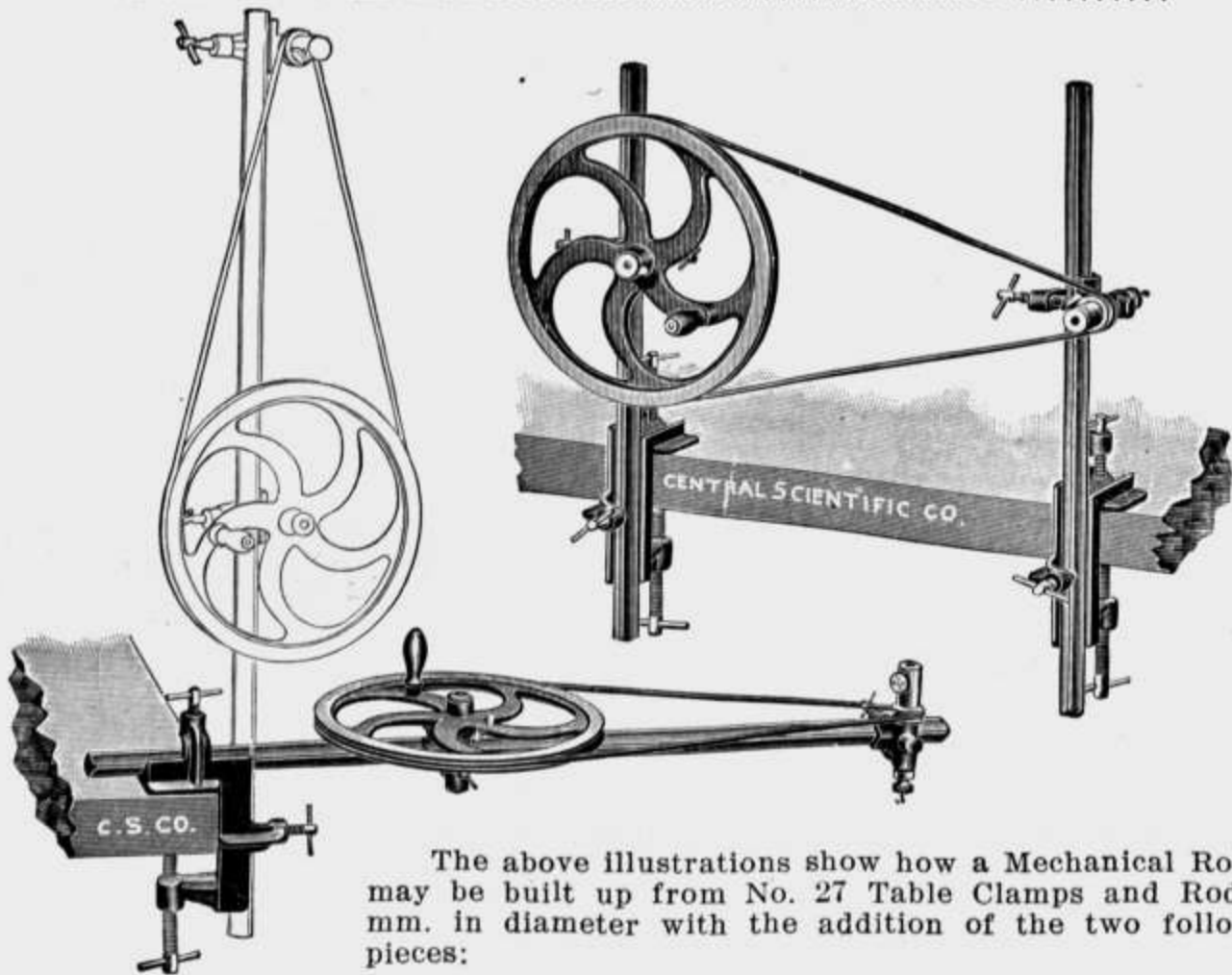


No. 94.

Set of No. 94 with Glass Plate.

No. 95.

94. **Leveling Screws**, in sets of three, permitting the rapid leveling of table as illustrated. Made entirely of metal, the base of which is accurately planed. Base japanned, screw nickel plated. Height, 7.5 cm.; range of adjustment, 13 mm. Per set..... \$ 1.65
95. **Adjustable Wood Stand**. Made from well seasoned hardwood, very heavy and solid. The tops are three-ply to prevent warping. All metal parts are of brass. These stands are useful in supporting telescopes, galvanometers and other laboratory instruments, where the presence of a magnetic substance would be undesirable. Top is 35 cm. in diameter by 5 cm. thick, and height may be varied from 65 cm. to 115 cm..... 9.00



The above illustrations show how a Mechanical Rotator may be built up from No. 27 Table Clamps and Rods 19 mm. in diameter with the addition of the two following pieces:

96. **Drive Wheel and Clamp**, grooved for round belt. With 5-foot belt... 3.35
97. **Spindle and Clamp**, with socket and set screw on one end and a chuck with lock nut and washer for holding accessories on the other.... 4.00

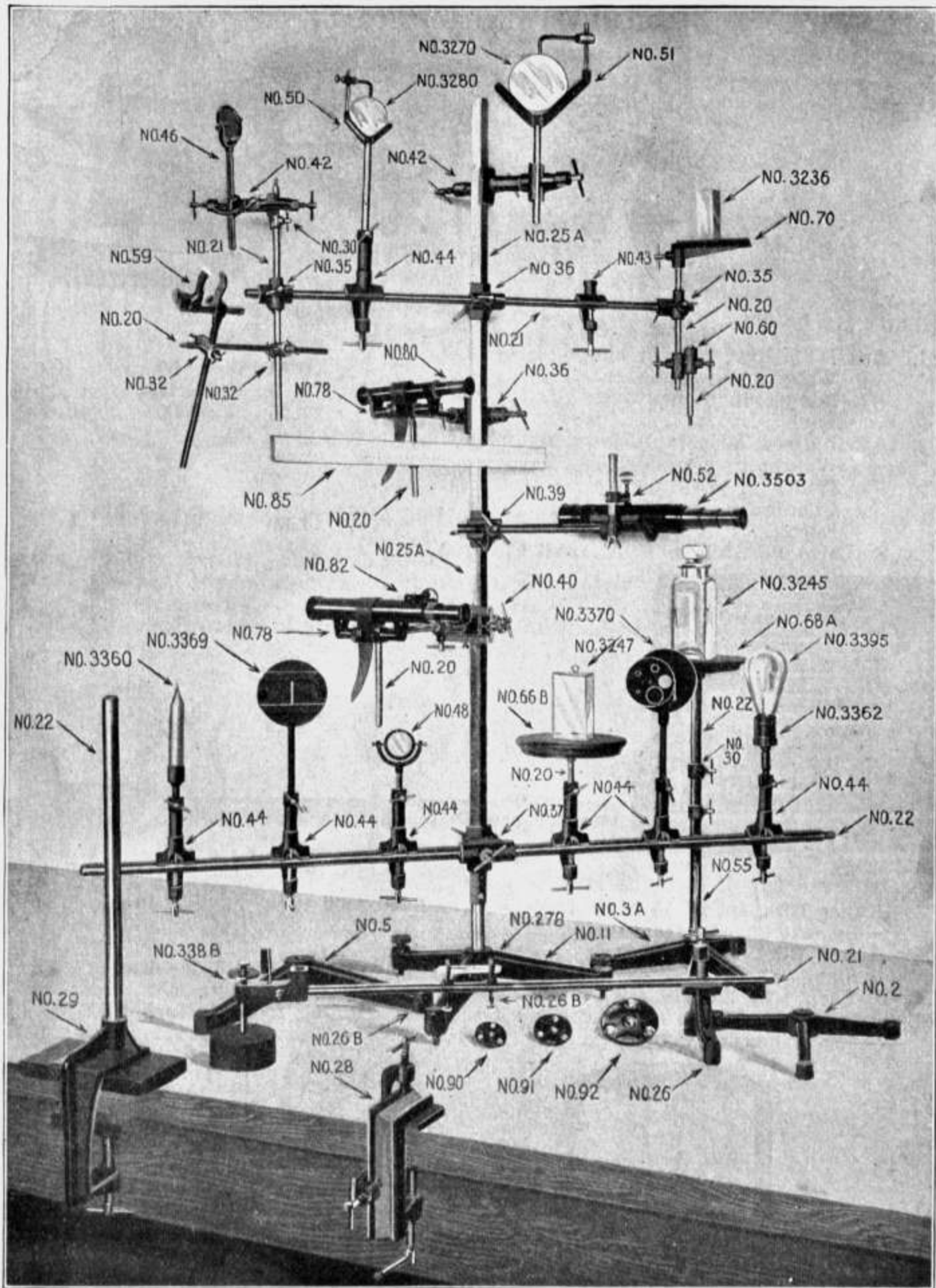


Illustration showing some of the possible combinations that can be made with the Universal Physical Laboratory Supports as listed in this Catalog.



# TOOLS AND MEASUREMENTS

ARRANGED ALPHABETICALLY.



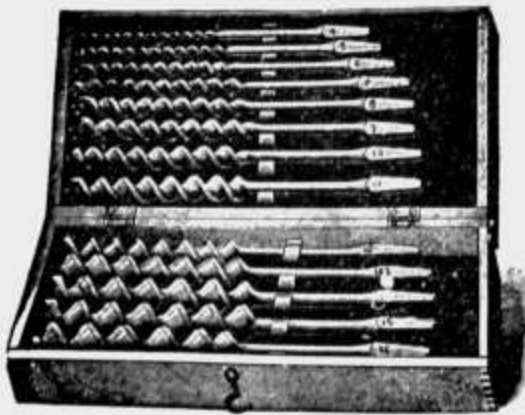
No. 101.



No. 102.

101. Anvil. Heavy, regular shape, steel face.			
Weight in pounds.....	15	50	100
Length in inches over all.....	9	14½	20½
Each .....	\$3.25	6.00	10.00
102. Anvil Vises, adjustable jaws, strongly constructed.			
Weight in pounds.....	9	25	35
Width of jaws, inches.....	2½	3½	4
Opening in inches.....	3	4	5
Each .....	4.30	5.50	6.75

See also Nos. 555 to 559A Anvil Clamp Vises.

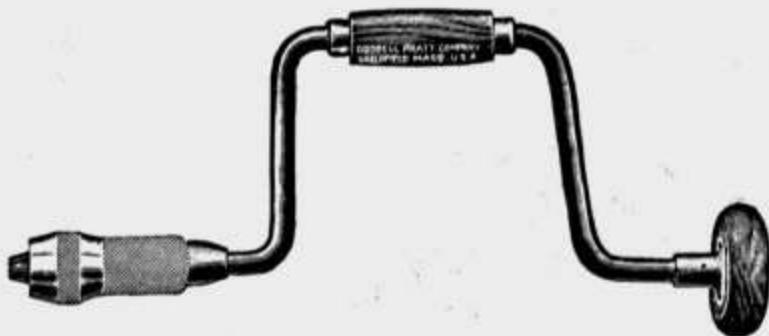


No. 103.

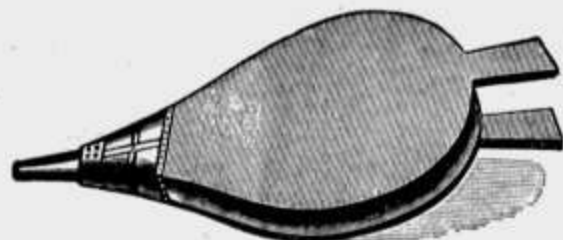


No. 107.

103. Auger Bits, set of 13 high grade bits in hardwood case; ¼ to 1 inch by sixteenths of an inch.....	4.80
105. Auger Bit, good quality.	
Size, 3 4 5 6 7 8 9 10 11 12 13 14 15 16-16ths	
Each, .22 .20 .20 .20 .22 .24 .26 .26 .33 .33 .38 .38 .40 .45	
107. Auger Bit, Clark's adjustable expansion bit, cutting from ½ inch to 1½ inches .....	.95

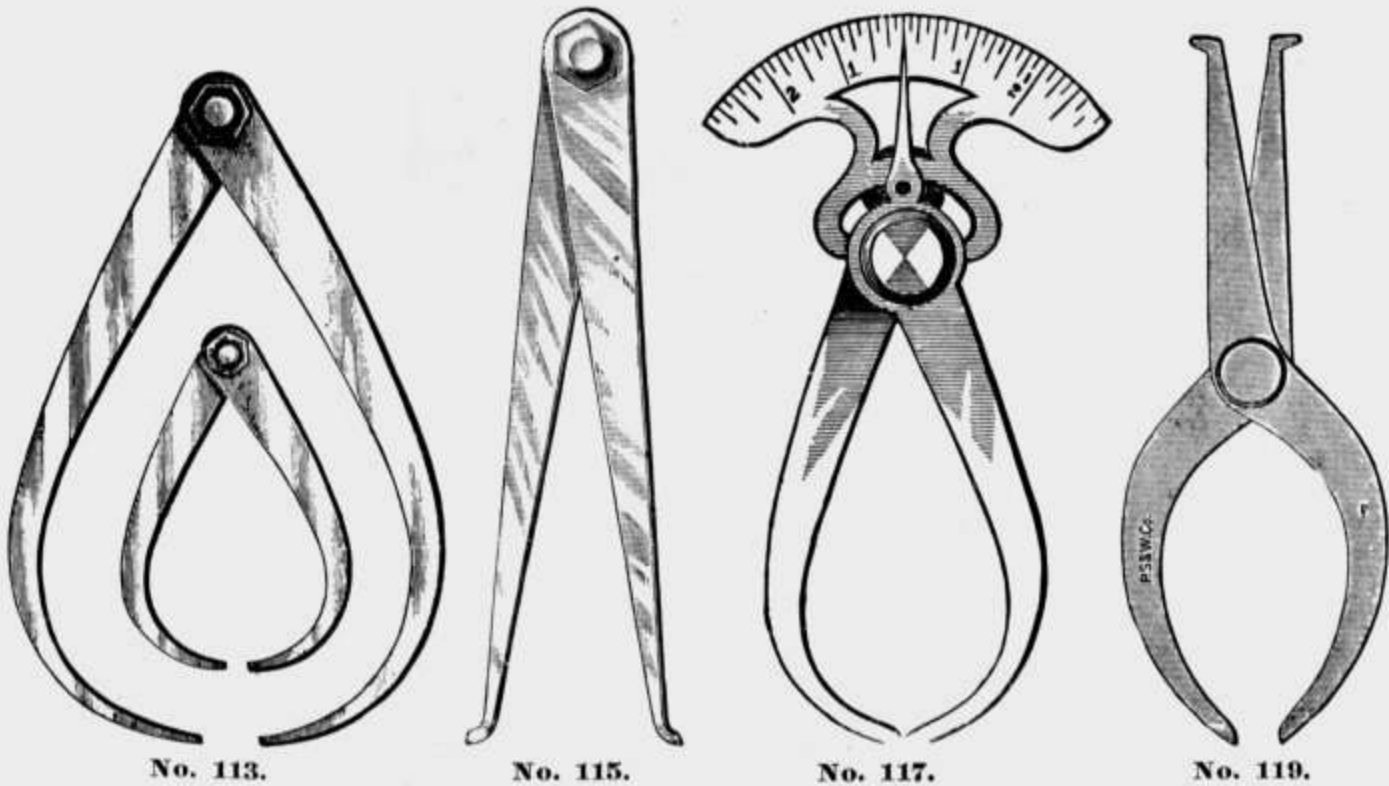


No. 109.

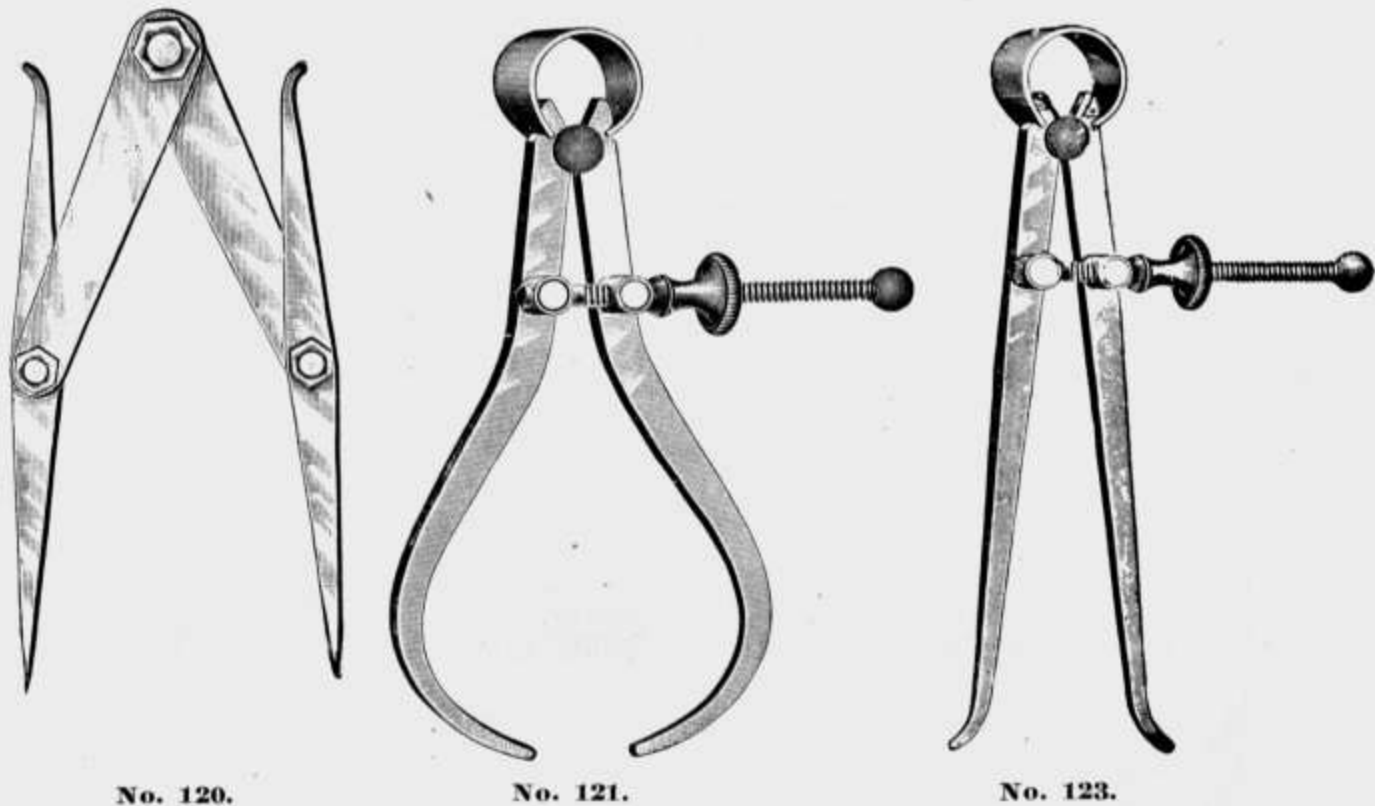


No. 111.

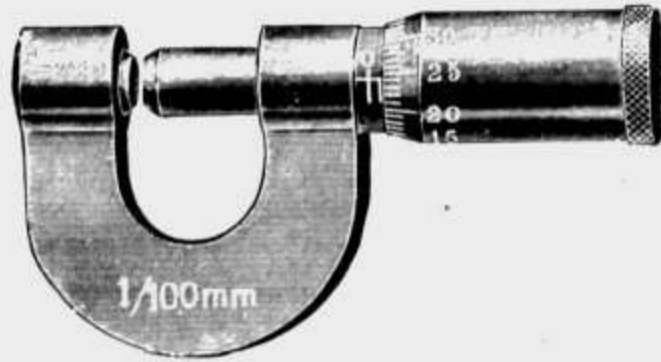
109. Bit Brace, plain, malleable iron socket and shell, forged steel jaws, 8-inch sweep .....	.95
110. Bit Brace, ratchet, with ball bearing head. Ratchet design is new and unique; the pawls are strong and positive in action; 8-inch sweep..	1.80
111. Bellows, hand, width 7 inches.....	.80



113.	Caliper, Outside. Polished steel. Length.....	4 in.	6 in.
	Each .....	\$0.13	.17
115.	Caliper, Inside. Polished steel. Each.....	.13	.17
117.	Caliper, Registering. Nickel plated, for outside and inside use, 6-inch .....		.70
119.	Caliper, Double. Outside and inside. Polished steel. Length, .....	4 in.	6 in.
	Each .....	.20	.25

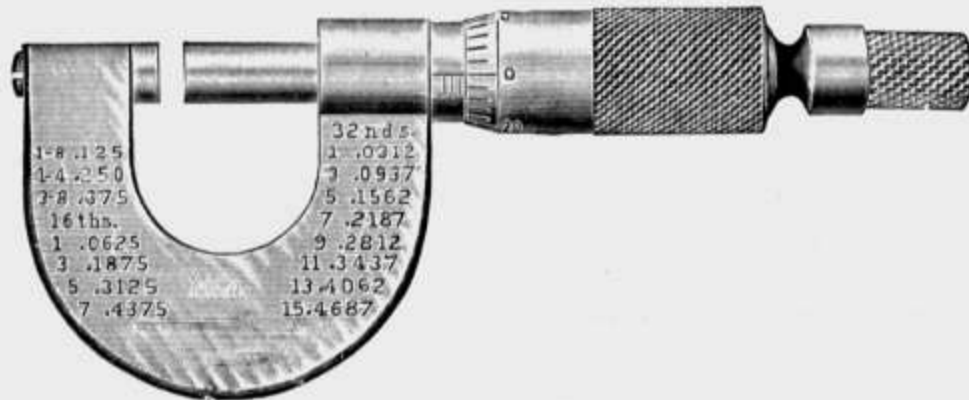


120.	Caliper, Double. Combined dividers and outside and inside calipers. Firm friction joints. Polished steel. Length, 6 inches.....		1.40
121.	Caliper, Spring, Outside. Even tension, solid nut, Polished steel.		
	Length .....	4 in.	5 in.
	Each .....	.85	.90
123.	Caliper, Spring, Inside. Even tension, solid nut. Polished steel.		
	Length .....	4 in.	5 in.
	Each .....	.85	.90



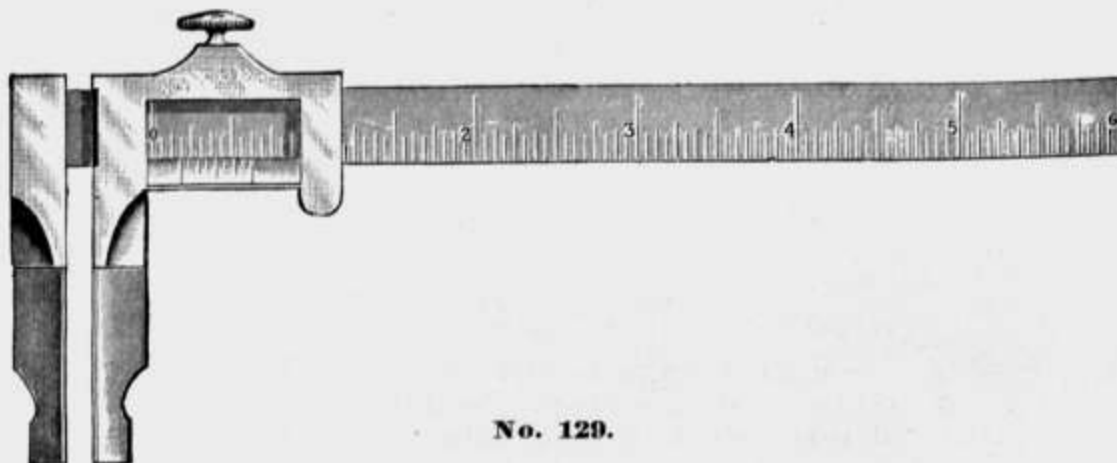
No. 125.

125. Caliper, Micrometer. Metric measure. This caliper will measure all sizes less than 15 mm. Graduated to read to 0.01 mm. Provided with friction head, which enables all objects measured to be subjected to the same degree of pressure..... \$ 3.35



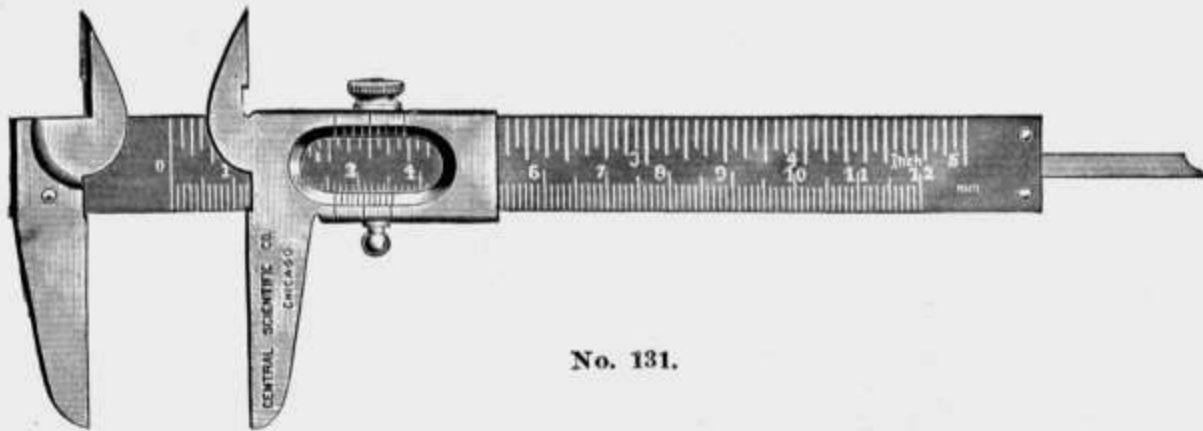
No. 127.

127. Caliper, Micrometer, same as No. 125, but provided with ratchet stop, which enables all objects measured to be subjected to the same degree of pressure. If more than a certain degree of pressure is exerted, the ratchet will throw the screw out of action. With ordinary usage the device can not get out of order and the wear is practically imperceptible ..... 4.75
- 127A. Caliper, Micrometer, same as No. 127, but larger. Will measure all sizes less than 25 mm. Reads to 0.01 mm..... 6.35
- 127B. Caliper, Micrometer, same as No. 127A, but without ratchet stop. Will measure all sizes less than 25 mm. Reads to 0.01 mm..... 5.55
- Morocco Cases for any of the above micrometer calipers, extra..... .50



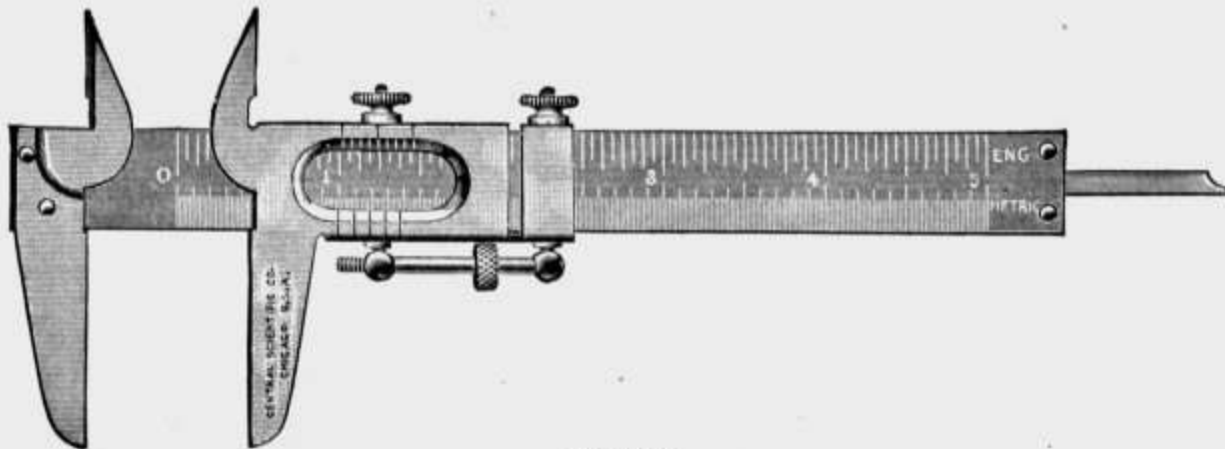
No. 129.

129. Caliper, Vernier, of steel, length 10 cm., with vernier reading to 0.1 millimeter ..... 1.25
130. Caliper, Vernier, Boley's ..... 1.90



No. 131.

131. Caliper, Vernier, of steel, length 16 cm.; the most complete Vernier caliper on the market. Inside caliper, outside caliper and depth gauge combined, with both **English** and **Metric** scales and **Verniers** for each, reading to 1-128 inches and 1-10 millimeters. Thumb attachment for easy operation. Neat, accurate and durable, in neat leather case.... \$ 2 50



No. 133.

133. Caliper, Vernier, of steel, same as No. 131 with the addition of a micrometer screw adjustment, in neat leather case..... 3 75



No. 137.

137. Chisel, extra cast steel, 1/2-inch, .42c; 1-inch..... 55



No. 139.

139. Chisel, gouge, extra cast steel, 1/2-inch, .55; 1-inch..... 75

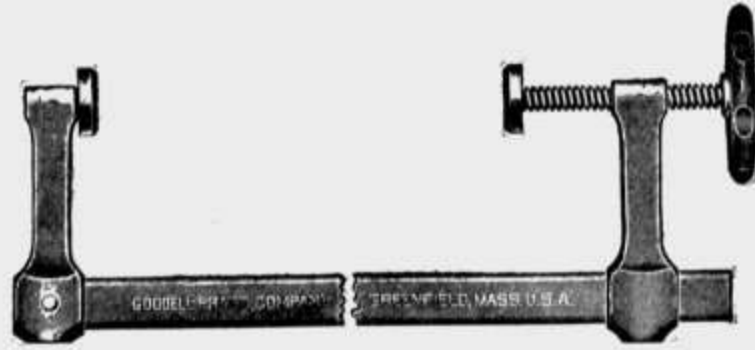


No. 141.

141. Chisel, Cold, 1/2-inch..... 20  
Wood Turning Chisels, page 55.



No. 145.



No. 147.



No. 149.

145. **Clamp, Standard.** This Clamp is made of malleable iron, and provided with ball and socket swivel cap on screw.

Opens .....	3 in.	4 in.	6 in.
Each .....	\$0.22	.30	.45

147. **Clamps, Adjustable, steel.** These clamps are so constructed that they can be quickly adjusted and will lock themselves the moment the pressure is applied to the screw. The bar is 3 1/4 inches from the center of screw. A very desirable clamp for light or medium work.

Opens, inches .....	6	10	18
Each .....	.70	.90	1.25

149. **Clamp, Hand Screw, wood, with saw cut threads on screws.**

Number .....	15	14	13	12	10
Length of jaws, inches.....	5	7	8	10	12
Opening, inches .....	2	3	4 1/2	5 1/2	8 1/2
Each .....	.33	.40	.48	.60	.72



No. 154.

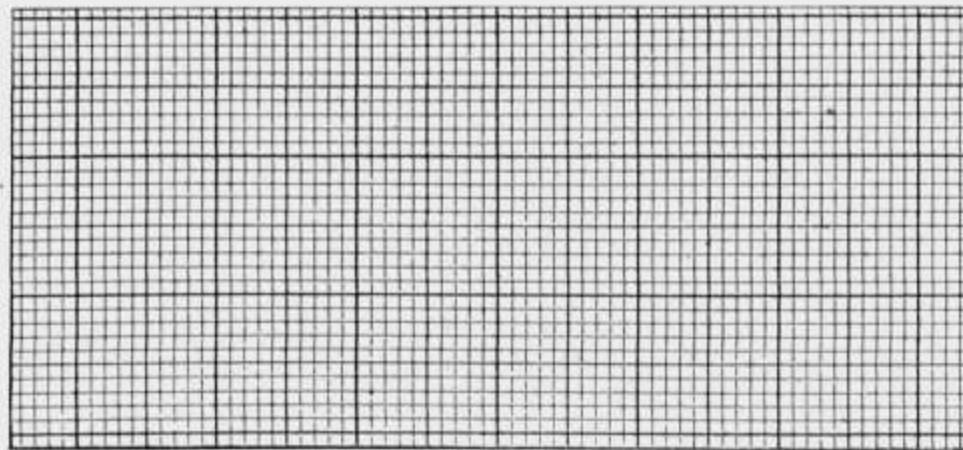


No. 155.

154. **Compass, Eagle Pencil.** The most universally used school compass. Pen, pencil, divider and compass combined. Provided with set nut. Each, net, 0.20. Per dozen.....Net \$ 2.00

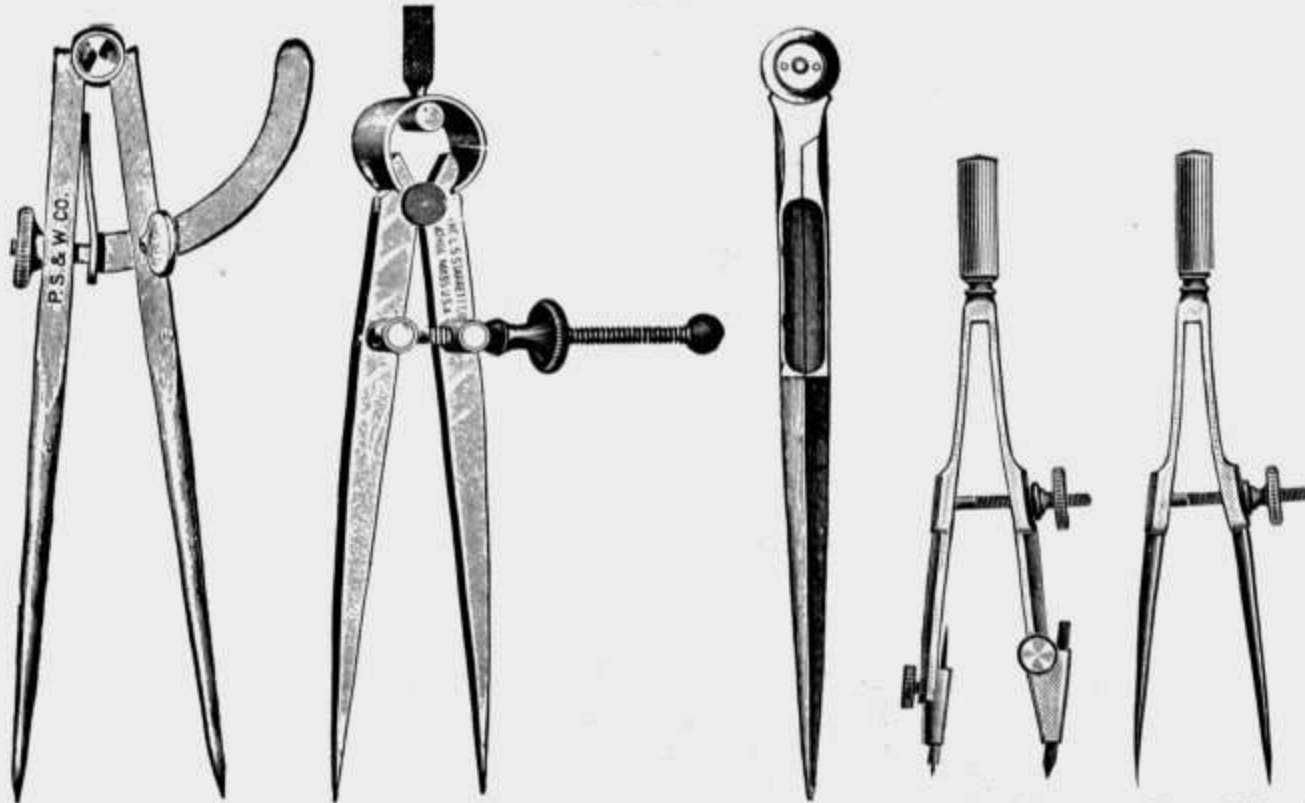
155. **Compass, Pencil.** Easily attached to a common pencil. Solid steel leg, durable and accurate. Superior quality. Each, 0.15. Per doz. 1.50

For Drawing Compasses, see next page.



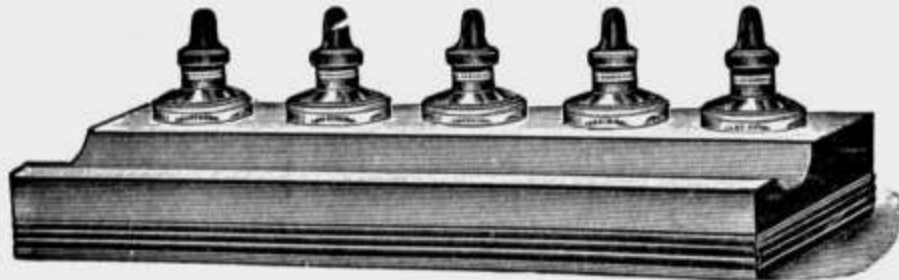
Nos. 157—159.

- 156. **Cross Section Paper**, one millimeter divisions with heavy centimeter ruling. In sheets 17x17 cm. on transparent onion skin paper. Per quire ..... \$ 0.25
  - 157. **Cross Section Paper**, accurately ruled, printed from an engraved plate. One millimeter divisions with heavier centimeter ruling; size 40x50 cm. Per sheet, 0.20. Per quire..... 4.00
  - 159. **Cross Section Paper**, same as above, continuous ruling in one millimeter divisions, 50 cm. wide. Per yard..... .33
  - 161. **Cross Section Paper**, ruled in  $\frac{1}{10}$ th inch divisions, size 16x21 inches. Per sheet, 0.06. Per quire..... 1.10
  - 162. **Polar Co-ordinate Paper**, printed from an engine divided plate, 17 cm. in diameter. Per quire..... .50
- 162A and 162B. Cross Section Charts, page 488.



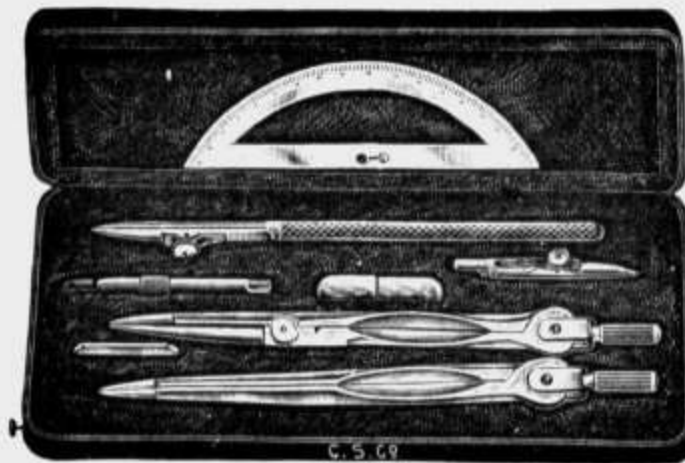
- No. 163. **Divider**, of polished steel, sharp points, wing and set screw, 6 in. long ..... .25
- No. 167. **Divider**. The popular "Yankee" polished steel spring divider, 5 inches long ..... .95
- No. 169. **Divider**, plain brass. Length..... 4½ in. 5½ in.  
Each ..... .25 .30
- No. 173. **Drawing Boards**, pinewood, with side ledges clamped.  
Size, inches ..... 16x22 20x24½ 23x31  
Each ..... 1.10 1.50 2.25
- No. 174. **Drawing Compass**, steel spring bow pencil compass. Made of German silver, nickel plated. Steel points, metal handle, length 3½ inches See also Nos. 154-5 Compasses, and No. 191 Drawing Pen. 1.10
- No. 175. **Drawing Divider**, steel spring bow divider. Metal handle, steel points. Length, 3¼ inches..... .80

- 176. Drawing Eraser, for pencil..... \$ 0.10
- 177. Drawing Eraser, for ink..... .10
- 178. Drawing Eraser, for both ink and pencil..... .15
- 179. Drawing Sponge Eraser, for cleaning drawings, 2½x1¾x⅝ inches.  
Each ..... .40



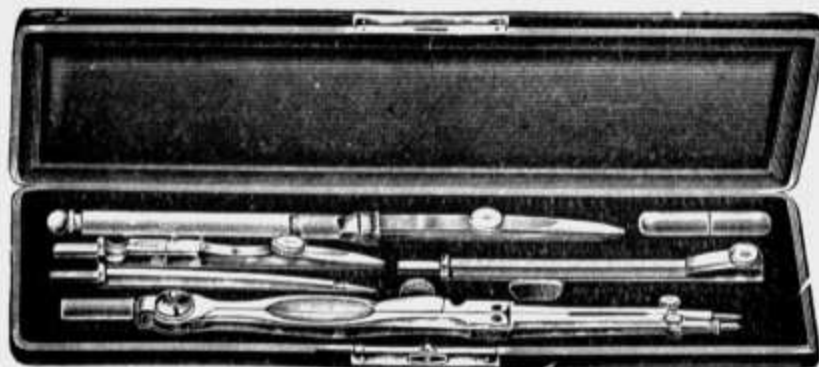
No. 181.

- 180. Drawing Inks in the following colors: Blue, brick red, brown, carmine, green, indigo, orange, scarlet, vermilion, violet, yellow and waterproof black, per ¼ ounce bottle.....Net .25
- 181. Drawing Inks in nicely finished hardwood tray. Choice of five different colors, selected from list under No. 180.....Net 1.60



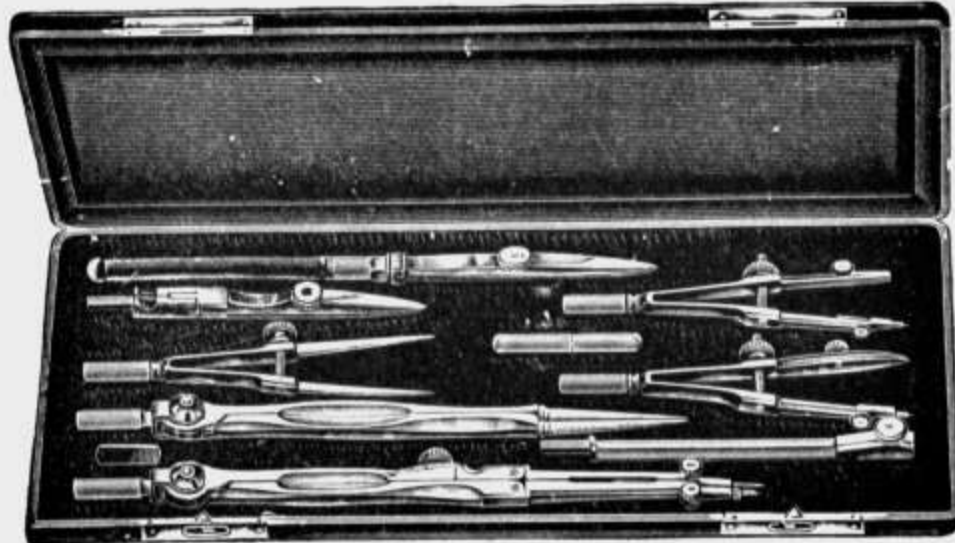
No. 182.

- 182. Drawing Instruments, for elementary work. Good grade German instruments in leather case, lined with velvet. Contains ruling pen 5-inch, with patent cleaning device. Compass, 5½-inch, with fixed needle point, pen and pencil point. Plain Dividers, 5½-inch. Metal Protractor, 3½ inch, and box of leads..... 1.50



No. 183.

- 183. Drawing Instruments. High grade German silver instruments with steel points, in morocco pocket case, lined with velvet. Contains ruling pen, 5-inch, with patent cleaning device. Compasses, 6-inch, with fixed needle point, pen, pencil point and lengthening bar. Extra steel divider point and box of leads..... 2.65



No. 187.

187. **Drawing Instruments**, same as No. 183, with the addition of plain dividers, 5½ inches, in place of the extra divider point; steel spring bow dividers, bow pencil and bow pen, 3¼ inches, with metal handles ..... \$ 5.00

191. **Drawing Pen.** Steel spring bow pen, with steel points. Metal handle, 3¼ inches..

1.10

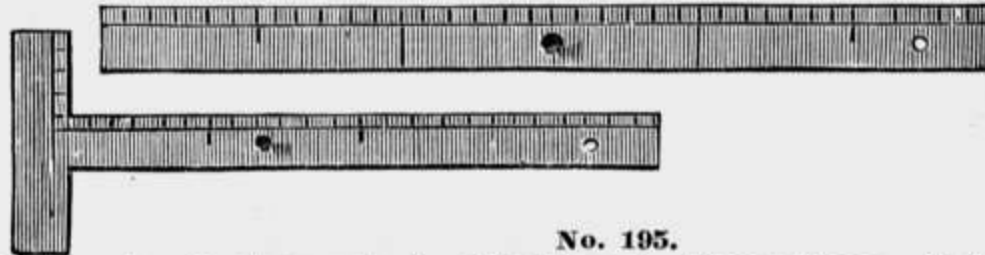
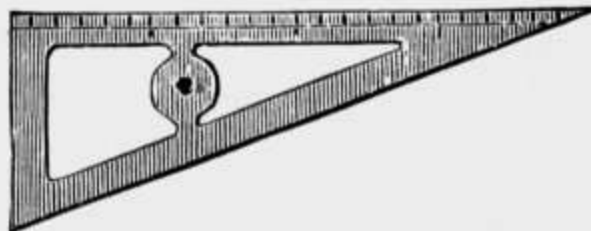
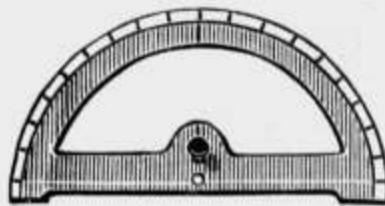


No. 191.



No. 193.

193. **Drawing Pen**, ruling pen, same as in set No. 183..... .40



No. 195.



No. 197.

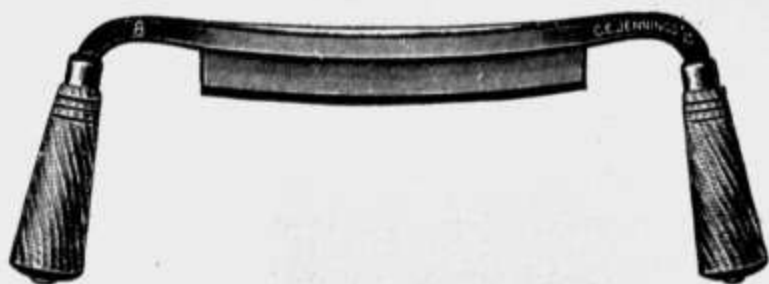
195. **Drawing Instruments for blackboard.** Four pieces—24-inch T square, 36-inch Straight Edge, 24-inch Triangle (graduated in inches) and a 15½-inch Protractor. Per set..... 4.50
- 195A. **T Square**, only..... 1.55      195C. **Triangle**, only ..... 1.55
- 195B. **Straight Edge**, only..... 1.00      195D. **Protractor**, only ..... 1.00
197. **Blackboard Compass**, of wood, 15 inches long, with crayon holder and rubber foot ..... .55
201. **Drawing Paper**, slightly grained surface. Suitable for school use.
- |                     |       |       |       |       |
|---------------------|-------|-------|-------|-------|
| Size sheet, inches, | 15x20 | 19x24 | 22x30 | 27x40 |
| Per quire .....     | .35   | .65   | 1.10  | 2.25  |



No. 205.

205. **Drawing Pencil**, "Koh-i-noor." These pencils are widely used and, being made of a special compressed lead, are durable and give an even line. Each ..... Net .10
207. **Drawing Pencil**, "Faber's," yellow polished. Each..... Net .06
209. **Linear Dividing Engine.** See Catalog K for description.... Duty free 162.50
- 209A. **Linear Dividing Engine.** See Catalog K for description.... Duty free 237.50
210. **Circular Dividing Engine.** See Catalog K for description.. Duty free 200.00
- 210A. **Circular Dividing Engine.** See Catalog K for description.. Duty free 237.50

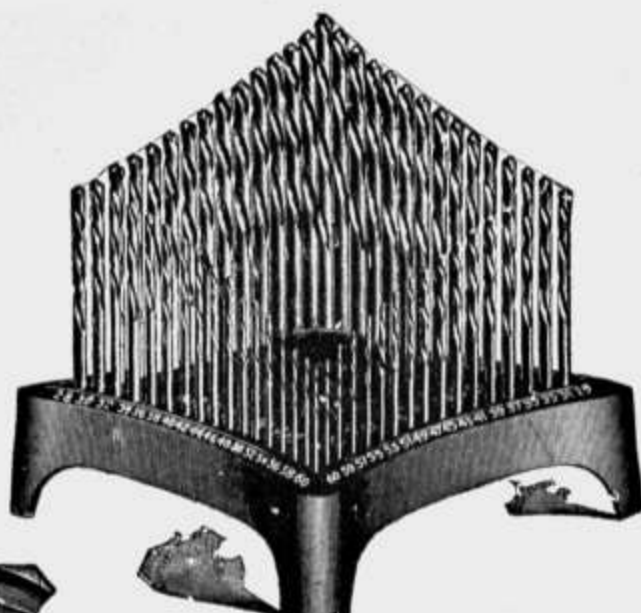




No. 211.



No. 213.



No. 215.

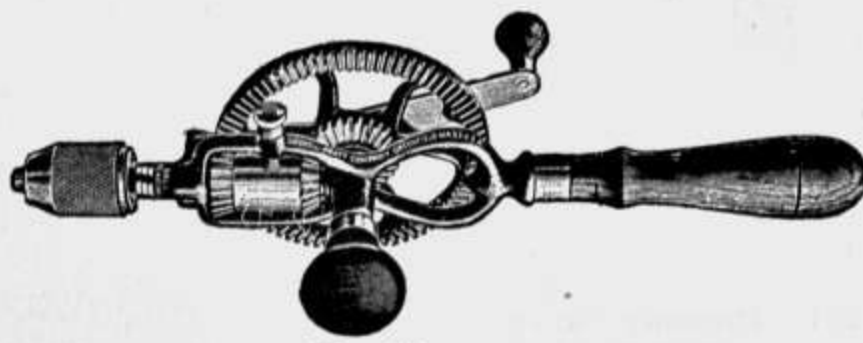
211. Draw Knife, extra polished cast steel, razor blade, 8-inch..... \$ 0.83
213. Drills, twist, straight shank, for wood or metal—
- |                    |                |               |                |               |                |               |                |               |
|--------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| Diameter, in. .... | $\frac{1}{16}$ | $\frac{1}{8}$ | $\frac{3}{16}$ | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ | $\frac{1}{2}$ |
| Each .....         | .07            | .09           | .13            | .20           | .25            | .33           | .40            | .50           |
215. Drills, twist, straight shank. No. 1 to 60, Stubs' steel wire gauge, mounted on neat iron base which can also be used as a STUBS' STEEL AND WIRE GAUGE. Indispensable for the laboratory shop ..... 6.00



No. 216.

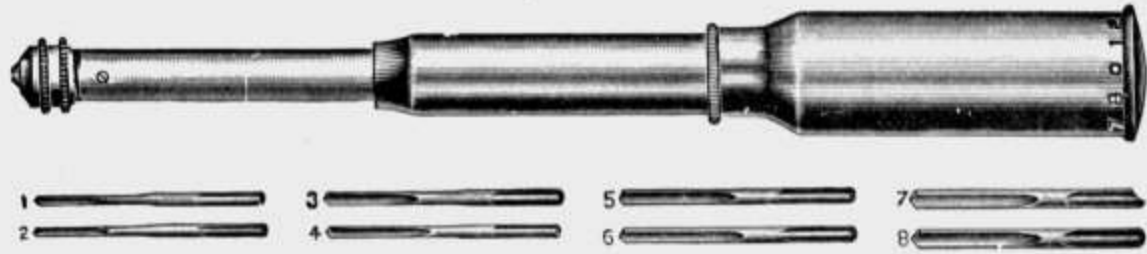


No. 217.



No. 218.

216. Drill, Breast. Double gears, capacity of chuck 0 to  $\frac{1}{2}$  inch. Two speeds; adjustable breast plate; spindle runs in a hardened steel cone bearing ..... 4.00
217. Drill, Hand. Single gear, length  $10\frac{1}{2}$  inches, with 8 steel drill points from  $\frac{1}{16}$  to  $\frac{11}{64}$  inch; capacity of chuck 0 to  $\frac{5}{32}$  inch; holds either fluted or round shank drills. Frame all steel, polished and nickel plated ..... 1.70
- 217A. Extra Drills for No. 217, plain shanks. May be used also with No. 216 and No. 218 Drills. Per set of 8,  $\frac{1}{16}$  to  $\frac{11}{64}$  inches..... .50
218. Drill, Hand. Double gears, two speeds; capacity of chuck 0 to  $\frac{3}{8}$  inch; knurled nut, frame of malleable iron, japanned..... 3.35



No. 219.

219. **Drill, Hand (Automatic Boring Tool)**, 9½ inches long, nickel plated. Eight steel fluted shank drills from 1-16 to 11-64 inches, enclosed in the handle in numbered compartments. A very useful tool for boring holes in wood, bone, etc. . . . . \$ 1.40
220. **Extra Drills**, fluted shank, as supplied with No. 219. Per set of 8. . . . . .50



No. 221.

221. **Drill, Automatic**. 11 inches long, nickel plated, with wood handle. Capacity of chuck, 0 to ¼ inch; chuck will hold accurately either fluted or round-shank drills. Without drill points. . . . . 1.70



No. 222.



No. 223.

222. **Drill Gauge**. Stub's steel gauge, Nos. 1 to 60. . . . . 1.65  
For Wire Gauge, see Nos. 565-6.
223. **Figures**, of steel, for stamping. . . . . Face, ⅛ in. 3-16 in.  
Per set . . . . . .65 .90



No. 225.



No. 227.



No. 229.

- |      |   |       |       |       |       |        |
|------|---|-------|-------|-------|-------|--------|
|      | Size . . . . .  | 4 in. | 5 in. | 6 in. | 8 in. | 10 in. |
| 225. | <b>Files</b> , round (rat tail), bastard cut. Each. . . . .                                   | .09   | .10   | .11   | .13   | ...    |
| 227. | <b>Files</b> , triangular (slim tapers), single cut. Each. . . . .                            | .07   | .09   | .10   | .13   | ...    |
| 229. | <b>Files</b> , half round, bastard cut. Each. . . . .   | ...   | ...   | ...   | .20   | .25    |
| 231. | <b>Files</b> , cabinet wood rasp, half round. Each. . . . .                                   | ...   | ...   | ...   | .30   | .40    |
| 233. | <b>File Handles</b> , soft wood with ferrule for small, medium or large files. Each . . . . . | ...   | ...   | ...   | ...   | .03    |



No. 234.

234. Gauge, Marking, of boxwood, adjustable, steel point, brass thumb screw and shoe..... \$ 0.50



No. 235.

235. Gauge, Tube, of steel. For measuring the internal diameters of tubing, etc. Graduated to  $\frac{1}{10}$  mm.  
 Scale range ..... 1 to 15 mm. 15 to 30 mm.  
 Each ..... .80 1.50

Drill Gauge, see No. 222.  
 Wire Gauges, see Nos. 565-6.



No. 236.

236. Gimlets, metal heads, sizes  $\frac{1}{8}$ ,  $\frac{3}{16}$  and  $\frac{1}{4}$  inch. Per set of three..... .15



No. 237.

237. Glass Cutter, steel wheel, polished and bronze finish..... .07



No. 237A.

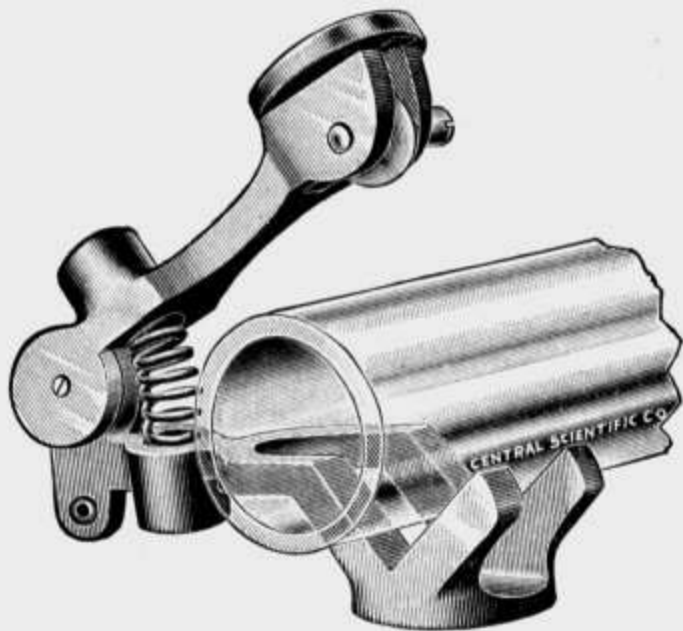
- 237A. Glass Cutter, turret head. The special feature of this cutter is the turret-like holder for 6 cutters, which may be revolved on or clamped to the frame. This enables the operator to place any of the cutters in position for use instantly or to replace the cutters with new ones in a minute's time. The cutters are protected when not in position for use..... .30

- 237B. Extra Cutter Wheels, for No. 237A. Per dozen..... .45

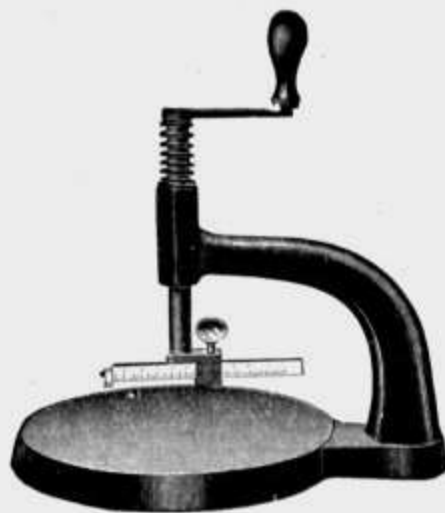


No. 238.

238. Glass Cutter. Glazier's diamond, for cutting or writing on glass. Finished in best manner possible and nickel plated. Diamond is guaranteed to re-set several times and to give entire satisfaction. Cuts "single thick" .....Net 5.40

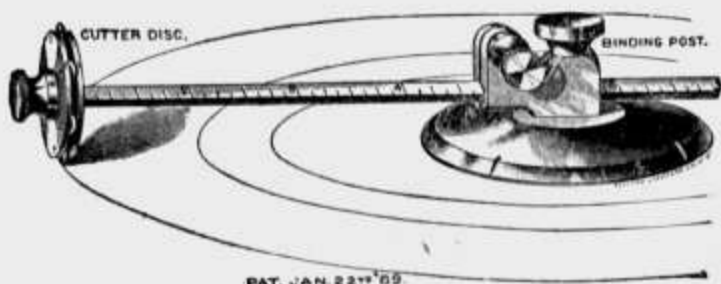


No. 239.

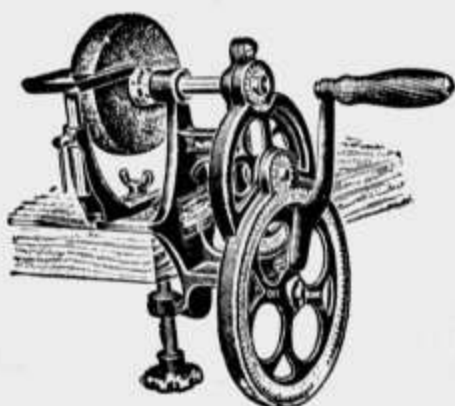


No. 241.

239. **Glass Cutter.** This is the only glass cutter by which the pressure on the cutting wheel may be regulated so as to be firm and even. The cutting wheel may readily be renewed when worn..... \$ 0.90
- 239A. **Extra Cutting Wheel** for No. 239..... Net .15
- 239B. **Extra Screw** for cutting wheel of No. 239..... .07
240. **Glass Cutter,** for cutting circles of from 4 to 40 inches in diameter... .40
241. **Glass Disc Cutting Apparatus.** Finest grade of workmanship. Will cut discs from 1 to 20 cm. in diameter. The cutter arm is graduated in millimeters and provided with six cutters. The apparatus can also be used for cutting discs of cardboard, metal and other materials. It will be found of universal adaptability and value.....Net 6.25



PAT. JAN. 22<sup>nd</sup> '69  
No. 242.



No. 243A.



No. 243.

242. **Glass Cutter, Rotary Form.** Cutting disc at end of 13-inch adjustable graduated arm, carries six steel cutting wheels, mounted on heavy brass base faced with rubber on under side..... 3.30
243. **Grindstone.** A fine specially selected Berea grindstone, turned and rubbed smooth, mounted in an extra heavy cast iron trough, with pressed steel base, steel shaft and steel ball bearings. Shipped "knocked down."  
 Diameter, inches ..... 6                      10  
 Each ..... 1.30                      2.10
- 243A. **Grinder,** with clamp for fastening to table 2 inches thick or less. High quality abrasive wheel 4 inches in diameter, 1 inch face; gears enclosed for protection..... 5.50



No. 244.



No. 245.

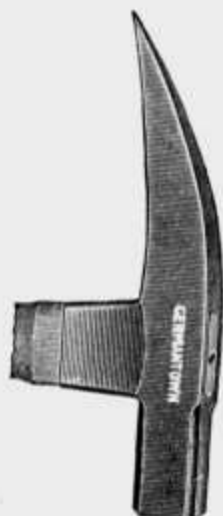


No. 247.

- |   |       |            |
|---|-------|------------|
| 244. Hack Saw, for cutting metals. Solid steel frame, natural finish, enamel handle; blade can be faced four ways. With one blade.....                  | \$    | 0.60       |
| 245. Hack Saw, of steel, white nickel plated, except the handle. Adjustable for 8 to 12 inch blades; blades can be faced four ways. With one blade..... |       | 1.10       |
| 246. Hack Saw Blades, made of best grade of steel.....  | 8 in. | 12 in.     |
| Per dozen .....   | .65   | 1.05       |
| 247. Hammer, claw, extra quality cast steel.  |       |            |
| 7 1/2 oz.....   | .50   | 13 oz..... |
|   |       | .60        |



No. 248.



No. 249.



No. 250.

- |  |       |        |        |
|--|-------|--------|--------|
| 248. Hammer, wedge shaped end, for breaking ores... Each .....   | 7 oz. | 12 oz. | 16 oz. |
|  | .50   | .55    | .60    |
| 249. Hammer, "Prospecting Pick." Finest grade cast steel. Square head with flat face. Pick point hardened steel. Weight 1 1/2 lbs..... |       |        | 1.00   |
| 250. Hatchet, extra tool steel, black finish, polished face and bevel, selected white hickory handle, 3 1/2 inch bit.....              |       |        | .75    |



No. 9411.

No. 9413.

- |   |      |
|---|------|
| 9411. Knife, one blade, excellent quality steel, iron lined, cocoa handle, 4 inch .....                     | .70  |
| 9413. Knife, two blades crocus polished, iron lined, stag handle, 4 inch. An excellent all-round knife..... | 1.10 |



No. 251.



No. 252.

- |   |     |
|---|-----|
| 251. Knife, good steel blade 4 inches long. Round wood handle. A very useful form for the laboratory..... | .20 |
| 252. Ladle, of wrought iron, 2 1/2 inch bowl.....   | .20 |

**LATHES.**

255. **Lathe**, for turning both wood and iron; for boring, drilling, polishing, etc. Swings 7 inches; takes 20 inches between centers; has a patent velocipede foot power, the best power for a foot-driven lathe. The speed can be varied from 1,000 to 2,000 R. P. M., and the motion can be started, stopped or reversed instantly.

The lathe is made entirely of iron and steel. The lead screw for the carriage is operated by hand; by it the carriage can be traveled 20 inches between centers. The carriage can be engaged or disengaged instantly from the lead screw. The cross feed-way can be set at any desired angle for taper turning and boring. The tail stock can be moved and set at any point desired, or it can be taken off entirely. The head stock spindle is hollow, with 9-32 inch hole, has taper bearings, and is capable of very nice adjustment. The tail stock center is self-discharging.

Price, including face plate, 2 pointed centers, 1 spur center, hand rest, wrenches and necessary belting, as shown in cut. Net, F. O. B. factory \$ 50.00

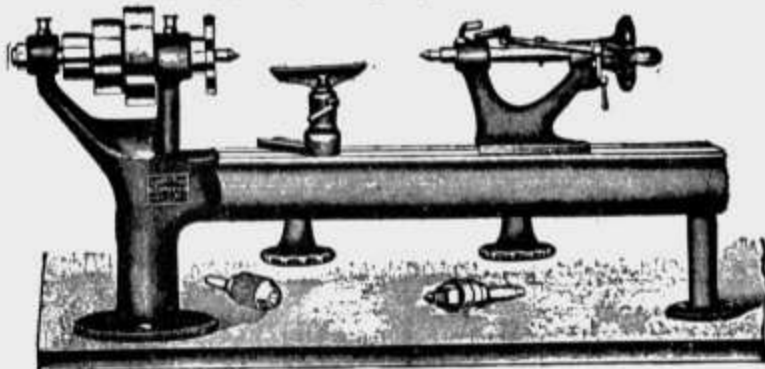
256. **Lathe**, same as No. 255, but furnished with a countershaft in place of foot power. The pulleys on countershaft are 7x1½ inches and should be speeded to 250 revolutions.....Net, F. O. B. factory 50.00

NOTE.—Above prices do not include a chuck, which must be fitted to the lathe at the factory. For prices see next page.

256A. **Belt**, 1½ in., single, for No. 256. Per foot..... .20



No. 255.



No. 257.

257. **Lathe**, for turning wood or iron; for hand turning tools only. Swings 7 inches; takes 12 inches between centers; has a milled bed, hollow spindle with ¾-inch hole, is provided with a No. 1 Morse taper, and both screw and lever feed in tail stock. It includes a foot-power table 35 inches high, 14 inches wide, 31 inches long, with special tool rack having 11 small and 12 large holes. (See cut No. 257A.) Well finished with machine enamel, steel parts polished bright. Complete with three-jawed chuck, capacity 0 to ¼ inch, slotted face plate, saw arbor and belt..... 45.00

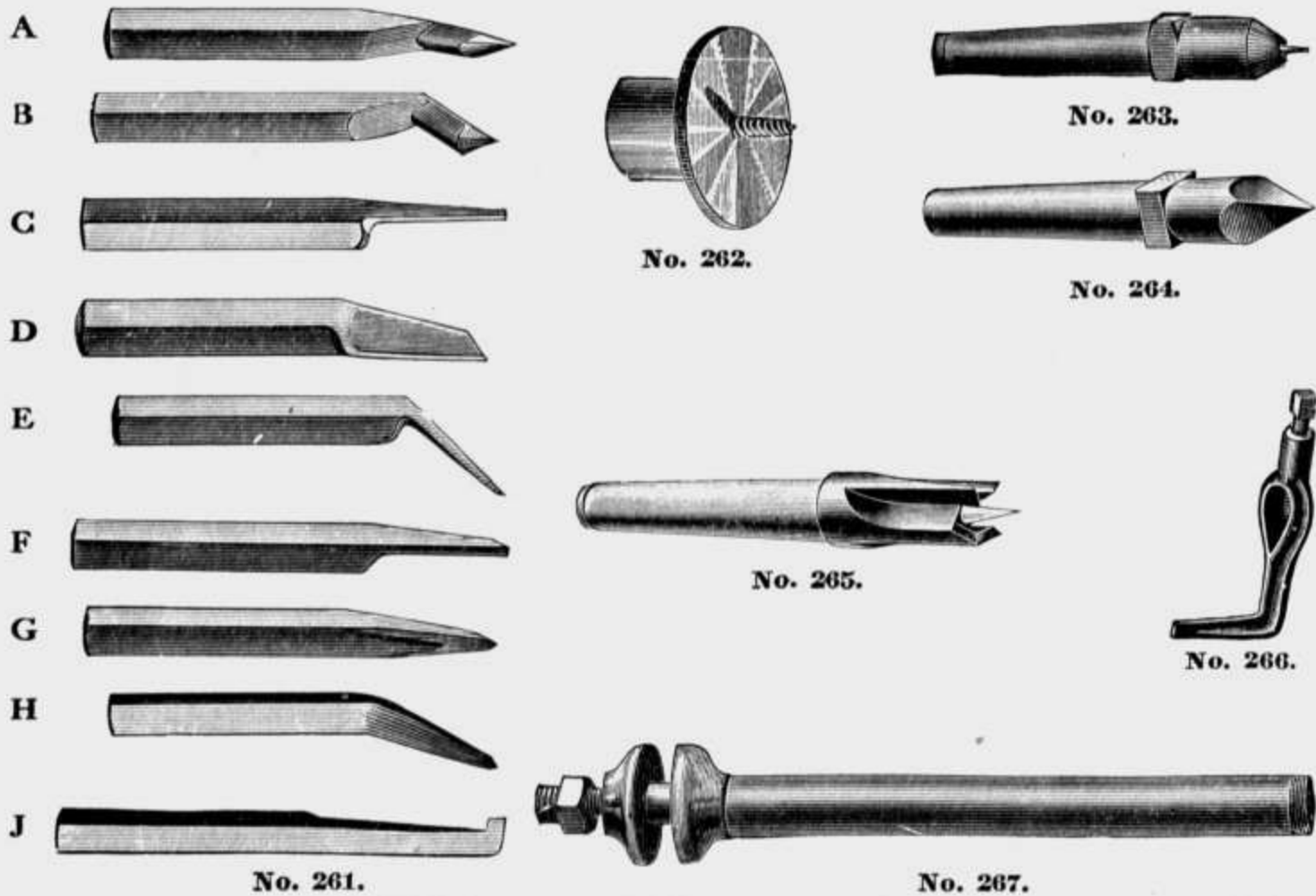


No. 257A.

258. **Lathe**. Consists of No. 257 Lathe without foot-power table but with countershaft. Belt not included; see No. 259..... 30.00

259. **Belt**, 1 in. single, for No. 258. Per foot..... .15

For **Lathe Accessories**, see next page.  
For **Drills**, see Nos. 213-215.  
For **Taps and Dies**, see Nos. 491-498A.



**ACCESSORIES FOR NO. 255-256 LATHES.**  
**Hand Turning Tools, without Handles.**

	Prices Net
260A. Milling Tool, with one knurl.....	\$ 1.00
260B. Flat Tool, for brass, ivory, hardwood, etc. 1/4 inch.....	.25
260C. Side Tool, right, for brass, ivory, hardwood, etc. 1/4 inch.....	.25
260D. Side Tool, left, for brass, ivory, hardwood, etc. 1/4 inch.....	.25
260E. Point Tool, for brass, ivory, hardwood, etc. 1/4 inch.....	.25
260F. Round Pointed Tool, for brass, ivory, hardwood, etc. 1/4 inch.....	.25
260G. Square Graver, for metal. 1/4 inch.....	.25

For Handles, see No. 233 File Handles.

**Lathe Tools for Metal.**  
 Size of steel, 1/4x1/2 inch.

261A. Right Hand Diamond Point.....	.30
261B. Left Hand Diamond Point.....	.30
261C. Right Hand Side Tool.....	.30
261D. Left Hand Side Tool.....	.30
261E. Bent Right Hand Side Tool.....	.30
260F. Round Pointed Tool, for brass, ivory, hardwood, etc. 1/4 inch.....	.25
261G. Thread Tool.....	.30
261H. Bent Thread Tool.....	.30
261J. Inside or Boring Tool.....	.30
262. Screw Chuck.....	1.50
263. Cup Center.....	1.50
264. Square Center, for iron.....	1.50
265. Spur Center.....	1.50
266. Common Dogs.	

Size, inches.....	1/4	3/8	3/4	1	1 1/4	1 1/2
Each.....	.25	.25	.35	.35	.50	.50

267. Steel Lathe Arbors, for holding saws, emery wheels, etc., as listed on page 40.	
Diameter, inches.....	3/8      1/2
Each.....	1.25      1.75

268. Champion Scroll Chuck. Diameter 3 inches, with two sets of jaws...	6.75
269. Champion Scroll Chuck. Diameter 4 inches, with two sets of jaws...	8.00
270. Almond Drill Chuck, to hold 0 to 11-32 inch drills, with taper fitting..	5.50
271. Almond Drill Chuck, to hold 0 to 17-32 inch drills, with taper fitting..	9.00

N. B.—The above Chucks mounted and fitted to the lathe at an extra charge of \$2.00 each.



No. 274.



No. 275.

274. Letters, of steel, for stamping A to Z, and period.  
 Face ..... 1/8 in. 3-16 in.  
 Per set ..... \$2.00 2.70
275. Level. This is the most effective and useful level on the market. The little "Which Way," as it is called, being more sensitive than any other level, is specially adapted for balances and other instruments. Nickel plated. Diameter, 3.75 cm..... \$ 1.10



No. 276.



No. 277.

276. Level, pocket, jappanned iron..... .15
277. Level, of brass, ground flat on the base, nickel plated. Very useful in making apparatus; 2 inches long..... .33
- 277A. Adjustable Bench Level. See Catalog K for description..... 2.50



No. 278.

278. Level Glasses, for use in level testing. Ungraduated. 3 inches long. Per dozen ..... 1.35
- 278A. Level Glass, for use in level testing. 5 to 6 cm. long, reading from 60 to 30 seconds, accurately ground and graduated..... .75
- 278B. Level Glass, same as No. 278A, but reading from 30 to 20 seconds.... .90
- 278C. Level Glass, same as No. 278A, but 7 to 9 cm. long..... .85
- 278D. Level Glass, same as No. 278C, but reading from 30 to 20 seconds..... 1.10



No. 279.

279. Level. Ordinary type of wood level. 10 to 16 inches long. Oval top plate, two side views..... .45

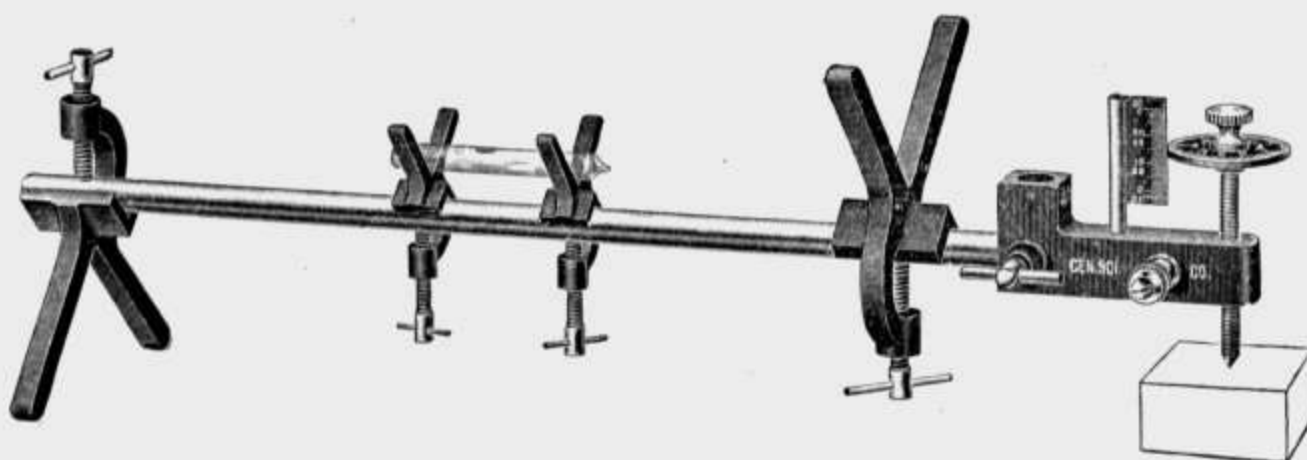


No. 279A.

- 279A. Level, Iron. 12 inches long, ground face and ends, jappanned body, double plumb ..... 1.75

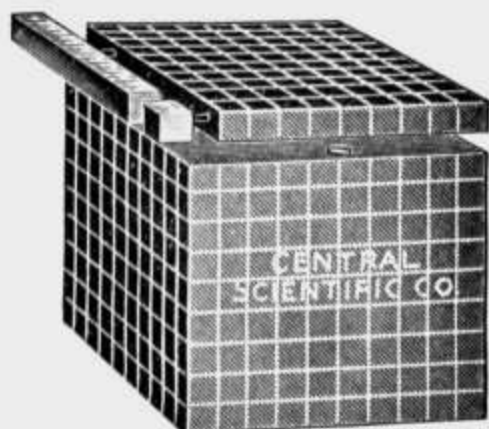
For Leveling Screws, see No. 94.



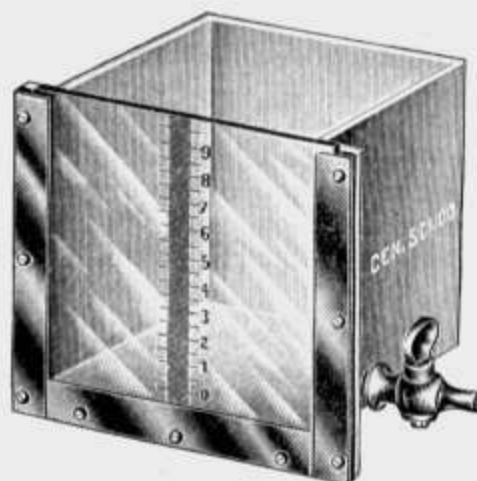


No. 280.

280. **Level Tester.** Composed of 2 No. 26C V Supports, 2 No. 26B V Supports, 1 No. 21 40 cm. Rod and 1 No. 338B Micrometer Screw. Complete, without level ..... \$ 7.50
- 280A. **Level Tester,** page 488.



No. 281.



No. 285.

281. **Liter Block.** An important adjunct in teaching density, as well as the metric system. The block is loaded and has a graduated face, showing 100 square centimeters on a side. It is dissectible to 1-10, 1-100 and 1-1000 of its volume, each piece being weighted to the specific gravity of water. (See also No. 285 Liter Case)..... 2.75
283. **Liter Block,** plain, neither loaded nor dissected..... .65
285. **Liter Case,** to be used in connection with No. 281 Liter Block. It is made of cast aluminum, one side being of glass with etched graduation in millimeters. This case is especially adapted for specific gravity work and measuring irregular solids. It is the counterpart of the liter block in hollow form. The glass face allows a full inspection of the contents, the stop cock which is attached permits of a nicer adjustment and measurement than is possible in common capacity measures, and the graduations indicate exact amounts. If this case is put on a balance and its weight exactly balanced, the addition of water shows an increase of 10 grams of water for every millimeter of scale division, which is equal to a centiliter or 10 c. c. of water. Any small solid, of however irregular shape, may be measured in this case and its specific gravity taken with a minimum of trouble.. 3.00



- 289. **Liter Measure**, polished brass, standard form, one liter piece only.. \$ 0.50
  - 291. **Liter Measure**, polished brass, standard form, two liter piece only... .55
  - 293. **Liter Measures**, brass, outer measure polished, standard form, one liter to one centiliter, 7 pieces..... 1.80
  - 295. **Liter Measures**, brass, outer measure polished, standard form, two liter to one centiliter, 8 pieces..... 2.35
- NOTE.—“Standard form” is that in which the diameter equals half the height.



No. 303.

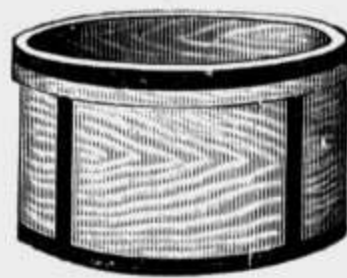


No. 304.

- 303. **Mallet**, round, wood; 3-inch face..... .22
- 304. **Mallet**, rawhide; 5 oz..... .70



No. 305.



No. 306.

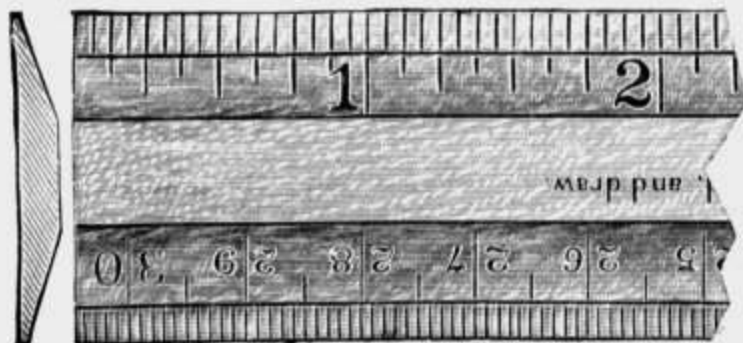
- 305. **Measures, Liquid**, of tin, 1 gallon to 1/2 pint, 5 pieces..... 1.00
- 306. **Measures, Dry**, of wood, iron bound, 1/2 bushel to 1 quart, 5 pieces.... 1.50
- 307. **Measuring Microscope**. See Catalog K for description.....Net 10.00
- 309. **Measuring Microscope**. See Catalog K for description.....Net 25.00
- 310. **Microscope Support**. See Catalog K for description.....Net 6.75
- 311. **Vernier Microscope**. See Catalog K for description.....Duty free 32.50
- 312. **Cathetometer**. See Catalog K for description.....Duty free 55.00
- 313. **Cathetometer**. See Catalog K for description.....Duty free 117.50
- For Wilson Cathetometers, see Catalog K.
- 314. **Measuring Disc**, of brass, as used in “Millikan and Gale” Experiment 1, for the determination of . Diameter, 7.5 cm..... .11
- 314A. **Measuring Disc**. Diameter, 12.5 cm. Of heavy brass, accurately turned and finely finished..... .67
- 1590A. **Measuring Cup**, as used in “Millikan and Gale” Experiment 2, for the determination of volume. See page 128..... .40
- 315. **Metric Chart**. Excellent for comparison of English and Metric Systems of Weights and Measures. Mounted on cloth with roller..... 2.00

- 316. **Standard Meter Scale.** See Catalog K for description.....Duty free \$ 50.00
- 316A. **Standard Meter Scale.** See Catalog K for description.....Duty free 77.50
- 316B. **Standard Meter Scale.** See Catalog K for description.....Duty free 87.50
- 317. **Meter Stick (School Meter),** of maple, 2 cm. square. One surface is plain and shows the length of the simple meter; the second face is graduated in tenths of meters, or decimeters; the third face is graduated in hundredths of meters, or centimeters; and the fourth face is graduated in thousandths of meters, or millimeters. The last named face gives divisions also in decimeters and centimeters. This piece is valuable in teaching students the metric system of lengths. .75
- 318. **Meter Stick,** of boxwood. A high-grade stick graduated in millimeters ..... .55
- 318A. **Meter Stick,** of boxwood. Same as No. 318, but graduated in millimeters and inches ..... .67

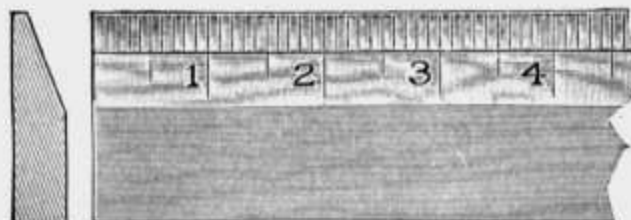


No. 319.

- 319. **Meter Stick,** of maple. One side is graduated in decimeters, centimeters and millimeters; the other side in inches and eighths..... .28
- 321. **Meter Stick,** same as No. 319, but ends tipped with brass..... .35
- 322. **Meter Stick,** same as No. 321, but two meters long, brass tipped..... 1.35
- 323. **Meter Scale,** of paper, graduated in millimeters. For use vertically; zero at the top.  
Each..... .07 Per dozen ..... .60
- 323A. **Meter Scale,** same as No. 323, but with zero at the bottom.  
Each..... .07 Per dozen ..... .60



No. 325.

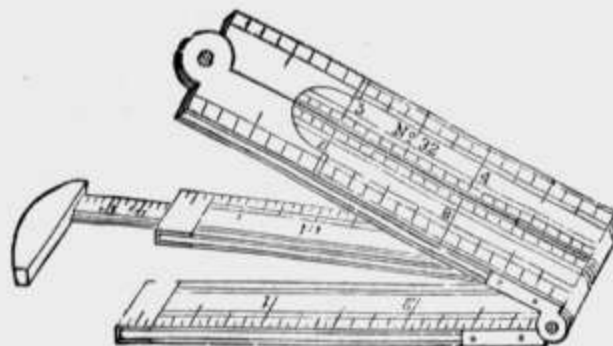


No. 327.

- 325. **Metric Rule,** of maple, 12 inches long. Graduated on one edge in millimeters and on the other in 16ths of inches. Double bevel with protractor on back.  
Each..... .04 Per dozen ..... .40
- 326. **Metric Rule,** of white celluloid, 6 inches long. One edge graduated in mm., other edge in eighths of inches. May easily be carried in vest pocket.  
Each..... .05 Per 100 ..... 4.50
- 327. **Metric Rule,** of boxwood, 12 inches long. One edge beveled and accurately graduated in millimeters, the other side of ruler graduated in 16ths of inches.  
Each..... .08 Per dozen ..... .90
- 328. **Metric Rule,** on heavy bond paper, 3.5x23.5 cm., graduated for 20 cm. along one edge in mm. divisions.  
Per dozen..... .10 Per 100..... .75
- 319A and 321A. **Half Meter Sticks,** page 489.

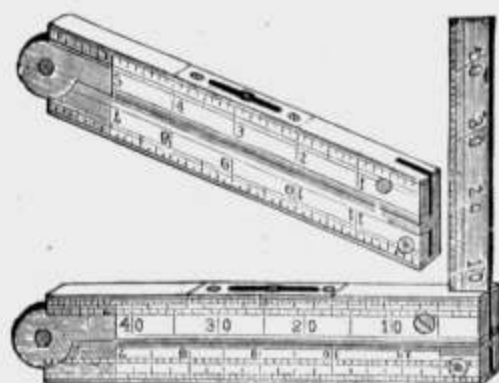
- 329. **Metric Measure,** boxwood, graduated in millimeters on one side and 16ths of inches on the other. Four fold, solid brass joints, with brass caliper extension for measuring diameters up to 2 3/4 inches or 70 mm. Made to carry in the pocket.....

.50



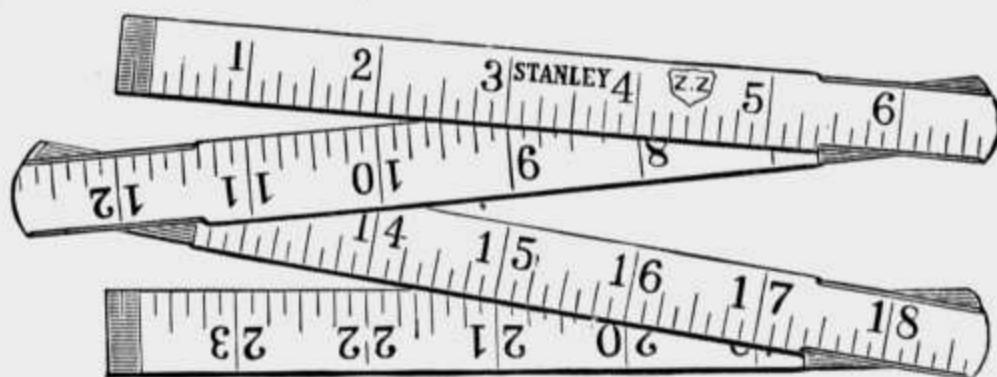
No. 329.

For other Rules, see page 44.



No. 330.

330. **Metric Measure (Combination Rule).** Made of boxwood, heavy brass binding, one joint. When folded it is 6 inches long, 1 3/8 inches wide and 3/8 of an inch thick. May be used as (1) Spirit Level, (2) Try Square, (3) Level and Plumb, (4) as a Clinometer or Slope Level. Strong, firm and reliable..... \$ 2.65

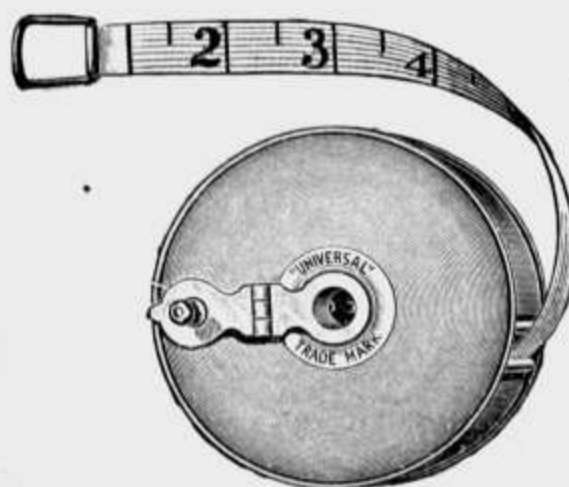


No. 331.

331. **Metric Measure,** light boxwood, 24 inches by 16ths on one side, millimeters on the other. Four fold, spring joints, very convenient for comparing English and metric measurements. Made to carry in the vest pocket ..... .17



No. 335.

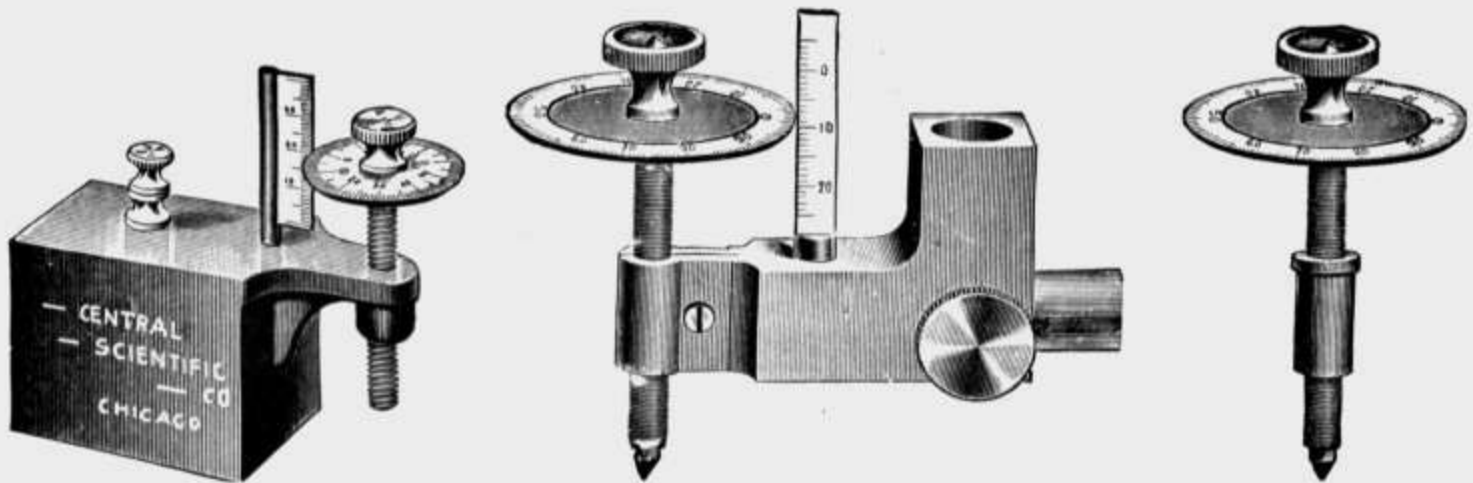


No. 337.

335. **Metric and English Steel Pocket Tape,** in German silver case with spring wind and stop. Graduated in millimeters and 16ths of inches.  
 Length, meters ..... 1 2 5  
 Each ..... 1.00 1.50 4.50

336. **Metric and English Linen Pocket Tape,** in nickel plated brass case with spring wind and center stop. Graduated in millimeters and 16ths of inches.  
 Length, meters ..... 1 2  
 Price ..... .50 .75

337. **Metric Linen Pocket Tape,** strong linen tape 1/2 inch wide, brass bound case and folding handle. Graduated in centimeters.  
 Length, meters ..... 10 25  
 Each ..... .67 1.35

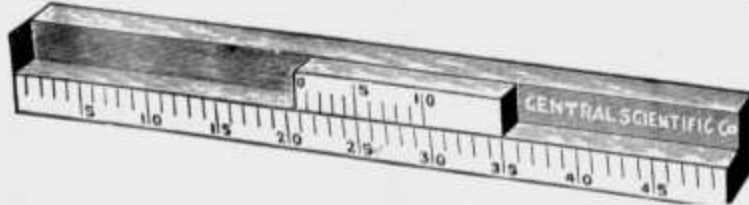


No. 338.

No. 338B.

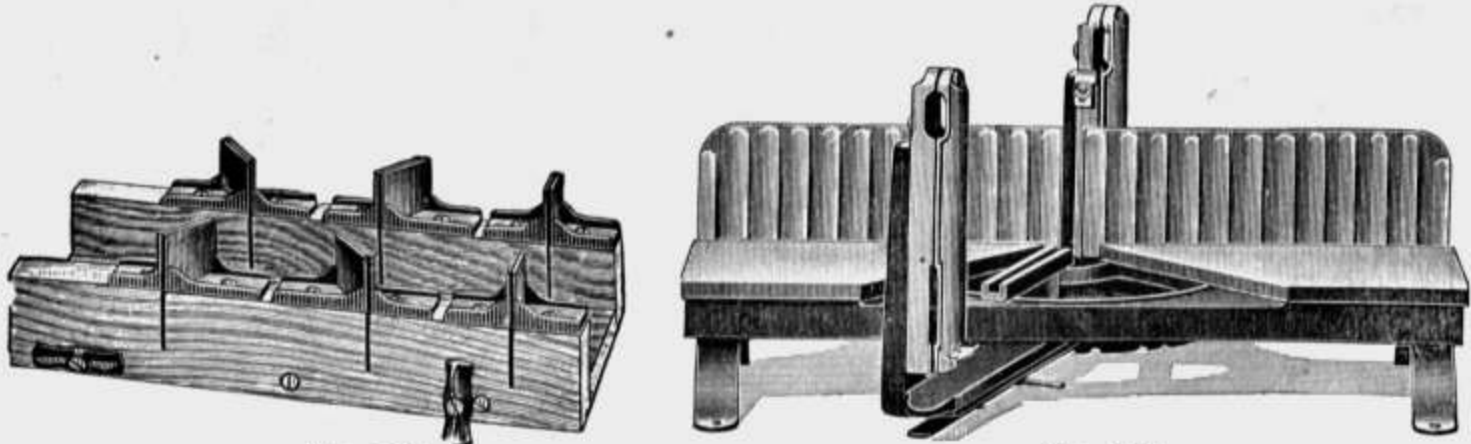
No. 338C.

338. **Micrometer Screw.** Mounted on a heavy iron base, milled on two sides so that it may be used in either vertical or horizontal position, the screw moving in an overhanging bracket. Pitch of screw, 1 mm., length, 6.5 cm. Head is 4 cm. in diameter and is divided into 100 parts, therefore reading to .01 mm. Provided with binding post for electrical connections. This screw is indispensable for accurate measurements in experiments on the flexure of beams..... \$ 3.35
- 338A. **Micrometer Screw.** Same as No. 338, but furnished with platinum contact and with brass stirrup having binding post and platinum contact for suspending weights from beam in flexure experiments..... 5.50  
See cut of No. 652A, showing use of above.
- 338B. **Micrometer Screw.** Same screw as No. 338, but mounted so as to be used with standard 13 mm. rods, which permit its use in a variety of ways in building special apparatus. Provided with binding post for electrical connections..... 5.00
- 338C. **Micrometer Screw.** Screw only of No. 338, with 13 mm. nut, unmounted ..... 1.80
- See also No. 517 Spherometer and Nos. 518 and 518A Screw Holders.



No. 339.

339. **Model of Vernier,** graduated rod, half meter long, with sliding Vernier 1.80.



No. 343.

No. 344.

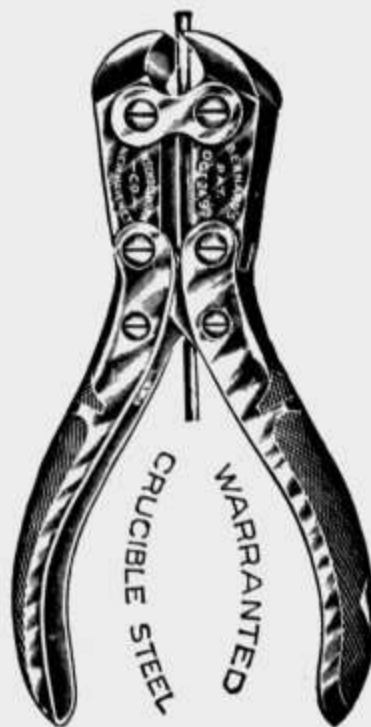
343. **Mitre Box, Olmsted's.** Can be used with ordinary hand saw, which will do perfect work and not cut the frame away. Provided with iron guides for saw. Small size, will cut 1½ in. x 3 in. moulding, etc. 2.10
344. **Mitre Box,** with bed and back of a single piece of iron, steel legs, and emery boards to keep the work from slipping. The saw guides are quickly adjustable for any thickness back or panel saw. Stops are provided so that any depth may be sawed with back saw. Locks automatically at all regular angles; can be instantly set and locked at any angle. Gives 7¼ inches width at right angles and 4½ inches at mitre. Includes 24x4-in. back saw.....Net 7.50



No. 346.

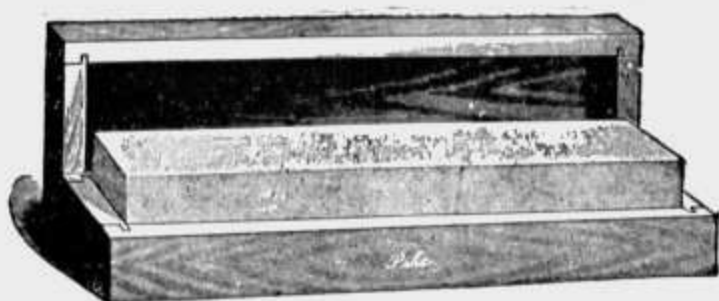


No. 347.



No. 348.

346. **Nail Sets**, made of fine grade steel, both ends hardened, centers nicely knurled, tips concaved, tops oval and the size exact.
- |                              |                |               |  |
|------------------------------|----------------|---------------|--|
| Size .....                   | A              | C             |  |
| Length, inches .....         | 4              | 4             |  |
| Diameter at tip, inches..... | $\frac{1}{16}$ | $\frac{1}{8}$ |  |
| Each .....                   | \$0.10         | .10           |  |
347. **Nippers**, end cutting, 6 inch..... \$ 0.60
348. **Nippers**, end cutting, Bernard's, 6 inch, open throat jaws, full nickel plated, interchangeable parts. Its compound system of leverage makes this tool a very powerful cutter..... 1.70
353. **Oil Stone**, genuine Washita, 5 inch, unmounted..... .85



No. 355.



No. 357.

355. **Oil Stone**, same as No. 353, mounted in case..... 1.10
357. **Oil Stone**, Washita slips, beveled with rounding edge, for gouges and fine tools.
- |              |       |       |  |
|--------------|-------|-------|--|
| Length ..... | 3 in. | 4 in. |  |
| Each .....   | .18   | .20   |  |
359. **Oil Can**, zinc, diameter 2 inches..... .07  
See also No. 1303 Oil Can.

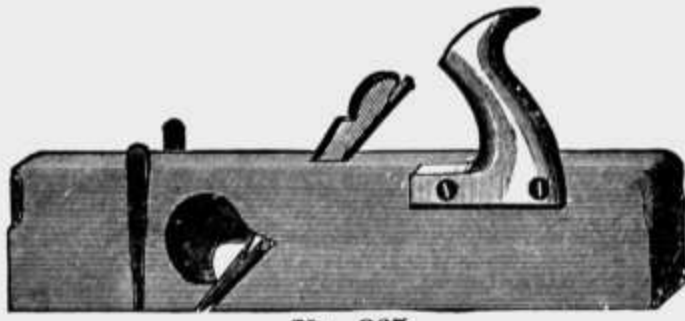


No. 361.



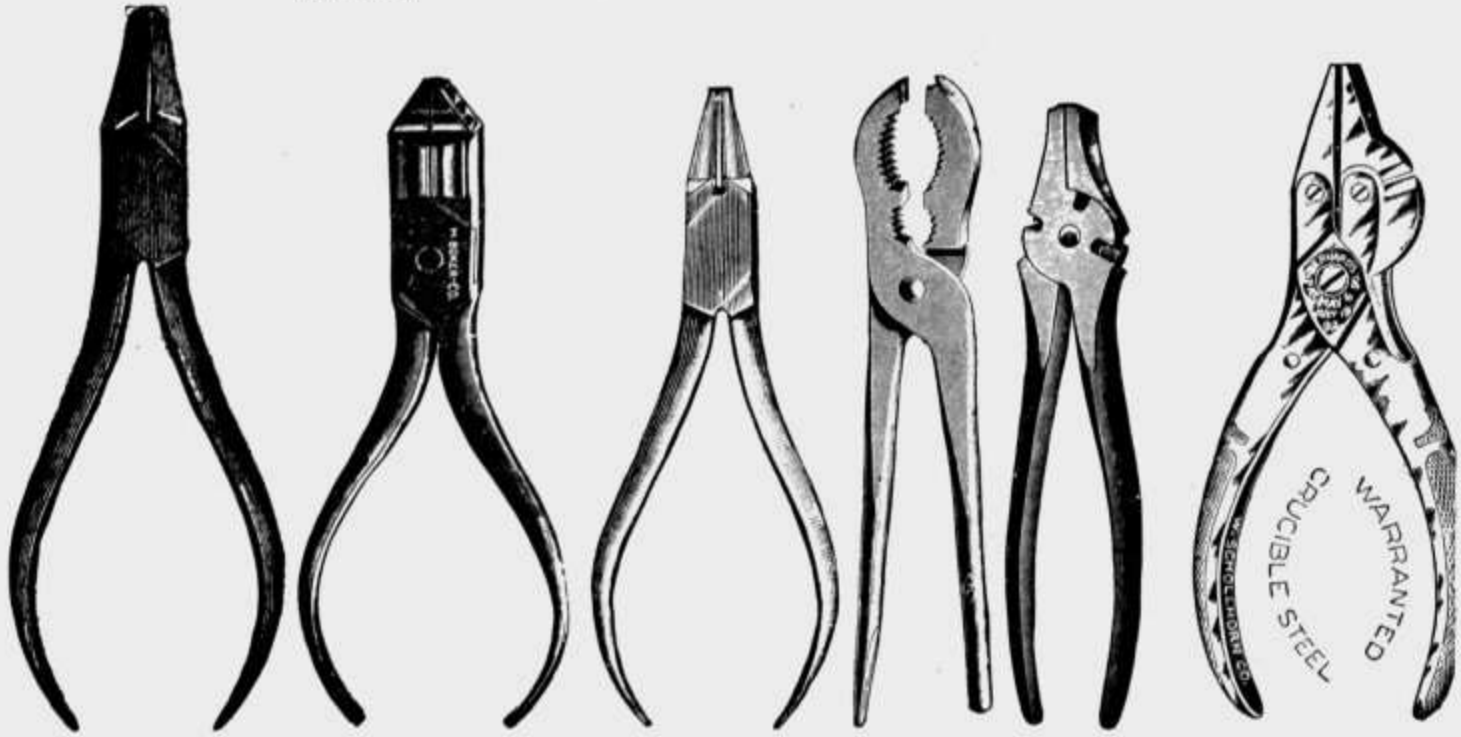
No. 363.

361. **Plane**, iron block, 5½ inches long, 1¼-inch cutter..... .45
363. **Plane**, iron, double ender, 8 inches long, 1¼-inch cutter. This plane may be used as a block plane, or by reversing the cutter and wedge it can be used to plane close up into corners or other difficult places..... .90

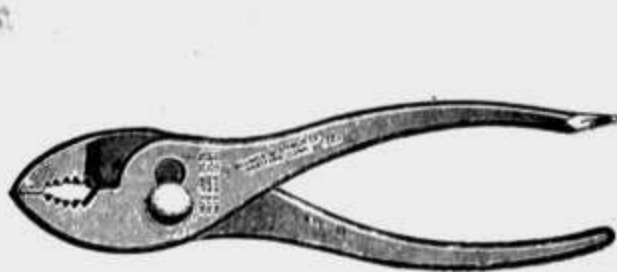


No. 365.

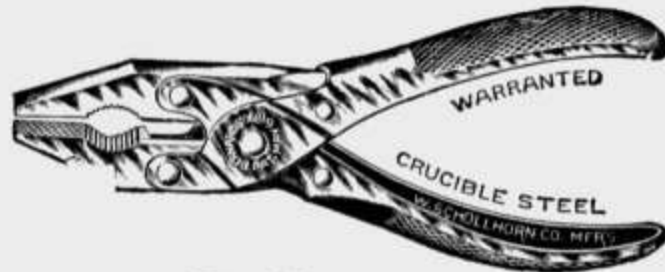
- 365. Plane, Jack, wood bench plane, 2-inch cutter, double iron ..... \$ 1.20
- 366. Planimeter. See Catalog K for description.....Net 17.50
- 366A. Planimeter. See Catalog K for description. Duty free 20.00



- |   |          |          |          |          |              |
|---|----------|----------|----------|----------|--------------|
| No. 367.  | No. 369. | No. 371. | No. 373. | No. 375. | No. 379.     |
| 367. Pliers, flat nose.....5 inch,                        |          |          |          |          | 6 inch, .35  |
| 369. Pliers, flat nose, side cutting.....5 inch,          |          |          |          |          | 6 inch, .75  |
| 371. Pliers, round nose.....5 inch,                       |          |          |          |          | 6 inch, .35  |
| 373. Pliers, Gas, cast steel, best quality.....7 inch,    |          |          |          |          | 9 inch, .45  |
| 375. Pliers and Nippers combined, Button's patent 4½ in., |          |          |          |          | 6 inch, .40  |
| 379. Pliers, Bernard's, cutting, open throat, paral-      |          |          |          |          | 5½ in., 1.45 |
|   |          |          |          |          | 4½ in., 1.15 |



No. 381.



No. 382.

- 381. Pliers, Combination. Gas plier, wire cutter, wrench and screw driver combined. Drop forged from high grade tool steel and warranted free from defects. Full nickel plated. A very useful tool.....6-inch, .45 10-inch, .80
- 382. Pliers, Combination. A flat nose gas plier and cutter combined. Open throat, parallel jaws, full nickel plated. Length, 5½ inches..... 1.10

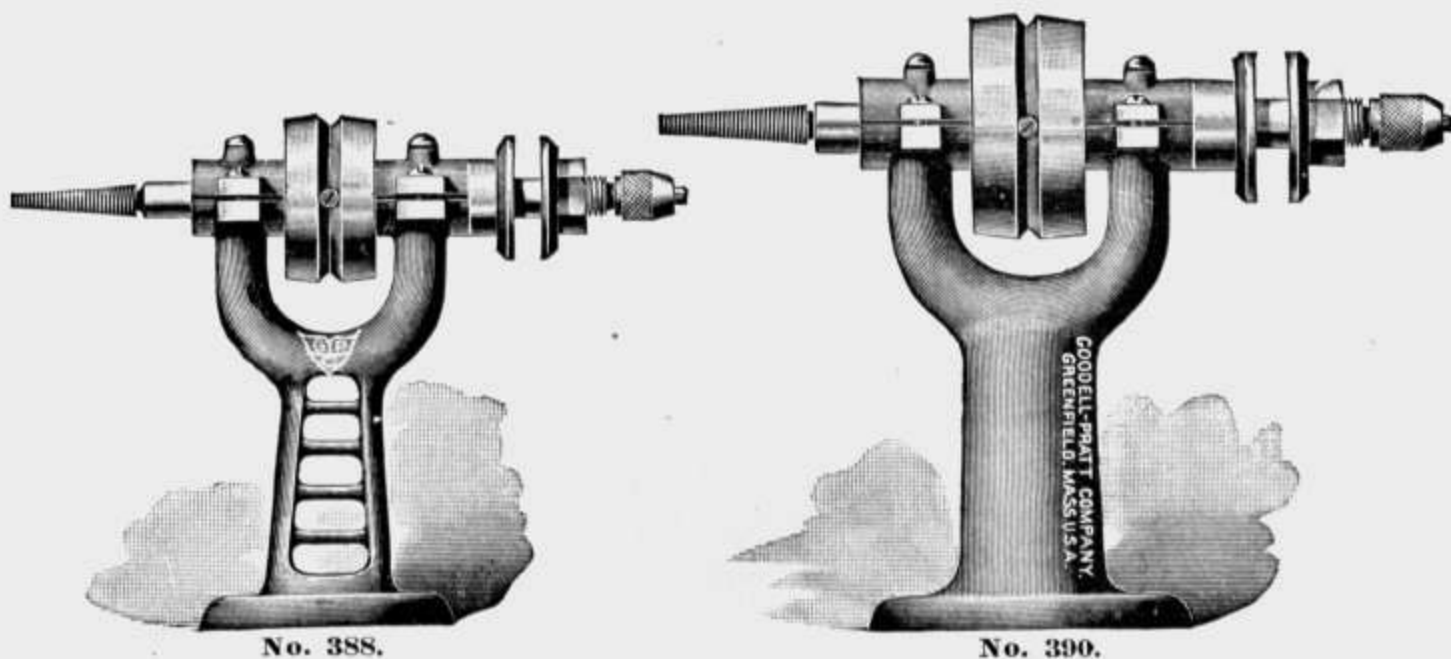


No. 383.

- For Nippers, see Nos. 347-8.
- 383. Plumb Bob, japanned iron, weight 9 oz.... .13
- 387. Plumb Bob, Mercury. Made from solid steel rod, bored out and filled with mercury, which makes it unusually heavy in proportion to its size, and the center of gravity low. The small diameter allows it to be used close to corners and walls. The point is hardened and the body and point ground. Nickel plated and furnished with a braided silk line. Size, 5/8 x 4½ inches; weight, 6 ounces.....Net 1.50



No. 387.



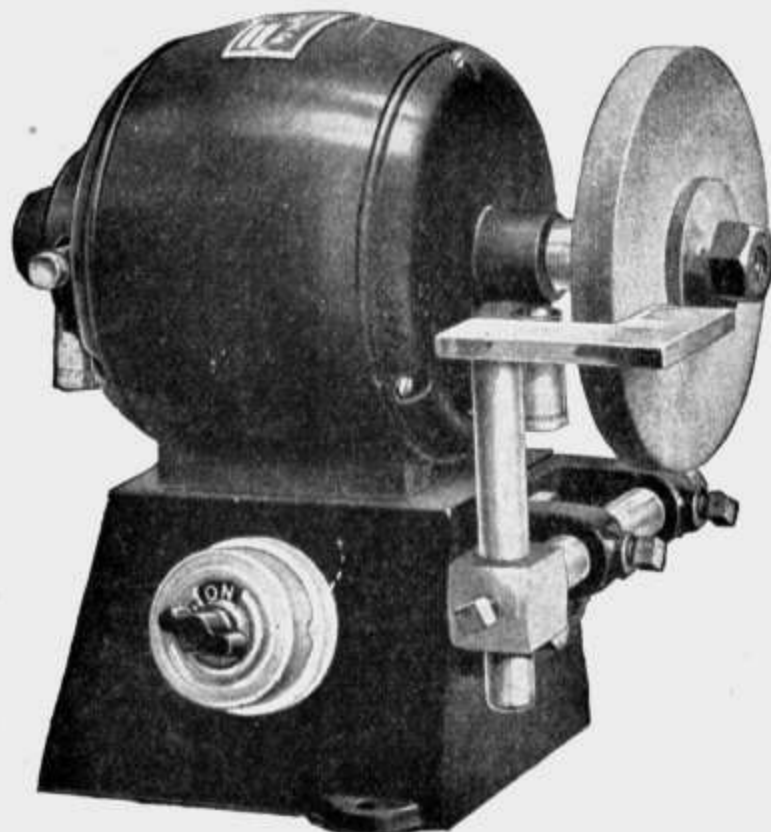
388. **Polishing Head.** Solid japanned iron frame, 6 inches high; steel spindle  $\frac{3}{8}$  of an inch in diameter, 8 inches long; adjustable boxes. Carefully threaded taper screw on one end and three-jawed chuck for 0 to  $\frac{5}{32}$ -inch drills on the other. Fitted to hold emery wheels, circular saws, buffers, etc. which have  $\frac{3}{8}$ -inch hole and are not over  $\frac{3}{4}$ -inch in thickness. Pulley grooved for  $\frac{7}{32}$ -inch round belt..... \$ 2.50
390. **Polishing Head.** Solid japanned iron frame slightly more than 6 inches in height; steel spindle  $\frac{1}{2}$  inch in diameter and 10 inches long; adjustable boxes. Carefully threaded taper screw on one end and three-jawed chuck for 0 to  $\frac{1}{4}$ -inch drills on the other. Fitted to hold emery wheels, circular saws, buffers, etc., which have  $\frac{1}{2}$ -inch hole and are not over  $\frac{7}{8}$  inch in thickness. Pulley grooved for  $\frac{7}{32}$ -inch round belt..... 4.00



No. 392.

392. **Foot Power.** 20-inch wheel with turned face, grooved so that it can be used for either 1-inch flat or  $\frac{7}{32}$ -inch round belt. Solid iron base, powerful foot lever and a leather belt pull. This wheel can never get on a dead center. Finished in machine enamel..... 12.00
- For Polishing Head Accessories, see next page.  
For Belt, see No. 259 for 1-inch flat and No. 1955 for  $\frac{7}{32}$ -inch round.





No. 394.

394. **Polishing Head, Electric**, for 110 volt direct current. Will meet all requirements for light grinding, buffing, etc. Motor enclosed, protecting all working parts from flying dust and dirt. Bearings are made of extra heavy phosphor bronze, steel shaft  $\frac{1}{2}$  inch in diameter. Lubrication is automatic by means of feed wick oil cups. Motor practically noiseless in operation. Has a speed of 3,000 R. P. M. and will develop  $\frac{1}{6}$  H. P. Dimensions: Height over all,  $9\frac{1}{2}$  inches; base, 6x5 inches; length of shaft,  $9\frac{1}{2}$  inches. Finished in black japan. Buffing attachment to hold small buffs for buffing wheel is furnished extra. (See No. 394D.) Complete with adjustable tool rest, emery wheel 5 inches in diameter,  $\frac{1}{2}$  inch face, indicating snap switch, attachment plug and six feet reinforced cord .....Net \$ 27.00
- 394A. **Polishing Head, Electric**, same as No. 394, but for 220 volt direct current .....Net 27.00
- 394B. **Polishing Head, Electric**, same as No. 394, without tool rest.....Net 22.50
- 394C. **Polishing Head, Electric**, same as No. 394A, without tool rest.....Net 22.50
- 394D. **Buffing Attachment**, for either of the above Electric Polishing Heads, extra .....Net 2.00
- 394E. **Pulley**,  $2\frac{1}{4}$  inches in diameter, for round belt, for attaching to shaft of Nos. 394 to 394C.....Net 1.00

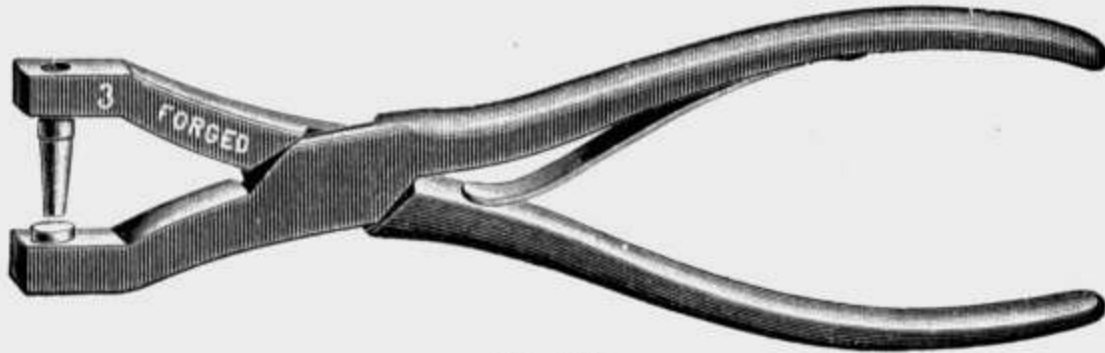
#### POLISHING HEAD ACCESSORIES.

395. **Emery Wheel**, extra fine quality. 3 inches in diameter,  $\frac{1}{2}$  inch thick,  $\frac{3}{8}$  inch hole. Fits No. 388 Polishing Head..... .55
396. **Emery Wheel**, extra fine quality. 3 inches in diameter,  $\frac{1}{2}$  inch thick,  $\frac{1}{2}$  inch hole. Fits No. 390 Polishing Head..... .55
397. **Circular Saw**, good quality steel,  $2\frac{1}{2}$  inches in diameter,  $\frac{3}{8}$  inch hole. Fits No. 388 Polishing Head..... .40
398. **Circular Saw**, good quality steel, 3 inches in diameter,  $\frac{1}{2}$  inch hole. Fits No. 390 Polishing Head..... .50
399. **Felt Polishing Wheel**, fine quality felt, 5 inches in diameter, 1 inch wide,  $\frac{1}{8}$  inch hole. Fits screw end of either No. 388 or No. 390 Polishing Head ..... 1.65
401. **Muslin Buff Wheel**. 35 pieces heavy muslin, strongly stitched together. 3 inches in diameter,  $\frac{3}{8}$  inch hole. Fits No. 388 Polishing Head ..... .22
402. **Muslin Buff Wheel**. Same as No. 401, but with  $\frac{1}{2}$  inch hole to fit No. 390 Polishing Head..... .22



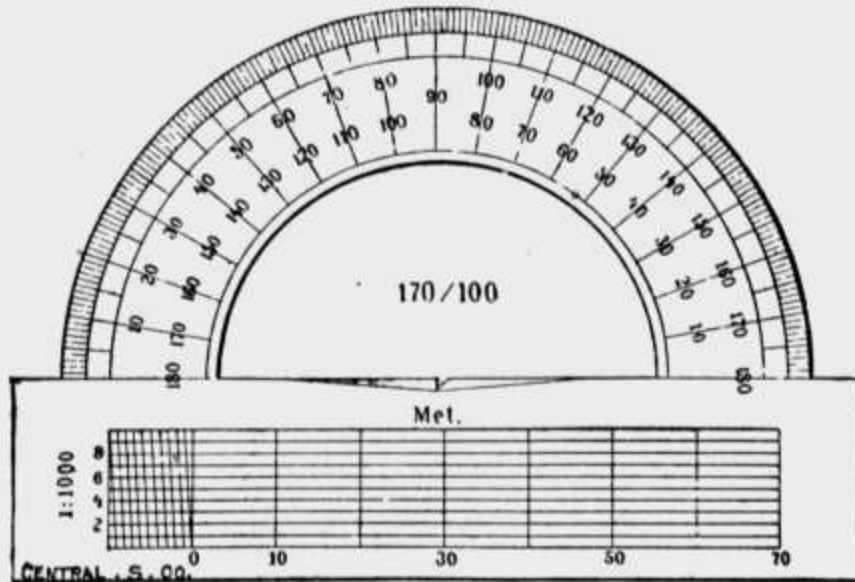
No. 405.

- |                                    |         |         |         |         |
|------------------------------------|---------|---------|---------|---------|
| 405. Punch, hollow cast steel..... | 1/8 in. | 1/4 in. | 3/8 in. | 1/2 in. |
| Each .....                         | \$0.13  | .15     | .22     | .35     |



No. 407.

- |   |    |      |
|---|----|------|
| 407. Punch, spring, cast steel, double joint..... | \$ | 0.35 |
|---|----|------|



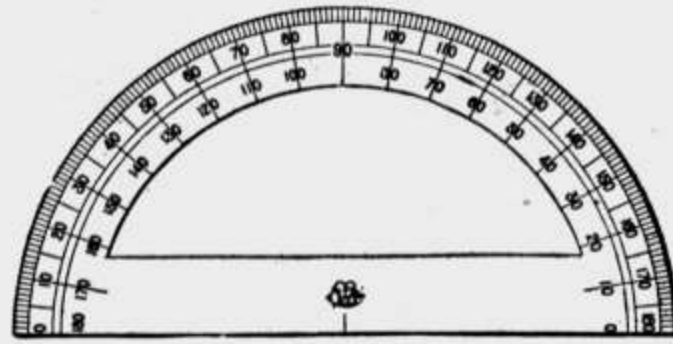
No. 409.

- |   |     |
|---|-----|
| 409. Protractor and Diagonal Scale Combined, of silvered metal, 5 1/8 inches long, 1 degree divisions, metric diagonal scale.....                     | .55 |
| 411. Protractor and Diagonal Scale Combined, same as No. 409, printed on bristol board, 1/2 degree divisions, English and metric diagonal scale ..... | .20 |
| 412. Protractor and Rule, page 489.   |     |



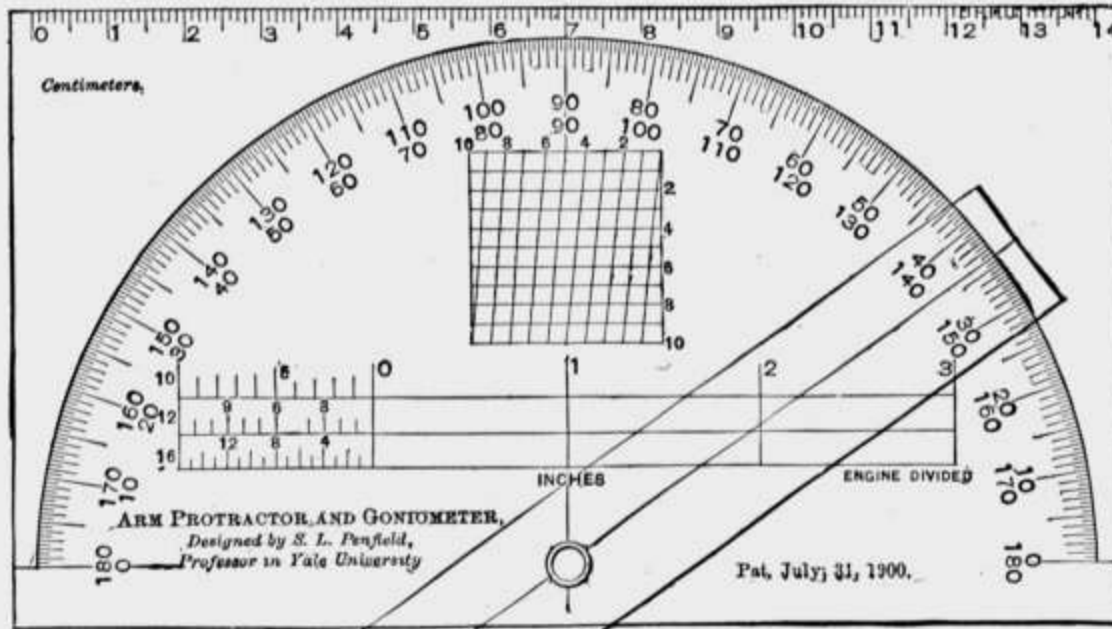
No. 413.

- |   |     |
|---|-----|
| 413. Protractor, boxwood, 6 inches long, 1 3/4 inches wide, scales of 1/4, 1/2, 3/4 and 1 inch to the foot. Scale of chords, diagonal scales and scales of 10ths, 20ths, 30ths and 40ths of inches..... | .45 |
|---|-----|



No. 419.

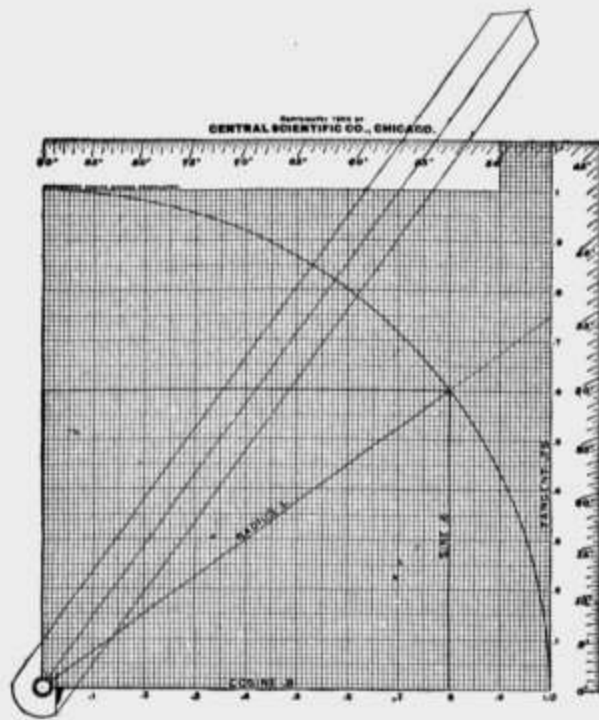
415. Protractors, cardboard, 4-inch, per dozen.....				\$ 0.33
417. Protractors, celluloid .....	4¼ in.	5⅛ in.		
Smallest division .....	1°	½°		
Each .....	.18	.40		
419. Protractors, brass .....	3½ in.	4¼ in.	5⅛ in.	
Smallest division .....	1°	1°	½°	
Each .....	.10	.27	.50	
421. Protractors, German silver.....		4¼ in.	5⅛ in.	
Smallest division .....		1°	½°	
Each .....		.40	.75	
423. Protractors, whole circle, on bristol board, 8 inches in diameter, ½ degree divisions .....				.22
425. Protractors, same as No. 423, 14 inch, ¼ degree divisions.....				.60
Protractor, see No. 522 Walter Smith School Square.				
426, 426A, 426B, and 426C. Protractors, page 489.				



No. 427.

427. **Protractor and Goniometer, Penfield's.** A graduated semicircle printed on a heavy card, with an arm of transparent celluloid, swiveled on an eyelet at the center of the semicircle. A fine index line on the under side of the celluloid arm indicates the angle. The instrument is also an accurate goniometer for measuring plane angles. The millimeter scale, English diagonal scale, scales

	for 10ths, 12ths, and 16ths of inches, and graduation of the semicircle are all engine divided. Each instrument placed in a stout manila envelope with complete printed instructions by Prof. Penfield .....	.67
427A. Contact Goniometer (Model A). For measuring internal angles and for use where an arm protractor cannot be employed. Consists of two pairs of measuring arms with separate protractor.....		.67
427B. Contact Goniometer (Model B). As it is difficult to adjust a transparent edge in exact contact with some surfaces, a modified form of No. 427 is made for measuring crystals, having the celluloid arm opaque for a portion of its length.....		.67



No. 428.

428. **Protractor or Trigonometer**, engine divided, for graphical solution of all fundamental trigonometrical problems. Two edges are graduated for reading angles, the smallest graduations being 15 minutes. A celluloid arm with fine lines scratched upon it, swings about the center of the circle. Sines and cosines are read graphically by interpolation to .002 at the point where the fine line on the arm intersects the circle. Tangents are read at the intersection of this fine line with the tangent line. Complete instructions are furnished on the back of each instrument. Printed on strong litho card, 8x8 inches.....

.30



No. 429.

429. **Rule, Johnson's Patent Combination**. This six-inch folding pocket rule is made of spring German silver accurately and distinctly graduated; it can be used as a Hook-rule, Caliper-gauge, Protractor, Triangle or Try-square. The upper edge is graduated in 32nds, the lower edge in 16ths. The caliper blade is graduated in 16ths on one side and 32nds on the other. The protractor is graduated every five degrees and is provided with a vernier reading to  $\frac{1}{2}$  degree. This handy and indispensable rule can be set to any desired angle, and the center joint is so constructed that the rule remains firm wherever set .....

1.80



No. 431.

431. **Rule, Parallel**, of ebony; 9-inch, .75; 12-inch.....

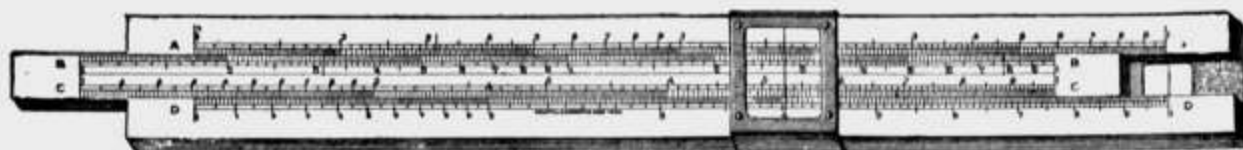
1.00

432. Steel Rule, page 490.



No. 437.

- 433. Rule, Steel, standard improved, metric and English measure. First corner graduated to  $\frac{1}{2}$  mm.; second corner to 1 mm.; third corner to  $\frac{1}{64}$  inch; fourth corner to  $\frac{1}{100}$  inch; 5 cm. long..... \$ 0.30
- 435. Rule, Steel, same as No. 433; 10 cm. long..... .50
- 437. Rule, Steel, standard improved, metric and English measure. First corner, 5 cm., graduated to  $\frac{1}{2}$  mm.; the remainder of that corner together with second corner, to 1 mm.; third corner, 2 inches to  $\frac{1}{64}$ , the remainder to  $\frac{1}{16}$  of an inch; fourth corner, 2 inches to  $\frac{1}{100}$ , the remainder to  $\frac{1}{50}$  of an inch; 20 cm. long..... 1.00
- 439. Rule, Steel, same as No. 437, 30 cm. long..... 1.40
- 441. Rule, Steel, same as No. 437, 50 cm. long..... 2.20
- 443. Rule, Steel, same as No. 437, 1 meter long..... 7.75



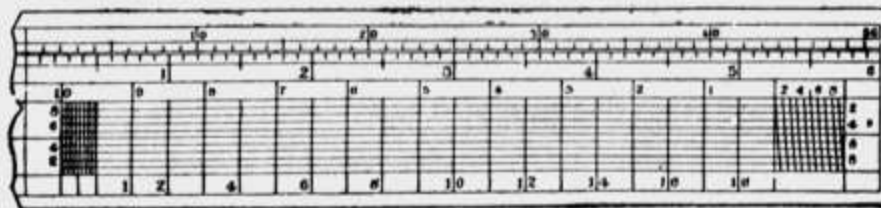
No. 446.

- 445. Rule, Slide [Woodworth], a simple machine for multiplying and dividing. It is printed on heavy bristol board, ready for the student to cut and fit together. Recommended by the Central Association of Science and Mathematics Teachers. Each, 11c. Per dozen..... 1.10
- 446. Rule, Slide [Mannheim], boxwood, 10 inches, graduations on white paper, with a protective coating.....Net 1.00
- 446A. Rule, Slide, fine quality, 10 inch, with book of instructions..... 4.00
- 446B. Rule, Slide, Multiplex, best quality, 10 inch, with scales of cubes and reciprocals .....Net 5.00



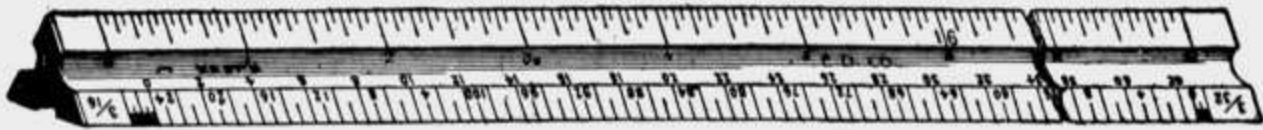
No. 447.

- 447. Scale, Comparing Scale, metric and English. Engine divided, printed on bristol board,  $\frac{1}{2}$  meter long..... .33



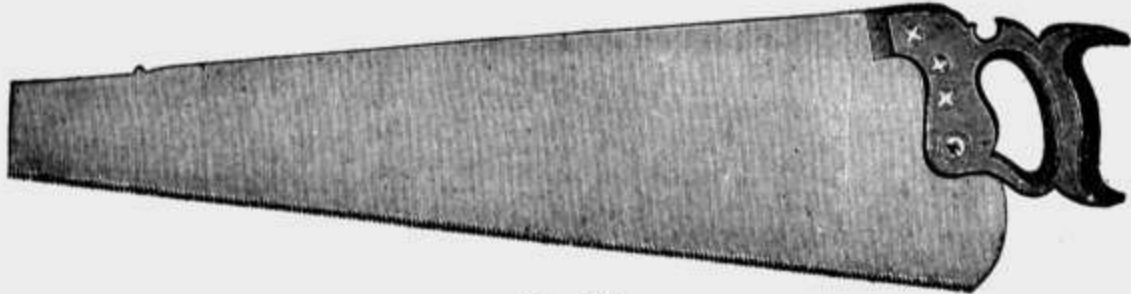
Nos. 449—450.

- 449. Scale, Diagonal or Plotting, boxwood, 6 inch, metric..... .10
  - 450. Scale, same as No. 449, English..... .10
  - 451. Scale, Diagonal, of silvered metal, 7 inch, metric..... .45
  - 452. Scale, Diagonal, on best bristol board, 6 inch, metric..... .08
  - 453. Scale, same as No. 452, English..... .08
  - 455. Scales for Galvanometers, printed on bristol board,  $2\frac{3}{4}$ ,  $3\frac{1}{4}$  and 5 inches in diameter, in 1 degree divisions, each..... .11
  - 458. Scale, Mirror, for Jolly's Balance, half mirror, with No. 323 Paper Scale pasted on back, 65 cm. long..... .75
  - 459. Scale, Mirror, for Jolly's Balance and other apparatus, accurately etched on plate glass and finely silvered,  $\frac{1}{2}$  meter long in millimeters ..... 2.25
  - 461. Scale, Mirror, same as No. 459, 1 meter long..... 6.50
  - 462. Scale, Mirror, vertical, 12 centimeters long, graduated in millimeters. .30
  - 463. Scale, Paper, for reading telescopes, 50 cm. long, graduated in mm. both ways from 0, which is in the center..... .17
  - 323. Scale, Paper, 1 meter long, graduated in millimeters..... .07
- For Reading Telescope Scales, see pages 13 and 200.  
For other Rules and Scales, see pages 34 and 35.



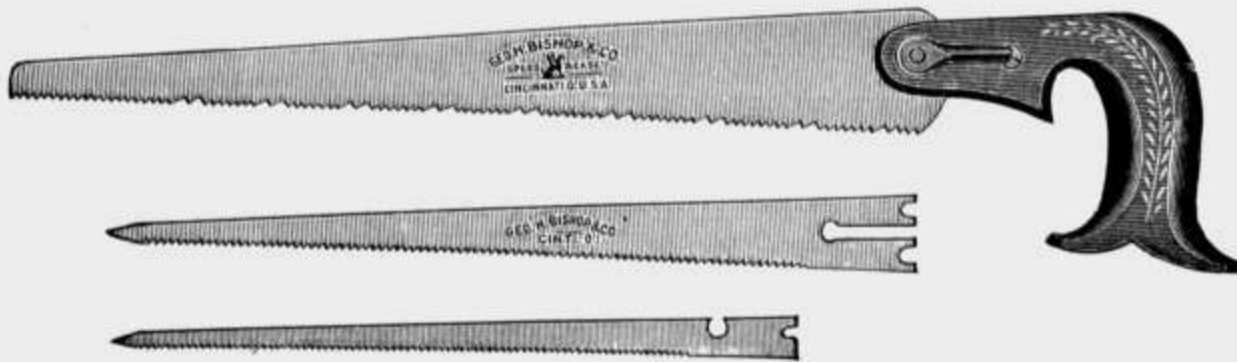
No. 467.

467. Scale, Triangular Boxwood, U. S. standard, machine divided, 12 inches long, divided to 1-16th inch, 10 different scales to the foot..... \$ 55



No. 469.

469. Saw, Crosscut, good grade steel, hand filed and ready for use; 20-inch, 1.15; 26-inch ..... 1 50  
 470. Saw, Rip, good quality, filed ready for use, 28 inches long..... 1 75



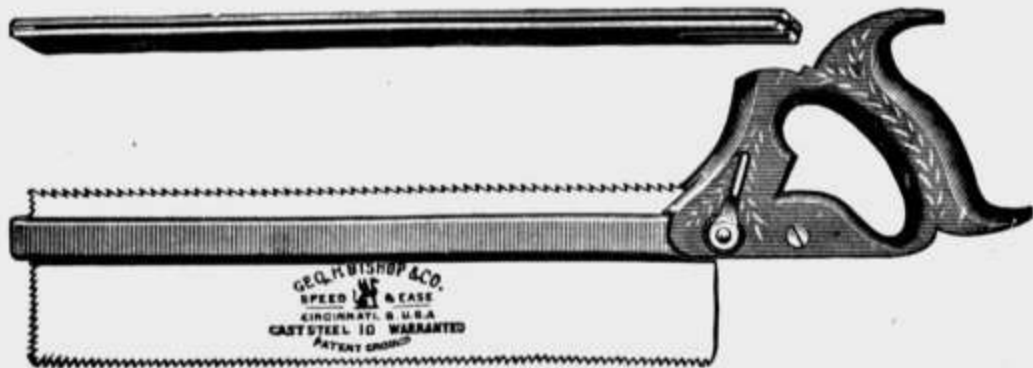
No. 472.

472. Saw, Keyhole, adjustable with interchangeable nest of saws. Apple wood handle, polished brass adjusting lever. With set of three blades ..... 1 45



No. 473.

473. Saw, Keyhole, cheap..... 25



No. 474.

474. Saw, Dovetailing, Rip and Crosscut. The back of this saw constitutes a slot through which the blade slides, enabling the workman to move, space and adjust it to any desired width or distance from edge of back.  
 Length of blade, inches..... 18  
 Each ..... 2 45  
 For Hack Saws, see Nos. 244-5.

## SCREWS.

Wood and machine screws are put up in packages of one gross. The prices given below are per gross. Packages will not be broken.

## 475. Wood Screws, iron, flat head.

Length, in.	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
No. 2	\$0.20	.20	.20	.20	...	...	...
No. 4	.20	.20	.20	.20	.22	.22	.25
No. 6	...	.22	.22	.22	.22	.25	.27
No. 8	...	.25	.25	.27	.27	.30	.30
No. 10	...	...	.30	.30	.33	.33	.33

## 476. Wood Screws, iron, round head. Sizes and prices same as No. 475.

## 477. Wood Screws, brass, flat head.

Length, in.	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
No. 2	.40	.40	.40	.45	.50	.60	...
No. 4	.40	.45	.45	.50	.55	.65	.75
No. 6	...	.50	.55	.60	.65	.70	.75
No. 8	...	.65	.75	.80	.85	.95	1.10
No. 10	...	...	.95	1.05	1.15	1.25	1.35

## 478. Wood Screws, brass, round head. Sizes and prices same as No. 477.

## 479. Machine Screws, iron, flat head.

Length, in.	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{2}$
No. 2	.15	.15	.15	.15	.15	.17	.20	...	...	...
No. 4	.15	.15	.15	.15	.15	.17	.20	.24	...	...
No. 6	.15	.15	.16	.16	.17	.18	.22	.24	.27	.30
No. 8	.18	.18	.20	.20	.21	.23	.26	.28	.30	.35
No. 10	...	.20	.22	.24	.25	.27	.28	.30	.33	.38

## 480. Machine Screws, iron, round head. Sizes and prices same as No. 479.

## 481. Machine Screws, brass, flat head.

Length, in.	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{2}$
No. 2	.18	.18	.20	.22	.25	.27	...	...	...	...
No. 4	.18	.18	.20	.22	.25	.27	.30	...	...	...
No. 6	.20	.20	.22	.25	.27	.30	.35	.40	.45	.75
No. 8	.30	.30	.33	.35	.38	.40	.45	.50	.55	.90
No. 10	.33	.33	.35	.37	.40	.42	.47	.55	.60	.95

## 482. Machine Screws, brass, round head. Sizes and prices same as No. 481.



No. 483.



No. 485.

## 483. Screw Eyes, of bright wire.

No. ....	214	12	7
Length .....	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{2}$ in.
Price, per dozen.....	.05	.07	.09

## 485. Screw Hooks, of bright wire.

No. ....	14	12	10	8
Length, over all.....	$1\frac{1}{4}$ in.	$1\frac{5}{8}$ in.	2 in.	$2\frac{1}{2}$ in.
Price, per dozen.....	.05	.07	.09	.11



No. 487.

487. Screw Drivers, 4-inch blade, .13; 6-inch blade, .20; 8-inch blade..... \$ 0.28



No. 488.

488. Screw Driver Pocket Set, with 3 blades of assorted sizes and 1 reamer for making or enlarging holes. When not in use the blades are kept in the hollow handle. 3¼ inches long when closed; polished and nickel plated..... .60



No. 489.

489. Screw Driver, rosewood handle and finest steel blade, elegantly polished throughout. Especially adapted for instrument use. Indispensable to the physical laboratory. Length of blade, 2 inches; width of blade, ⅛ inch..... .30



No. 490.

490. Screw Driver, Ratchet, a high grade tool. Blade and ratchet mechanism made of oil-tempered tool steel; changes from right to left are made by turning the knurled ferrule. Length, 6 inches..... .70



No. 491.

491. Screw Die, round, adjustable, ⅝ inch in diameter, ¼ inch thick.

Screw Gauge No.	Approx. Diam., in.	Threads to inch	Each
2	5-64	56	.45
4	7-64	36	.45
6	9-64	32 or 40	.45
8	5-32	32 or 40	.45
10	3-16	32	.45
12	7-32	24	.45
14	1-4	20	.45

492. Screw Die, round, adjustable.

Diam. of Die, in.	Approx. Diam., in.	Threads to inch	Each
1	1-4	20	.90
1	3-8	16	.90
1 5-16	1-2	12	1.15
2	3-4	10	1.80





No. 493.

493. Screw Die Stock, for holding No. 491 dies, 5 inches long..... \$ 0.50  
 493A. Screw Die Stock, for No. 492 Dies.  
 Diameter of die, inches..... 1      1 5/8      2  
 Each ..... \$1.20      1.50      1.80



No. 494.



No. 495.



No. 497.

494. Screw Tap.

Screw Gauge No.	Approx. Diam., in.	Threads to Inch	Each
2	5-64	56	\$0.17
4	7-64	36	.17
6	9-64	32 or 40	.17
8	5-32	32 or 40	.17
10	3-16	32	.17
	1-4	20	.30
	3-8	16	.38
	1-2	12	.45
	3-4	10	.80

495. Screw Tap Wrench, for taps 1/4 inch and smaller..... 1.00  
 496. Screw Tap Wrench, for taps 1/4 to 3/4 inch..... 2.00  
 497. Screw Pitch Gauge, with 24 pitches, 4 to 30 threads to the inch;  
 V thread ..... 1.65



No. 498.

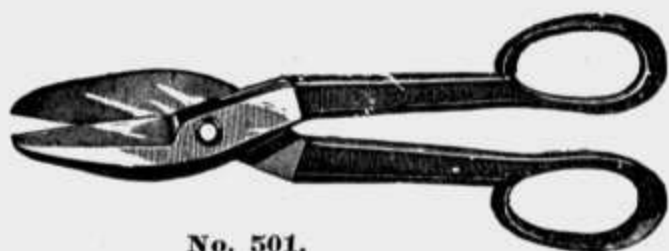


No. 498A.



No. 499.

498. Screw Die and Tap Set, with stock 7 inches long, tap wrench 7 1/2 inches long, 6 dies 13-16 inch diameter and 6 taps cutting threads 4, 36; 6, 32; 8, 32; 10, 24; 12, 24, and 14, 20. Set is enclosed in neat hard wood case ..... 7.50  
 498A. Screw Die and Tap Set, with stock 9 inches long, 5 dies 1 inch in diameter, and 5 taps cutting threads 1/4, 20; 5/8, 18; 3/8, 16; 1/8, 14; and 1/2, 12. Set is enclosed in neat hardwood case..... 8.10  
 499. Shears, paper, best quality steel, 6-inch..... .67  
 500. Shears, paper, best quality steel, 8-inch..... .80



No. 501.

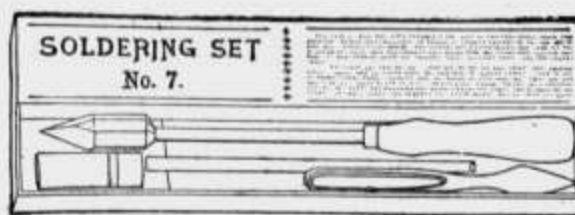


No. 503.

501. Snips or Metal Shears, 2½-inch cut, best quality..... \$ 1.50  
 503. Soldering Copper, with handle, ½ lb..... .33  
 505. Soldering Copper, 1 oz., jeweler's size, high grade, for instrument use .20



No. 506.



No. 506A.

506. Soldering Outfit, consisting of a soldering iron, bar of solder, scraper and flux, in a neat wood box..... .75  
 506A. Soldering Outfit, less elaborate than No. 506, consisting of soldering iron, piece of wire solder, and flux..... .17

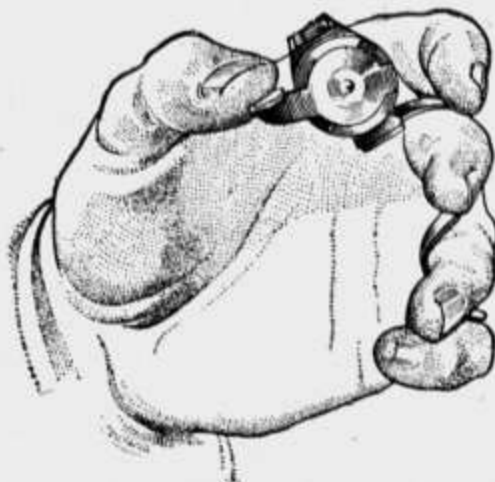


No. 507A.



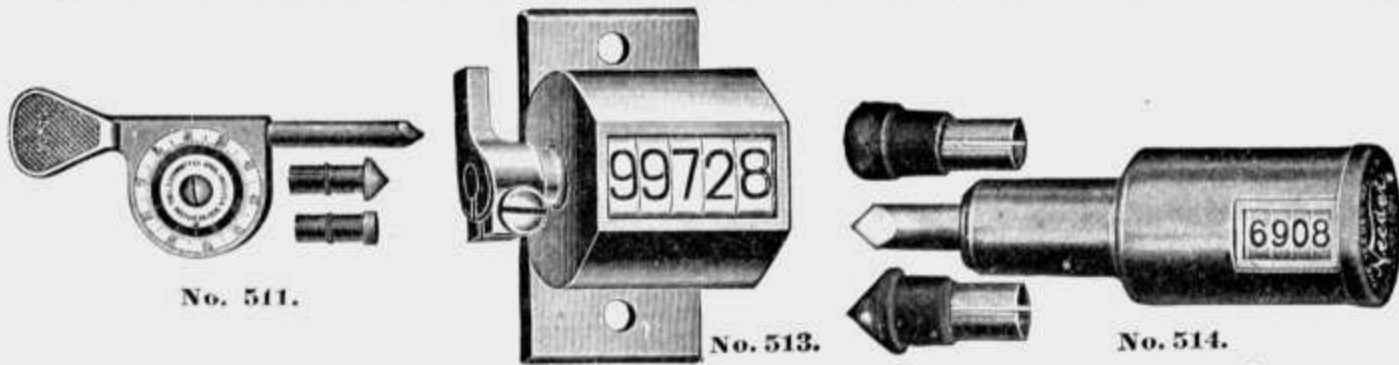
No. 507B.

- 507A. Electric Soldering Copper, for either D. C. or A. C. circuits. Length 10 inches, weight 9 ounces, tip ½ inch in diameter. Tip interchangeable and can be replaced instantly. 60 watts consumption. In ordering, kindly state exact voltage. Complete with cord and plug .....Net 6.25  
 507B. Electric Soldering Copper, for either D. C. or A. C. circuits. Length 14¼ inches, weight 18 ounces, tip ¾ inch in diameter. Tip interchangeable and can be replaced instantly. 150 watts consumption. In ordering, kindly state exact voltage. Complete with cord and plug .....Net 9.00  
 508. Solder, half lead and half tin, stick form, weight 2 pounds. Per stick.. .85  
 509. Solder, half lead and half tin, wire form. Per pound..... .40  
 509A. Solder, half lead and half tin, wire form with resin center. Used for all electrical joints and splices where danger of corrosion must be eliminated. No flux required when using this solder. Per 1-pound package ..... .60

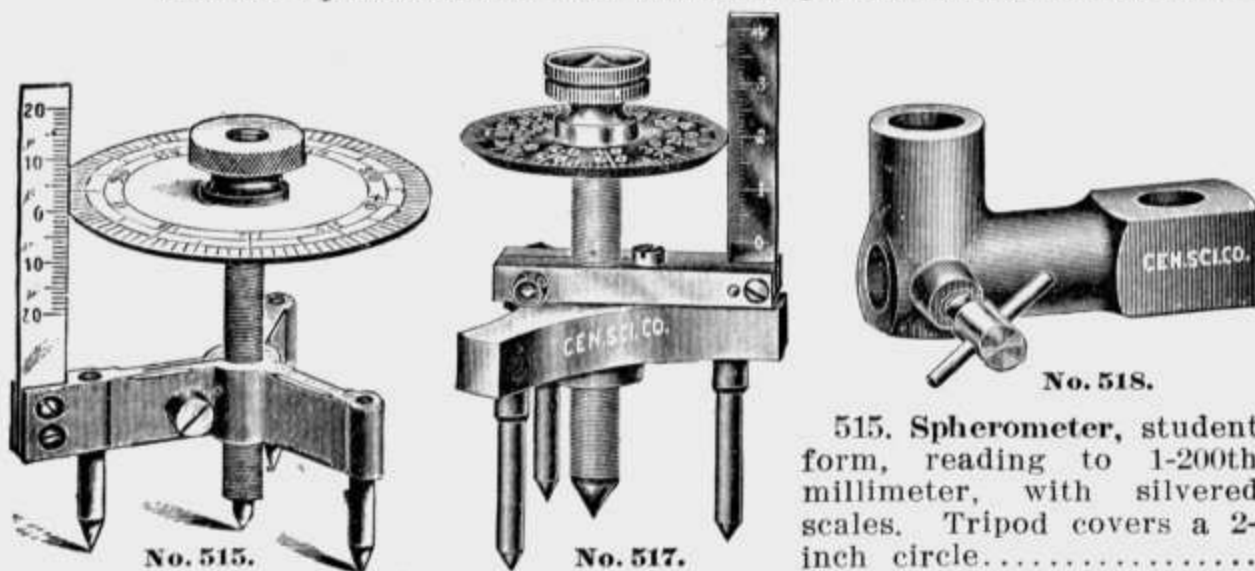


No. 510.

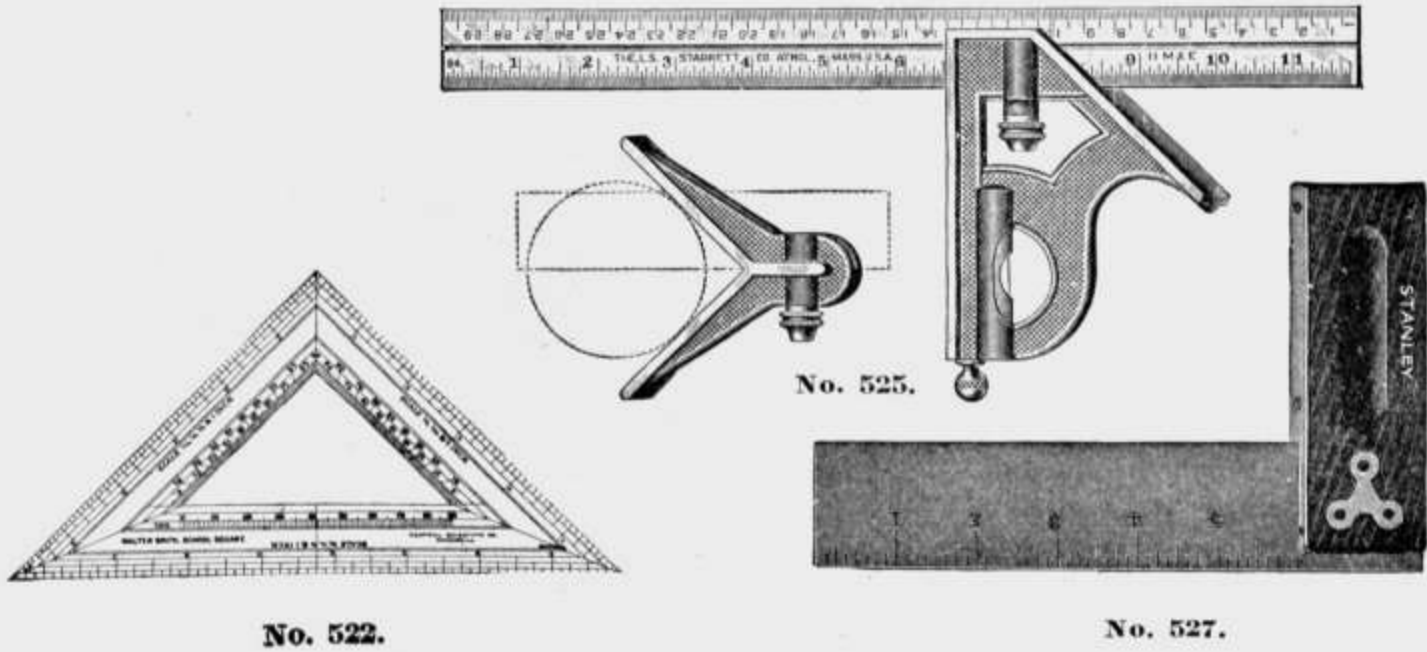
510. Hand Tally, designed to fit the fingers of the left hand as shown in the illustration. Very convenient for counting pendulum swings, etc. 3.00



- 511. **Speed Indicator**, improved form, may be run at highest speed required without heating; dial plate has two rows of figures reading right or left; rubber tips for both pointed and centered shafts, which not only remove the jar and run smoothly, but produce a stronger frictional contact with the shaft. The rotating disc, being carried by friction, may be moved to the starting point where the raised knobs coincide. Pressing the raised knob on the rotating disc with the thumb prevents the disc from moving until the hand of the watch gets to the right position to take the time. Every hundred revolutions may be noted by feeling the knob pass under the thumb, thus relieving the eye which has only to look on the watch to note the time. Nickel plated.....Net \$ 1.10
- 513. **Speed Counter, or Revolution Counter**, suitable for any purpose requiring a small, light and accurate counter. Registers up to 99,999. Its action is very smooth and uniform and it will stand a very high rate of speed. If run backwards, it counts backwards. Illustration is full size..... 1.50
- 514. **Speed Counter**, with ball thrust bearing and spring clutch which allows the spindle to turn freely until the second hand of one's watch has come to zero; a slight pressure on the end of the instrument starts the count; when pressure is released the count stops. Registers 9,999, and can be used on either high speed or low speed machinery. One pointed and one flat rubber tip furnished which serve as insulators when taking the speed of electric machinery. The flat tip can also be used on flat or pointed shafts..... 4.50



- 515. **Spherometer**, student form, reading to 1-200th millimeter, with silvered scales. Tripod covers a 2-inch circle..... 3.35
- 517. **Spherometer**, with removable micrometer screw. A carefully made instrument of high grade. The entire micrometer screw and nut, including the divided head, may be removed from the tripod base for use on other pieces of apparatus. When used in connection with Nos. 518 and 518A Screw Holders, it forms a very conveniently used micrometer for experiments on expansion, bending, etc. The legs may be placed at either 1.5 or 2.5 cm. from the center. Pitch of screw, 0.5 mm.; length of screw, 7 cm.; diameter of head, 5 cm.; number of divisions on head, 100.....Net 10.00
- 518. **Spherometer Screw Holder**, for use with the screw of No. 517 Spherometer to form a micrometer. Reamed to fit a 13 mm. rod, which may be placed either parallel with or perpendicular to the screw... Net 2.50
- 518A. **Spherometer Screw Holder**, same as No. 518, but for 19 mm. rod. Net 3.00
- 519. **Spherometer**, high grade, see Catalog K.....Duty free 27.50
- 520. **Spherometer**, high grade, see Catalog K.....Duty free 20.00

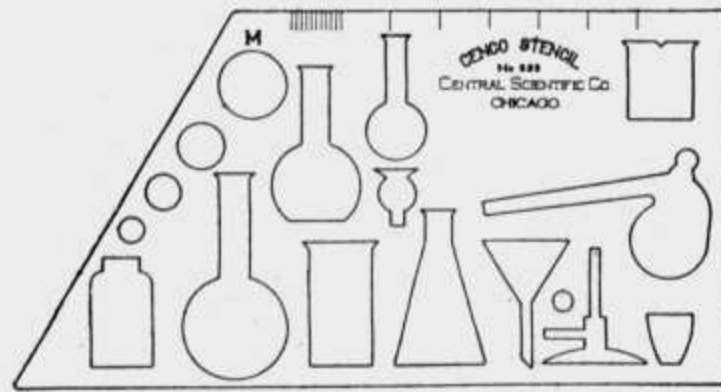


- No. 522.**
- No. 527.**
522. **Square, Walter Smith School Square**, finely lithographed on heavy bristol board. Can be used as a measure, ruler or protractor, small size, length of hypotenuse, 8½ inches..... \$ 0.07
525. **Square, Patent Combination** of new design. Every tool warranted accurate. One of the most convenient and useful tools ever devised for mechanics' use. It is a complete substitute for a whole set of common try squares, and is one of the best gauges made for transferring exact measurements or laying out work. It is also convenient for a depth gauge or to square in a mortise. For a mitre it is perfect, while with the auxiliary center head it forms a centering square, both inside and outside, which for convenience and accuracy has no equal. Twelve inch blade, graduated on one side in ½ millimeters and 32nds of inches; on the other in millimeters and 64ths of inches. Complete, with center head and level..... 1.80
527. **Square, Try**, blued steel blade graduated in 8ths of inches, and rose-wood handle.
- |                    |     |     |
|--------------------|-----|-----|
| Size, inches ..... | 6   | 9   |
| Each .....         | .35 | .50 |
529. **Square**, all steel, nickel plated, length 2 feet, width 2 inches, face marked in 4ths, 8ths, and 16ths of inches, back in 4ths and 12ths of inches, with board and brace measure..... 1.50



**No. 530.**

530. **Stencil Letters.** Each letter has a beaded lock on its edge so that the letters can be joined together, permitting the use of combinations of letters at one time instead of single letters. Complete set of one-inch letters from A to &, with beginner and ender, period, apostrophe, comma and blank..... 1.10
531. **Stencil Figures.** Same style as No. 530. Complete set of one-inch numbers from 0 to 9, dollar mark, cent mark, beginner, ender and period ..... .50

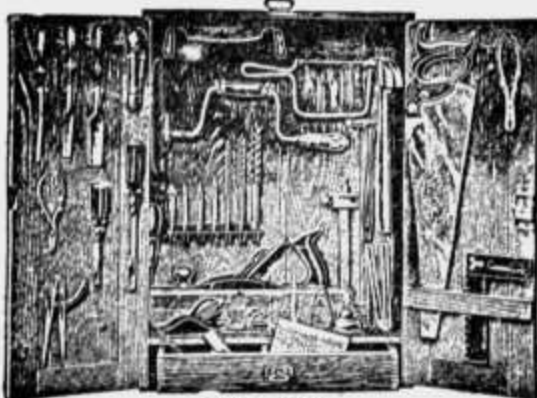


No. 532.

532. "Cenco" Stencil. This stencil was designed to eliminate bad drawings in students' laboratory note books. It consists of a flexible plate having "cut-outs" of various articles, such as flasks, beakers, Bunsen burners, funnels, etc., so that by placing the point of a pencil inside these "cut-outs" and following the curves and lines, all the articles in the illustration may be produced. The edges of the stencil itself form different angles which are of the greatest assistance when drawing bent delivery tubes. The mm. scale may be used for finding the center of any article drawn with the edge of the stencil and also for determining the length to which a line shall be drawn.

The stencil is transparent, therefore no difficulty should be experienced in drawing one piece of apparatus in the desired relative position to another. Each.....Net \$ 0.10  
For Stop Watches, see Nos. 774 and 774A.

535. Straight Edge, cherry, one edge bevelled; 24 inch..... .28  
537. Thumb Tacks, stamped steel, made of one piece, head  $\frac{5}{16}$  in., per doz... .10

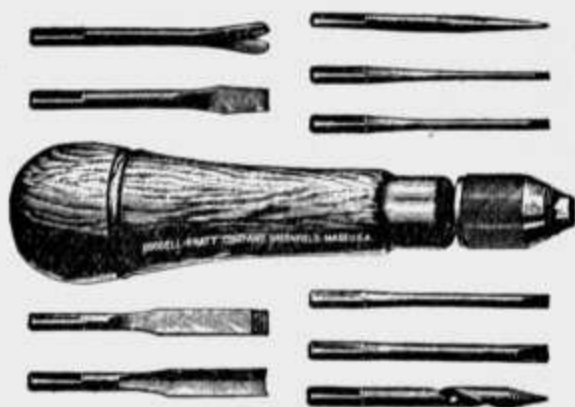


No. 539.

539. Tool Chest, made of chestnut, panelled and nicely finished, containing the following tools of the very best quality:

Panel saw, brace, 3 gimlet bits, 3 auger bits, 3 chisels, 2 screw drivers, hack saw frame, pocket level, countersink, scraper, hammer, tack hammer, tool handle with 10 tools, spoke shave, block plane, jack plane, 2-foot rule, try square, marking gauge, nail sets, wing dividers, gas pliers, flat nose

pliers, nippers, saw file, oil stone, oil can, can of glue, and coping saw. Weight, 55 lbs.....Net 17.00

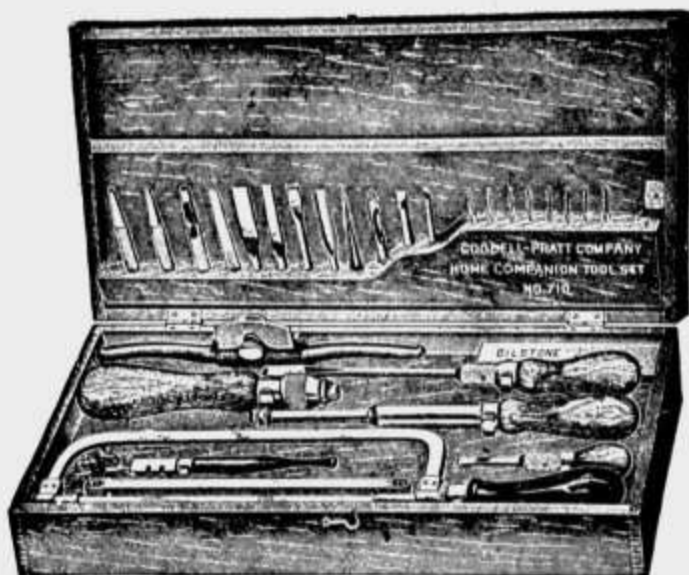


No. 540.

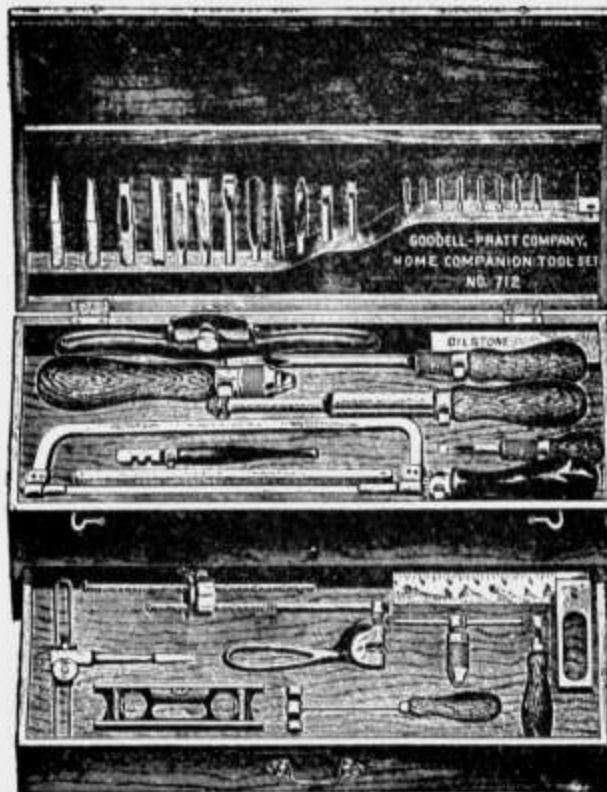


No. 541.

540. Tool Holder, with hollow polished wood handle and 10 tools, hardened and tempered from best cast steel, nicely finished. Nickel plated chuck ..... 1.10  
541. Tool Holder and 10 tools enclosed in handle. A very handy tool..... .45



No. 542.



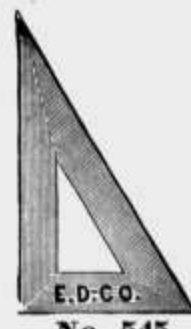
No. 542A.

542. **Tool Set.** Polished hardwood case, 16 x 8½ x 3½ inches, containing 6 in. and 1½ in. ratchet screw drivers, hand shave, hack saw frame with 11 blades and one bone saw, glass cutter, wood handle automatic drill, tool handle with 9 tools, nail set, prick punch, saddlers' drive punch, solid punch, and oil stone..... \$ 7.50

542A. **Tool Set.** Polished hardwood case, 16 x 8½ x 5½ inches, containing 6 in. steel try square, 6 in. iron level, double beam roller gauge, washer cutter, gunsmiths' screw driver, tool holder for small square shank tools, brass hammer, lever metal punch, 6 in. and 1½ in. ratchet screw drivers, hand shave, hack saw frame with 11 blades and one bone saw, glass cutter, wood handle automatic drill, tool handle with 9 tools, nail set, prick punch, saddlers' drive punch, solid punch, and oil stone..... 15.00



No. 543.



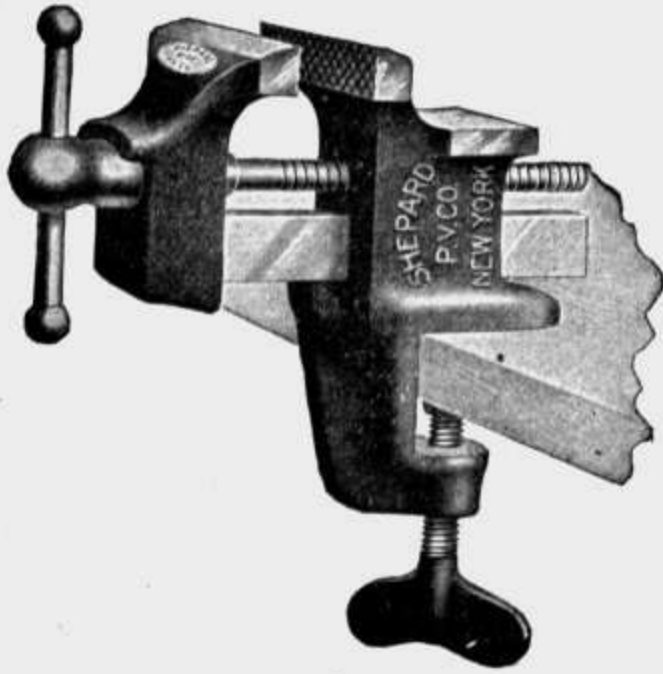
No. 545.

543. **T Square**, pearwood blade and head, extra quality.  
 Length .....24 in. 30 in. 36 in.  
 Each ..... .40 .50 .67

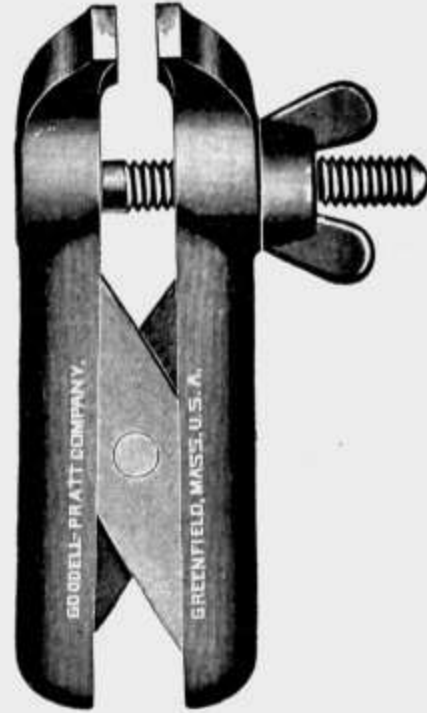


No. 547.

545. **Triangles**, pearwood, framed, 30°x60°, 6 in., .15; 8 in. .... .20  
 547. **Triangles**, pearwood, framed, 45°, 6 in., .20; 8 in. .... .27  
 549. **Triangles**, hard rubber, 30°x60°, 6 in., .25; 8 in... .30  
 551. **Triangles**, hard rubber, 45°, 6 in., .30; 8 in..... .40  
 552. **Triangles**, celluloid, 30°x60°, 6 in., .40; 8 in..... .55  
 553. **Triangles**, celluloid, 45°, 6 in., .55; 8 in..... .75

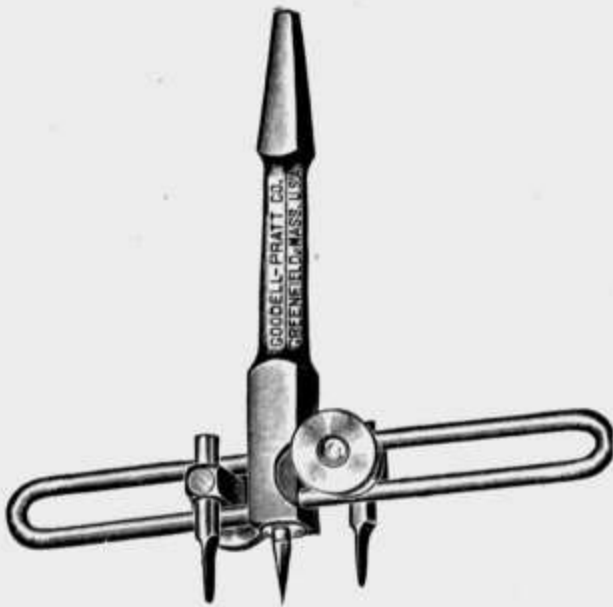


No. 555.



No. 562.

- 555. **Vise, Anvil Clamp**, 1½ inch jaw, steel faced, opens 1½ inches; weight 1½ lbs. . . . . \$ 0.40
- 557. **Vise, Anvil Clamp**, 2 inch jaw, steel faced, opens 1¾ inches; weight 2½ lbs. . . . . .70
- 559. **Vise, Anvil Clamp**, 2¼ inch jaw, steel faced, opens 2½ inches; weight 5½ lbs. Has in addition to the clamp a steel base drilled to fasten rigidly to bench by screws. The vise is thus easily held securely, and yet is free to be removed at will. . . . . 1.33
- 559A. **Vise, Anvil Clamp**, same as No. 559 but with 2¾-inch jaw, opens 3½ inches. Weight 9 pounds. . . . . 1.75
- 562. **Vise, Hand**, with parallel jaws. Very convenient and useful. Made from drop forgings, with the faces of the jaws scored and case hardened. The faces of the jaws are 1⅜ inches long, ⅜ inch wide; jaws open 1⅜ inches; whole tool 4½ inches long. Black finish. . . . 1.50



No. 563.



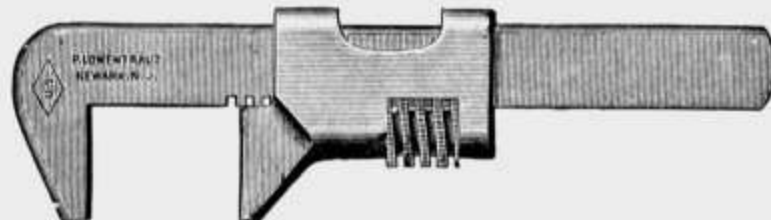
No. 565.

- 563. **Washer Cutter**. A strong, well made, useful device for cutting washers of diameter from ½ in. to 5½ in. Provided with removable blades adjustable as to length of cutting edge as well as position. These blades can easily be removed for sharpening or replaced when they wear out. Nicely polished and attractive in appearance. . . . . 1.50
  - 565. **Wire Gauge**, American standard, sizes 0 to 36. Net. . . . . 2.50
  - 566. **Wire Gauge**, same as No. 565, sizes 5 to 36. Net. . . . . 2.00
- Wire Cutters**, see **Nippers**, Nos. 347-348, and **Pliers**, Nos. 369-381.



No. 567.

567. **Wrench.** Good quality. 6 inch, \$0.55; 8 inch..... \$ 0.60



No. 569.

569. **Wrench.** Pocket monkey wrench..... .20



No. 571.

571. **Stillson's Pipe Wrench.** 10 inches long, will take pipe from 1/8 inch to 1 inch..... 1.10



No. 573.

573. **Work Bench.** This bench is 50 inches long, exclusive of tail vise, or 56 inches over all. It is 32 inches high and 20 inches wide, with a 13 inch glued up maple top 1 3/4 inches thick and a 7 inch well for tools. It has holes for stops, and three spring wood stops are supplied. It is fitted with both front and tail vises, each having 1 1/2 inch patent saw cut threaded bench screws. Bench is fitted with both back board and tool rack, as shown in illustration.  
Weight packed for shipment, 120 pounds....F. O. B. factory, net 8.40



No. 590.



No. 591.

590. <b>Wood Turning Chisel.</b> Solid cast steel, with wood handle.		
Width of blade, inches.....	1/2	1
Price .....	.75	1.15
591. <b>Wood Turning Gouge.</b> Solid cast steel, with wood handle.		
Width of blade, inches.....	1/2	1
Price .....	1.00	1.45



# PROPERTIES OF MATTER



No. 601



No. 603.

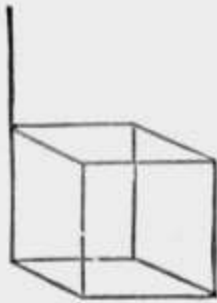


No. 607.

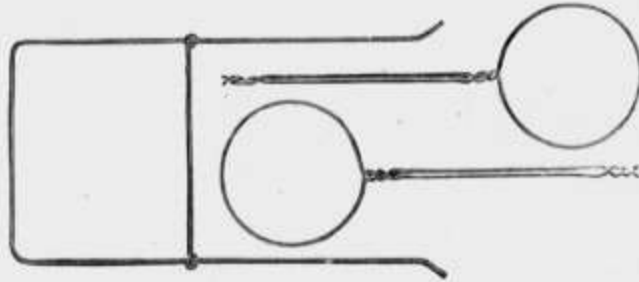


No. 609.

- |      |  |    |      |
|------|--|----|------|
| 601. | <b>Adhesion Disc</b> , to show the adhesion between a liquid and glass. Made of glass 3 inches in diameter with ground edge, suspended by three silk cords ..... | \$ | 0.20 |
| 602. | <b>Adhesion Disc</b> . Glass disc attached to wood cone, with supporting thread. Form approved by Prof. Millikan.....  |    | .33  |
| 603. | <b>Cohesion Plates</b> , to show cohesion between two glass plates. Plates are 3 inches square by 1/4 inch thick, perfectly plane. Provided with handles .....   |    | .45  |
| 607. | <b>Cohesion Hemispheres</b> , to show cohesion between lead surfaces. Faces ground plane. Diameter, 2 inches.....  |    | .40  |
| 609. | <b>Prince Rupert Drops</b> . Per dozen.....  |    | .25  |



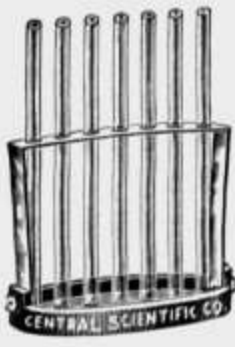
No. 613.



No. 615.

No. 616.

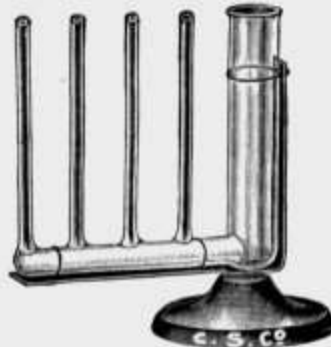
- |      |   |  |      |
|------|---|--|------|
| 613. | <b>Cohesion Figures</b> , to show phenomena of surface tension and cohesion. Four wire forms as illustrated, for making liquid films, with clay pipe for making bubbles.....                                    |  | .55  |
| 615. | <b>Surface Tension Apparatus</b> , to show surface tension in a water film. The floating ring sinks below surface when tapped and is held under by the water film. Simple and effective. Each, without jar..... |  | .40  |
| 616. | <b>Steel Scale</b> , 10 centimeters long, graduated in millimeters with zero at the tip, for measuring capillary attraction according to Chute.....   |  | 1.10 |



No. 619



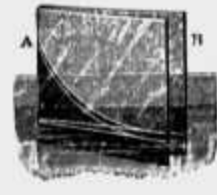
No. 621.



No. 623.



No. 627.



No. 631.

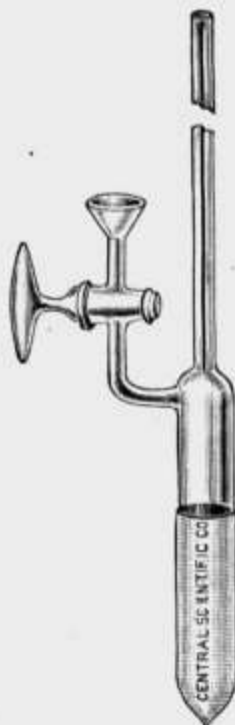
- |      |  |  |      |
|------|--|--|------|
| 617. | <b>Capillary Tubes</b> , set of seven.....                                     |  | .33  |
| 619. | <b>Capillary Tubes</b> , set of 7, with nickel plated support, japanned base.. |  | .67  |
| 621. | <b>Capillary Tubes</b> , set of four, in wood bar to rest upon a tumbler.....  |  | .40  |
| 623. | <b>Capillary Tubes</b> , set of four, all glass, mounted on support.....       |  | 1.25 |
| 625. | <b>Capillary Tubes</b> , glass part only of No. 623.....                       |  | .67  |
| 627. | <b>Capillary Phenomenon</b> , mounted on support.....                          |  | 1.33 |
| 629. | <b>Capillary Phenomenon</b> , glass part only of No. 627.....                  |  | .33  |
| 631. | <b>Capillary Plates</b> , pair with rubber band.....                           |  | .22  |



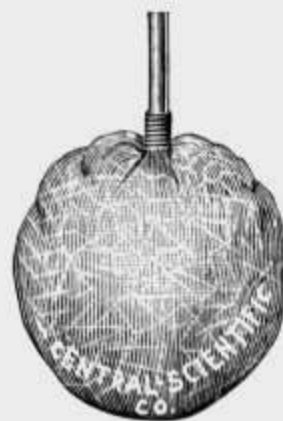
No. 635.



No. 638.



No. 640.



No. 643.

- 635. **Osmose Apparatus**, to show diffusion of gases. Simple form, two glass bottles connected by a brass tube..... \$ 0.55
- 638. **Osmose Apparatus**, to show diffusion of gases. Glass tube attached to a porous cup by means of a rubber cap..... .55
- 640. **Osmotic Pressure Tube**, as used at University of Chicago. Consists of a glass tube of small bore 5 feet long, lower end closed by an S. & S. diffusion shell. Colored sugar solution is introduced by means of a stopcock. Very rapid in action, certain in its results, ready for use in an instant. Complete with one No. 4844 Diffusion Shell..... 4.00
- 4844. **Diffusion Shells**, for No. 640, S. & S. No. 579, 100x16 mm. Each, .25; per box of 25..... 3.75
- 643. **Osmose Apparatus**, to show diffusion of liquids. Long tube, to which is attached a bag made of porous membrane. Tube and bag are to be filled with a glucose solution and membrane placed in water with the tube upright..... .27

For apparatus illustrating **Porosity of Wood**, see No. 1403.

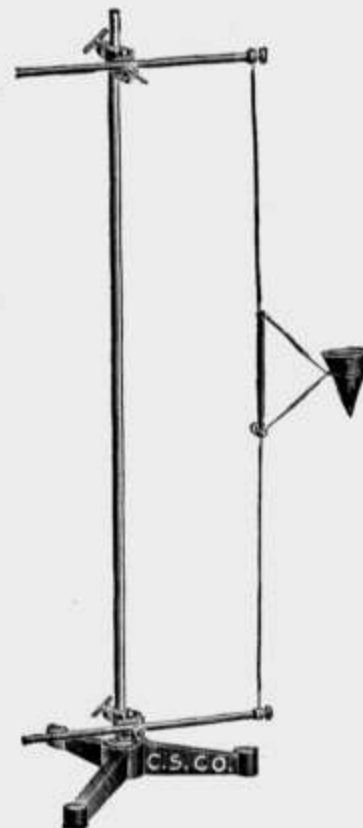


No. 647.

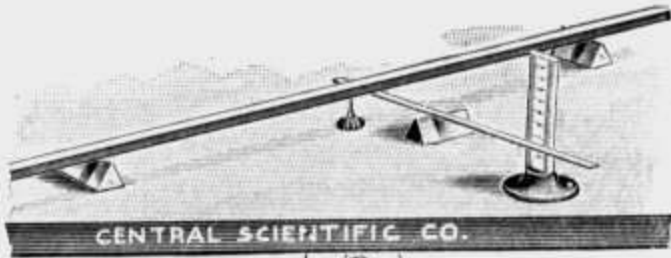


No. 706A.

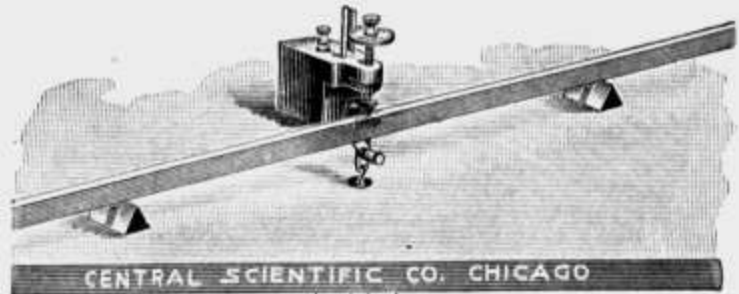
- 647. **Inertia Apparatus**. Wood stand, with card, ball and spring ..... .80
- 706A. **Inertia Ball**. A cast iron ball 3 inches in diameter, provided with two hooks. When suspended by a light string, with another string of the same size attached to the lower hook, a steady pull on the lower string breaks the upper string, a sudden pull breaks the lower string ..... .55
- 649. **Inertia Balance**, for measuring the mass of a body without measuring its weight (see Crew & Tatnall, Ex. 17). Mounted on tripod base with upright rod 90 cm. long; funnel support adjustable on wire..... 4.00



No. 649.

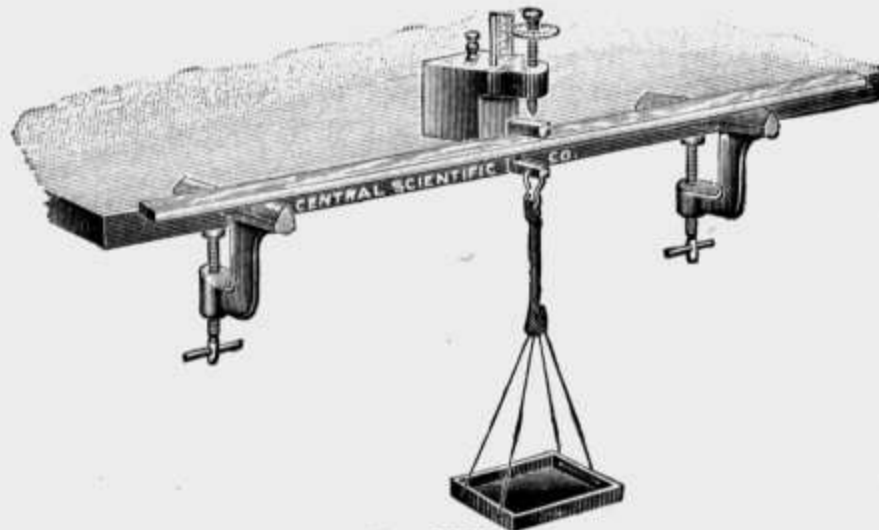


No. 651.



No. 652.

651. **Elasticity of Flexure Apparatus (Lever Method)** for studying the laws of bending beams. Parts listed below from A to G (including three F) constitute the complete outfit..... \$ 0.67
- 651A. **Pine Rod**, 102x1x1 cm..... .06
- 651B. **Pine Rod**, 102x2x1 cm..... .07
- 651C. **Maple Rod**, 102x1x1 cm..... .06
- 651D. **Scale of wood**, 10 cm., on iron base..... .18
- 651E. **Indicator**, of light wood..... .05
- 651F. **Prism**, of hardwood, 5 cm. long, 2.5 cm. wide..... .05
- 651G. **Scale Pan**, of metal..... .11
- 651H. **Contact Piece**, brass stirrup with knife edge and binding post, to be used in Contact Method No. 652..... .67
- 651K. **Elasticity of Flexure Apparatus**. Same as No. 651, with two No. 47 Knife Edge Clamps substituted for two of the No. 651F Prisms.... 1.66
652. **Elasticity of Flexure Apparatus (Contact Method)**. In this method Nos. 651A, B, C, G, H, and two No. 651F are used with the addition of No. 338 Micrometer Screw. Complete, without battery..... 4.45



No. 652A.

- 652A. **Elasticity of Flexure Apparatus**. Same as No. 652, with two No. 47 Knife Edge Clamps substituted for the two No. 651F Prisms. Complete, without battery..... 5.45
- For **Weights** for use with Nos. 651, 651K, 652 and 652A, see Nos. 3915 to 3969.

47. **Knife Edge Clamp**. Superior to a wood prism, as it can be clamped to the table. The knife edge extends over the edge of the table and a weight pan can be suspended without cutting through the table top.....

.55



No. 47.



**No. 654.**  
Patented March 25, 1913.

654. **Testing Machine** for measuring tensile strength of wires. New and convenient form made entirely of metal. The recoil of the spring is taken up by an ingenious device so that there is no danger from the flying wire. The scale is provided with an indicator which remains fixed at the breaking point, thus eliminating possibility of error in reading. Complete with spring and scale reading to 15 Kg., and full directions..... \$ 6.00



**No. 656.**

656. **Wire Testing Apparatus.** Consists of a fastening clamp, a tension clamp and a guard or balance block. This apparatus forms a convenient and inexpensive device for testing the tensile strength of wires, and is capable of very accurate results with a minimum of labor. Furnished complete with directions for operating, but without balance or board..... 2.25  
For Balances, see Nos. 3861 to 3879.

658. **Hooke's Law Apparatus,** according to Millikan and Gale, Experiment No. 12, consisting of a mirror glass scale graduated in millimeters for 12 centimeters (No. 462), a neat metal support and a spring and weight holder without weights  
For **Weights** for No. 658, see Nos. 751 and 3939.

1.00

- 658A. **Mirror Scale,** with support, of No. 658.....

.80

- 658B. **Spring and Weight Holder,** of No. 658.....

.20

462. **Mirror Scale,** of No. 658, without support .....

.30

660. **Young's Modulus Apparatus.** See Catalog K for description .....

21.00

661. **Hooke's Law and Young's Modulus Apparatus,** for verifying Hooke's Law and determining Young's Modulus. Modified design after Ames and Bliss. Consists of a bracket supporting two brass wires, one of which is furnished with a metal millimeter scale and the other with a vernier. Each wire is also furnished with a one kilo weight hanger. Four extra two kilo slotted weights complete the apparatus.....

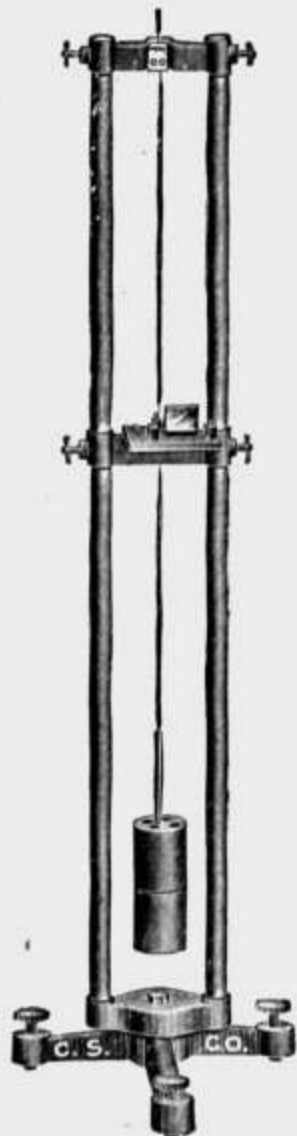
12.00

For Wire, see Nos. 6101ff. For Weights, see No. 3063.



No. 658A. No. 658B.

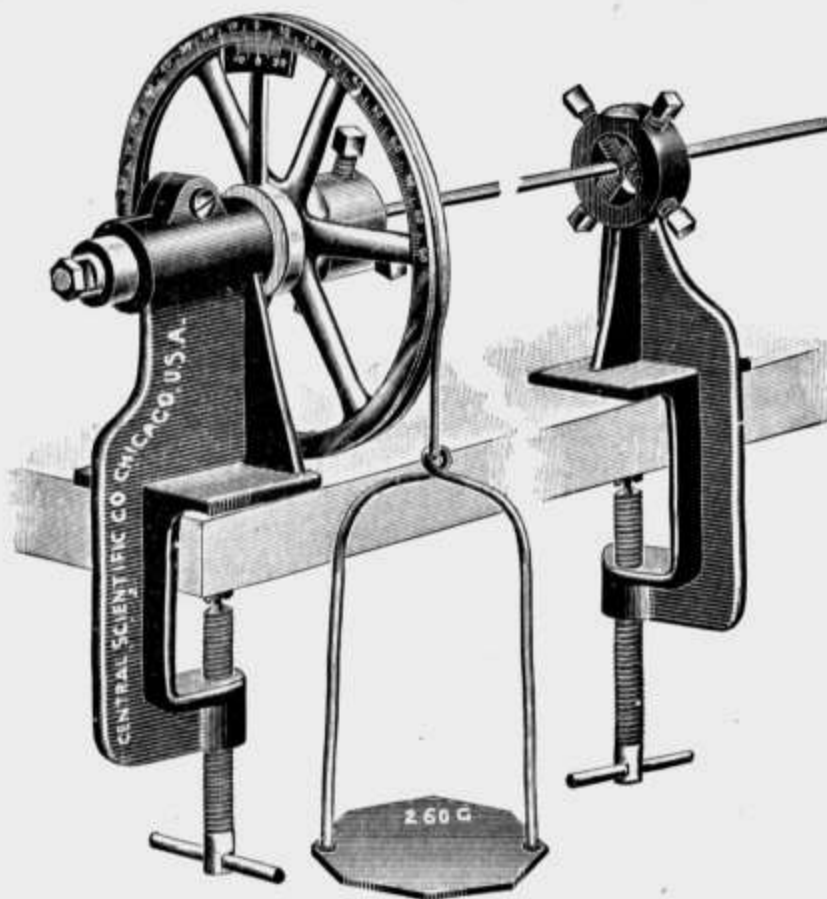
No. 661.



No. 662.



No. 662A.



No. 663.

662. **Young's Modulus Apparatus.** The supporting frame consists of two heavy steel rods 90 cm. high, mounted on tripod with leveling screws and fitted with strong clamp on top of rod for holding the wire. A small bushing of hardened steel is clamped near the end of the wire and

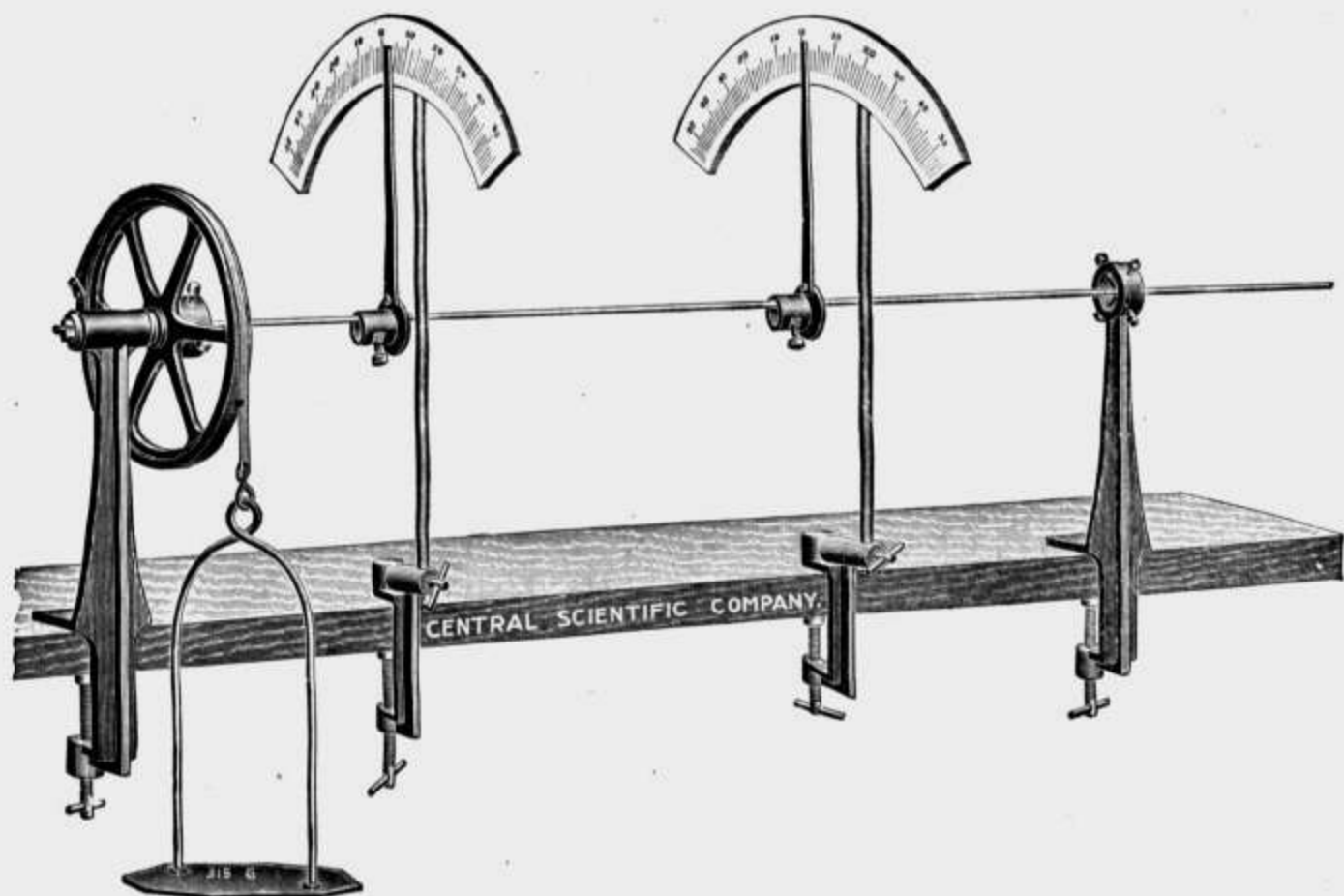
on this one leg of an optical lever rests. The other two legs rest on an adjustable platform attached to the support rods. The elongation is measured by a telescope and scale. A micrometer microscope clamped to one of the supporting rods may also be used for measuring the elongation of the wire. Complete with optical lever and weights ..... \$ 22.25

662A. **Torsion Pendulum Attachment** for No. 662. Consists of a brass disc about 96 mm. in diameter by 2 cm. thick with brass ring of the same diameter and approximately the same moment of inertia. Complete with wire and removable clamp for wire which screws into the disc..... 8.00

For Wire, see Nos. 6101ff. For Weights, see Nos. 751 and 3939.

663. **Torsion Apparatus,** to test Hooke's Law for torsion and to determine coefficients of rigidity. The apparatus illustrated is an improved form, recommended wherever used. A heavy table clamp carries a ball bearing hub, to which is attached a wheel 6 inches in diameter, one-half the rim of which is graduated in degrees. An adjustable vernier arm fits closely to the scale and is graduated to read to  $\frac{1}{10}$  of a degree in either direction. In the hub is a socket, in which the rod to be tested is centered and rigidly fastened. The other end is held in a similar socket, mounted in another table clamp. The pulley is flat for a steel ribbon band, which holds a scale pan of known weight. Complete with full directions and eight rods, all 110 centimeters long but of different materials and dimensions, as follows: One each brass rod 6 millimeters round and 6 millimeters square, one each steel rod 6 millimeters round and 6 millimeters square, one each maple rod 10 millimeters round and 10 millimeters square, one each whitewood rod 10 millimeters round and 10 millimeters square..... 13.35

For Extra Rods, see next page.

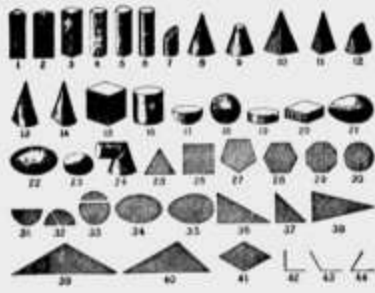


No. 664.

664. **Torsion Apparatus.** This design does away with errors due to slipping of the rods at the points where they are clamped. Two pointers are fastened to the rod at any convenient distance apart and the amount of twist is measured by taking the difference between the displacement of one pointer and the displacement of the second as read upon the two graduated arcs. With this apparatus it is possible to test different lengths of a rod without reclamping it. The rod under experiment is held rigidly at one end by a clamp, while the other end is held by a ball bearing wheel 20 cm. in diameter, to which is attached a flat steel band carrying a scale pan of known weight. Complete with directions and four rods; steel 3 mm. and 6 mm. in diameter, brass 3 mm. and 6 mm. in diameter..... \$ 16.65

**EXTRA RODS FOR NO. 663 AND NO. 664.**

665.	<b>Brass Rod</b> , round, 110 centimeters long, 6 millimeters diameter.....	.27
665A.	<b>Brass Rod</b> , round, 110 centimeters long, 3 millimeters diameter.....	.11
666.	<b>Brass Rod</b> , square, 110 centimeters long, 6 millimeters square.....	.40
667.	<b>Steel Rod</b> , round, 110 centimeters long, 6 millimeters diameter.....	.11
667A.	<b>Steel Rod</b> , round, 110 centimeters long, 3 millimeters diameter.....	.10
668.	<b>Steel Rod</b> , square, 110 centimeters long, 6 millimeters square.....	.20
669.	<b>Maple Rod</b> , round, 110 centimeters long, 10 millimeters diameter.....	.11
670.	<b>Maple Rod</b> , square, 110 centimeters long, 10 millimeters square.....	.11
671.	<b>Whitewood Rod</b> , round, 110 centimeters long, 10 millimeters diameter.....	.11
672.	<b>Whitewood Rod</b> , square, 110 centimeters long, 10 millimeters square..	.11
	For Rods of other dimensions, see <b>Raw Material</b> , Nos. 6001ff.	
674.	<b>Pointers and Graduated Arcs</b> , as used on No. 664 Torsion Apparatus. Set consists of two each arcs mounted on rods, table clamps and pointers as shown in above illustration. These attachments can also be used with No. 663 Torsion Apparatus. Per set.....	9.00



No. 676.



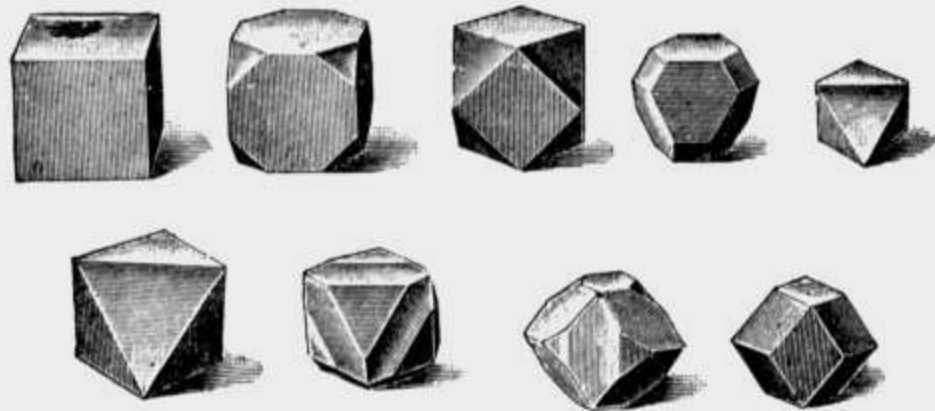
No. 677.



No. 681.



- 676. **Geometrical Solids and Surfaces.** Includes 24 solids, 17 surfaces and 3 angles, in strong wooden box..... \$ 2.90
- 677. **Dissected Cone.** Illustrates conic sections, viz.: the circle, ellipse, parabola and hyperbola. Made of highly polished black walnut, cherry and maple, with heavy pins; easily dissectible. Height 9 inches; base 6 inches in diameter..... 3.35
- 678. **Plain Cone.** Illustrating stable, unstable and neutral equilibrium. Of wood, finely finished. Base 6 inches in diameter..... 1.65
- 679. **Area of Circle.** Visual demonstration that the area of a circle is equal to the radius multiplied by one-half of the circumference. Diameter 8 inches.....Net 1.25
- 680. **Area of Triangle.** Visual demonstration that the area of a triangle is equal to its base multiplied by one-half its altitude.....Net 1.25
- 681. **Cone, Sphere and Cylinder.** Actual demonstration shows that the contents of the cone three times filled with water fills the cylinder, and that if the cylinder is filled with water and the ball entirely immersed there will remain in the cylinder just water enough to fill the cone. It follows, therefore, that the contents of the three are as 1:2:3. The pieces are packed together in a box..... 1.10
- 681A. **Cone, only of No. 681.**..... .45



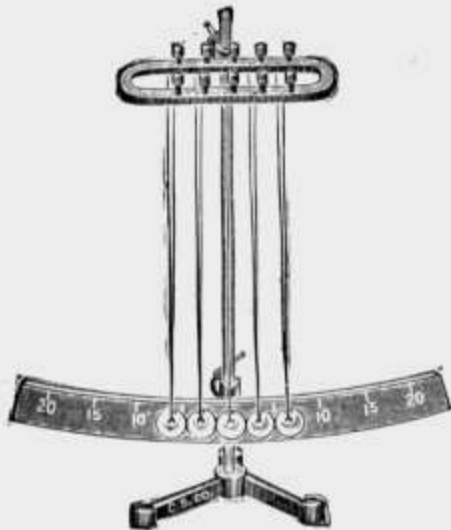
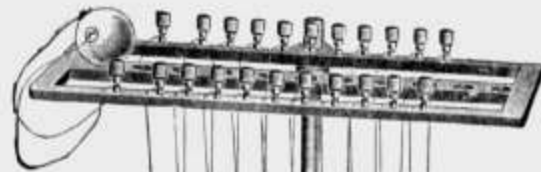
No. 683.

- 683. **Models of Crystals,** of solid Bohemian glass, surfaces ground and polished. Set of 20 models in pasteboard box..... 10.00
  - 685. **Models of Crystals,** same as No. 683. Set of 40 models in velvet lined case .....Duty free 20.00
  - 686. **Models of Crystals,** same as No. 683. Set of 90 models in velvet lined case .....Duty free 40.00
  - 687. **Models of Crystals,** constructed of glass plates, axes indicated by colored silk threads. Collection of 15 models.....Duty free 20.00
  - 688. **Models of Crystals.** Set of 50 wooden models in neat box. Set contains principal plane forms as well as the various combinations and twin forms. Size, 5 cm.....Duty free 19.00
  - 689. **Models of Crystals,** same as above, 80 models.....Duty free 38.00
- For Stereoscopic Slides for showing LUSTER of CRYSTALS, see No. 3500A.

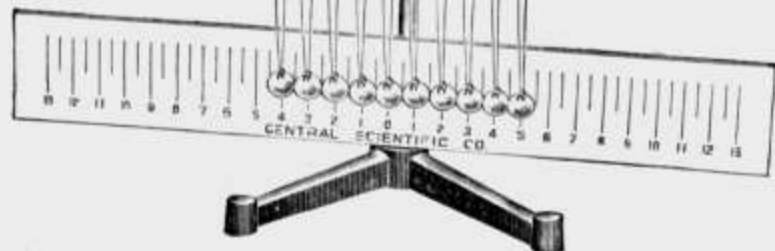
# MECHANICS OF SOLIDS



No. 691.



No. 695.



No. 698.

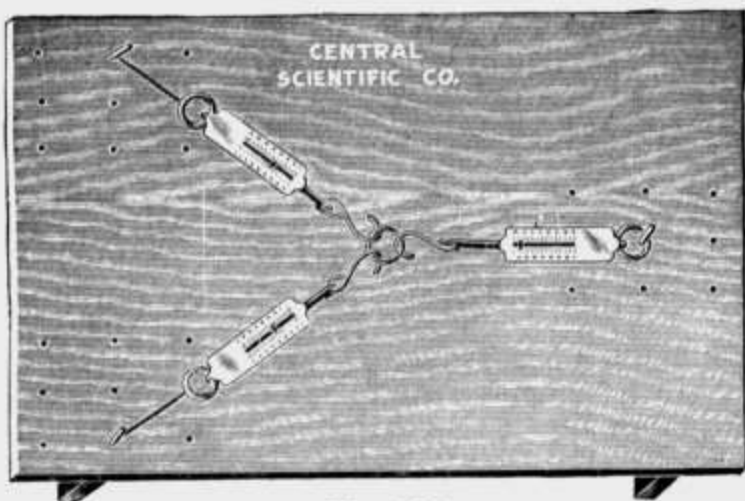
- |      |   |    |       |
|------|---|----|-------|
| 691. | <b>Collision Balls.</b> Set of seven glass balls, 1½ inches in diameter, with grooved base 1 meter in length.....   | \$ | 1.35  |
| 692. | <b>Collision Balls,</b> iron frame, with clamp and screw for use with tripod and rod; set of five lignum vitae balls, 1½ inches in diameter, suspended from iron frame by double adjustable cords.....  |    | 2.75  |
| 693. | <b>Collision Balls.</b> Consists of No. 692 complete with tripod base and rod   |    | 3.50  |
| 694. | <b>Graduated Arc,</b> on wood, with clamp and screw for use with No. 692..  |    | 1.50  |
| 695. | <b>Collision Balls,</b> same as No. 693, with addition of No. 694 Graduated Arc .....   |    | 5.00  |
| 696. | <b>Collision Balls.</b> Consists of a rectangular frame adjustably mounted on a tripod support. Ten highly elastic and polished steel balls 1 inch in diameter and one of four times the mass are supported on this frame by double cords, whose adjustment is secured by means of tapered keys. This construction gives a bifilar suspension to each ball, thus affording ease in alignment and providing a directive force to the ball, a great improvement over old designs. When it is desired to place one or more balls out of service it is only necessary to place them in receptacles on the cross bar. A scale (No. 697) for quantitative work may be added if desired..... |    | 10.00 |
| 697. | <b>Scale,</b> on wood, with clamp and screw for use with No. 696.....   |    | 1.65  |
| 698. | <b>Collision Balls,</b> same as No. 696, with addition of No. 697 Scale.....  |    | 11.65 |
| 701. | <b>Impact Apparatus.</b> See Catalog K for description.....   |    | 35.00 |

## BALLS.

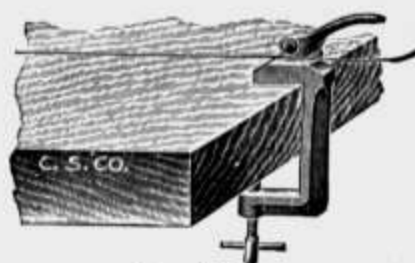
- |       |  |       |       |        |
|-------|--|-------|-------|--------|
| 703.  | <b>Brass Balls,</b> accurately turned and drilled for suspension.  |       |       |        |
|       | Diameter .....   | ¾ in. | 1 in. | 1½ in. |
|       | Each .....   | .15   | .22   | .78    |
| 704.  | <b>Brass Balls,</b> same as No. 703, but not drilled.  |       |       |        |
|       | Diameter .....   | ½ in. | ¾ in. | 1 in.  |
|       | Each .....   | .11   | .15   | .20    |
| 705.  | <b>Cast Iron Balls,</b> accurately ground and polished, similar in appearance and accuracy to No. 717 Steel Balls; drilled for suspension.                 |       |       |        |
|       | Diameter .....   | ¾ in. | 1 in. | 1½ in. |
|       | Each .....   | .06   | .09   | .13    |
| 706.  | <b>Cast Iron Balls,</b> not turned, japanned and with hook for suspension.   |       |       |        |
|       | Diameter .....   | 2 in. | 3 in. |        |
|       | Each .....   | .20   | .50   |        |
| 706A. | <b>Cast Iron Ball,</b> 3 inches in diameter, provided with two hooks, one at each end of the same diameter of the ball. (See illustration on page 57)..... |       |       | .55    |
| 707.  | <b>Copper Balls,</b> not turned, drilled for suspension.   |       |       |        |
|       | Diameter .....   | ¾ in. | 1 in. | 1½ in. |
|       | Each .....   | .22   | .33   | .67    |



708.	<b>Cork Balls</b> , lathe turned and drilled for suspension.							
	Diameter .....	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{2}$ in.				
	Each .....	\$0.07	.09	.25				
709.	<b>Glass Balls</b> (Marbles).							
	Diameter .....	$\frac{5}{8}$ in.	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{2}$ in.			
	Dozen .....	.11	.11	.17	.70			
711.	<b>Hardwood Balls</b> , of maple, accurately turned, polished and drilled for suspension.							
	Diameter .....	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{2}$ in.	2 in.			
	Each .....	.06	.07	.11	.16			
713.	<b>Ivory Balls</b> , guaranteed genuine ivory, accurately turned, polished and drilled for suspension.							
	Diameter .....	1 in.	$1\frac{1}{2}$ in.	2 in.				
	Each .....	1.65	1.95	2.25				
713A.	<b>Ivory Ball</b> , $\frac{1}{2}$ inch, accurately turned and polished, but not drilled for suspension .....							\$ 1.10
715.	<b>Lead Balls</b> , not turned, drilled for suspension.							
	Diameter .....	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{2}$ in.				
	Each .....	.08	.11	.18				
716.	<b>Lignum Vitae Balls</b> , accurately turned, drilled for suspension. Diameter $1\frac{1}{2}$ inches. Each.....							.22
717.	<b>Steel Balls</b> , hardened, accurately ground and polished, same as used in ball bearings. Not drilled.							
	Diameter .....	$\frac{1}{4}$ in.	$\frac{3}{8}$ in.	$\frac{1}{2}$ in.	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{2}$ in.	2 in.
	Each .....	.04	.05	.06	.08	.15	.40	1.10
718.	<b>Steel Ball</b> , 1 inch in diameter, provided with two suspension loops, as used on No. 696 Impact Apparatus.....							.50
719.	<b>Set of Balls</b> . In this set we have included an outfit that has proved very convenient and efficient for all work in impact experiments and in experiments on the pendulum. Each ball (except D) is drilled for suspension and the set comprises the following:							
	A. Four balls, highly elastic, of equal weight, each $1\frac{1}{2}$ inch diameter.							
	B. Two balls, each one-half the weight of A.							
	C. One ball, four times the weight of A.							
	D. One iron ball with screw eyes, weight $3\frac{1}{2}$ pounds.							
	E. One inelastic ball, same diameter as A.							
	Complete set as listed above.....							2.25



No. 720.



No. 723.

720.	<b>Composition of Force Board</b> , after specifications of Prof. Millikan. A great improvement over the old checker board type. Easily and quickly set up ready for use, and results more conveniently obtained. Size of board is 58x84 cm. With ring and pegs, but without balances .....							1.65
723.	<b>Stone's Tension Clamp</b> , modified form, for use in experiments on composition of forces and tensile strength of wires, and in sonometer and many other experiments where it is desired to maintain a strain on a wire or cord and enable an individual operator to readily adjust the tension without the co-operation of a second person. This clamp is substantially made of cast iron and neatly finished. Will fit any table or board 7 centimeters thick or less. Wires, cords, etc., are securely clamped by an eccentric lever, as shown in the illustration. Each .....							.45



No. 725.



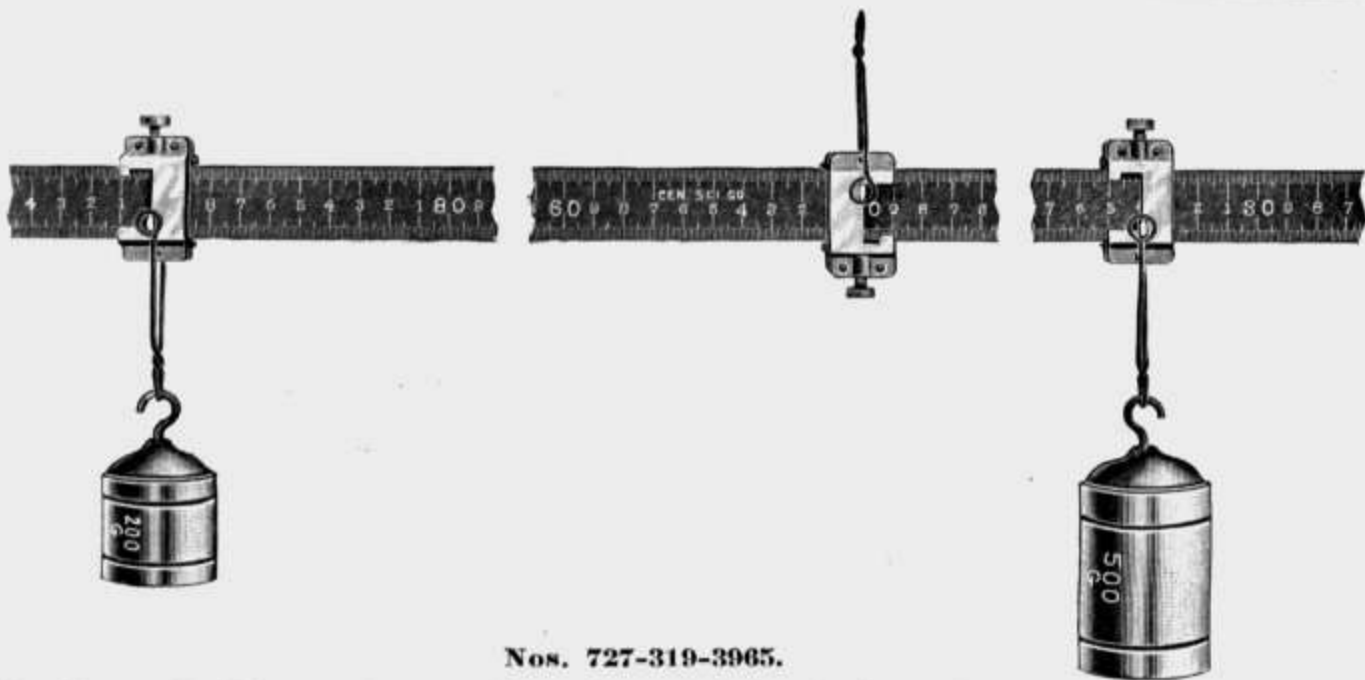
No. 725B.

725. **Composition of Force Table**, to demonstrate the laws of the composition and resolution of forces. The table top, 40 cm. in diameter, is of cast iron, accurately turned. The outer edge is raised and graduated in degrees. The vertical rod is 30 mm. in diameter and 45 cm. long, mounted on a heavy tripod base. The pulleys run with very little friction on cone bearings, may be clamped to any part of the rim, and are provided with an index line for reading angular positions. The cords are attached to a small ring, which can be held in the center of the table by a pin in order to adjust the weights easily. The tripod is supplied with leveling screws (not shown in illustration). Complete with 4 pulley clamps, 4 weight hangers and weights ..... \$ 25.00
- 725A. **Composition of Force Table**, same as No. 725, but with 100 cm. rod.. 26.00
- 725B. **Pulley** only of No. 725. A pulley of 4.5 cm. diameter, running with little friction on cone bearings. Can be clamped to table tops of from three-eighths inch to one and one-eighth inches in thickness. Convenient for composition of forces..... 1.10



No. 726.

726. **Demonstration Balance**, for demonstrating the principle of moments, consisting of a knife edge clamp which will fit a standard meter stick, and a support of heavily japanned iron. The top of the support is grooved so that the meter stick and clamp will not slip off while adjustments are being made..... .45
- 726A. **Demonstration Balance**, high grade. See Catalog K for description.. 16.65



Nos. 727-319-3965.

727. **Lever Holder**, to demonstrate the principle of the balance and laws of levers, made to fit standard meter stick. The holder is fitted with steel knife edges and a set screw for clamping the holder to the meter stick. A simple device allows the exact position of the knife edges to be read without difficulty. Each..... \$ 0.20  
 For the study of levers and moments, use this combination:

- A. Three No. 727 Lever Holders.
- B. One set of No. 3965 or No. 3967 Weights.
- C. One No. 319 Meter Stick.

728. **Wheel and Axle**, of wood, four diameters, largest diameter about 14 cm., mounted on cone bearings in an iron frame with straight rod 1/2 inch in diameter, for use with clamp holder. (See page 8.) Without weights.... 1.25

728A. **Wheel and Axle**, same as No. 728, but of aluminum, accurately turned. Much superior to a wooden wheel and axle, as it cannot warp. 2.00



No. 728.



No. 729.



No. 730.



No. 731.



No. 732.

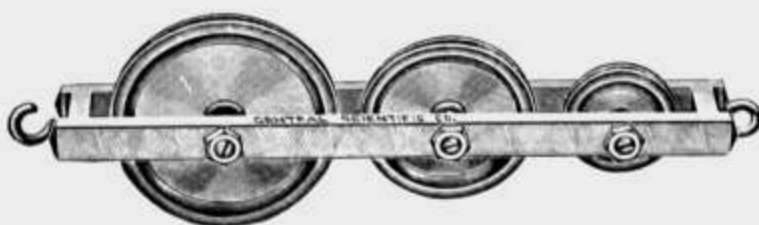
**Pulleys, New Form**, a great improvement over the old type brass pulley. The wheels are made of thin pressed steel, 5 cm. in diameter, and, being lighter and having less bearing surface than the old style, turn freely. Each pulley is carefully mounted and runs true, and will give longer service and more efficient results than any other pulley of the same price. For use as either fixed or movable pulley.

729. Single Pulley .....	.18	731. Triple Pulley .....	.40
730. Double Pulley .....	.30	732. Quadruple Pulley .....	.55



No. 733.

733. **Triple Pulleys** in tandem, of varying diameters, largest being 50 mm. in diameter. Pulleys are of brass, accurately turned, with plain bearings. Block has two hooks for use either fixed or movable. Each ..... \$ 1.10



No. 734.

734. **Triple Pulleys**, cone bearing. Three pulleys of different diameters, the largest 50 mm., of brass finely finished. Block has two hooks for use either fixed or movable..... 2.50

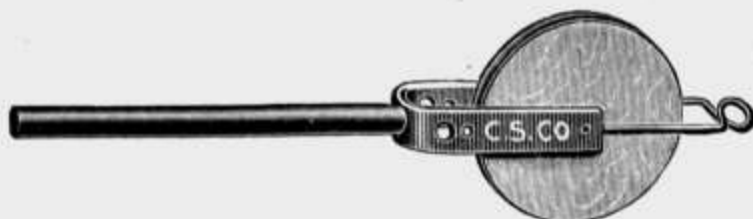


No. 736.



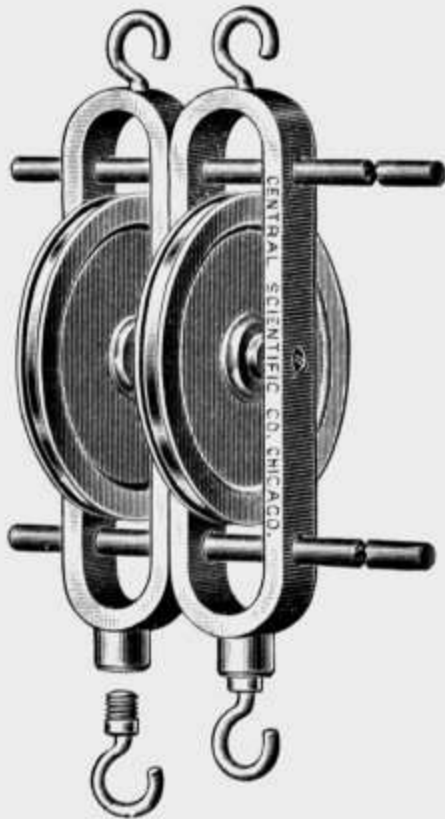
No. 736 in combination.

736. **Pulleys**, freely running, of hardwood, 2 inches in diameter, centered and balanced. The bearings are steel cones, greatly reducing friction. When used in combination, as shown above, the pulleys are held together by two closely fitting steel rods. May be used as either fixed or movable pulley. Each..... .45
737. **Rods of Steel**, for combining two, three or four No. 736 Pulleys. Per pair ..... .07



No. 738.

738. **Pulley**, of hardwood, with 8 mm. rod, same construction as No. 736.. .55  
 For **Weights and Weight Hangers** for use with pulleys, see Nos. 750, 751, 3939 to 3969.



No. 739 in combination.



No. 740.



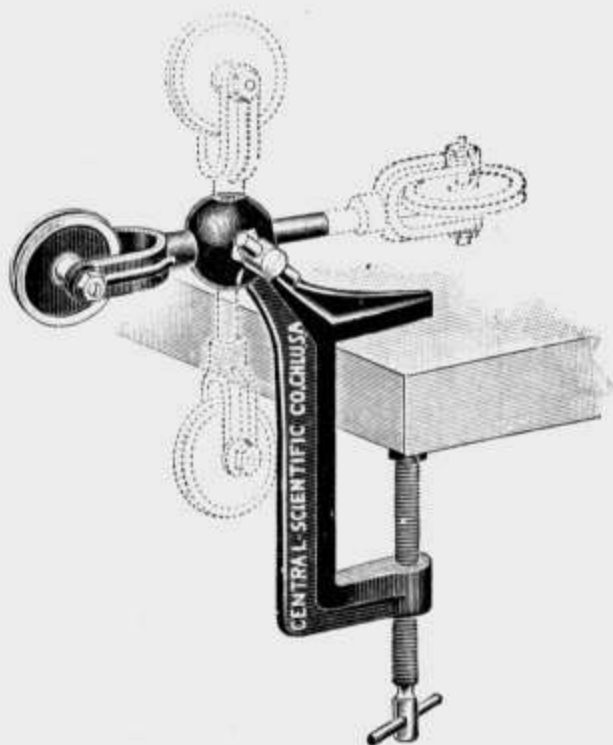
No. 741.

739. **Pulley**, special design after Prof. Harry Chase of Tuft's College. Consists of a brass pulley, lathe turned,  $2\frac{1}{2}$  inches diameter, with a square groove for convenience in accurate measurement of diameter. Mounted on hardened steel cone bearings, fitted with inside lock nut, in a heavy brass frame which is provided with two hooks, one of which may be unscrewed and rods 10 mm. in diameter (as listed under No. 20) attached. This permits its use with a clamp in connection with a system of laboratory supports. Different combinations may be arranged, as illustrated, by use of a pair of the steel rods listed below. This pulley runs so true and free from friction that gyroscopic effects are felt if the wheel is rapidly rotated. May be used as either fixed or movable pulley..... \$ 2.50
- 739A. **Steel Rod**, for use with No. 739 Pulley in making combinations. Per pair ..... .11

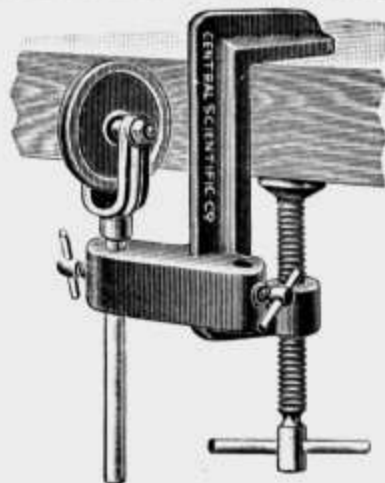


No. 743.

740. **Pulley, Tackle Block** of wood, commercial type, iron strapped and bushed with steel pin, 3-inch pulley.
- A. Single Pulley ..... .40
  - B. Double Pulley ..... .75
  - C. Triple Pulley ..... 1.00
741. **Pulley, Differential**, commercial type, one-quarter ton capacity, regular hoist 6 feet, minimum distance between blocks 17 inches. Chain pull of 72 pounds through 18 feet, lifts full load through 1 foot. Net weight, 22 pounds. Complete with chain..... 12.00
742. **Pulley, Ball Bearing**. This pulley is of aluminum and is 10 cm. in diameter. It runs in carefully constructed ball bearings and is provided with a rod 20 cm. long for attaching it to any system of supports; will be found very useful in any place where minimum friction is desired, including Inclined Plane experiments, Atwood Machines, etc. .... 5.00
743. **Pulley, Ball Bearing**. Same as No. 742, except that the pulley is 20 cm. in diameter..... 7.75
- For Weights and Weight Hangers for use with pulleys, see Nos. 750, 751, 3939 to 3969.



No. 745.



No. 744 Pulley (see page 490).



No. 770.

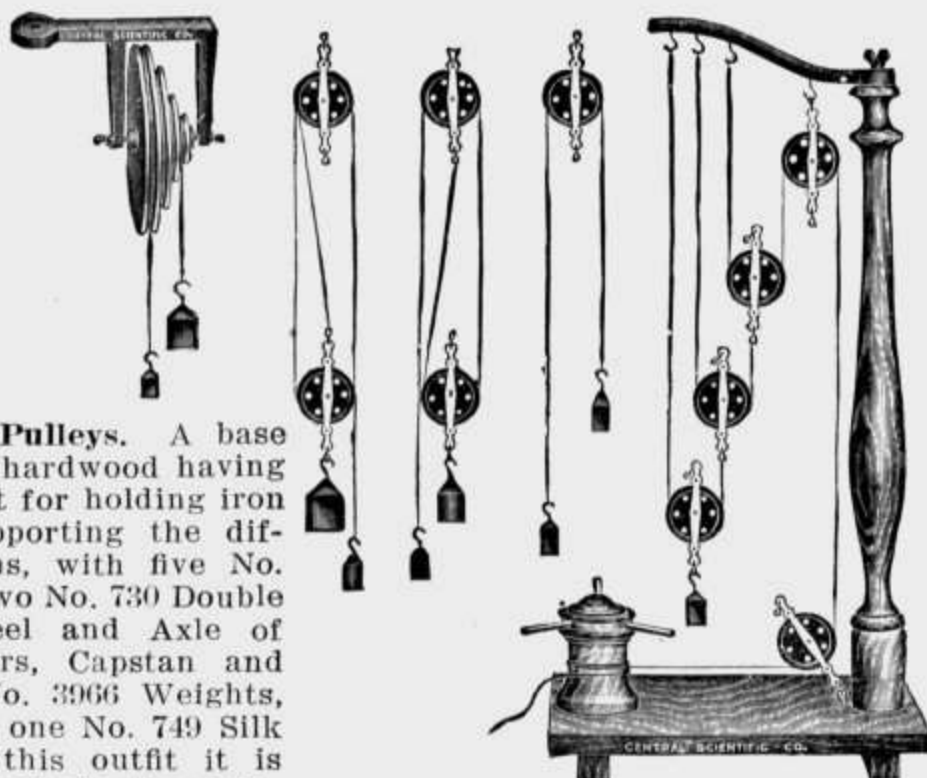
745. **Pulley, Universal**, of steel, white nickel plated, 45 mm. in diameter, mounted on hardened steel cones provided with nuts for locking, thereby reducing friction to a minimum. The ball holding the pulley is drilled and tapped so that the pulley stem may be clamped in six different positions. The clamp, which is rigid and neatly finished, has an opening of about 6.5 cm., enabling it to be clamped to any laboratory table. The pulley, being mounted on a detachable stem, is adapted for use with the system of Laboratory Supports (See pages 5 to 15) ..... \$ 1.55
46. **Pulley**, same as the pulley of No. 745, mounted on 10 mm. nickel plated rod 15 cm. long, for use with system of Laboratory Supports (See illustration, page 9) ..... .75
770. **Pulley**, of steel, 35 mm. in diameter, mounted on hardened steel cones with lock nuts, in frame, with wood screw for attaching to board ..... .33
746. **Manila Rope**, good quality, for use with No. 740 and No. 741.  
 Diameter .....  $\frac{3}{8}$  inch.       $\frac{1}{2}$  inch.  
 Per foot ..... .02      .04  
 N. B.—12 feet smallest quantity sold.



Nos. 750—751.

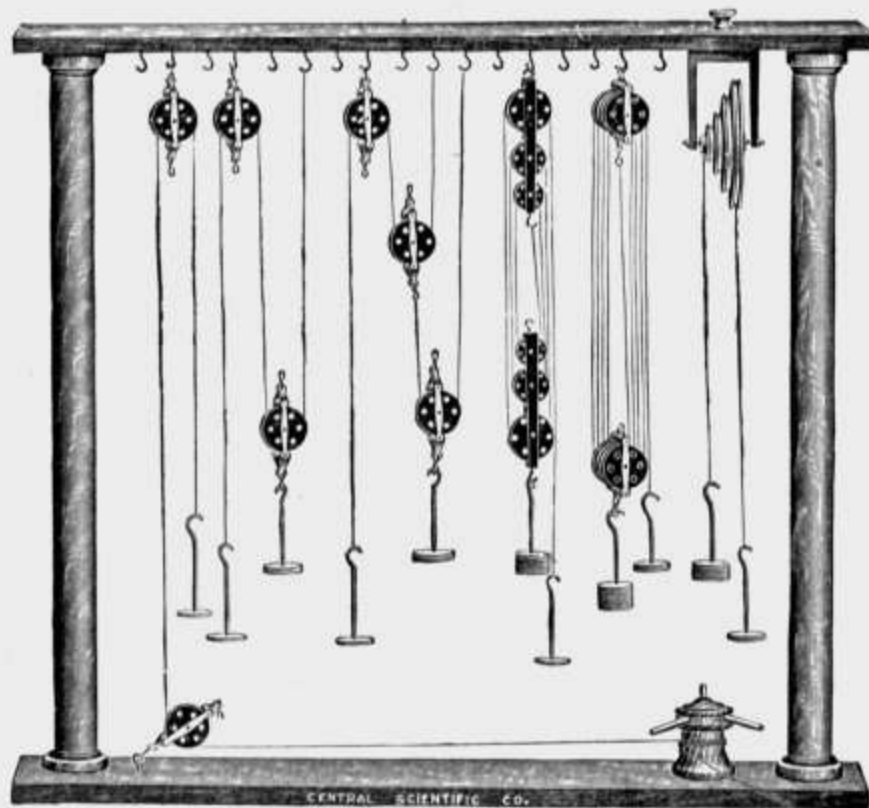
747. **Cord**, for use with pulleys and levers, extra fine quality of twisted flax, large balls weighing  $\frac{1}{2}$  pound each ..... .45
748. **Cord**, Fish Line, braided linen, best quality, 25 yards on card ..... .20
749. **Cord**, Fish Line, braided silk, 25 yards on card..... .33
750. **Weight Hanger**, of brass, for pulley experiments. Capacity, 1,000 grams. Total weight of hanger, 50 grams ..... .45
751. **Pulley Weights**, nickel plated, accurately adjusted. With slot to fit No. 750 hanger.  
 Weight, grams.... 10    20    50    100    500  
 Each ..... .20    .25    .30    .35    .55

For Weights with Hooks, see Nos. 3965 to 3969.



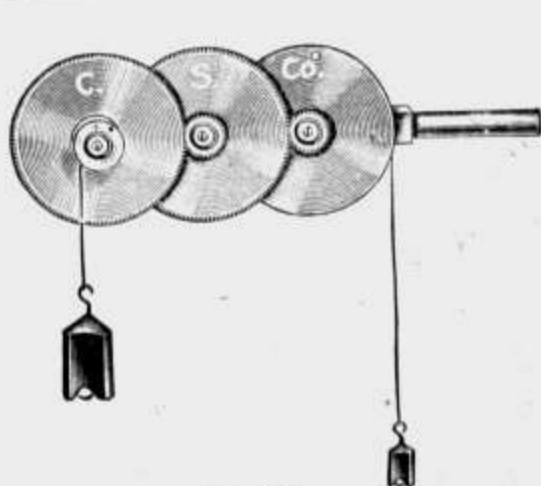
752. **Illustration of Pulleys.** A base and pillar of hardwood having screw and nut for holding iron arms for supporting the different systems, with five No. 729 Pulleys, two No. 730 Double Pulleys, Wheel and Axle of four diameters, Capstan and Levers, six No. 3966 Weights, assorted, and one No. 749 Silk Line. With this outfit it is possible to illustrate the principles of the wheel and axle and capstan as well as of fixed pulleys with power and weight equal, fixed and movable pulleys with power and weight as 1 to 2, 1 to 3 and 1 to 4 and a train of fixed and movable pulleys as illustrated ..... \$ 7.75

No. 752.

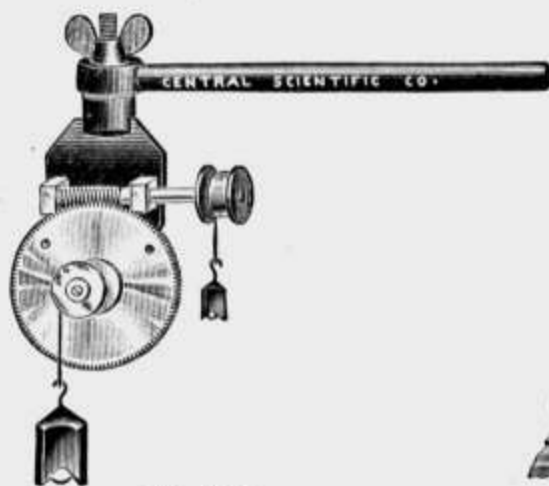


No. 753.

753. **Illustration of Pulleys.** Finely polished hardwood frame three feet high, six No. 729 Pulleys, two No. 732 Quadruple Pulleys, two No. 733 Triple Tandem Pulleys, Wheel and Axle of four diameters, Capstan and Levers, four No. 750 Weight Hangers, fourteen No. 751 Weights, assorted, and one No. 749 Silk Line. With this outfit it is possible to illustrate the principles of the wheel and axle and capstan as well as of fixed pulleys with power and weight equal, fixed and movable pulleys with power and weight as 1 to 2, 1 to 3, 1 to 4, 1 to 5, 1 to 6, 1 to 7 and 1 to 8, and trains of fixed and movable pulleys ..... 22.25



No. 757.



No. 759.



No. 761.

755. **Mechanical Powers Apparatus**, for illustrating the laws of the lever, pulley, and wheel and axle. Includes one No. 319 Meter Stick, two No. 727 Lever Holders, one No. 726 Demonstration Balance, ten No. 3969 Weights, 50 g., one No. 728 Wheel and Axle, two No. 729 Pulleys and one No. 748 Linen Line with necessary supports and clamps.. \$ 6.65
757. **Geared Wheels**. A train of gears consisting of two wheels with pinions one-fourth the diameter of the wheels and a third wheel with drum of the same diameter, giving a mechanical advantage of sixty-four. Mounted on a 13 mm. rod. Nicely finished. Without weights 3.90
759. **Endless Screw**, model of brass, nicely finished, mounted on a 10 mm. rod to be held with a clamp. Without weights..... 5.55

761. **Screw**, mounted in metal frame with opening about 16 cm. high by 8 cm. wide. The screw has a range of up and down movement of more than 10 cm. .... 1.65

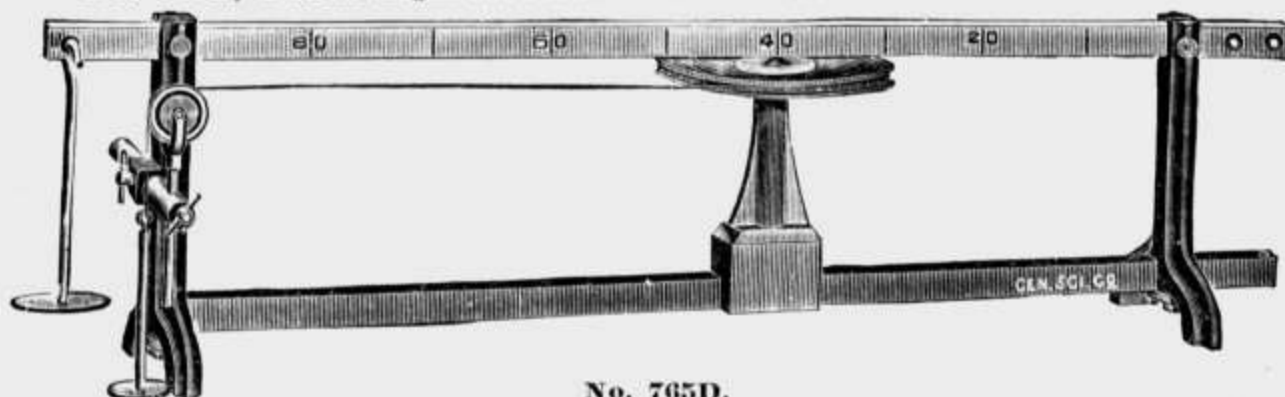
765. **Jack Screw**. A perfect model, capable of raising 1,000 pounds or more. Diameter at base, 1 1/4 inches, with a range from 2 1/4 to 3 5/8 inches. An auxiliary pointed screw is supplied, to be used in place of the screw with swivel cap in places where it may be preferable. Complete, as shown in cut 1.10

- 765B. **Extension Base**, to fit above, 2 in. high .27

- 765C. **Extension Base**, to fit either No. 765 or No. 765B, 1 inch high..... .20



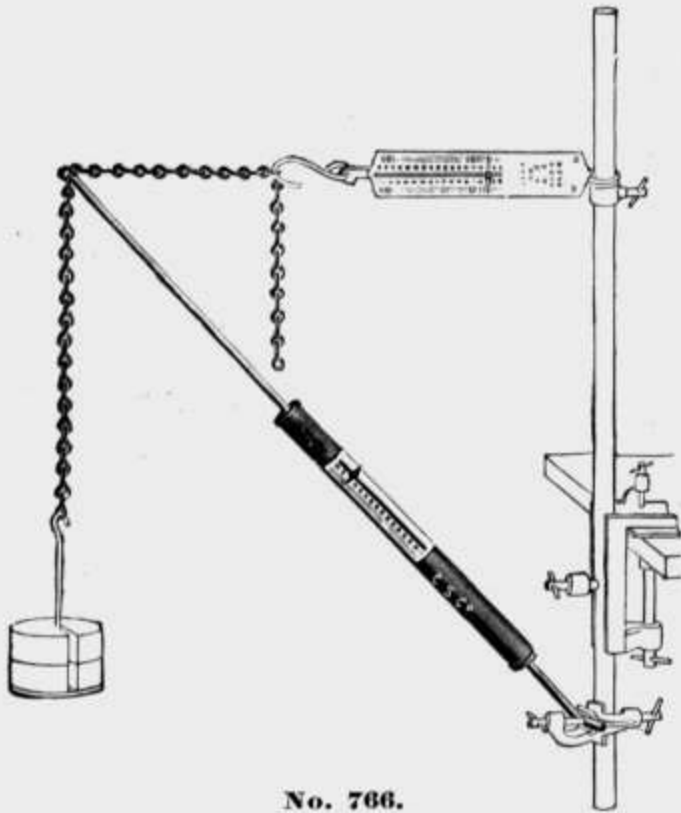
No. 765.



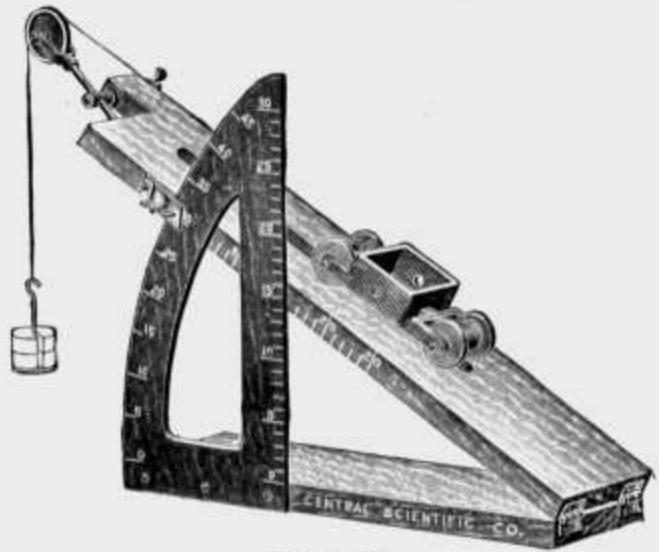
No. 765D.

- 765D. **Jack Screw Tester**. Consists of a mounted steel bar graduated in decimeters, pivoted at one end, and with knife edge for weight hanger at a distance of 100 cm. from the axis. On the cross bar of the support is a slide which carries a jack screw which is provided with a pulley for applying the power. The top of the jack screw is countersunk and provided with a ball bearing which fits in small holes countersunk along the lower edge of the lever. Power is applied to the jack screw pulley by means of weights attached to a cord which passes over a small adjustable auxiliary pulley at the side of the apparatus. By means of this apparatus a complete study of a jack screw may be made, showing the relation between power and load, and the efficiency of the screw. Constructed entirely of metal. (For weights use one No. 3939 Set of Weights, and 5 No. 3063 Weights, 1 kilo)..... 19.00
- 765E. **Accessories** to convert No. 765D into No. 1734 Magnet Tester..... 8.90





No. 766.

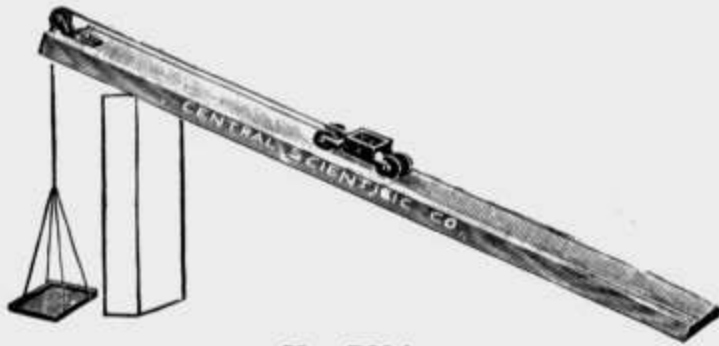


No. 767.

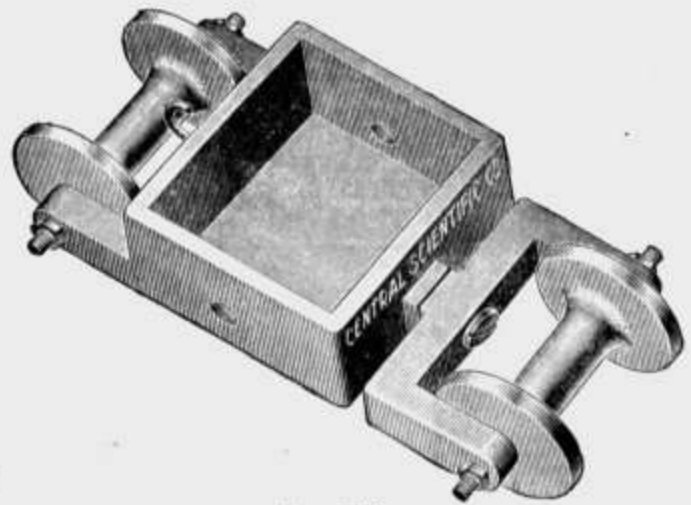
766. Crane Boom, for use in observing crane stresses and determining laws of Parallelogram of Forces. The illustration shows the Crane Boom mounted for use on the edge of a table by means

of No. 27 Table Clamp, No. 22 Support Rod, 100 cm., No. 39 Right Angle Clamp, No. 30 Collar, No. 3873 Spring Balance, No. 3062 Weight Hanger, and No. 3063 Weights. The Crane Boom consists of a special Compression Spring Balance registering from 0 to 10 kilos in  $\frac{1}{10}$ th divisions with bent rod at one end and rod with chains attached at the other end. It makes a valuable addition to any equipment for the study of mechanics. Crane Boom only, with chains

767. Inclined Plane, of hardwood, fine mahogany finish, with graduated arc and freely running cone bearing adjustable pulley. Without car or weights	\$ 6.65
	3.90



No. 769A.



No. 771.

769. Board for Inclined Plane, of hardwood, smooth surface, length four feet. Without supporting block, scale pan or car	.60
769A. Board, No. 769, with No. 770 Pulley	.93
770. Pulley for No. 769A, of steel, 35 mm. in diameter, mounted on hardened steel cones with lock nuts, in frame with wood screw for attaching to No. 769 or any other board	.33
771. Hall's Carriage, improved form, well finished. Made entirely of metal. Each pair of wheels with their axles are of one piece, being lathe turned from solid steel $1\frac{1}{2}$ inches in diameter, and are held to truck in cone bearings, thus reducing friction to a minimum. One of the trucks is so mounted that the four wheels will always bear on the plane	1.00
771A. Friction Block, of pine, 10x5x2 cm	.11
772. Inclined Plane, of metal. See Catalog K for description	30.00
772A. Inclined Plane, of metal. See Catalog K for description	27.00



No. 773.



No. 773A.

773. **Pendulum Clamp.** Can be clamped to any vertical or horizontal support rod 19 mm. or less in diameter. Upon the arm are three removable clamps, each consisting of a flat brass plate with guide pin, and held (by means of a thumb screw) against the plane face of the arm and flush with its lower edge. This gives exact points of suspension. Finished in japan and white nickel plate. . . . . \$ 0.75

773A. **Pendulum Clamp,** of wood. Jaws held together by two thumb screws. For Balls for pendulum experiments, see Nos. 703 to 719. . . . . \$ .33

No. 774B. Delay Stop Watch, Electrically Operated, see pages 490-491.



No. 774.

774. **Stop Watch,** stem wind, lever escapement,  $\frac{1}{5}$  second divisions. Convenient for testing and experimental work, being non-magnetic. . . . . 7.25

774A. **Stop Watch.** Split second, stem wind, lever escapement,  $\frac{1}{5}$  second divisions, non-magnetic, provided with two hands for timing two events which start simultaneously but end at different times. Useful in pendulum and inclined plane experiments and in timing first and second places in a race. . . . . Net 15.00

775. **Metronome,** for counting seconds and fractional parts of a second, etc. Best French make, in fine mahogany case. . . . . 3.85

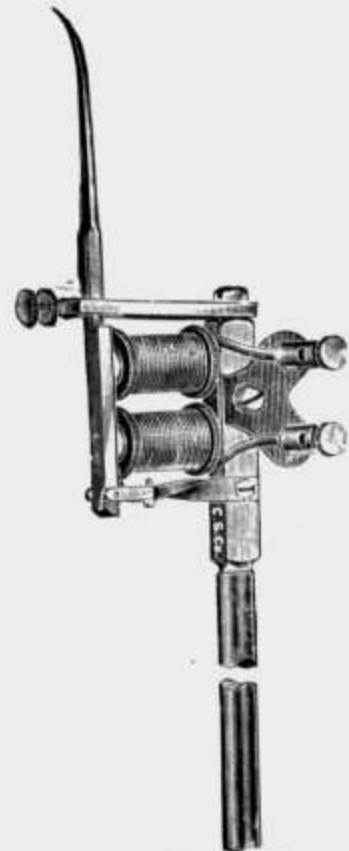
776. **Metronome,** same as No. 775, with adjustable bell attachment, striking every beat, every second beat, or every fourth beat, as desired. . . . . 5.50

777. **Metronome,** after Kronecker. No. 775 Metronome fitted with mercury cups and binding posts for tracing time on revolving drum in connection with a "Time Marker". . . . . 11.00

778. **Time Marker,** aluminum stylus. Mounted on a 10 mm. rod 22 cm. long, for clamping to any support. Small and compact; positive in action. . . . . 6.65

779. **Interval Clock,** constructed so as to give warning at the expiration of intervals of from 1 minute to 5 hours duration, and by interpolation, fractions of a minute. Valuable in all experiments in which action for a definite length of time is necessary, as the operator is free to go on with other duties without fear of overrunning the time. Many uses of this clock will readily present themselves. Net 4.50

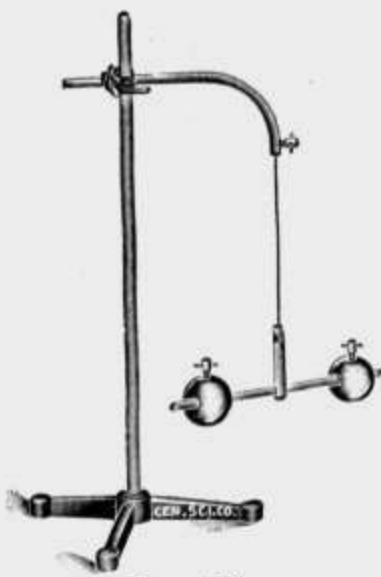
510. **Hand Tally,** designed to fit the fingers of the left hand as shown on page 49. Very convenient for counting pendulum swings, etc.. . . . . 3.00



No. 778.



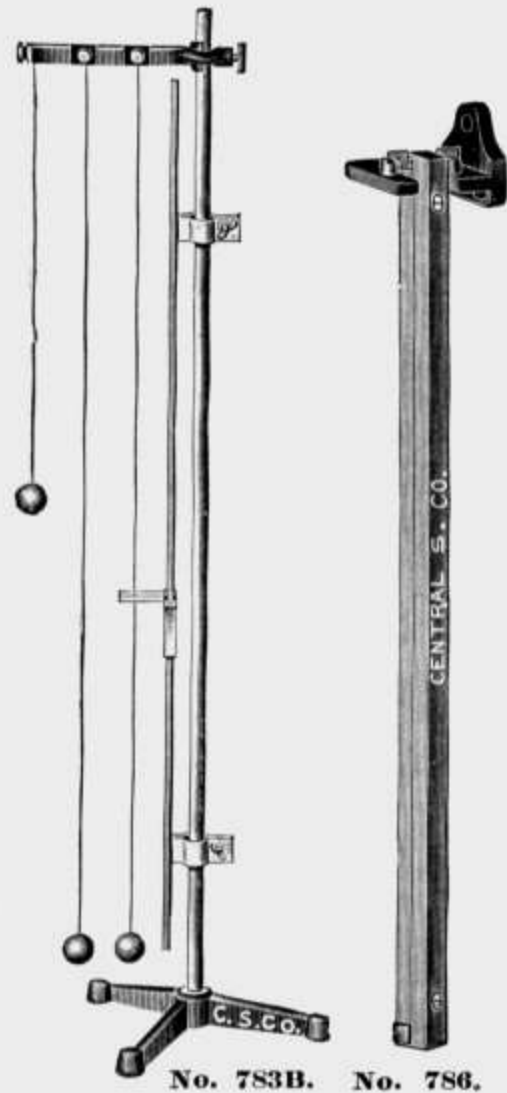
No. 779.



No. 780.



No. 782.



No. 783B. No. 786.

- |   |  |
|---|--|
| <p>780. <b>Torsion Pendulum</b>, for the study of Rotational Inertia. Consists of tripod support with clamp and rod, to which is fastened a steel wire carrying two adjustable sliding weights.....</p> <p>781. <b>Torsion Pendulum</b>. See Catalog K for description.....</p> <p>781A. <b>Torsion Pendulum</b>, simple form, a flat disc with pointer and graduated circle, with support</p> <p><b>Torsion Pendulum Attachment</b>. See No. 662A.</p> <p>782. <b>Sand Pendulum</b>. An iron funnel for carrying fine sand, suspended by two cords. When these cords are suspended from two points several centimeters apart and the adjustable slider arranged as shown in the illustration, the funnel may be given motion in two planes and will trace out, by a path of sand, a figure which is the resultant of the two harmonic motions. Without support.....</p> <p>783. <b>Pendulum Illustration</b>. Apparatus for Pendulum experiments. Consists of a heavy tripod base, white nickel plated rod, No. 773 Pendulum Clamp, with two 1-inch cast iron balls and one 1-inch wood ball</p> <p>783A. <b>Adjustable Pendulum Attachment</b>, intended for use with No. 783 Pendulum Illustration, but may be used with any pendulum support using a 13 mm. rod, over one meter long. Consists of a meter stick with clamps for fastening to the support rod and a slide which can instantly be set at any desired point on the scale. This slide has a projecting piece provided with a narrow slot through which the pendulum cord passes, and which acts as a point of suspension for the pendulum. The zero of the meter stick is placed at the bottom and when the center of the pendulum bob has once been placed opposite this point the length of the pendulum is read directly from the position of the slider.</p> <p>This piece should prove most attractive to those who are looking for a pendulum with which the maximum number of readings can be taken in a given time.....</p> <p>783B. <b>Pendulum Illustration Complete</b>. Consists of Nos. 783 and 783A.....</p> <p>784. <b>Compensated Pendulum</b>. Consists of five alternate bars of brass and steel, mounted on neat wall bracket.....</p> <p>785. <b>Kater's Pendulum</b>. See Catalog K for description.....</p> <p>786. <b>Kater's Bar Pendulum</b>, to find length of equivalent second's pendulum and the value of "g." This is a very serviceable pendulum for student use in laboratory experiments. It is unbreakable, portable and accurate. A screw driver makes all necessary adjustments. Made of steel, 24x1x1 inches, with two hardened steel knife edges, coincidence mirror, wall support and complete directions.....</p> | <p>\$ 3.00</p> <p>16.65</p> <p>3.35</p> <p>.67</p> <p>2.50</p> <p>1.50</p> <p>4.00</p> <p>10.00</p> <p>26.65</p> <p>3.35</p> |
|---|--|



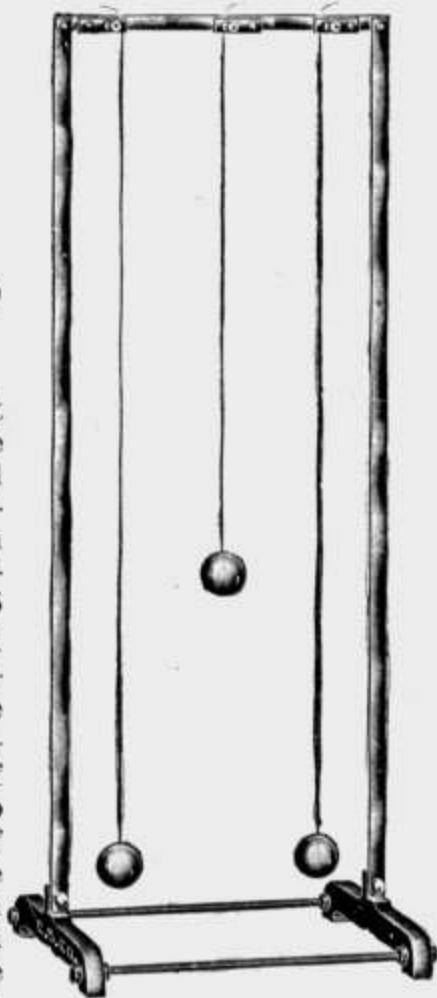
No. 787.



No. 789.

787. **Mercury Clock Contact**, on support ready for attaching to clock case or wall. The mercury cup is of steel fully adjustable, and is so arranged that the mercury forms a narrow ribbon, adjustable in height. Has an overflow basin to prevent scattering of mercury. Complete with binding posts.....\$5.55

789. **Magnetic Clock Contact**, after Prof. Shedd, of Olivet College. (See "Physical Review," August, 1904.) This device avoids the disadvantages of a mercury contact. A permanent magnet attached to the lower end of the pendulum passes at each swing over two soft iron armatures mounted on the ends of phosphor bronze springs. On one of these springs is placed an auxiliary spring with platinum contact plate, and on the other an adjustable platinum contact point. As the magnet passes the armatures they are drawn together, thus bringing the two platinum pieces in contact. This contact can be mounted in any clock case. Complete with magnet, adjustable support, and binding posts.....



No. 790.



No. 791.

..... 12.00

790. **Resonance Pendulums**. Three simple pendulums with 2 inch balls adjustably attached to a cross bar which is supported by two flexible steel strips 40 inches long, mounted on a japanned iron base. When two of the pendulums are adjusted to the same length and one set in vibration, the second begins to swing and gradually absorbs all the energy of the first, which comes to rest while the second continues to swing with wide amplitude. The process is then reversed and the first pendulum absorbs the energy of the second. The third pendulum may be used to show the lack of resonance between two pendulums of different lengths.....

5.55

791. **Seconds Pendulum**, an inexpensive instrument to take the place of a more expensive clock for simple experiments. Consists of a lens shaped iron bob six inches in diameter, with adjustable contact tip, supported at the upper end on a knife edge. The apparatus is mounted on a polished board and provided with an improved adjustable mercury well which exudes a thin knife edge of mercury, giving a sharp contact. Complete with binding posts for attaching battery and sounder.....

6.00

For **Ballistic Pendulum**, see No. 701, Catalog K.

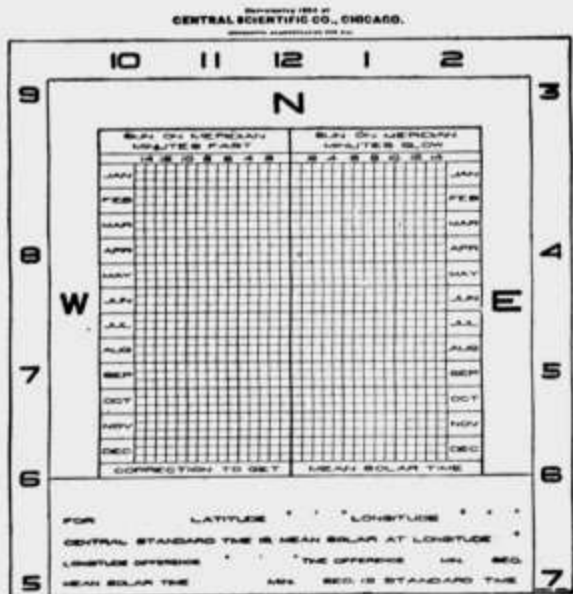
For **Balls** for pendulum work, see Nos. 703 to 719.

792. **Universal Sun Dial**. The Dial is over 10 inches in diameter, and is of very substantial construction. A valuable feature consists of a spirit level and a graduated arc indicating the correct setting for any latitude, so that the instrument can be used with fair approximation in any locality. With each instrument is supplied a correction curve which reads directly the variation between sun time and mean solar (clock) time for every day in the year. With complete instructions.. 4.50



No. 792.

791A. Coincidence Pendulum, see page 492.



793. **Sun Dial, Student Demonstration Form.** This Sun Dial is prepared in a convenient form, on which the student can lay off the hour angles and obtain the relation between sun time, mean solar time and standard time, experiments which hitherto have seldom been attempted. All the necessary data can be obtained from a school geography or almanac. Printed on 8x8 litho board with full instructions for making style, etc. With every order of a dozen or more a copy of a sun dial, worked out for Chicago (for the instructor's use) is included. Per dozen...\$ 1.25

No. 793.

794. **Harmonic Motion Apparatus.** See Catalog K for description.....\$ 20.00

794A. **Wilberforce Spiral Spring.** See Catalog K for description..... 5.55

795. **Laboratory Clock.** This is the best clock we can furnish, adaptable to the needs of the average laboratory.

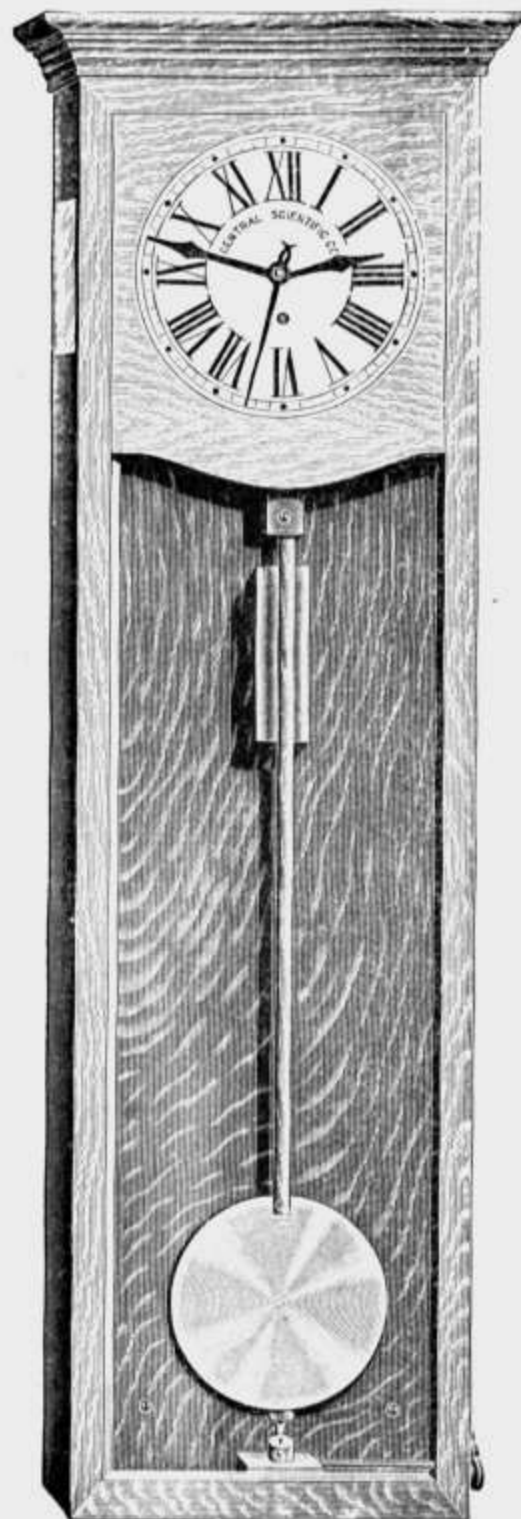
It is an eight-day movement, weight-driven clock, made for us by the Waltham Clock Co., and we guarantee it to be a reliable time-keeper.

The dial is 12 inches in diameter with seconds divisions. It is provided with hour and minute hands and a full sweep seconds hand for timing laboratory experiments.

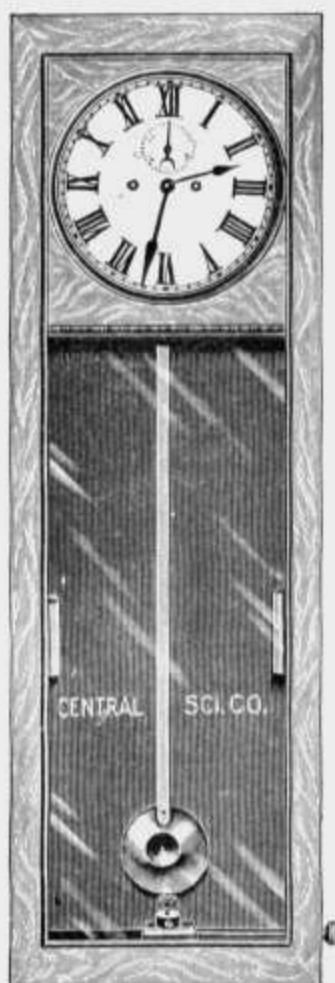
The pendulum is full seconds length, and provided with an adjustable platinum contact.

The mercury well is placed exactly in center of the arc of the pendulum swing. Regulating device for adjusting the height of the mercury in the well is operated from the outside of the clock case. By means of the construction of the mercury well, a thin strip of mercury is exposed, a great improvement, as it provides for a quick, yet sure contact, and with proper adjustment of the sounder, a sharp, clean click can be obtained.

The clock is completely enclosed in a polished oak case, with glass front, glass covered opening in the sides opposite the works, and binding posts on the outside for attaching battery and sounder.  
 Net. . . . . 55.00



No. 795.



No. 796.



No. 797.

SWISS CLOCK.



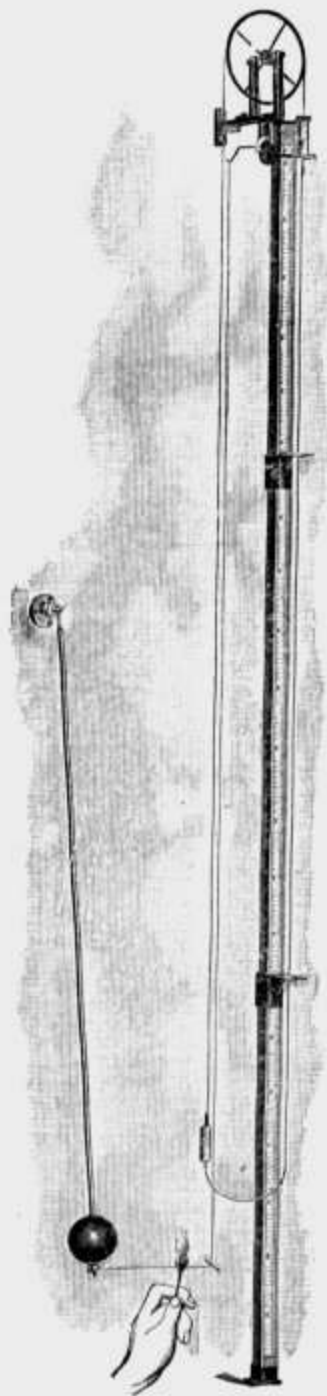
Details of Mechanism

No. 797 Parts.

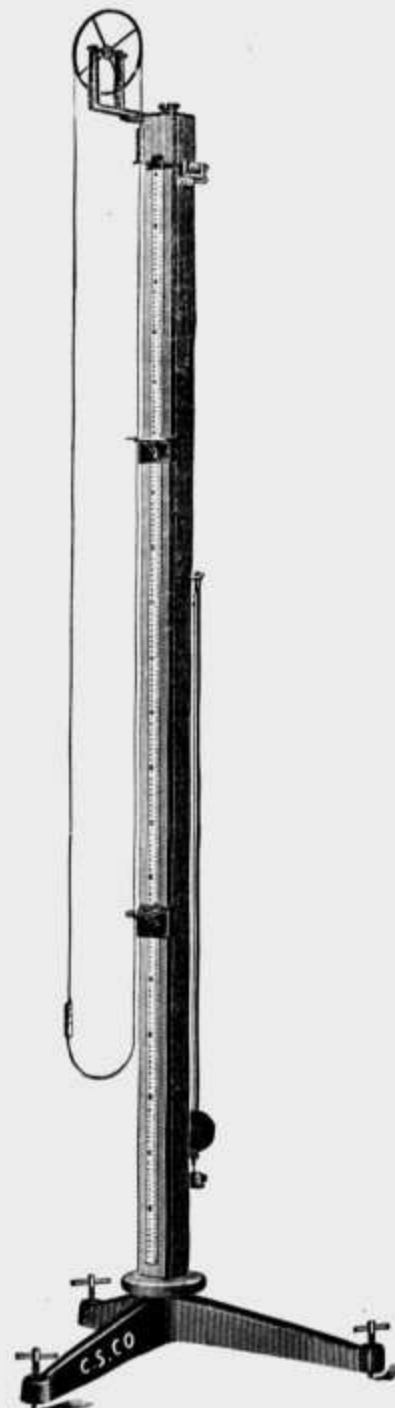
796. **Laboratory Clock.** An eight-day clock with good movement, driven by two weights. The dial is 12 inches in diameter and is provided with hour, minute and second hands. The pendulum beats seconds. The clock is provided with mercury contact adjustable from the outside of the case, and with binding posts for electrical connections. Complete in polished oak case with glass door.....Net \$ 35.00

797. **Dissected Clock,** for studying the mechanics of a weight-driven clock. This is a most ingenious and remarkable device, which the student can put together in a few minutes without the use of tools. A complete clock which will keep good time and requires no mechanical skill to assemble.

The works are mounted on a card and are suitably designated by numbers or letters. The weight, pendulum and wooden case are separate. The whole is packed in a neat box, accompanied by full and simple directions. The parts are so exactly and perfectly adjusted that each fits precisely into its proper place. No screws are required, no special tools are necessary—the fingers are the only tools needed. The parts are strongly and substantially made and suffer no injury from ordinary handling..... 1.75



No. 801.



No. 803.

801. **Atwood's Machine**, for the determination of the laws of falling bodies. Simple form, consisting of a japanned iron frame to be attached to the wall, on which is mounted a delicately balanced, cone-bearing brass wheel with adjustment screws; a drop table with detent, sprung by a cord, a square **HARDWOOD METRIC SCALE** 180 cm. in length, graduated in millimeters, with attachment to the frame and a socket for the lower end to be screwed to the floor, a sliding ring and sliding stop plate; cylindrical compound weight and two impulse riders; a full seconds pendulum with knife edge, to be attached to the wall. Complete with directions..... \$ 13.00
803. **Atwood's Machine**, improved form on heavy japanned iron tripod base with nickel plated brass leveling screws, polished hardwood pillar with metric graduations, sliding platforms and set screws, large brass wheel delicately balanced on steel pivots, full seconds pendulum with new improved mercury well and automatic drop table which falls the instant the pendulum touches the contact point. The electromagnet clicks at the same instant and with each subsequent stroke of the pendulum, so marking the time. Balance and impulse weights of brass with silk cord and directions..... 25.00

808. **Acceleration Apparatus.** This instrument is used to verify the laws governing acceleration of falling bodies.

The falling carriage is very freely guided between two highly polished and nickel plated steel rods, and carries a tuning fork of known rate of vibration. The prongs of the fork are spread slightly apart by means of an eccentric on top of the frame. This eccentric can be drawn up in the frame by turning a lever, and thus the fork is released and set in vibration. A light metal stylus attached to one of the prongs records the vibrations on the smoked glass plate while the fork is falling. The heavy glass plate is held parallel to the rods, and can easily be shifted sidewise, so that a number of curves can be traced with one smoking of the plate. Two dash pots at the base of the instrument catch the falling piece and take up the jar. For measuring the curves the plate is taken from the frame and laid on a table, and the measurements are made with a pair of dividers, or by directly applying a scale.

The apparatus is mounted on a heavy tripod with leveling screws, stands more than 165 centimeters high, and is provided with a plumb bob for the easy vertical adjustment of the rods. The carriage has a free fall of over 115 cm.

This apparatus is in use in many leading universities and colleges, with very satisfactory results. The value of "g" has been obtained with an accuracy of from 1 to 1½ per cent., the error being due to the friction in the rods.

Directions for setting up and adjusting the apparatus, as well as suggestions as to the experiments for which it is adapted, and methods of smoking the glass and measuring the vibrations, will be sent with the apparatus. . . Net

\$25.00

808A. **Atwood Attachment** for No. 808 Acceleration Apparatus. This includes a light aluminum wheel, a counterbalance weight, extra weights for use as riders, a trip attachment (not shown in the illustration), a glass plate, and an adjustable platform. In using the apparatus as an Atwood machine, the light aluminum wheel is attached to the top of the frame of No. 808. This wheel runs very free of friction in light ball bearings. The falling carriage is attached to a cord passing over this wheel and holding on its other end the counterbalance weights. The carriage is started from the bottom and the tuning fork set in vibration by means of the trip attachment, and the extra weights may be picked up by the adjustable platform which is attached to the back of the glass plate, so that the carriage will move without acceleration. By taking several traces with riders of different weights Newton's Second Law of Motion can be verified . . . . . Net

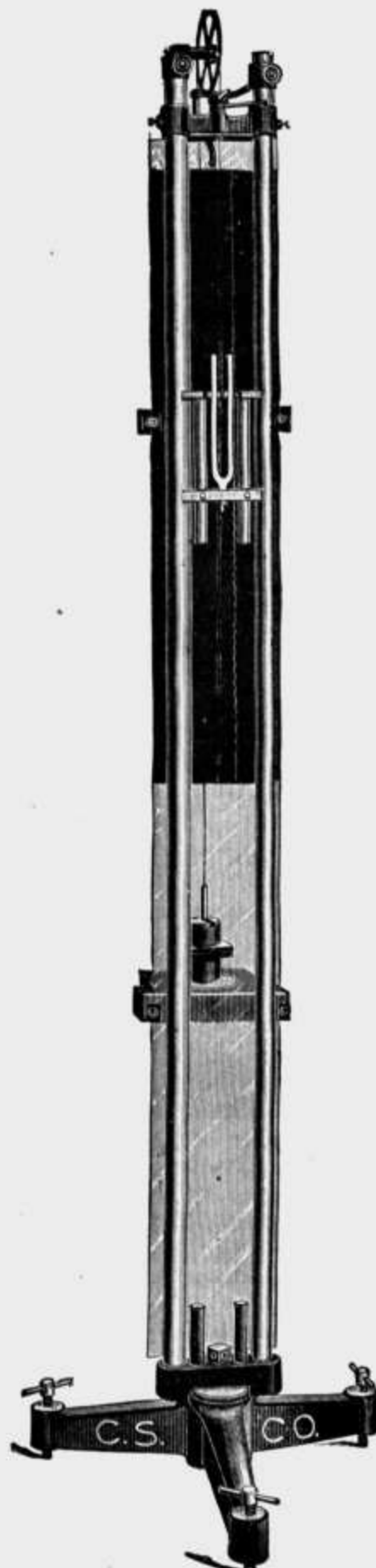
15.00

810. **Acceleration Apparatus and Atwood Machine** combined, consisting of Nos. 808 and 808A. . . . . Net

40.00

811. **Glass Plate** for Nos. 808A or 810, when ordered separately. . . . .

3.00



Nos. 808-808A.



812. Inclined Plane and Car, page 492.



- No. 814. **Falling Body Apparatus (Inclined Plane)**, according to Millikan and Gale. For determination of the distance traversed by a body under force of gravity. Consists of a straight-grained wooden track 16 feet long, which, when inclined, furnishes a slope down which a steel ball may roll. Complete with block stop, but without supporting blocks or ball..... \$ 5.55
- No. 813. **Falling Body Apparatus (Inclined Plane)**, to be used in connection with No. 813, for measuring velocity acquired by a body under force of gravity. Consists of a straight-grained wooden track 8 feet long, to be placed at a slight inclination (to eliminate friction) at the bottom of the incline No. 813. This frees the rolling ball from force of gravity, and it will move along at the velocity it had at the end of the incline..... 2.77



- No. 816. **Center of Gravity Apparatus**, comprising Nos. 816-821 and No. 383.... 4.15
- No. 817. **Two Balls** of unequal weight, balanced on handle, showing center of gravity of the system..... .78
- No. 818. **Leaning Tower**, in explanation of the leaning tower of Pisa. Shows stability when the center of mass is within the base of tower. With removable top ..... .90
- No. 819. **Loaded Wheel**, with support. A metal disc with holes at the center and along one radius, and with a weight on one side which may be adjusted so as to bring the center of gravity of the disc at any one of the eccentric holes..... 1.25
- No. 820. **Witch**. Cylinder of pith attached to a hemisphere of lead. Very interesting and instructive..... .11
- No. 820. **Horse and Rider**. Horse stands on his hind legs in the position shown in the illustration. Heavy ball changes center of mass so that it is under the point of support of the horse.. .67
- No. 383. **Plumb Bob** (see page 38)..... .13
- No. 821. **Center of Gravity Block**, new form; more positions possible than with old form. Provided with handle and pin..... .33
- No. 821A. **Center of Gravity Block** of sheet metal. Not drilled..... .17
- No. 822. **Gravity Bar**. See Catalog K for description..... 6.65
- No. 822A. **Gravity Bar**. See Catalog K for description..... 12.00
- No. 823. **Double Cone and Plane**. Cone appears to roll up the plane, the bars of which diverge so that the axis of the cone actually descends.... 1.10





No. 825.



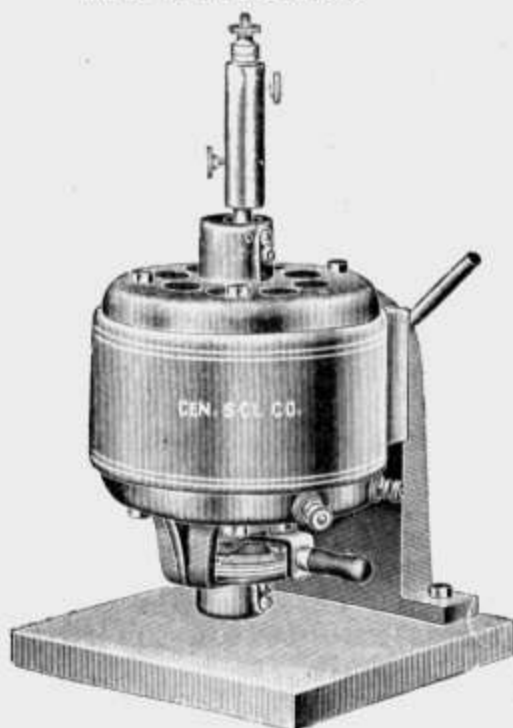
No. 827.



No. 828.

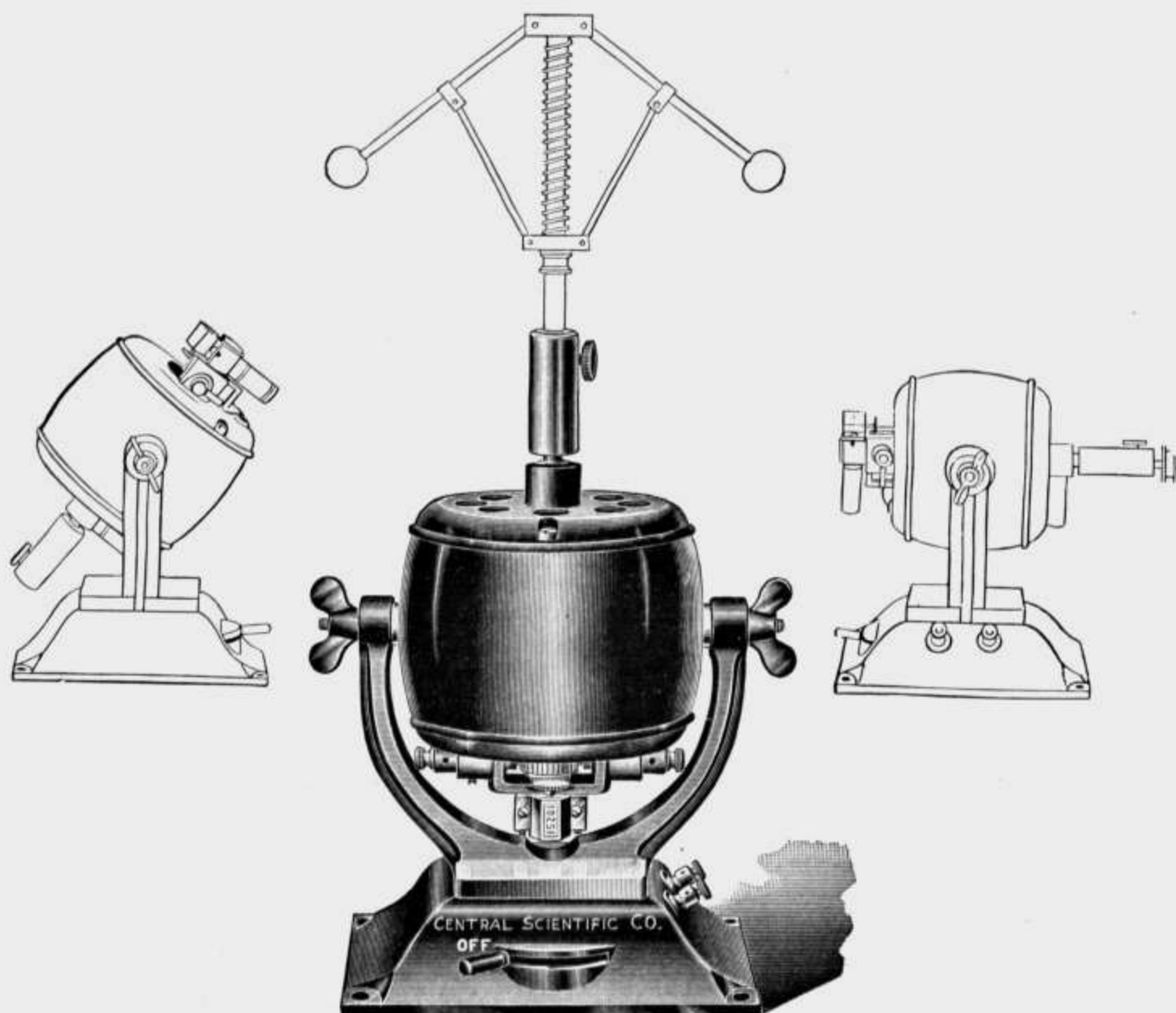
- |      |   |         |
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| 825. | Equilibrium Balls mounted on stand. Balls are adjustable so that the different states of equilibrium are readily illustrated.....   | \$ 1.50 |
| 678. | Equilibrium Cone, of wood, finely finished. Base six inches in diameter .....   | 1.65    |
| 827. | Second Law of Motion Apparatus. A spring hammer propels one ball and releases another at the same instant. Both balls reach the floor at the same time, although one reaches it after describing a parabola, while the other drops in a straight line. A rod for attaching the apparatus to a table clamp is provided.....  | 2.75    |
| 828. | Second Law of Motion Apparatus. Consists of a flexible wood strip, one end of which is to be fastened securely in a vise while at the other end is attached a right angle head having a notch at each upper corner in which are placed small marbles. When the apparatus is bent to one side and allowed to spring back to position one marble shoots out horizontally, and the other is released at the same instant and drops in a straight line..... | .45     |

**ROTATORS.**



No. 829.

- |      |   |           |
|------|---|-----------|
| 829. | Motor Rotator for 110 volt alternating current. A variable speed motor of about 1/8 horsepower so mounted on a heavy base that the shaft can be turned in any position from horizontal to vertical, and can be held rigidly in this position. The speed of rotation may be varied from 300 to 3000 R. P. M., any desired speed between these limits being obtained by adjusting a small lever. Provided with socket, set screws and chuck for use with the rotator accessories listed on pages 84 to 86. Complete with speed counter..... | Net 45.00 |
|------|---|-----------|



No. 830.

830. **Motor Rotator.** The Motor Rotator illustrated above is designed to meet the demands of laboratories for an inexpensive, efficient and conveniently operated rotator for demonstration and experimental work. It has the advantage of being small and thus easily portable; as it is well built, it runs true and without noise, and has a high efficiency.

The motor proper is mounted on a trunnion so as to give any position of shaft from horizontal to vertical, and can be held rigidly in any such position by tightening the thumb nuts. The bearings are made of hard drawn phosphor bronze and the lubrication is provided by means of self-feeding oil cups which need refilling only once in six months. A speed controller is mounted in the base, giving approximately 200, 800, 1,400 and 2,000 revolutions per minute and is regulated by means of a handle extending out from the base. A speed counter is mounted on the front bearing, registering the revolutions of the shaft.

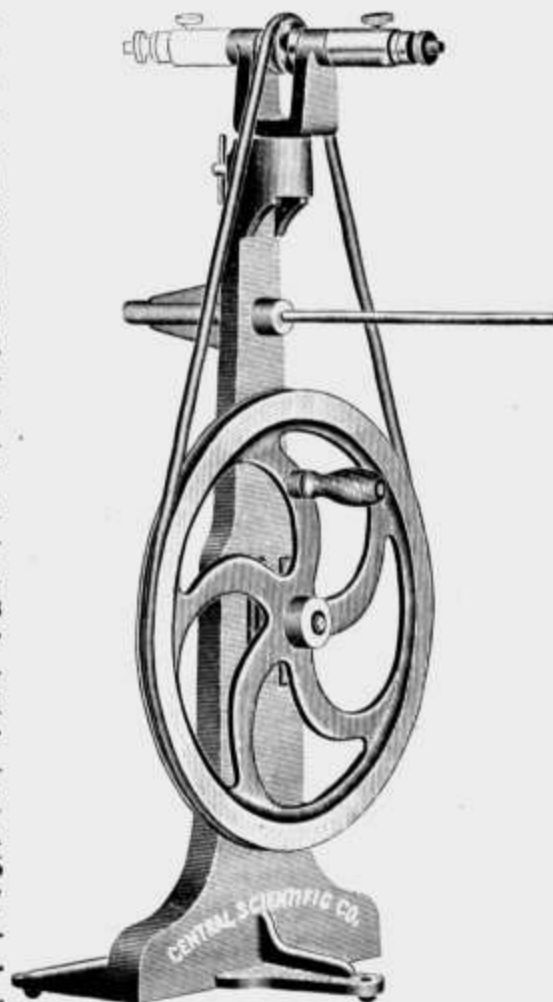
The dimensions of the motor are: Length of shaft with chucks, 10 inches; base, 6 inches square; height over all (shaft horizontal), 9½ inches (shaft vertical), 13½ inches.

Though this rotator is intended for a portable form, screw holes are provided for the permanent attachment to a table, base board, wall or wherever desired.

The finish and construction of this instrument is of such a quality that it will prove a valuable addition to the laboratory. Finished in black japan with nickle plated trimmings. Provided with socket, set screws and thumb screw for use with any of the rotator accessories listed on pages 84-86. Wound for 6 to 10 volts..... Net \$ 30.00

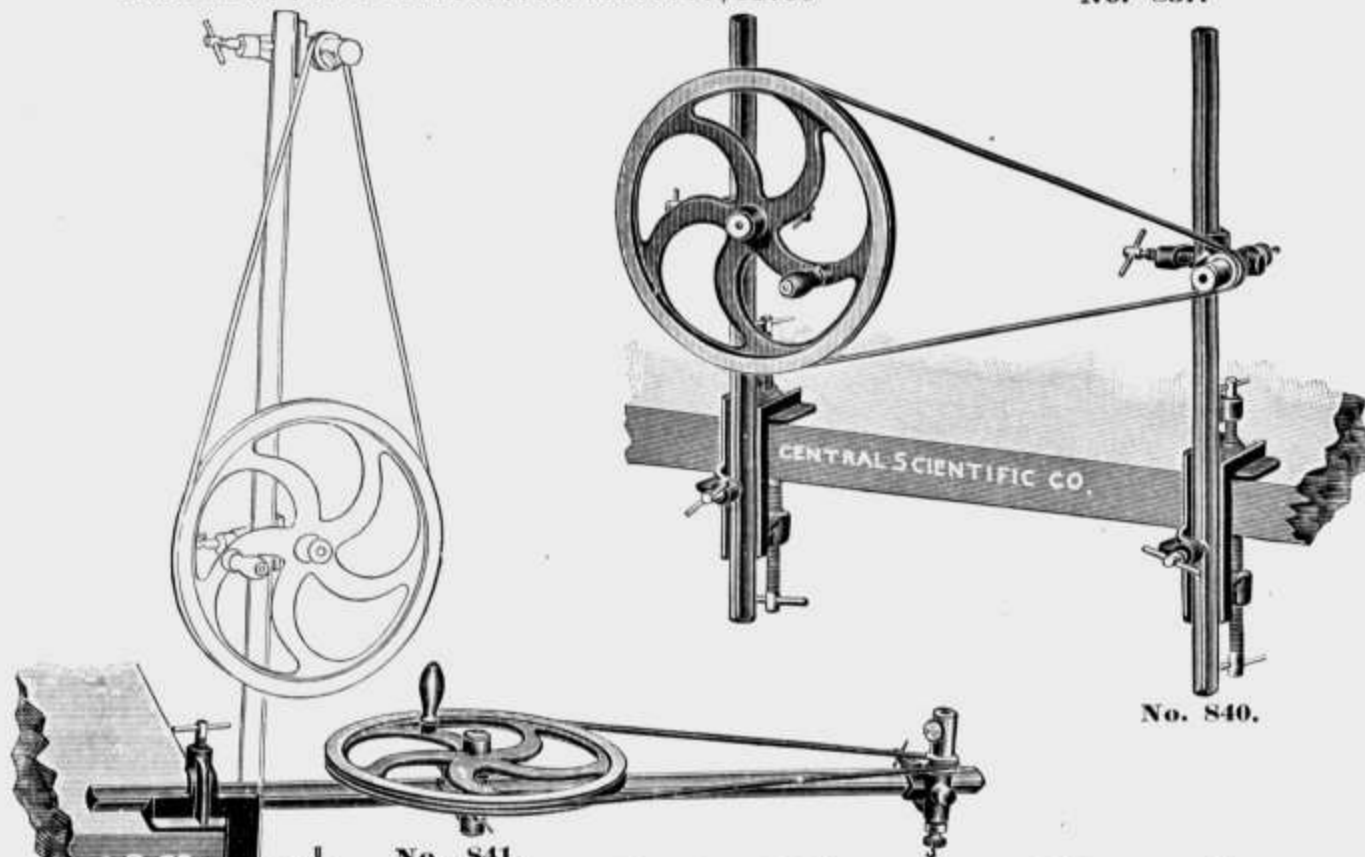
831. **Motor Rotator**, wound for 110 volts, direct current..... Net 32.00

837. **Rotator or Whirling Table.** One of the most important pieces of apparatus in the laboratory. Constructed entirely of iron and brass in the best and strongest manner; can be used vertically or horizontally as the experiment requires. Has a round belt and tension slide for tightening the same. The spindle is of steel with socket and set screw on one end for holding all attachments except discs. For holding discs a steel chuck is supplied having a washer with a flat side so that it is impossible for the disc to work loose while being rotated. The head in which the spindle revolves may be rotated through 180° so that the socket and chuck may be used on either side of the machine. This feature will be found a great convenience on the lecture table, as all rotating objects may be placed on the side of the rotator opposite to the wheel. A hook is also supplied for use with No. 867 Ring, Chain and Cylinder and with small attachments. Our latest design is of much heavier construction than before and an especially broad base gives the rotator great stability when used in an upright position.....\$6.65



No. 837.

839. **Rotator,** same as No. 837, with addition of improved speed indicator No. 513, operating by means of bevel gears and accurately registering the number of revolutions.....\$11.00



No. 840.

No. 841.

- 96. **Drive Wheel and Clamp,** grooved for round belt. With 5 foot belt..... \$ 3.35
  - 97. **Spindle and Clamp,** socket and set screw on one end; chuck with lock nut and washer for holding accessories on the other..... 4.00
  - 840. **Rotator.** Consists of No. 96 and No. 97 together with 2 No. 27 Table Clamps and 2 No. 22 Support Rods, 80 cm. long..... 11.85
  - 841. **Rotator.** Consists of No. 96 and No. 97 together with 1 No. 27 Table Clamp and 1 No. 22 Support Rod, 80 cm. long..... 9.60
  - See also No. 2027 **Geissler Tube Rotator.**
  - 842. **Pulley,** 5½ inches in diameter, for use with Nos. 837 to 841 Rotators to drive Nos. 2255 and 2259 Dynamos..... 1.10
- For Belt, see No. 1955, ¾ inch.

### ACCESSORIES FOR ROTATORS.

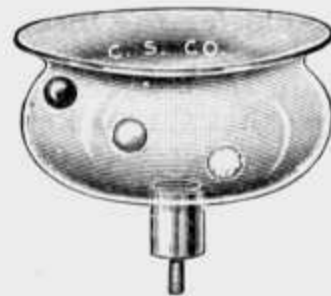
The following pieces of apparatus are made to fit Rotators Nos. 829, 830, 831, 837 to 841 and No. 843 Clamp. They cover the entire field of physical demonstration, including mechanics, heat, magnetism, electricity, acoustics and optics.



No. 843.

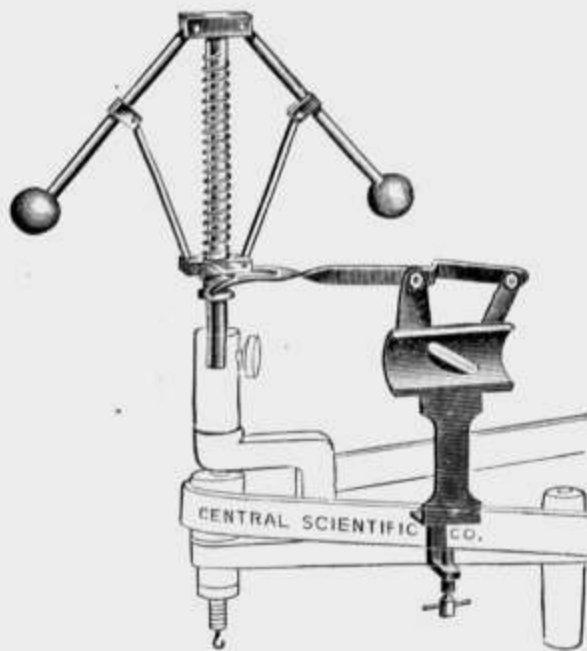


No. 849.

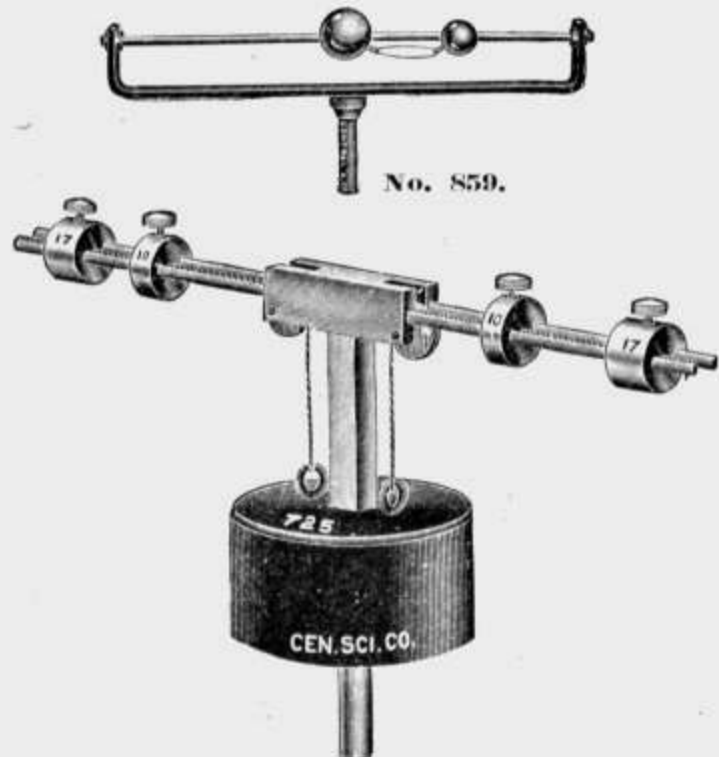


No. 851.

- |      |   |      |
|------|---|------|
| 843. | <b>Clamp.</b> In schools having no rotator it is often desired to illustrate the following experiments. For such we list a table clamp with chuck and brass drum. By use of a cord wound about the drum the different accessories may be rotated by rapidly pulling the cord. This clamp, however, is not recommended for the heavier accessories and is a poor substitute for a rotator.....\$ | 2.50 |
| 849. | <b>Centrifugal Hoop.</b> Two brass rings to show the effect of the earth's rotation in flattening the poles.....  | 1.25 |
| 851. | <b>Glass Dish,</b> with three balls of same size but of unequal weight, to show the effect of momentum and of specific gravity; the upper edges of dish are inclined inward to prevent escape of balls.....   | 2.90 |



No. 855.



No. 861.

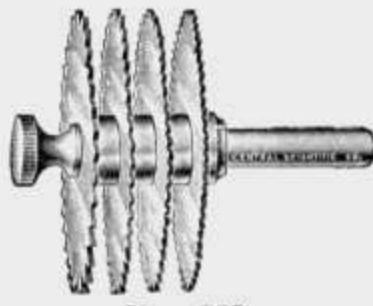
- |      |  |      |
|------|--|------|
| 853. | <b>Governor or Watt's Regulator</b> without valve regulating gear.....   | 4.00 |
| 855. | <b>Governor</b> with valve regulating gear. As the speed increases it is noted that the valve begins to shut. Essential to explanation of the use of the governor on an engine. Clamps to No. 837 or No. 839 Rotator . . . . . | 7.50 |
| 859. | <b>Centrifugal Force Apparatus,</b> two balls of unequal weight connected by a cord; mounted on frame.....   | 2.00 |
| 861. | <b>Centrifugal Force Apparatus,</b> improved form, detachable weights, cone bearing pulleys. A most satisfactory form of apparatus for the demonstration of centrifugal force.....   | 4.50 |



No. 863.



No. 865.

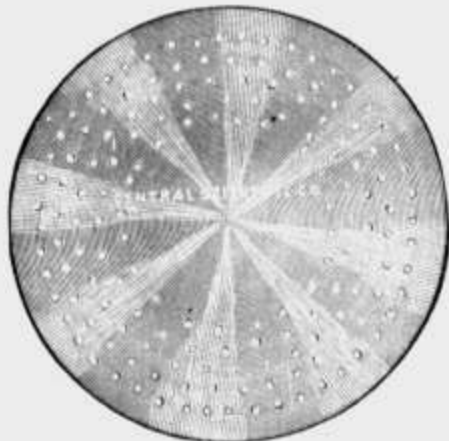


No. 869.

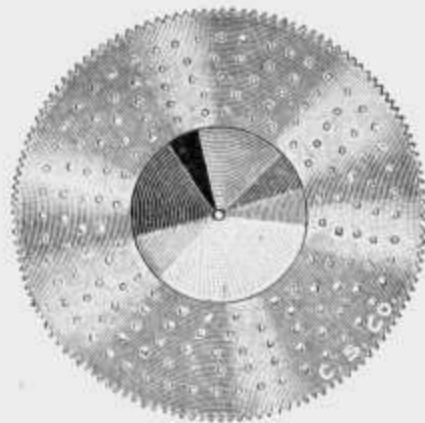


No. 873.

863. **Centrifugal Separator or Filter.** On rotation, the particles held by the liquid in suspension are thrown to the bottom of the cups.....\$ 2.50
865. **Glass Globe,** for rotating liquids or colored water. When the globe is one-quarter full, on rapid rotation the liquid will rise and show a band at the point of the greatest circumference; when half full and a pith ball inserted, the liquid will fill the globe, and the ball disappear in the lower neck of the globe; when nearly full and corked, it shows an air bubble at center when rapidly rotated..... 2.00
867. **Ring Chain and Cylinder,** each suspended by cords, for showing that the shortest diameter tends to become the axis of rotation. The ring will assume, on rotation, a horizontal position. The cylinder will look like a ball with rays of light streaming from it, and the chain will act like the ring..... .45
869. **Savart's Toothed Wheels.** Four brass wheels on same axle, so that the speed is uniform for each wheel. When they are rotated rapidly a card held to the teeth will sound the octave..... 2.65
871. **Savart's Toothed Wheel,** a single wheel, 3 inches in diameter. Will sound single note if used as above..... .55
873. **Count Rumford's Experiment,** for boiling ether or alcohol by friction as suggested by Prof. Tyndall. With this apparatus ether or alcohol will in a short time boil sufficiently to blow a cork from the tube.. 1.35
875. **Crova's Disc,** consists of a thick cardboard 12 inches in diameter, with a series of eccentric circles. When fitted to the rotator and a card with slit (the length of the radius of the disc) is held in front of the rapidly rotated disc it will show a wave effect..... .28

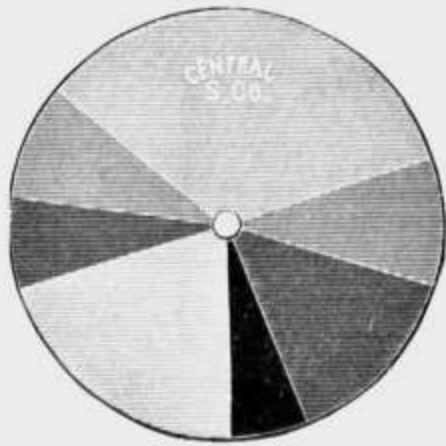


No. 879.

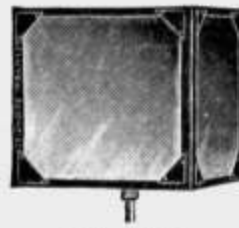


No. 881.

877. **Siren Disc,** of metal, diameter 8 in., one row of holes..... .55
879. **Siren Disc,** of metal, diameter 10 in., with five rows of holes, the first four giving the chord do, me, sol, do. To operate, hold the corner of a card on a row of holes in succession or blow strongly on the holes through a tube with bore slightly smaller than the holes. (See No. 833 Attachment.) The fifth row of holes is unevenly spaced and does not emit a musical tone, but a "noise"..... 1.10
881. **Combined Acoustic and Color Disc,** 10 inches in diameter, combining a Siren, Savart's Wheel and a Newton's Color Disc. The disc is made of heavy metal, which prevents its vibration when being rotated . . . . . 1.50
883. **Attachment,** for use with the Siren Disc for sounding any one note or four notes at the same time. Metal air tips, flexible hose and mouth-pieces, clamps to No. 837 or No. 839 Rotator..... 2.75
- For **Doppler's Principle Apparatus** for use with Rotator, see No. 3145.



Nos. 885—887.

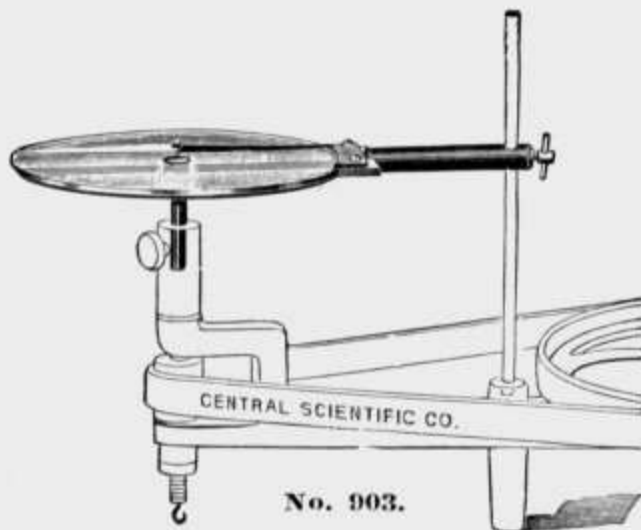


No. 897.

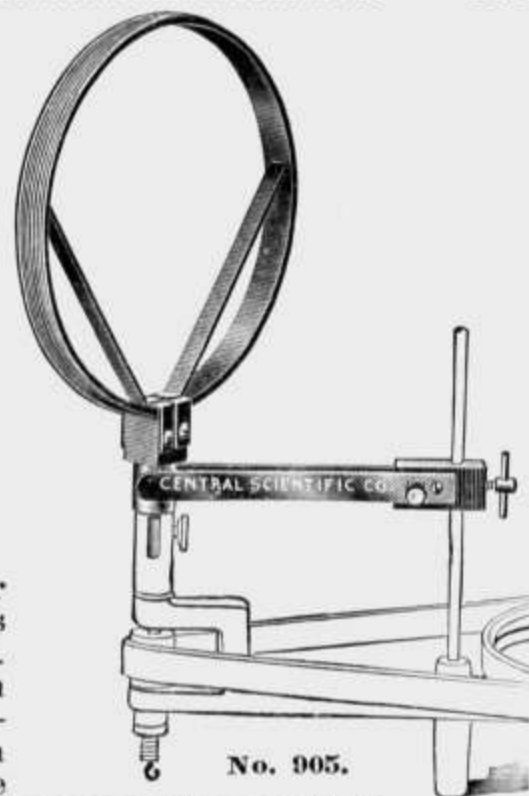


No. 899.

- 885. **Newton's Color Disc**, 8 inches in diameter, made of heavy zinc so as not to warp. The seven primary colors are obtained by using the imported Hering papers (for description, see No. 890)..... \$ 0.90
  - 887. **Newton's Color Disc**, of heavy cardboard, 8 inches in diameter, covered with same imported papers as on No. 885..... .55
  - 888. **Color Discs**, two sets of eight discs each. Each set has graduated disc for quantitative work in color mixing. Illustrates shading, blending, changing of colors, complementary colors, Maxwell's cut color discs, etc. .... 1.00
  - 890. **Hering's Colored Paper Discs**. The colored papers of Prof. Hering are justly celebrated for their purity of color, uniformity and absence of gloss. Furnished in discs 20 cm. in diameter in the following colors: Violet, indigo, blue, green, yellow, orange, red, black and white. Per sheet..... .11
  - 891. **Hering's Colored Paper Discs**. Complete set of 9 discs as described under No. 890..... .80
- For **Stroboscope** for use with Rotator, see No. 3498A.
- 897. **Cubical Mirror** for Manometric Flame Apparatus. Accurately centered; mirror approximately 14 cm. square..... 3.35
  - 899. **Diaphragm or Vibrator** for Manometric Flame Apparatus. Made of metal, with rubber tube and hard rubber mouthpiece, gas tube and jet. Easy to renew membrane..... 2.75



No. 903.



No. 905.

- 903. **Arago's Magnetic Rotations**, a revolving copper disc over which is placed a stationary glass plate with pivot and delicate magnetic needle. If the disc is moved with a slow and uniform velocity, the needle is deflected in the direction of the motion and stops at an angle from the magnetic meridian which depends on the velocity of the rotation; but if this velocity increases, the needle is deflected more and more until it is carried along, describes an entire revolution and follows the motion of the disc until it stops. Reversal causes the same result in the opposite way. For use with No. 837 or No. 839 Rotator..... 6.65
  - 905. **Earth Induction Apparatus**, with revolving coil and commutator for showing terrestrial magnetic induction. For use with No. 837 or No. 839 Rotator ..... 7.00
- See also No. 1776 **Earth Inductor**.



No. 908.

908. **Rotational Inertia Apparatus**, for demonstrating Newton's First Law of Motion with respect to rotating bodies. Two sliding weights are mounted on a horizontal rod which is free to turn about a vertical axis. When this rod is rotated and the weights are pulled toward the center by means of strings, the speed of rotation increases as the weights near the center; that is, as their moment of inertia becomes less. When the weights are released, they slide toward the ends of the rod and the speed of rotation again decreases. . . . . \$ 5.55
909. **Rotational Inertia Apparatus**, (Millikan, page 81). See Catalog K for description. . . . . Net 45.00
911. **Centrifugal Force Machine**, Robinson's. See Catalog K. . . . Duty free 29.00
- 911A. **Centrifugal Force Machine**, Robinson's. See Catalog K. . . . Duty free 29.00
- 911B. **Centrifugal Force Machine**, Robinson's. See Catalog K. . . . Duty free 31.50

**GYROSCOPES**



No. 913.



No. 915.

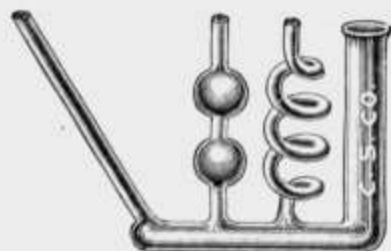


No. 917.

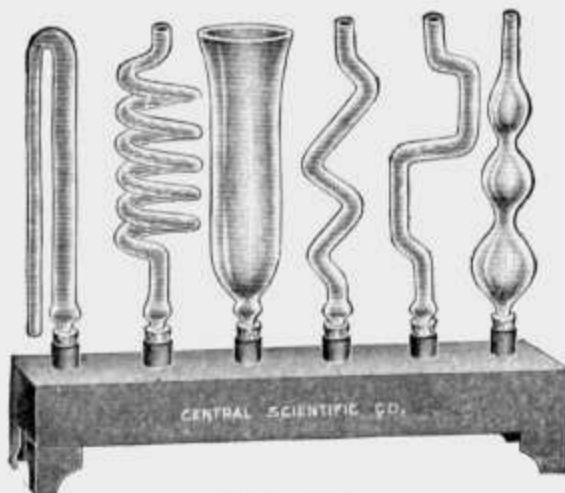
913. **Gyroscope**, simple form accurately centered wheel two inches in diameter, mounted on pivot and stand. . . . . 1.10
915. **Gyroscope**, accurately centered wheel three inches in diameter, with balance weight and lever supported on upright and base of finely finished brass and japanned iron. . . . . 6.65
917. **Gyroscope, Bohnenberger's Apparatus**. Consists of a heavy brass wheel accurately turned and balanced about an axis which is supported on steel points in the diameter of a brass ring. This brass ring in turn is supported in a second ring, so as to turn freely on steel pivots placed at 90 degrees from the points of support of the wheel. This second ring is supported in like manner on a third, on pivots situated at 90 degrees from pivots of the first ring. This construction permits the ball to revolve in any plane without confining its motion about any axis. The combination is mounted on a suitable support, from which it can be removed for use on a rotator, where a number of interesting phenomena may be studied. Finished in lacquered brass and japan. . . . . 13.35
945. **Schlick's Gyroscope Pendulum**. See Catalog K for description. . . Net 25.00
950. **Model of Brennan's Mono-Rail Car**. See Catalog K for description. Net 150.00



# MECHANICS OF FLUIDS



No. 1001.



No. 1005.

- |       |  |       |       |       |
|-------|--|-------|-------|-------|
| 1001. | <b>Equilibrium Tubes.</b> Consists of four connecting glass tubes of different shapes .....                        | \$    | 0.75  |       |
| 1005. | <b>Equilibrium Tubes.</b> Set of six glass tubes of different shapes and sizes mounted on polished brass base..... |       | 3.30  |       |
| 4684. | <b>U Tubes, of equal areas.</b>  |       |       |       |
|       | Length .....   | 4 in. | 6 in. | 8 in. |
|       | Each .....   | .11   | .17   | .25   |



No. 1010.

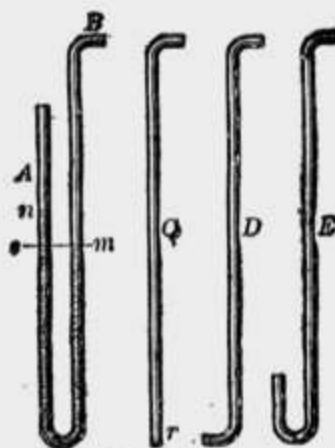
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|--------|--|------|
| 1010.  | <b>Graduated Tubes, of glass, closed at one end, for verifying the laws of liquid pressure.</b> (See Chute's Manual, page 88.) Tubes are 50 cm. long and graduated the entire length in millimeters. Per pair 19 mm. and 25 mm. in diameter..... | 2.50 |
| 1010A. | <b>Graduated Tube.</b> 19 mm. tube only of No. 1010.....   | 1.10 |
| 1010B. | <b>Graduated Tube.</b> 25 mm. tube only of No. 1010.....   | 1.40 |



No. 1013.

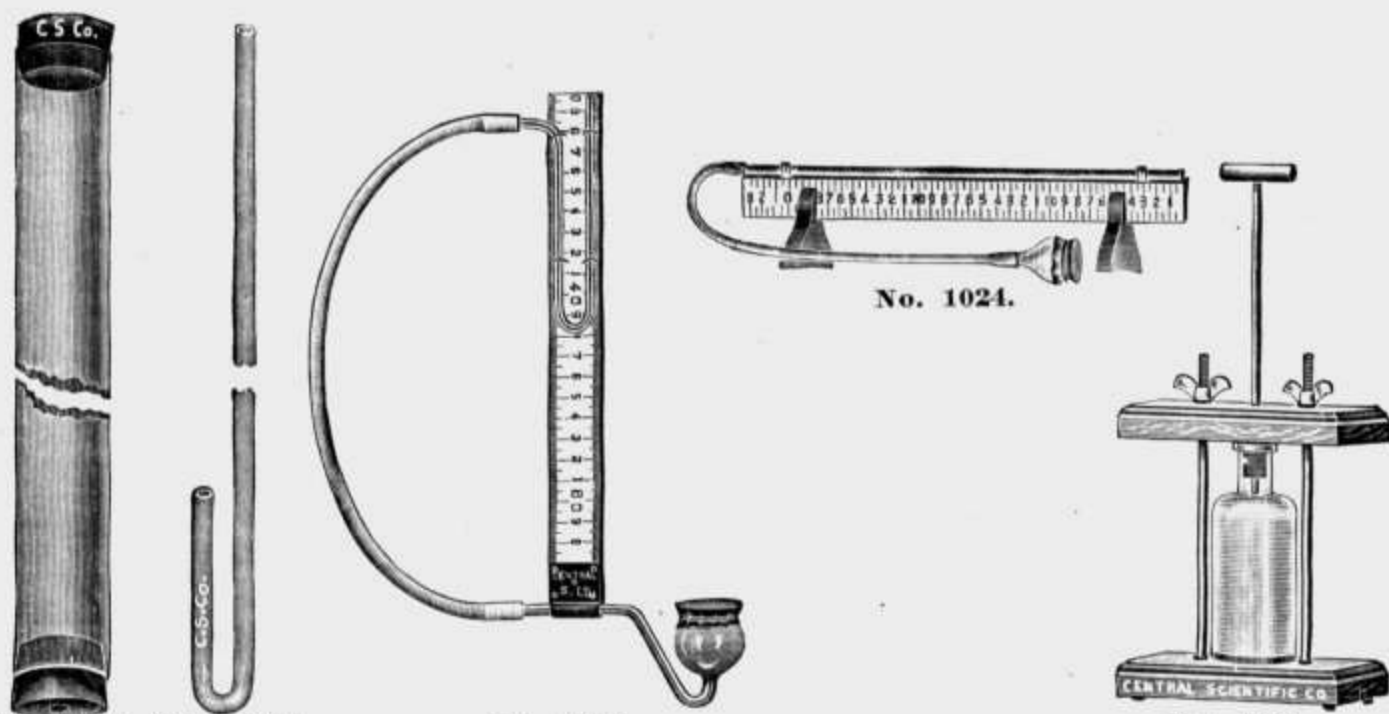


No. 1019.



No. 1021.

- |       |  |      |
|-------|--|------|
| 1011. | <b>Pressure Apparatus, to demonstrate upward and downward pressure.</b> Consists of a glass tube, the bottom of which is ground to fit a ground glass plate attached to a cord. Without support or jar.... | .67  |
| 1013. | <b>Pressure Apparatus, same as No. 1011, with support and jar complete.</b>  | 1.66 |
| 1019. | <b>Pressure Syringe, all glass; bulb perforated so that pressure may be shown to be equal in all directions.....</b>   | 2.00 |
| 1021. | <b>Pressure Tubes.</b> Consists of four tubes bent in shapes as shown above.   | .67  |



- No. 1022. No. 1022A. No. 1023. No. 1024. No. 1025.
1022. Glass Tube for the study of liquid pressure. 110 cm. x 4 cm. Ends annealed, with one solid and one 1-hole rubber stopper. . . . . \$ 1.33
- 1022A. Manometer Tube, of glass, for use with No. 1022 to show pressures at different depths; arms 102 cm. and 25 cm. long. . . . . .27
1023. Liquid Pressure Gauge, for illustrating the relation between depth and the pressure exerted by a liquid. The indicator is a column of colored liquid held in the manometer tube. Variations of pressure are measured by a scale, to which the tube is attached. The manometer tube is connected to a thistle shaped glass terminal, over which is stretched a rubber membrane. . . . . .78
1024. Liquid Pressure Gauge, according to Millikan & Gale. . . . . .67
1025. Bursting Bottle Apparatus. To demonstrate the incompressibility of a liquid. Consists of a bottle with a plunger held in a frame. The plunger forced into bottle when filled with water causes it to break. Complete with two extra bottles. . . . . .1.50

Extra Bottles for No. 1025, see No. 4543 Bottles, 6 oz.

1027. Pascal's Vases, to show that the pressure of liquids is independent of the shape of the containing vessel and therefore of the mass of liquid involved. Consists of three different shaped glass vessels with brass caps to be fastened to a metallic base supported on three legs. In our latest improved form this vase contains a very sensitive metallic diaphragm on which pressure is exerted by the liquid. The amount of this pressure is very accurately indicated by a pointer moving over a graduated arc, the motion of the diaphragm being so multiplied by means of a system of levers that the pointer swings through about 90° when the vessels are filled with water. An upright rod attached to the base carries a curved index pointer which indicates accurately the water level in either glass vessel. A valuable feature is a tube which enters the base of the apparatus and allows easy filling and emptying of the vases without moving the apparatus. For this purpose a siphon and rubber tube may be used or a rubber tube may connect the inlet tube with a water tap. Inaccuracies due to gradual leakage of water around a supporting disc, and the trouble of replacing rubber diaphragms are avoided in this apparatus. . . . . 6.65



No. 1027. (Patented Aug. 26, 1913.)

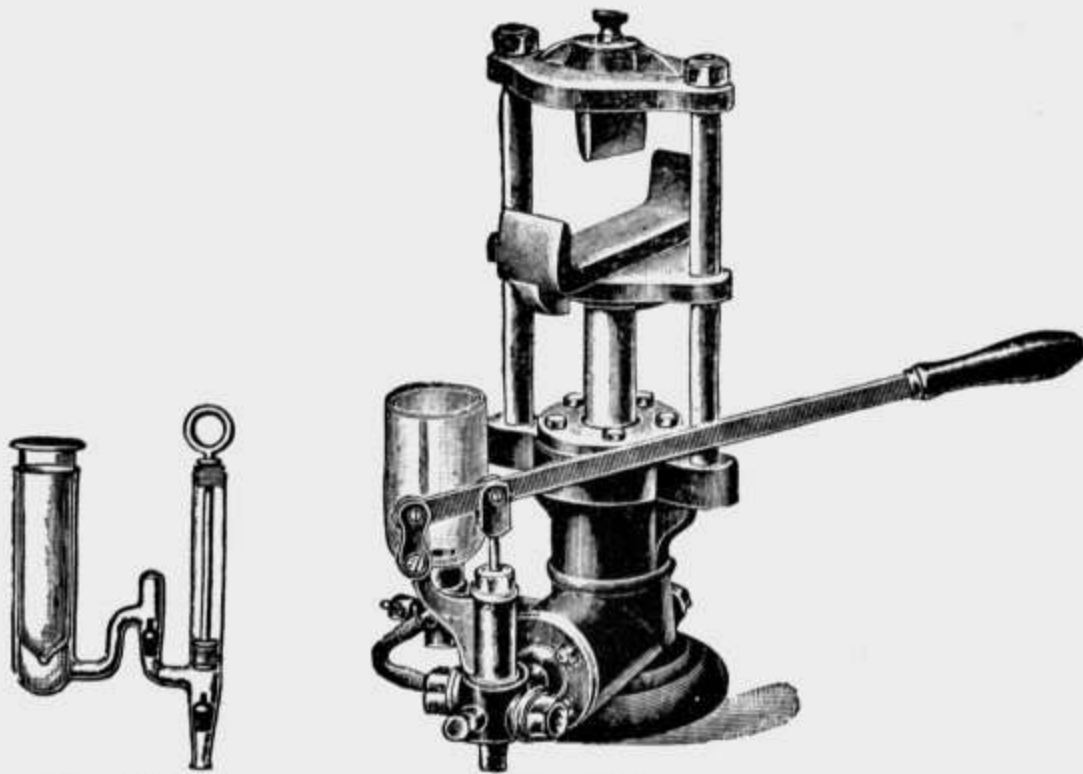
1028. Pascal's Vases consist of three glass vessels of the same form as those in No. 1027, with ground glass disc; no support. . . . . 1.33

1031. **Cartesian Diver**, to show successively the phenomena of floating, sinking and rising. The diver is so weighted that it will just float when the upper part of the jar is filled with air at atmospheric pressure. A finger pressed on the rubber diaphragm over the top of the jar will transmit pressure to the water in the jar, which in turn will cause water to enter the interior of the diver, and it will sink, owing to its increased weight. On releasing the pressure the air compressed within the diver will expel the excess of water and it rises to the surface. As the outlet in diver is horizontal, the reaction produced causes the diver to rotate during its ascent. By regulating the pressure on the rubber diaphragm very interesting and amusing antics will be observed. Diver only..... \$ 0.15



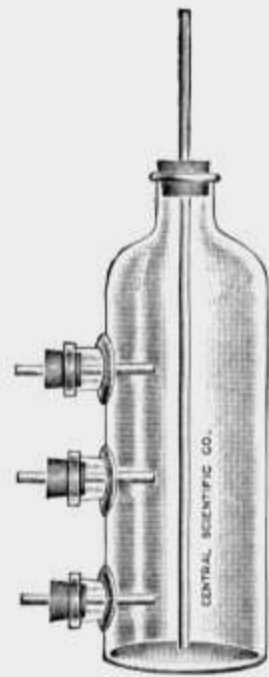
No. 1033.

- 1033. **Cartesian Diver**, No. 1031, complete with jar 12x2 inches, and diaphragm . . . . . .55
  - 1035. **Cartesian Diver**, same as No. 1031, but larger. . . . . .25
  - 1036. **Cartesian Diver**, No. 1035, complete with jar 12x2 inches and diaphragm . . . . . .67
- For Hydrometer Jars, see page 97.



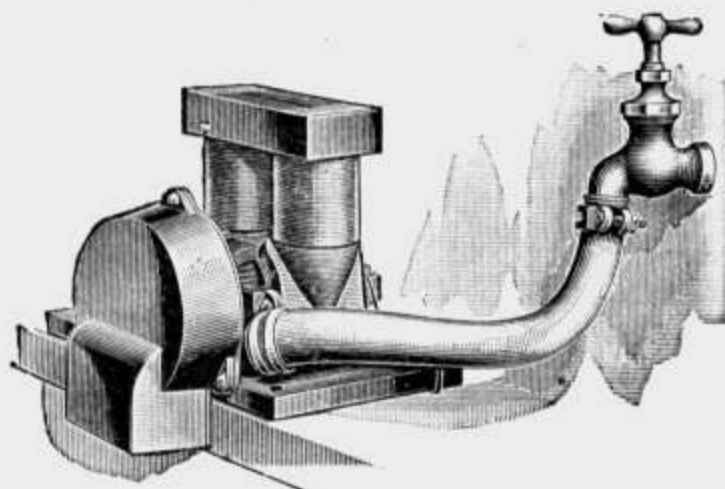
No. 1037.

No. 1039.



No. 1043

- 1037. **Hydraulic Press**. Made wholly of glass with visible valves. This is a perfect working model and will explain to a class the fundamental principle of the commercial machine. . . . . . 1.50
- 1039. **Hydraulic Press**. This instrument is a model capable of doing work, and will break bars of cast iron and wood very easily. It is mounted on a heavy iron standard containing an oil cistern and the press proper. The large cylinder has an internal diameter of 1½ inches, the small cylinder of the force pump 5-16ths of an inch. The valves are of improved design. Plunger of large cylinder carries a movable attachment for different breaking tests. Made entirely of metal, finely finished in nickel plate and japan. . . . . . 40.00
- 1043. **Mariotte's Bottle**, improved form, capacity one gallon. A study of the phenomena presented by this piece of apparatus furnishes excellent practice in applying the principles of hydrostatics; with glass tubes and rubber stoppers complete. . . . . . 3.35  
See No. 1417 **Seven-in-One Apparatus** for other experiments in hydraulics.
- 1046. **Water Motor with Prony Brake**. See Catalog K for description. . . . . . 35.50

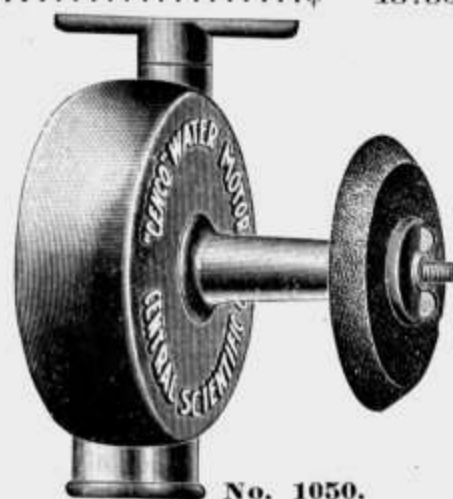


No. 1048.

1048. **Complete Water Power Plant, Water Motor and Dynamo.** Wherever water of 50 pounds pressure or over is available we recommend the use of one of these little machines to supply electric current for operating small motors, incandescent lamps, etc. Electricity may be obtained at practically no expense, the amount of water used being so small that it costs almost nothing. It can be attached to any household faucet by means of the rubber hose and clamps furnished with it. With 50 pounds water pressure enough current is obtained to light a four candle power 10 volt incandescent lamp. The output is 8 to 10 volts and 1 ampere. With greater pressure more current can be obtained .....\$ 13.30

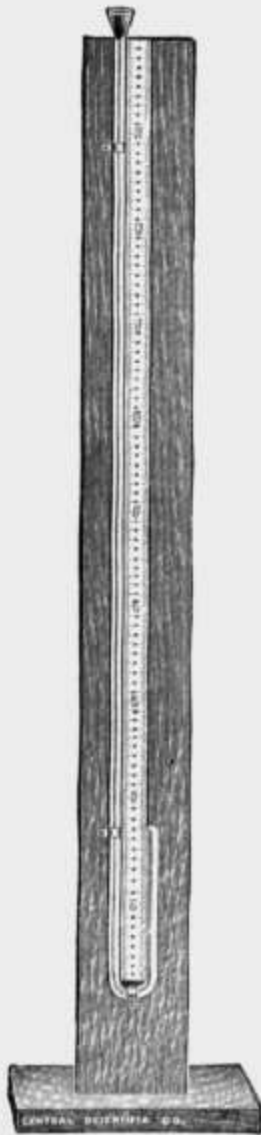


No. 1049.

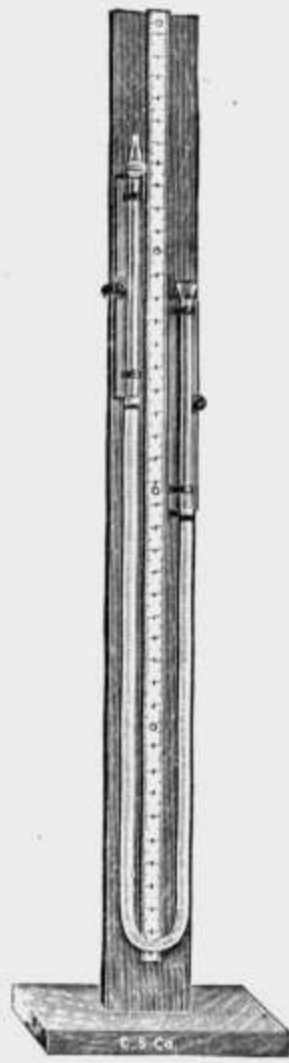


No. 1050.

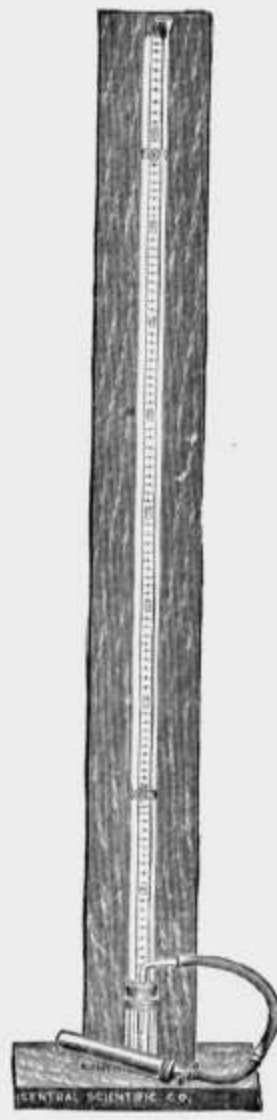
1049. **Water Turbine.** Improved form, having the outlet opposite the inlet, whereas all other forms have them on the same side, causing the water to go clear around. In the above form the water goes but half way around, eliminating clogging and giving better results and with less water. Diameter of wheel, 60 millimeters; 4,000 R. P. M.; 4 to 5 liters of water per hour..... 4.00
1050. **Cenco Water Motor,** a reliable motor made for us by one of the largest manufacturers of water motors and fully guaranteed. These motors will be found useful for power in grinding, buffing, etc., and as a test of efficiency in the laboratory, also in connection with bottle washing brushes, for the rapid cleaning of bottles, flasks, etc. Diameter 4 inches, weight 5 pounds. With 80 pounds water pressure will develop  $\frac{1}{8}$  H. P. when connected with  $\frac{1}{2}$  inch house pipe. The motor complete with 4 inch beveled face emery wheel, one cloth buffing wheel for brass, one stick of brass polish, one grooved wood pulley . . . . . 5.00
- 1050A. **Cenco Water Motor,** same design as No. 1050. Diameter 6 inches, weight 7 pounds. With 80 pounds water pressure will develop  $\frac{1}{4}$  H. P. when connected with  $\frac{1}{2}$  inch house pipe. Complete with grooved wheel for  $\frac{3}{2}$  in. round belt (See No. 1955)..... 8.00
- 1050B. **Universal Coupling,** for plain faucet (state size)..... 44
- 1050C. **Extra Rubber** for same..... .17
- 1050D. **Quart Bottle Washers**..... .80
- 1050E. **Pint Bottle Washers**..... .80
- 1050F. **Steel Polish** ..... .17
- 1050G. **Emery Wheel,** beveled edge, 4 in. diameter,  $\frac{1}{4}$  in. hole..... .80
- See Universal Couplings in list of Chemical Apparatus.



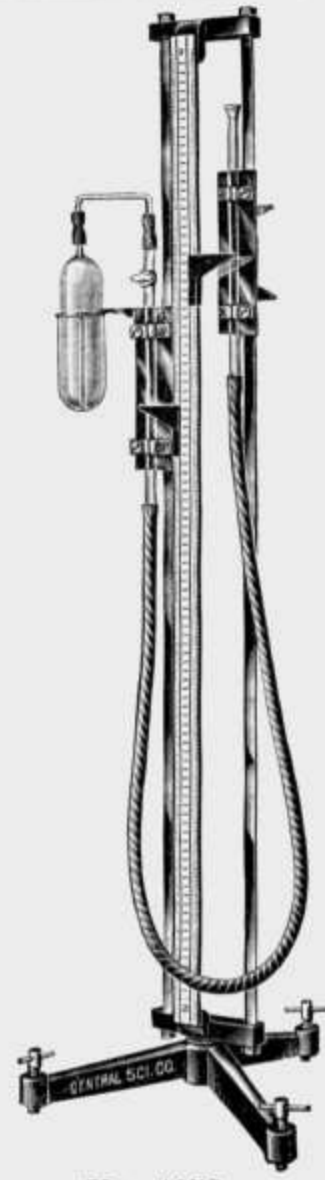
No. 1053.



No. 1055.

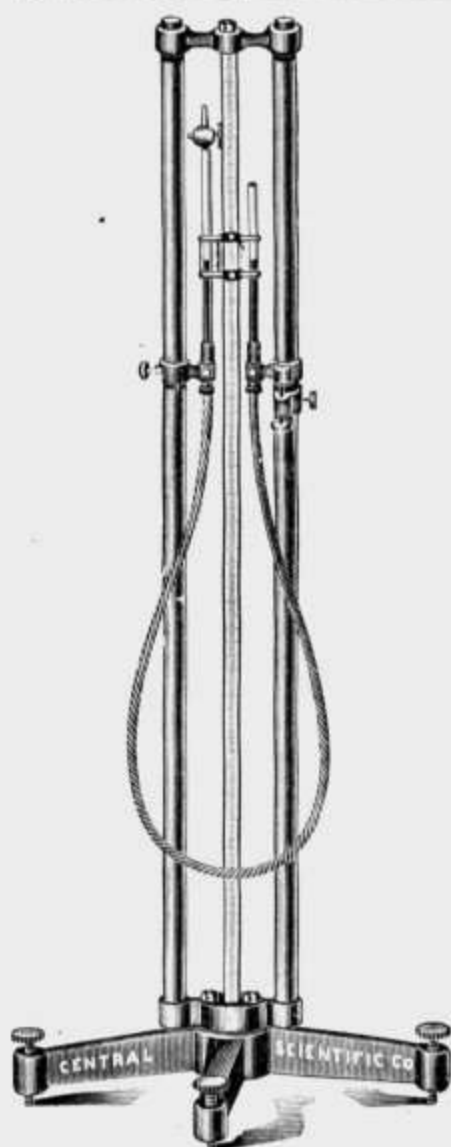


No. 1057.

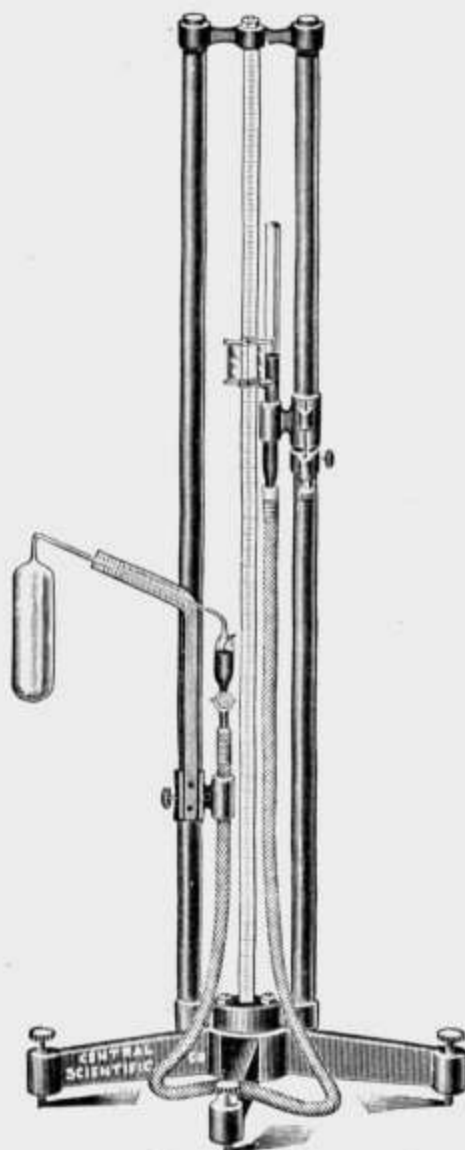


No. 1058.

- |        |  |       |
|--------|--|-------|
| 1051.  | <b>Boyle's Law Tube (Mariotte's Law)</b> to show that the volume of a gas, if temperature remains constant, varies inversely as the pressure to which it is subjected. Glass tube only, short end sealed.....\$  | 0.66  |
| 1053.  | <b>Boyle's Law Apparatus.</b> Glass Tube No. 1051 mounted on mahogany finish hardwood support with Metric scale.....   | 3.00  |
| 1055.  | <b>Boyle's Law Apparatus,</b> consisting of an open funnel end tube and a tube closed by a glass stop cock, each mounted upon a slide which can be clamped at any height on the standard, and connected by a heavy rubber tube with woven silk covering, preventing it from bulging. Metric scale. Mounted on mahogany finish hardwood support.  | 5.55  |
| 1055A. | <b>Funnel Tube</b> of No. 1055 .35   | 1.50  |
| 1055B. | <b>Stop Cock Tube</b> of No. 1055  | 1.50  |
| 1057.  | <b>Boyle's Law Apparatus,</b> improved form, as used at Northwestern University and the University of Chicago. Adapted for any pressure from one-half to two atmospheres. Pressure is applied by means of a small air pump, to the surface of mercury contained in a cistern. This is a convenient form, as there is no handling of mercury after the cistern is once filled. Complete with pump and full directions..   | 5.00  |
| 1058.  | <b>Boyle's Law Apparatus and Air Thermometer.</b> Support consists of two metal uprights, with a meter stick between them, mounted on a tripod base. The holders for funnel tube and stop-cock tube are of highly polished and lacquered metal, and may be conveniently clamped at any point along the scale by a rapid action clamp. Attached to the meter stick are two sliding index pointers which extend in front of the tubes on either side. These pointers, together with the mirror surface of the metal tube holders, enable the height of the mercury columns to be determined accurately without parallax, a feature which will be appreciated by all. The two tubes are connected by heavy silk-covered rubber tubing. A support is provided for air thermometer bulb which may be attached to the end of the stop-cock tube without removing from the apparatus... | 13.35 |
| 1059.  | <b>Boyle's Law Apparatus.</b> See Catalog K for description.....   | 24.00 |
| 1059A. | <b>Boyle's Law Apparatus,</b> for pressures of less than one atmosphere. A japanned iron mercury well, firmly mounted. (For Barometer Tubes see Nos. 1153 and 1161.).....  | 2.25  |



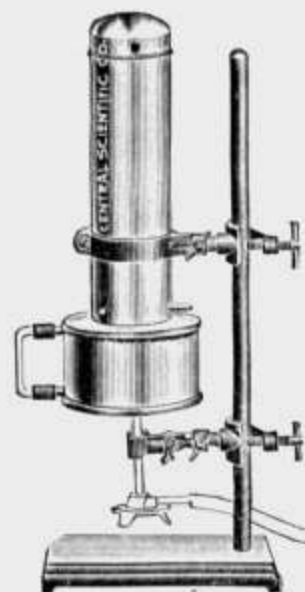
No. 1060.



No. 1060A.

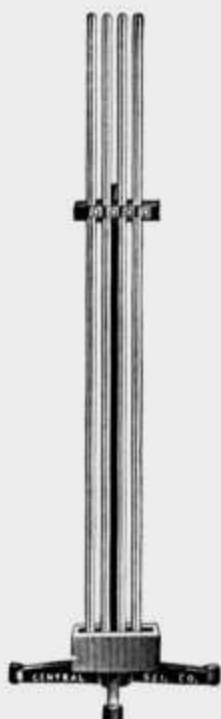


No. 1060F.



No. 1060E.

1060. **Boyle's Law Apparatus.** Height 150 cm. Mounted on a heavy tripod fitted with leveling screws. The middle rod is square and graduated in millimeters for 130 cm. of its length. A sliding mirror index is provided for reading the height of the mercury without parallax; attached vernier reads to  $\frac{1}{10}$  mm. No. 1060D Funnel Tube and No. 1060C Graduated Stop Cock Tube are provided, being connected at their lower ends by heavy silk-covered rubber tubing. A slow motion screw provides for fine adjustments of the height of the tube on the right hand side. No. 1060C Tube may be removed and No. 1060B Air Thermometer Attachment substituted. Finely finished in japan and nickel plate..... \$ 35.50
- 1060A. **Air Thermometer.** Same as No. 1060, with No. 1060B Air Thermometer Attachment substituted for No. 1060C Stop Cock Tube..... 42.25
- 1060B. **Air Thermometer Attachment** with three-way stop cock, steel coupling and platinum point for reading mercury meniscus..... 6.10
- 1060C. **Stop Cock Tube or Boyle's Law Attachment** of No. 1060. About 30 cm. long, accurately graduated, with steel coupling..... 3.00
- 1060D. **Funnel Tube**, of glass, over 25 cm. long, with steel coupling..... 1.10
- 1060E. **Steam Bath.** Made especially for use with No. 1516 Air Thermometer, but can also be used as a source of steam in the calibration of thermometers and other similar experiments. Consists of a heavy copper tank with double-walled copper steam-chamber, mounted adjustably on a substantial support. An adjustable holder for a Bunsen burner is mounted on the same support. The steam after reaching the top of the steam chamber is forced to escape by way of the space between the two walls, thus preventing rapid condensation in the inner chamber. Complete with support, burner holder and water gauge, but without burner..... 12.00
- 1060F. **Volumenometer Attachment**, for No. 1060. A glass tube closed at the top by a ground glass plate and provided with two platinum indexes. When this tube is substituted for the stop cock tube of No. 1060 the volume of any small solid, regular or irregular, may be found by means of a simple application of Boyle's law..... 3.50



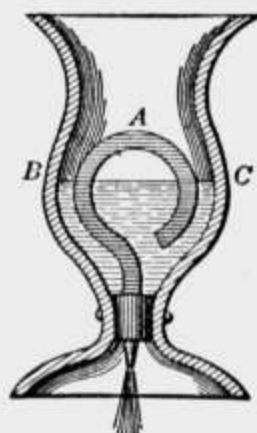
No. 1061.



No. 1065.



No. 1067.



No. 1069.

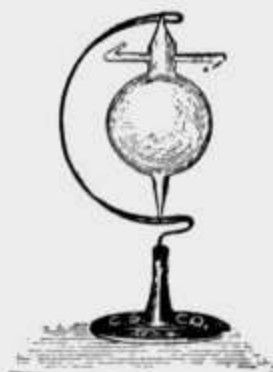


No. 1071.

- |       |  |         |
|-------|--|---------|
| 1061. | <b>Pressure of Saturated Vapor Apparatus.</b> Consists of a support with four barometer tubes, japanned iron mercury well and pipette..... | \$ 4.45 |
| 1062. | <b>Pressure of Saturated Vapor Apparatus.</b> Same as No. 1061, but with tubes graduated in millimeters.....                               | 9.00    |
| 1063. | <b>Vapor Pressure Apparatus.</b> See Catalog K.....  | 3.90    |
| 1064. | <b>Vapor Pressure Apparatus.</b> See Catalog K for description.....  | 19.00   |
| 1065. | <b>Siphon,</b> plain form of glass.....  | .22     |
| 1067. | <b>Siphon,</b> with suction tube, of glass, 12 inch.....   | .45     |
| 1068. | <b>Siphon,</b> of $\frac{1}{8}$ inch glass tubing, bent twice at right angles, with parallel arms 50 cm. long.....                         | .55     |
| 1069. | <b>Tantalus Cup,</b> illustrating intermittent springs.....  | .70     |
| 1071. | <b>Hero's Fountain,</b> to demonstrate the raising of water by the elastic force of air.....   | 2.75    |
- For Fountain in Vacuo see No. 1435.



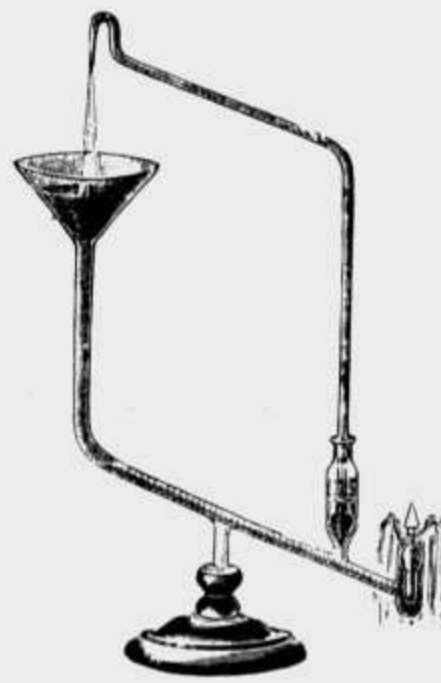
No. 1073.



No. 1081.

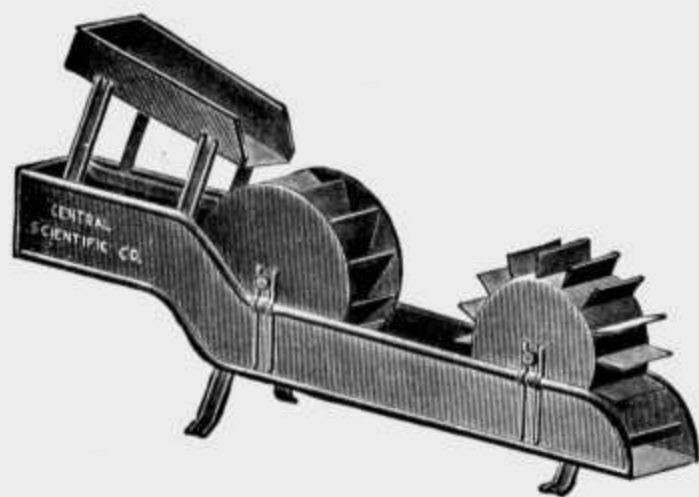


No. 1083.



No. 1087.

- |       |   |      |
|-------|---|------|
| 1073. | <b>Barker's Mill,</b> made of polished brass, much superior to other models. Water running from the nozzle tips causes the mill to rotate owing to the water reaction.....  | 4.50 |
| 1081. | <b>Reaction Wheel,</b> illustrating Third Law of Motion; for use under the receiver of an air pump.....   | 1.65 |
| 1083. | <b>Reaction Apparatus,</b> illustrates the Third Law of Motion. Water flowing out at C causes separation of the points as illustrated.....  | 1.00 |
| 1087. | <b>Hydraulic Ram.</b> After the funnel has been filled with water the valve is pushed down once or twice with the finger until the apparatus starts to act of itself. This experiment illustrates how water may be raised higher than the source of supply. This is a perfect working model, all of glass, showing the valve operating as the water flows ..... | 2.77 |



No. 1088.

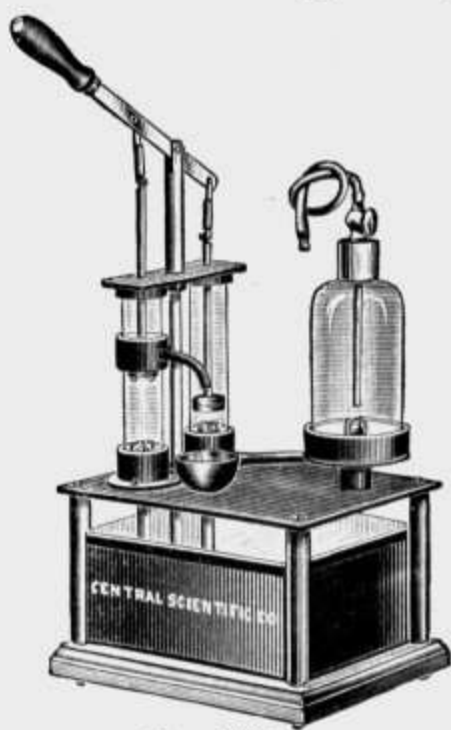


No. 1089. No. 1091.

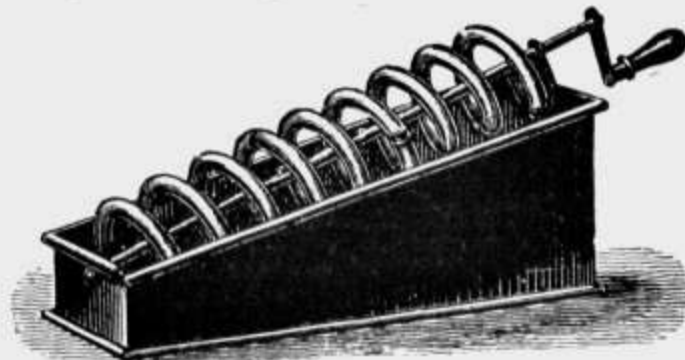


No. 1093.

1088. **Water Wheel Model**, illustrating "breast," "overshot" and "undershot" water wheels. Substantially made of sheet metal, neatly japanned . . . . . \$ 6.00
1089. **Archimedes' Principle**, a brass cylindrical cup with handle and hook beneath, a brass cylinder (with hook) exactly fills the cup. . . . . 1.25
1091. **Lift Pump**, a complete working model of glass. . . . . 1.35
1093. **Force Pump**, a complete working model of glass. . . . . 1.50



No. 1095.



No. 1099.

1095. **Lift and Force Pump**, mounted on finely polished hardwood stand, with japanned metal water tank. The barrels are of glass with brass mountings and brass pistons, valves being in plain sight . . . . . 25.00

1099. **Archimedes' Pump**. Consists of a metal vessel with glass worm attached to a crank. By turning the crank, water is caused to flow upward through the worm. Works on principle illustrated in Hero's Fountain. . . . . 4.45



No. 1101.

1101. **Specific Gravity Bottles**, unadjusted, perforated stopper, for student adjustment.  
 Approximate capacity . . . . . 25 c.c. 50 c.c.  
 Each . . . . . .30 .40
1103. **Specific Gravity Bottles**, very accurately adjusted.  
 Exact capacity at 15° C. . . . . 25 c.c. 50 c.c. 100 c.c.  
 Each . . . . . .67 .92 1.10

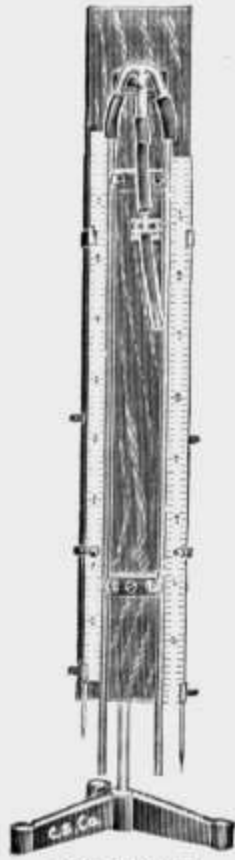
- 1105 **Specific Gravity Bottle**, Geissler's, with thermometer ground in central neck and a capillary stopper ground in side neck. Capacity, 25 c.c. . . . . 2.50
- 1105A. **Specific Gravity Bottle**, same as No. 1105, capacity 50 c.c. . . . . 2.75
- 1105B. **Specific Gravity Bottle**, Schumann's, for cement. . . . . 2.10
- 1105C. **Specific Gravity Bottle**, Sprengel's, (see illustration page 325) . . . . . .85

For Vapor Density Apparatus see list of Chemical Laboratory Glassware and Apparatus.  
 For Specific Gravity Balances, see Nos. 3815 to 3823.

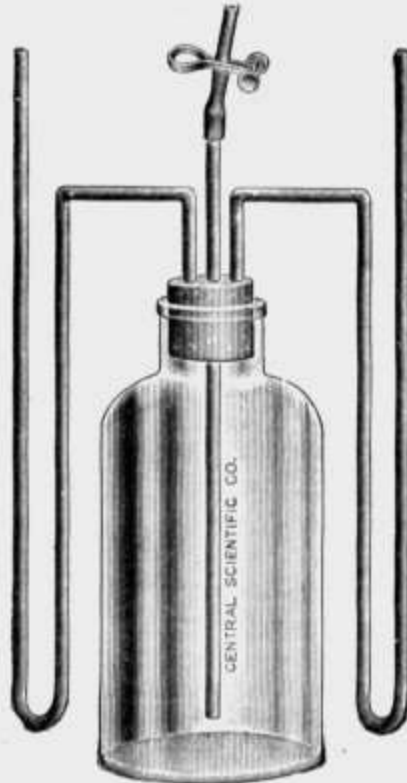




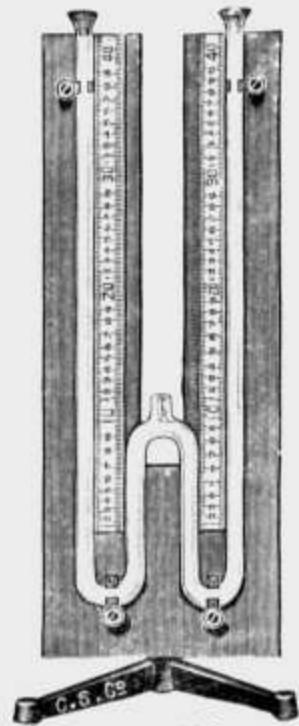
No. 1106.



No. 1106B.



No. 1108.



No. 1109.

1106. **Hare's Balancing Column Apparatus**, for determining the specific gravity of a liquid by balancing a column of the liquid with a column of water. Consists of two glass tubes, connected at the upper end by a glass Y tube, 2 No. 2102 tumblers, rubber tubes and pinch cock.. \$ 0.80
- 1106A. **Support**, of wood, with meter stick, for No. 1106..... 1.35
- 1106B. **Hare's Balancing Column Apparatus**, improved and complete form. By the side of each tube is mounted a sliding metric scale carrying at its lower end a pointer whose point is at zero of the scale. The wood back can be raised upon its support rod while the vessels containing the liquids are being filled, and can then be lowered to immerse the ends of the glass tubes in the liquids. When the liquids have been raised by suction into the tubes, the pointers may be lowered until their tips touch the surfaces of the liquids, and the height of the liquids in the two tubes may then be read directly from the scales. Complete as illustrated..... 7.00
1107. **Balancing Column Tube**, for use with two liquids which do not mix. U tube 30 cm. long..... .25
- 1107A. **Balancing Column Tube**, for use with two liquids of any kind. U tube 100 cm. long, 5 mm. bore..... .33
1108. **Liquid Density Jar**, with two manometers, inlet tube and pinch cock. For comparing the densities of two liquids..... 1.25
- 1108A. **Manometer Tube** only of No. 1108..... .40



No. 1010A.

1109. **Density U Tube**, for comparing the densities of two liquids. A double U tube mounted on a nicely finished back and provided with tripod base. Each half of the U tube is provided with a scale graduated in millimeters..... 4.45
- 1010A. **Hydrometer Tube, Constant Weight**, for finding the density of liquid by the principle of flotation. A straight glass tube 50 cm. long by 19 mm. in diameter closed at one end and graduated in millimeters for its entire length. For use with shot..... 1.10
1110. **Hydrometer Tube, Constant Weight**, similar to No. 1010A, but 60 cm. long and not graduated..... .44
1111. **Hydrometer Tube, Constant Volume**, for finding density of a liquid by principle of flotation and comparison of accuracy with No. 1110 Tube. For use with shot..... .33
1113. **Hydrometer, Demonstration**, of wood, paraffined, weighted at one end, 1 cm. square, graduated in millimeters..... .20



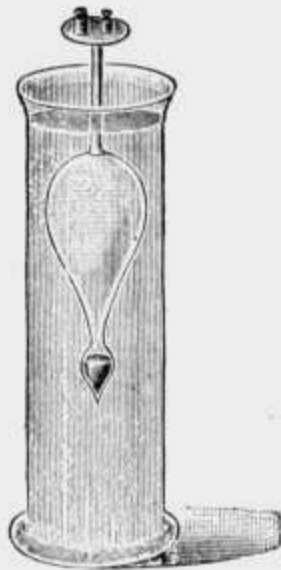
No. 1111.



No. 1113.



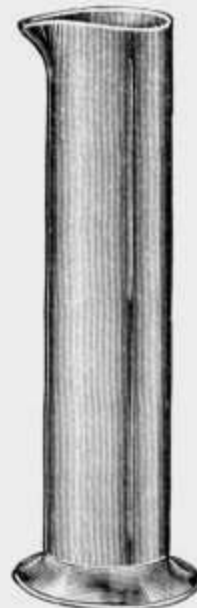
No. 1114.



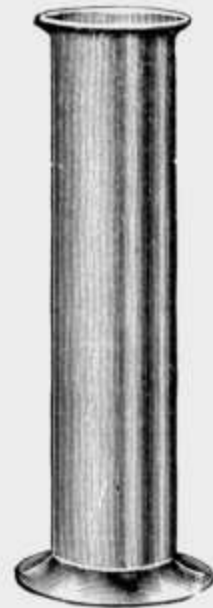
No. 1114A.



No. 1115.

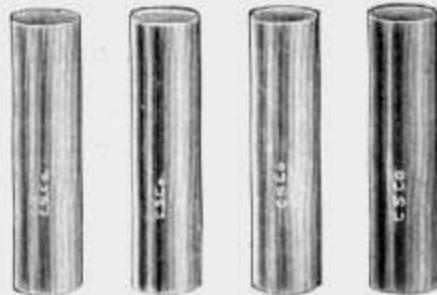


No. 1125.



No. 1127.

1114.	<b>Hydrometer, Nicholson's, constant volume.</b> Of brass, neatly finished	\$	1.35
1114A.	<b>Hydrometer, Nicholson's, Fahrenheit's form, of glass.</b> Without jar or weights		3.00
1115.	<b>Hydrometer</b> [constant weight], for light liquids, with Baumé's scale 70-10, and specific gravity scale 0.700 to 1.000		.40
1117.	<b>Hydrometer</b> [constant weight], for heavy liquids, with Baumé's scale 0-70, and specific gravity scale 1.000 to 2.000		.40
1119.	<b>Hydrometer, Universal, standard, weighted with mercury, for both light and heavy liquids, combining Nos. 1115 and 1117</b>		1.00
1120.	<b>Hydrometer, ungraduated, for student graduation, similar to Nos. 1115 and 1117</b>		.30
For other <b>Hydrometers</b> (including <b>Normal Hydrometers</b> ) see list of Chemical Laboratory Apparatus and Glassware.			
1125.	<b>Hydrometer Jar, with lip.</b>		
	Size, inches	10x1½	12x2
	Each	.30	.38
			.50
			.83
			1.10
1127.	<b>Hydrometer Jar, with flange.</b>		
	Size, inches	10x1½	12x2
	Each	.30	.38
			.50
			.83
			1.10
1128.	<b>Specific Gravity Bulbs.</b> See Catalog K for description	Duty free	6.25

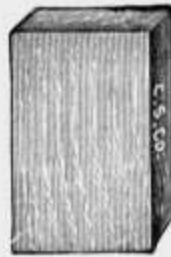


No. 1130.

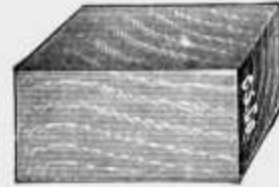
1129.	<b>Specific Gravity Specimens.</b> Set of ten different substances of irregular shape, and approximately 4 c.c. in volume, for student use in density experiments. Enclosed in a partitioned pasteboard box	.55
1130.	<b>Specific Gravity Specimens.</b> Set of four solid metal rods ½ inch in diameter and 2 inches long, ends squared accurately. Aluminum, brass, steel and copper	.70
1130A.	<b>Aluminum Rod</b> only of No. 1130	.17
1130B.	<b>Brass Rod</b> only of No. 1130	.17
1130C.	<b>Steel Rod</b> only of No. 1130	.17
1130D.	<b>Copper Rod</b> only of No. 1130	.22
1132.	<b>Specific Gravity Specimens.</b> See Catalog K for description	Duty free
1133.	<b>Specific Gravity Specimens.</b> See Catalog K for description	Duty free



No. 1134.



No. 1135.



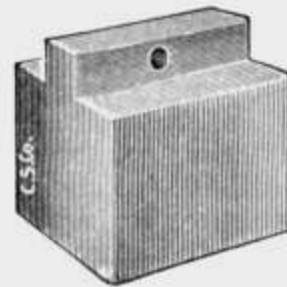
No. 1137.

- 1134. **Waterproof Wooden Cylinder**, 4.5x8 cm., loaded to float nearly submerged in water ..... \$ 0.17
- 1135. **Waterproof Wooden Block**, 7x4.5x4.5 cm., loaded to sink in water; weighs less than 225 grams..... .20
- 1137. **Waterproof Cherry Block**, 7.5x7.5x3.8 cm..... .11



No. 1139.

No. 1140.



No. 1141.

- 1139. **Overflow Can**, brass, nickel plated, 7x14 cm., capacity about 440 c. c... .45
- 1140. **Catch Bucket**, brass, nickel plated, capacity 175 c. c..... .30
- 1141. **Aluminum Block**, about 4 cm. on an edge, with rib at top and hole for attaching a thread..... .50



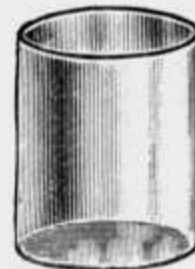
No. 1142.



No. 1143.



No. 1145-6.



No. 8088.

- 1142. **Aluminum Cylinder**, 7.5x2.5 cm., with hook..... .44
- 1143. **Lead Sinker**, weight about 175 grams, with hook..... .13
- 1145. **Waterproof Wooden Cylinder**, 1x20 cm..... .06
- 1146. **Brass Holder**, for keeping No. 1145 upright in jar. (Use 6x8 jar)..... .17
- 8088. **Glass Jars**, clear white glass of good quality.
 

Diameter, inches. ....	4	5	6	9
Height, inches... ..	5	7	8	12
Each .....	.25	.45	.55	1.35

For other **Jars**, see list of Chemical Apparatus and Glassware.

For **Specific Gravity Balances**, see Nos. 3815 to 3823.

# Meteorological Instruments

## BAROMETERS.

### Mercurial vs. Aneroid Barometers.

Reasons for selecting a high grade Aneroid Barometer (No. 1212B) in preference to a Mercurial Barometer.

1. The Aneroid Barometer is less liable to have its parts thrown out of adjustment because of rough handling by the transportation companies, which will not entertain claims for damages on account of breakage, and will not, for any consideration, insure or guarantee safe delivery.

2. It is more sensitive to changes of atmospheric pressure than the mercurial column, as it has no inertia or capillary attraction to overcome.

3. No vernier is required in taking a reading as is the case with a mercurial barometer, and the error due to personal equation is minimized. The scale divisions are 0.02 of an inch, and can be read within 0.01 of an inch. A reading can be made instantly without loss of time in adjusting zero point and vernier.

4. The movement of the aneroid is compensated for temperature, and no reference has to be made to a temperature correction table as in taking readings with a mercurial barometer.

5. On account of its portability the aneroid barometer can be carried in perfect safety to the nearest Weather Bureau station for checking and correction.

6. All of the parts of No. 1212B Aneroid Barometer are selected and made by hand by the oldest barometer makers in the world, Short & Mason, London, England, who are makers of barometers for the British government. It has been adopted by the United States Navy, and is used by the Weather Bureau in Washington for checking instruments.

7. Even if a mercurial barometer is not broken in transportation, it is so easily put out of order by rough handling, that it is impossible to tell after it reaches its destination whether the readings taken are standard or not, unless the instrument is checked on the spot by an official of the United States Weather Bureau.

8. A slight disarrangement of the zero pointer, or a strain of the parts, or the least amount of air in the tube due to rough handling by transportation companies, may cause an error of reading of  $\frac{1}{10}$  of an inch or more.

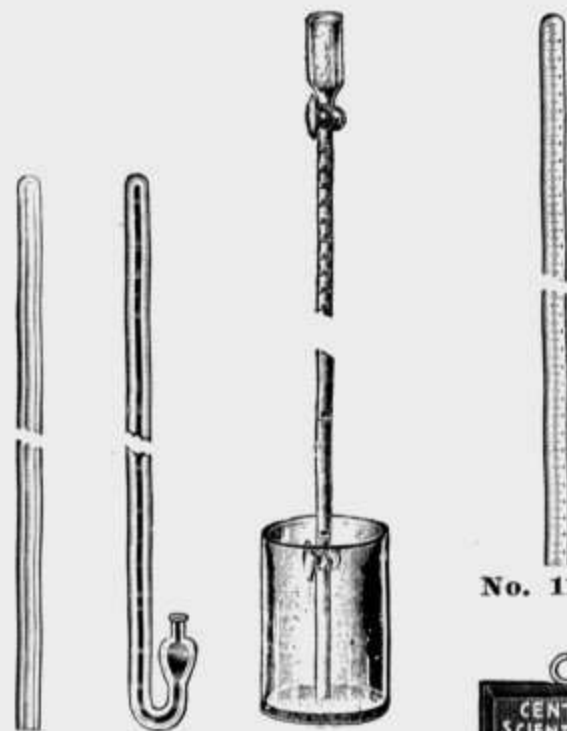
9. Unless the cistern and the mercury contained therein are occasionally cleaned and freed from dirt, the air will not pass in and out of the cistern freely and an error of as much as  $\frac{3}{10}$  of an inch may result from the pressure within the cistern.

10. In making a reading of a mercury column an error due to personal equation of as much as .03 to .04 of an inch may be made in adjusting the zero point.

11. Aneroids are displacing mercurial barometers in Germany, France and England.

12. Last, but not least, the cost of No. 1212B Aneroid Barometer is less than that of any mercurial barometer which could be recommended.

- 1151. **Barometer Tubing**, heavy, large bore, per meter... \$0.18
- 1153. **Barometer Tube**, large bore, thick walled, one end sealed, 80 cm. long... .28
- 1155. **Barometer Tube**, complete with glass cup and pipette for filling..... .40
- 1157. **Barometer Tube**, with bend and bulb ..... .40
- 1159. **Barometer Tube**, demonstration form, with funnel top and with stop cocks at top and bottom for easy filling and emptying of the tube. Graduated ..... 7.50
- 1161. **Barometer Tube**, same as No. 1153, graduated in millimeters ..... 2.00
- 1162. **Mercury Well** of japanned iron. Capacity about 50 c.c. .... .22



No. 1153. No. 1157. No. 1159.

**IMPROVED MERCURIAL BAROMETERS. FORTIN PRINCIPLE.**  
Patented Nov. 28, 1905.

A BAROMETER without provision for the adjustment of the mercury level (zero point) is of no practical value in scientific work. For this reason we have ceased to carry the "old line" instruments.

These new BAROMETERS embody all of the important features and operate on the same principle as the U. S. Weather Bureau Standard Barometers. (See also page 99.)

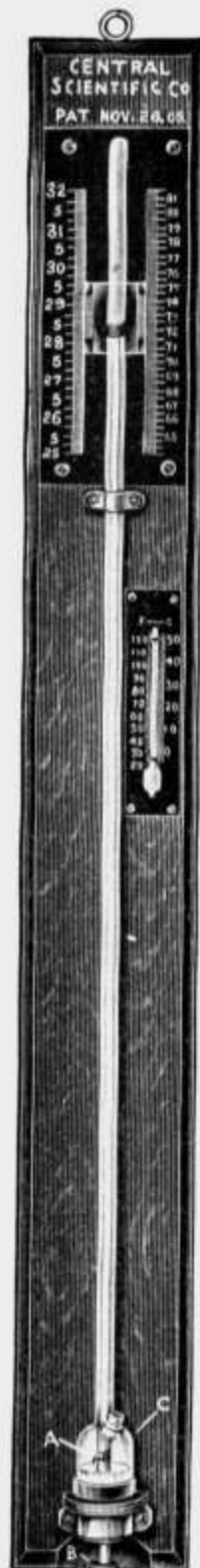
The GLASS TUBE is straight and of heavy wall and uniform bore.

The MERCURY CISTERN (C) is constructed of glass, sealed to the tube. A flexible and air-tight piece of leather forms the lower part of the cistern, and by means of the adjustment screw (B) the mercury level can be raised or lowered to coincide with the zero point. This zero point consists of a piece of colored glass (A) drawn to a point, and extending from the outer wall of the tube. This form is far superior to the "line" zero used on most low cost barometers.

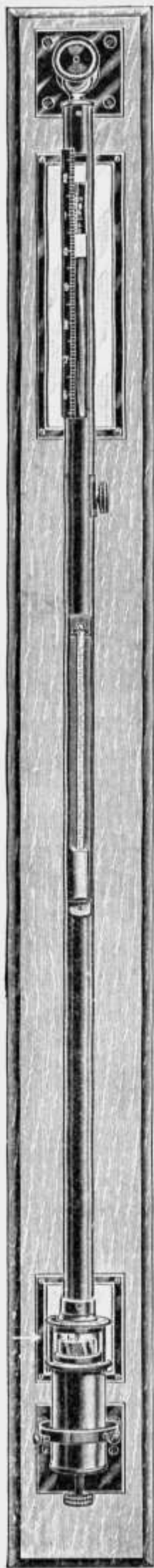
The HEIGHT of the MERCURY COLUMN is observed by means of a special device attached to the vernier.

The BAROMETER SCALE is fixed to the board, and is graduated in Metric and English, reading by means of a vernier to  $\frac{1}{10}$  mm. and 1-200 inch. The vernier slides in an accurately cut slot and moves freely and independently of the glass tube. The vernier graduations are placed on a beveled surface, bringing them close to the scale. A lens front thermometer with Centigrade and Fahrenheit scale is attached to the mounting.

- 1165. **Improved Mercurial Barometer.** The scale reads down to 25 inches, and is therefore not satisfactory for altitudes above 4,000 feet. See No. 1165A for a high altitude barometer. Complete with thermometer .....Net \$ 15.00
- 1165A. **Improved Mercurial Barometer.** Same as No. 1165, but with a scale reading down to 20 inches for use in high altitudes.....Net 17.00
- 1166. **Improved Mercurial Barometer.** Same as No. 1165, with addition of rack and pinion adjustment for the vernier and a certificate of error. For altitudes below 4,000 feet only.....Net 20.00



No. 1165.



Nos. 1169-71.

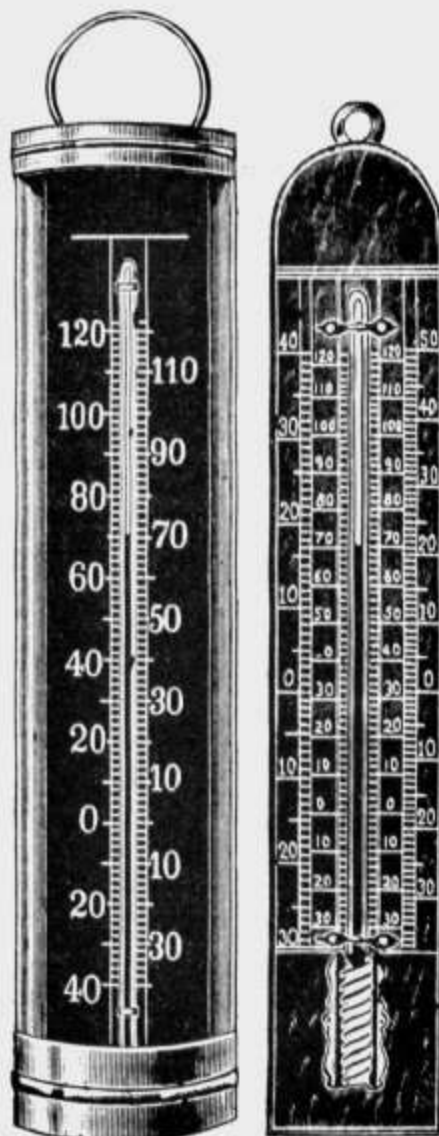
1169. **Standard Barometer, United States Weather Bureau Type, Fortin Principle.** This barometer is of the highest type of excellence, indorsed by the United States Weather Bureau and fully warranted by the manufacturer. (See also page 99.) The mercury tube is inclosed in a brass body with gun-metal finish, having at its upper end two vertical openings, in which the vernier works, the latter operated by a rack and pinion movement. The readings are taken through these openings, aided by light reflected from a white opaque glass reflector attached to the board behind. The scale is graduated on one side in inches and 10ths, and on the other in centimeters and millimeters, the vernier enabling a reading to be taken, in each case respectively, of one-thousandth of an inch and one-tenth of a millimeter. The attached thermometer consists of a well seasoned tube with both Centigrade and Fahrenheit scales, with the figures etched on the stem. It is so mounted that it can easily be removed for testing, etc. The barometer may be used without the board by suspending it by the ring at the top; but the board (No. 1171), as shown in the illustration, possesses many advantages. Without board.....Net \$40.00

1171. **Back for above, of finely finished hardwood, to which is attached a brass bracket to receive the ring in the top of the barometer, a ring with steadying screws to clamp about the cistern, and white opaque glass reflectors forming a translucent background for reading the instrument . . . . .**Net \$5.50

1175. **House Thermometer, standard grade, 10 inch, heavy japanned tin case, accurately tested . . . . .**\$1.10

1177. **House Thermometer, 8 inch, metal scale, oak back, beveled edge, with brass guard over bulb . . . . .**\$0.67

1179. **Three Scale Thermometer, box-wood, F., R. and C. scales** \$0.67



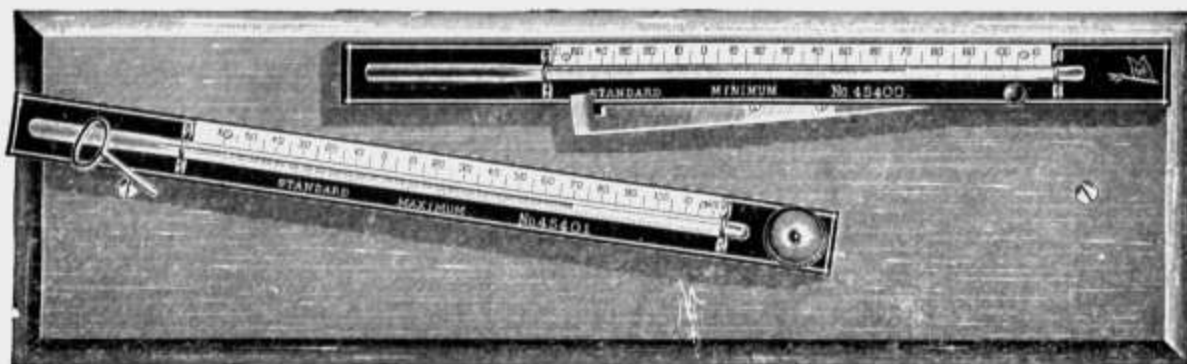
No. 1175.

No. 1179.



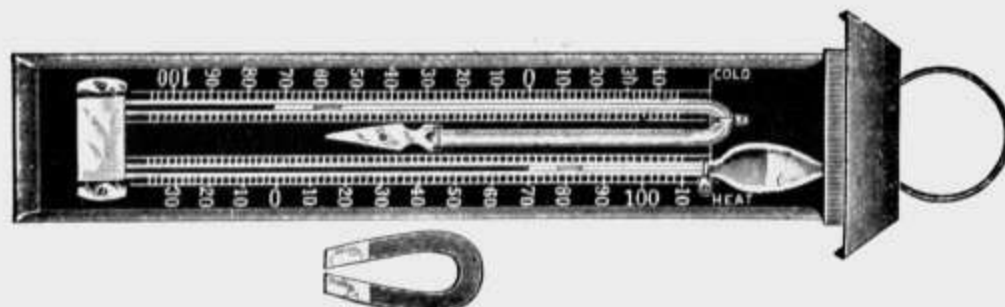
No. 1185.

- 1181. **Standard Thermometer**, 12-inch, latest Weather Bureau pattern, cylindrical bulb, graduation etched on tube, with raised metal strip at side of the tube on which are marked the figures and every fifth line of the scale. Furnished with support and binding screws. Certificate with each thermometer..... \$ 5.55
- 1183. **Standard Minimum Registering Thermometer**, same pattern and description as No. 1181. Certified..... 6.10
- 1185. **Standard Maximum Registering Thermometer**, same pattern and description as No. 1181. Certified..... 6.65



No. 1189.

- 1189. **U. S. Weather Bureau Set of Maximum and Minimum Registering Thermometers**, latest pattern, consisting of Nos. 1183 and 1185 Thermometers mounted on polished oil finished back. Furnished with certificates for each thermometer. Per set..... 12.00



No. 1190.

- 1190. **Six's Self-Registering Maximum and Minimum Thermometer**. Eight-inch black japanned tin case, silvered metal scale, with magnet ..... 3.35

- 9159. **Soil Thermometer**, for ascertaining the temperature of the soil at various depths. Thermometer set in oak with steel point. Scale engraved on stem. Range from  $-4^{\circ}$  to  $120^{\circ}$  Fahrenheit, by  $\frac{1}{5}^{\circ}$  divisions. Supplied for use at four different maximum depths.

Depth, cm. ....	25	50	75	100
Depth, inches, approx. ....	10	20	30	40
Price .....	5.50	6.65	7.75	9.00

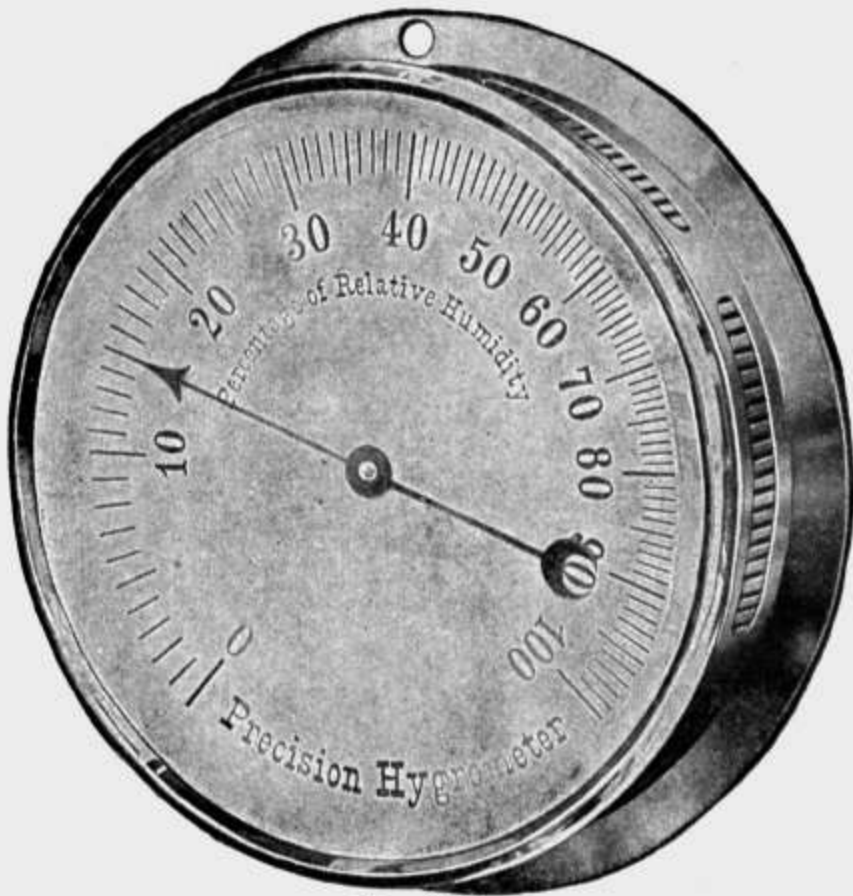
- 1191. **Soil Thermometer**, 10-inch glass cylindrical thermometer, with paper scale, in turned wood case with brass pointed bottom ..... 1.40

- 9161. **Soil Thermometer**, standard grade, 10-inch glass cylindrical thermometer, with metal scale, mounted on turned wood frame with brass pointed bottom..... 2.50

For Chemical Thermometers, see list of Chemical Apparatus.



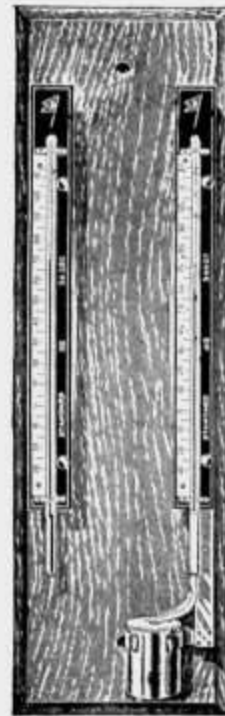
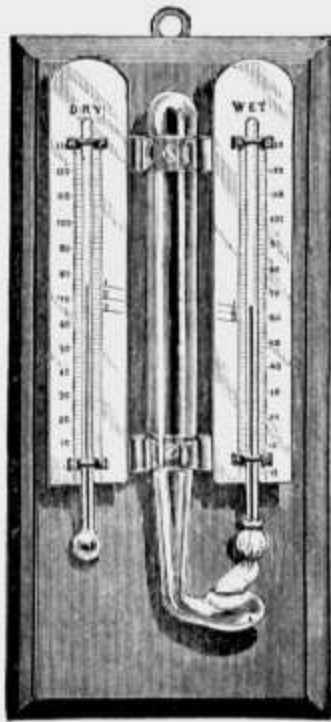
No. 1191.



No. 1193.

No. 1194.

1193. **Hair Hygrometer.** The standard direct reading Hygrometer. 5 inch enameled card dial showing relative humidity..... \$ 8.35
1194. **Hair Hygrometer.** Scale denotes the humidity of the air without reference to tables. In spun brass nickel plated case, 3 inch dial.. 2.00

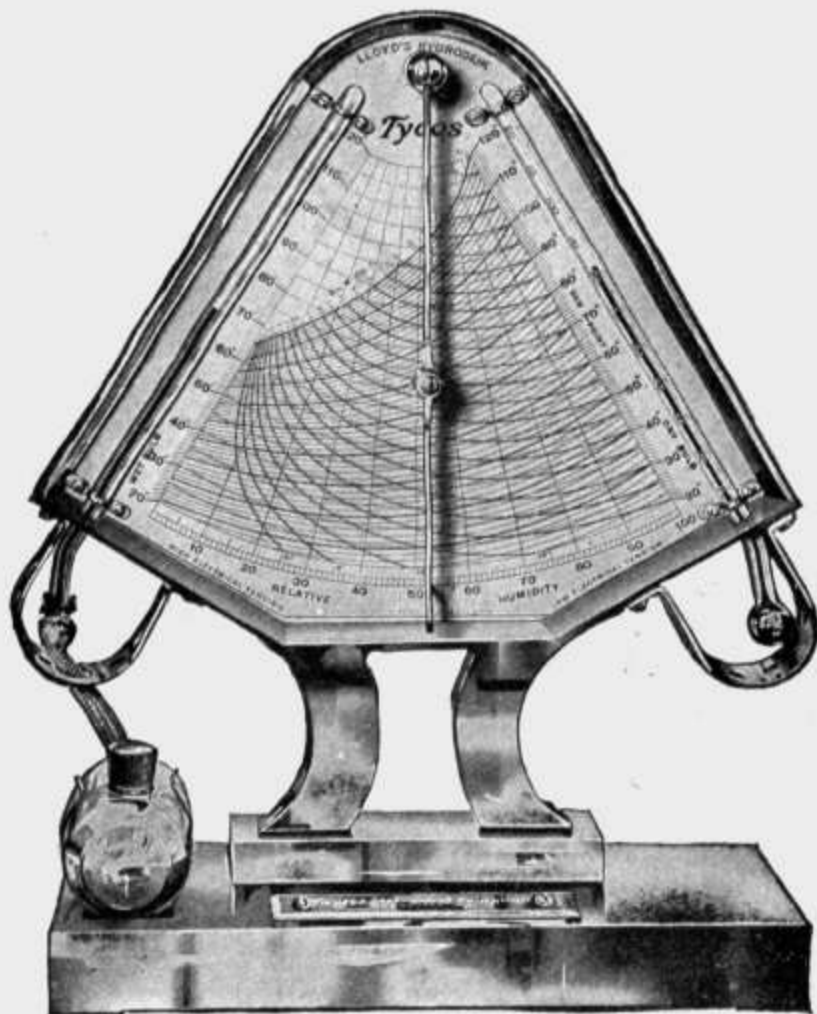


No. 1195.

No. 1199.

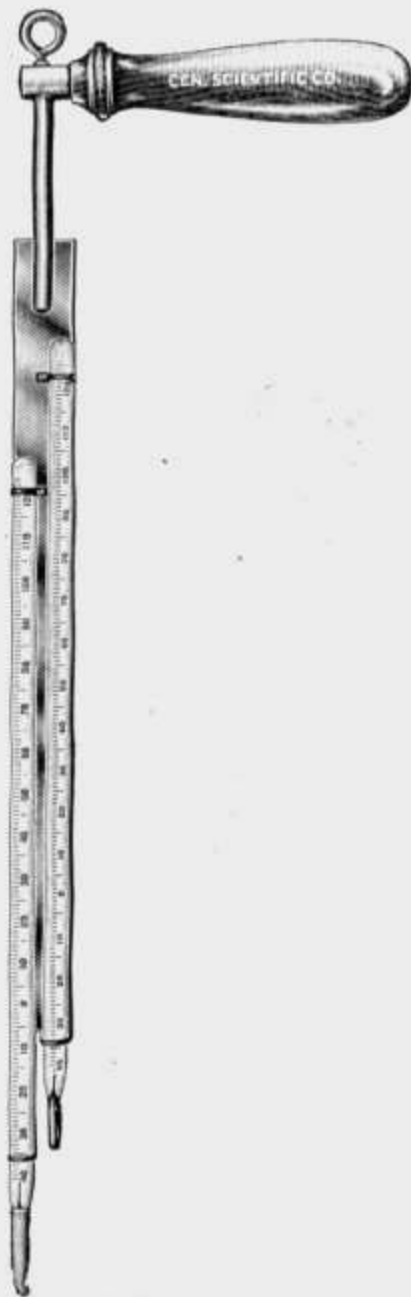
1195. **Mason's Hygrometer,** with lines drawn on the scale for convenience in maintaining a humidity of 50% at normal temperatures, mounted on polished hardwood frame, 8½x4½ inches, scale raised from frame by insulating strips, complete with glass cistern and tables for determining dew point and humidity..... 5.00
- 1195A. **Cistern, only,** for No. 1195..... .33
1197. **Mason's Hygrometer,** simpler form, thermometers not raised, mounted on polished hardwood frame..... 2.50
- 1197A. **Cistern, only,** for No. 1197..... .33
1199. **U. S. Weather Bureau Hygrometer,** consisting of two No. 1181 Standard Thermometers mounted on a finely polished hardwood back, metal cistern with wick, and certificate for each thermometer..... 12.00
1200. **Silk Wicks for Hygrometers.**.....Each .17





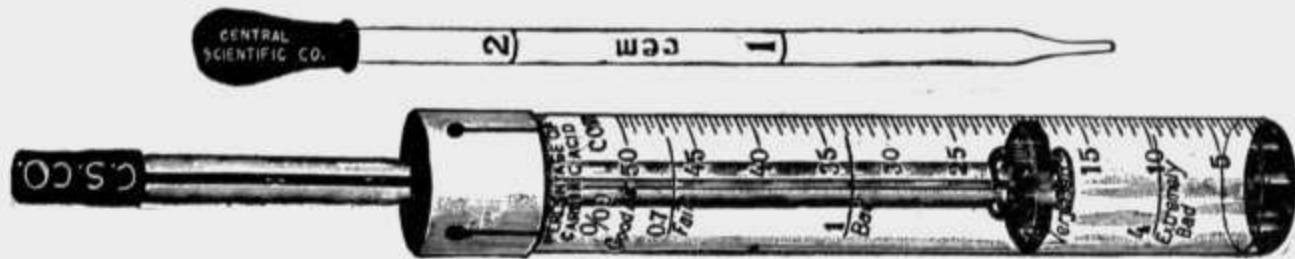
No. 1203.

1203. **Hygrodeik**, an improved form of the Mason's Hygrometer. Consists of two thermometers, wet and dry bulbs, mounted upon the outer edge of a chart which has been plotted from new and corrected tables prepared under the direction of the U. S. Weather Bureau. This chart, while complicated in appearance, is very simple and obviates entirely the use of tables for temperatures between 20 and 100 degrees Fahrenheit. Full directions furnished with each instrument ..... \$ 10.00



No. 1206.

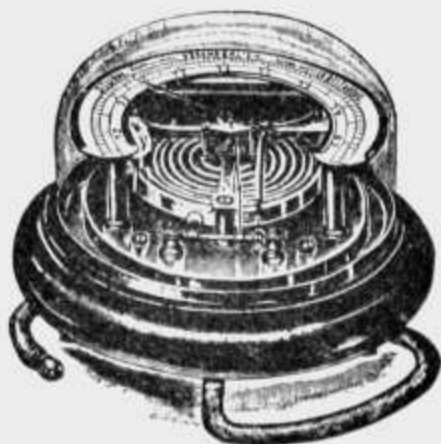
1206. **"Sling" Psychrometer or Hygrometer**, designed for the purpose of obtaining quicker and more accurate results than are possible with the stationary wet and dry bulb instruments. Two special thermometers, carefully selected, are mounted on a nicely finished metal plate provided with a wooden handle and swivel, and a ring for suspending the instrument when not in use..... 5.00



No. 1209.

1209. **Wolpert's Air Tester (Carbacidometer)**, for obtaining the amount of carbonic acid gas in a room by direct readings from the graduations etched on the glass, thus doing away with all computations and tables as in the old forms. Another advantage of this form is that the air of a room may be secretly tested, if desired. Directions and full set of capsules for making test solutions furnished with each instrument ..... 3.75

1209A. **Extra Capsules for No. 1209.** Per dozen capsules (six of each reagent) .....Net 1.00



**No. 1210.**  
 1210. **Aneroid Barometer, Demonstration Form.** This is a very desirable and useful instrument which should be in every laboratory. By simply blowing in or drawing out the air by means of a rubber tube the effect of the atmospheric pressure upon a barometer is clearly demonstrated. This barometer is handsomely mounted and finished and makes a very accurate instrument to hang up in the



schoolroom for daily barometric observations..... \$ 13.35  
**No. 1211.**  
 1211. **Aneroid Barometer, Sea Level Reading Type, with rearranged Weather Marks.** This instrument is arranged in such a manner that it is suitable for use in any location from sea level to 3,500 feet elevation. The adjustment is very simple and no derangement of the working parts is necessary. Once adjusted for a given location by the observer, no further adjustment is required. A list showing altitudes of Meteorological Stations in the United States is furnished with each barometer.

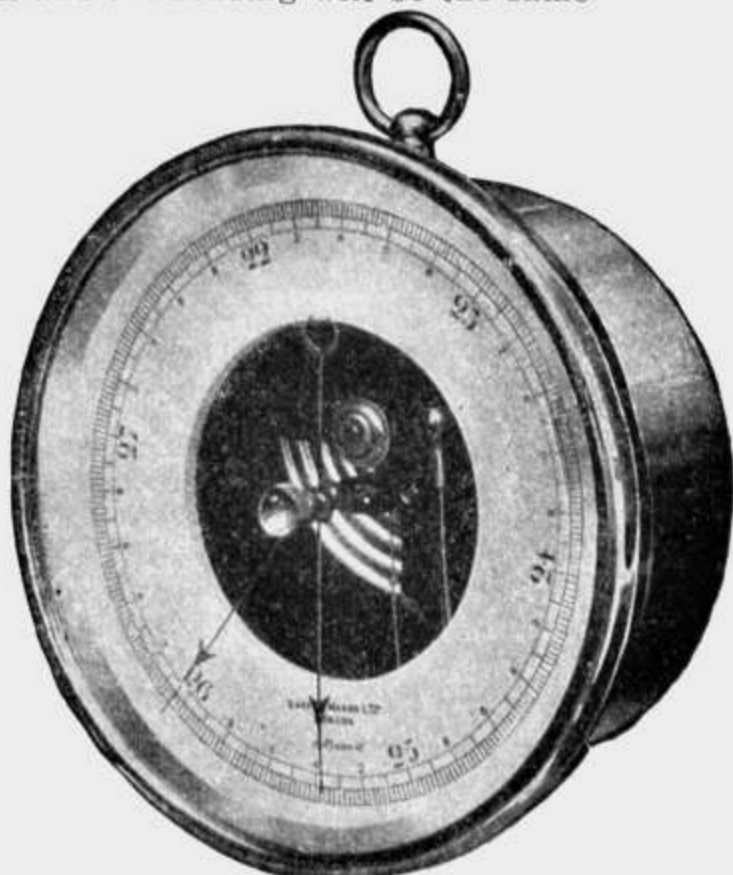
To adjust the barometer for altitude for a given city, town or location, turn the brass plate set in the back of the case (this is easily done with the fingers) until the number of feet corresponding to the elevation of the city or town is opposite the arrow. The hand will then point to the proper weather mark and the reading will be the same as that of the U. S. Weather Bureau, which is Sea Level Reading.

Spun brass case, porcelain dial, 5 inches in diameter; adjustable stationary hand for marking the last position of the movable hand ..... 11.00

1211A. **Aneroid Barometer.** Same as No. 1211, but with metal silvered dial and first quality compensated movement ..... 16.65

1212. **Aneroid Barometer,** for use in altitudes between 4,900 and 9,500 feet. 5 inch brass case, open porcelain dial, visible works... 10.30

1212A. **Aneroid Barometer.** Same as No. 1212, but for altitudes between 2,900 and 7,100 feet.. 10.30



**No. 1212.**



No. 1212B.



No. 1213.

1212B. **Aneroid Barometer**, as adopted by the United States Navy. A brass case barometer of extra quality, with specially finished movement compensated for temperature, and silvered open metal dial graduated to 0.02 inches. For altitudes up to 3,500 feet. The best barometer of this style on the market..... \$ 16.65

1213. **Aneroid Barometer**, 4 inches in diameter. The mechanism is mounted in a highly polished copper case and is in full view. The graduations read in both English and metric systems. For altitudes up to 3,000 feet..... 6.65

1214. **Aneroid Barometer**, 4 inch card dial, open face, nickel plated case. Graduations in both English and metric systems. For altitudes up to 3,000 feet ..... 3.00

1215. **Aneroid Barometer**, pocket mountain type, watch case form, 1 3/4 inches in diameter, first quality, compensated for temperature, silvered metal dial, revolving altitude scale, 3,000 feet, in gilt case. Inclosed in neat morocco case .....Net 16.00

1217. **Aneroid Barometer**, same as No. 1215, reading to 10,000 feet.....Net 15.00

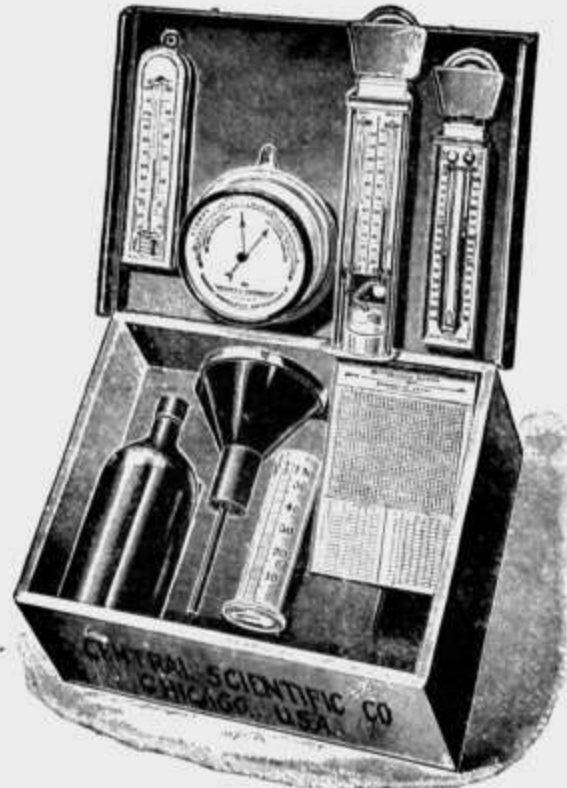
1218. **Aneroid Barometer**, same as No. 1215, reading to 16,000 feet.....Net 18.00



No. 1217.



No. 1219.

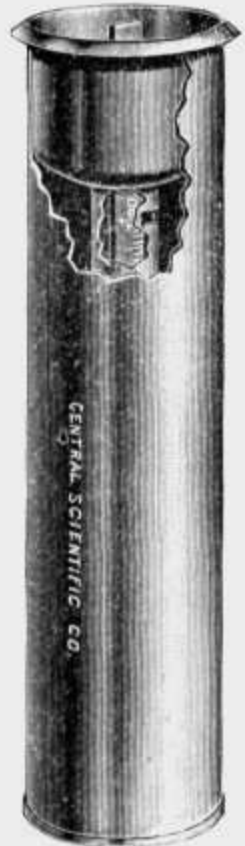


No. 1220.

1219. **Surveying Aneroid**, especially designed and constructed for the purpose of readily ascertaining slight variations in gradients, levels, etc. Besides extreme sensitiveness, the specialty claimed for this instrument is an arrangement of the scale of altitudes which admits of subdivisions by a vernier. Compensated for temperature changes and reads to single feet of altitude scale. 3 inch bronze metal case, silvered metal dial, with vernier scale moved by rackwork motion, reading lens arranged to traverse the entire circle, altitude scale 6,000 feet, in solid leather sling case.....Duty free \$ 40.00
1220. **Universal Meteorological Set**, a complete set of meteorological instruments suitable for a beginner, and of such a quality as to give entire satisfaction. The set comprises a 5 inch metal case aneroid barometer, 8 inch thermometer with F. and C. scales, 8 inch maximum and minimum (Six's) thermometer with magnet, 8 inch Mason's wet and dry bulb hygrometer, 5 inch Howard rain gauge, and a calendar for keeping a record of the instruments in the set. Packed in neatly finished box ..... 16.65
1221. **Weather Forecast Chart, or Key to Barometer Reading, and Chart for Aneroid Barometer**, by J. Benj. F. Rawson, late of the Weather Bureau. This chart is intended as an aid in the intelligent interpretation of barometer readings and in forecasting weather for twenty-four hours. By a comparison of outside air temperature and the direction of the wind at 30 inch readings, with temperature and wind reference given on the chart, one can know the nature of a coming change of weather, also the general location of centers of areas of high and low pressure and the rapidity with which the pressure areas travel, which will be indicated by the rate of change of the barometer. High pressure areas read above, while low pressures read below, 30 inches. This chart will be found quite accurate and most useful in any science laboratory. Full directions on each chart. Each ..... .50
- 1221A. **"Weather and Weather Instruments."** Many teachers have written us for information regarding the management and use of weather instruments. This book contains the most complete information of any book or books of which we have knowledge. It describes the mechanism of the many instruments and in addition gives in concrete and simplified form the practical uses of the different instruments. The tables of classified data recommend it particularly to teachers. Pasteboard covers..... .50
- 1221B. **"Weather and Weather Instruments,"** same as above, cloth covers... 1.10

1222. **Rain Gauge**, United States Weather Bureau type. A zinc vessel 3 inches in diameter by 13 inches long, in the top of which is placed a copper cup having an open top exactly 3 inches in diameter with sharp edge and projecting rim. The bottom of this copper cup is open and fits in the top of a brass tube 1 inch in diameter in which the amount of rain is measured. This tube is provided with an overflow opening and a wood rule graduated for reading the rainfall directly to 1/100th of an inch .....\$ 2.75

1222A. **Rain Gauge**. United States Weather Bureau standard rain gauge. Similar to No. 1222 but 8 inches in diameter, with measuring stick..... 6.65

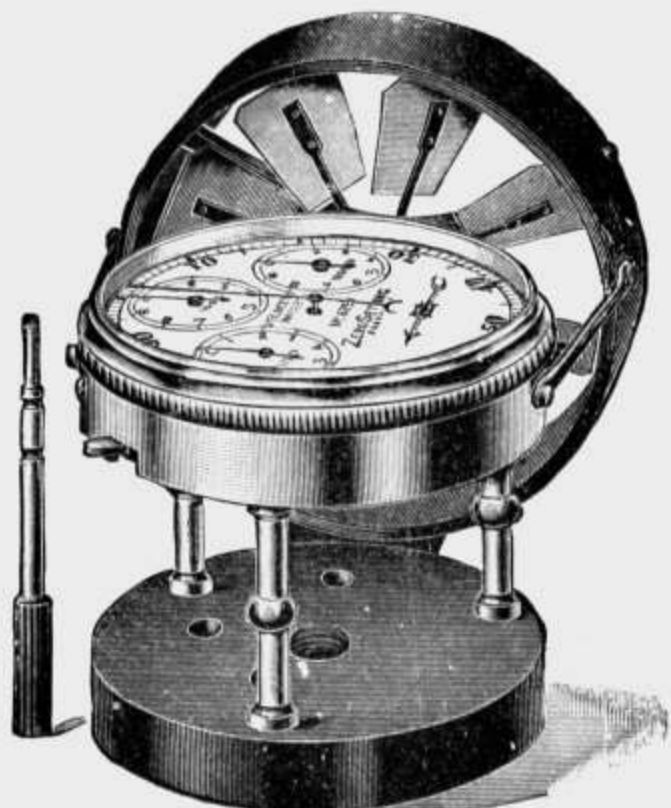


No. 1222.



No. 1222B.

1222B. **Registering Rain Gauge**, "tilting bucket" type. The rain is collected in an 8-inch receiver, taken through a small pipe and dropped into one side of a bucket. When 1/100 inch of rain has collected in the bucket, the weight of the rain causes it to overbalance, and by a mechanical arrangement the hand moves 1/100 on the dial. The rain is then collected in the opposite bucket, and when that has received the same amount the above operation is repeated. This rain gauge has the great advantage of being zero-setting and is, therefore, particularly useful when a record of rainfall by the month or week is desired, as by the zero setting device no calculation is necessary. The large dial registers 1 inch by 100ths. The small dial reads to 12 inches. In copper case 10x8 inches..... 25.00



No. 1223.



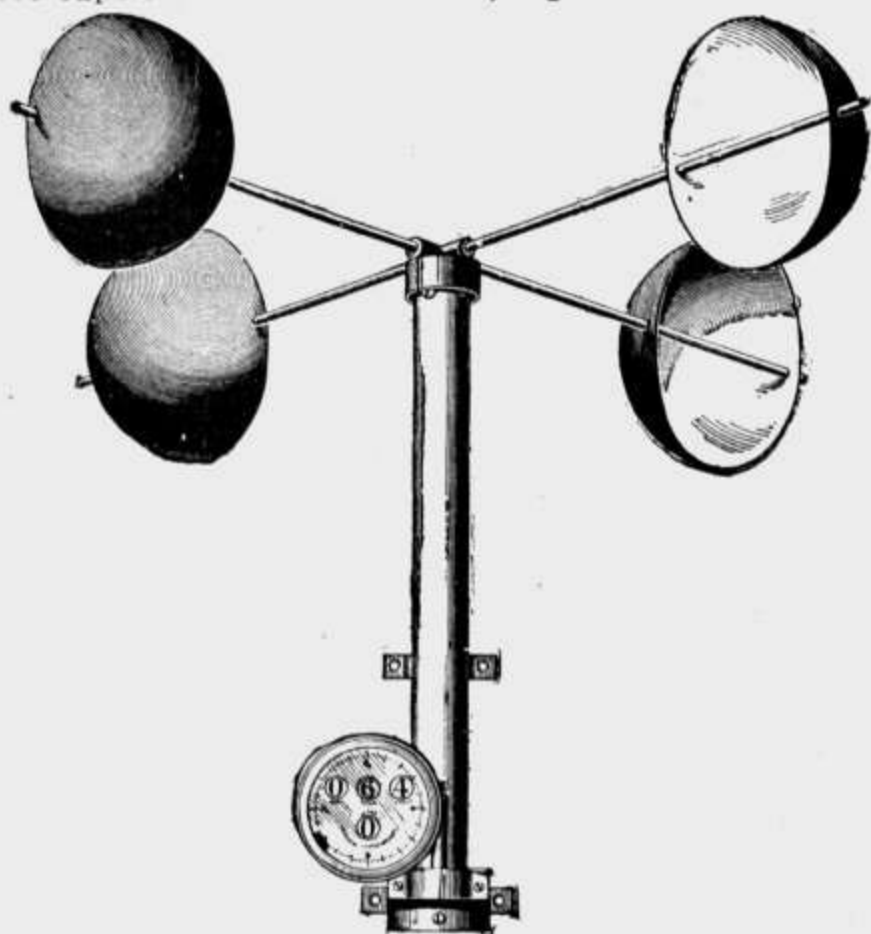
No. 1225.

1223. **Anemometer**, portable form, for measuring velocities of air currents in buildings, etc. Indications are obtained by means of a delicately poised fan wheel  $2\frac{3}{4}$  inches in diameter. The long hand indicates on the outer circumference of the main dial the passage of 100 feet or less of air. The readings are continued up to 100,000 feet by a series of smaller dials, as shown in the illustration. Complete with jointed socket holder, zero setting device and disconnecter, in leather case .....Net. \$ 22.50
1225. **Anemometer**, Biram's, 4 inches in diameter, four dials reading to 100,000 feet, complete with zero setting device and disconnecter, in leather case .....Net. 21.00

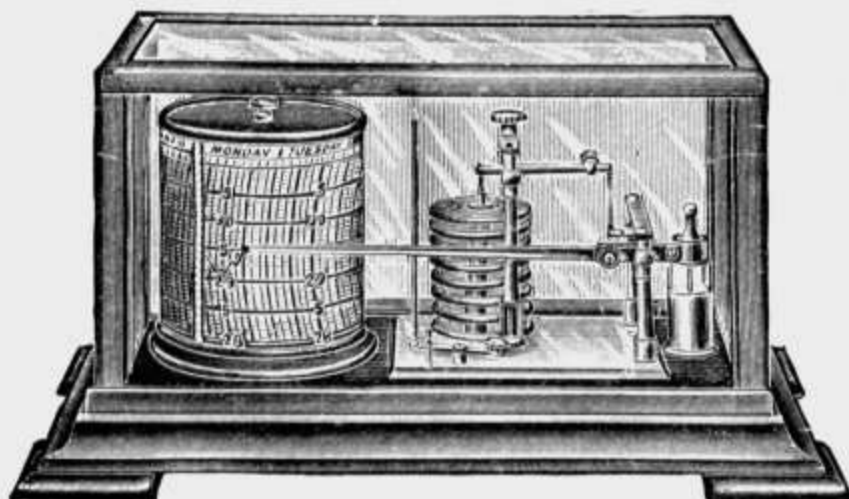
1227. **Wind Gauge or Anemometer**. This simple device for indicating the velocity of the wind in miles consists of a vertical shaft, to the upper end of which are fastened four arms, each carrying a Robinson hemispherical copper cup. These cups turn in one direction, regardless of the direction of the wind, and at a ratio determined by experiment. To the lower end of the shaft is rigidly fastened a plate carrying two small roller bearings, which, as the shaft revolves, actuate a wheel, which in turn meshes into a series of other wheels; thus the miles are indicated on the registering dial. The dial is so divided as to show velocities from one hundredth of a mile to 10,000 miles, and then it repeats, commencing at zero.

This instrument is carefully made and requires no care or attention, save a little oiling, say once a month. All parts are interchangeable.

Each instrument is standardized and fully warranted; weight,  $3\frac{1}{2}$  lbs. ....Net. \$ 26.75

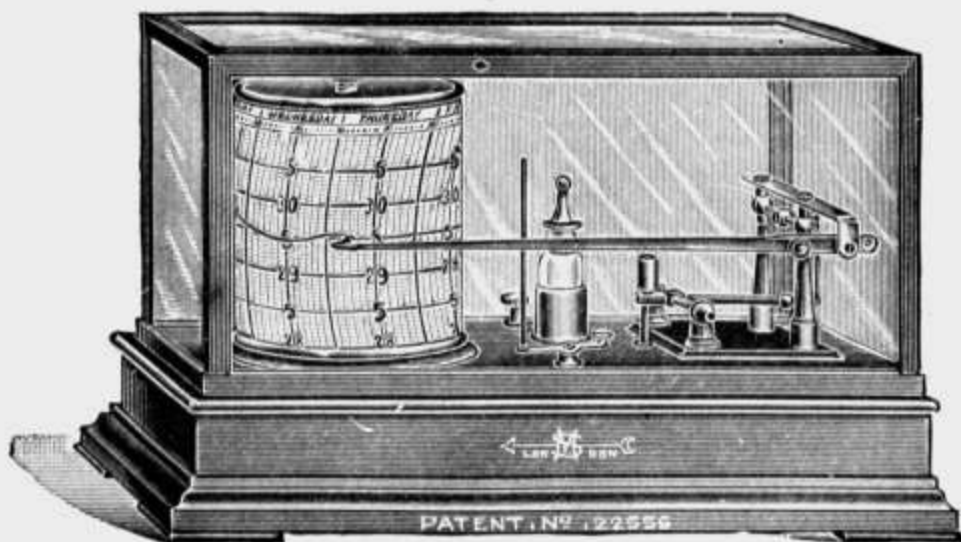


No. 1227.



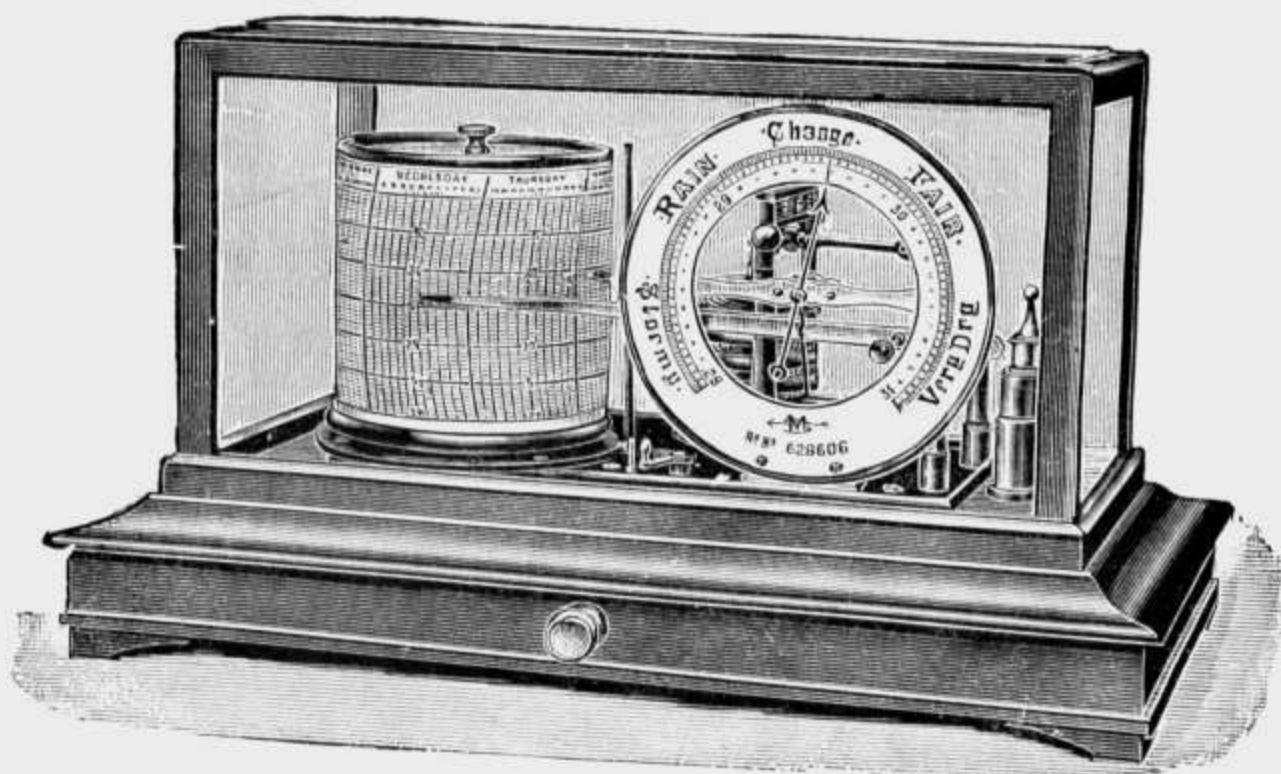
No. 1229.

1229. **Barograph (Recording Barometer)**, a most interesting instrument to those who take note of atmospheric variations, as a complete record is given by a pen upon a printed chart for an entire week, and, by its form, the exact barometric reading can be seen at any moment, as well as the varying line traced by the pen for the time preceding. The charts, which are changed at the beginning of each week, can be retained as a record for the entire year. The mechanism consists of a series of vacuum chambers, eight in number, joined to each other. The movement of pen is magnified by a series of levers. Chart reading 28 to 31 inches is held on a drum driven by eight day clock movement. Mahogany frame with glass case. Complete with full directions for use, charts for a year, pen and ink...Duty free \$ 30.00
- 1229A. **Barograph**, same as No. 1229, but in copper case, glass front and end, with handle. Cover hinged at end. Complete with directions for use, charts for a year, pen and ink.....Duty free 33.00
- 1229B. **Barograph**, same as No. 1229, but for use in high altitudes. Unfigured charts are supplied graduated for a range of 3 inches, the numbers to be written in by the user. In ordering specify in what altitude the instrument is to be used.....Duty free 32.50



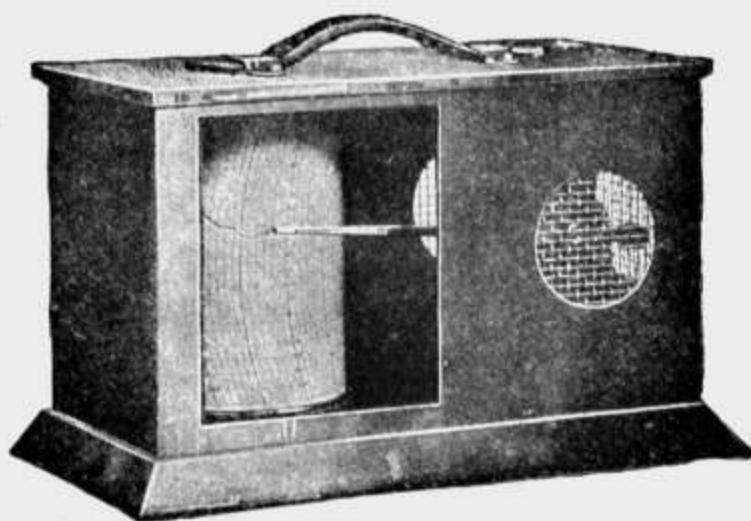
No. 1230.

1230. **Barograph**, same as No. 1229, but of new design. The movement is worked by a large vacuum pan concealed in the base of the instrument. In fumed oak case, glass top and sides. Complete with full directions for use, charts for a year, pen and ink.....Duty free 25.00  
**Certificate from Kew Observatory**, extra..... 7.50
- 1230A. **Barograph Charts**, for barographs reading 28 to 31 inches. Per box containing one year's supply..... 2.00
- 1230B. **Barograph Charts**, unfigured, but graduated for a 3 inch range. For use with No. 1229B Barograph, the numbering being done by the user. Per box containing one year's supply..... 2.00



No. 1231.

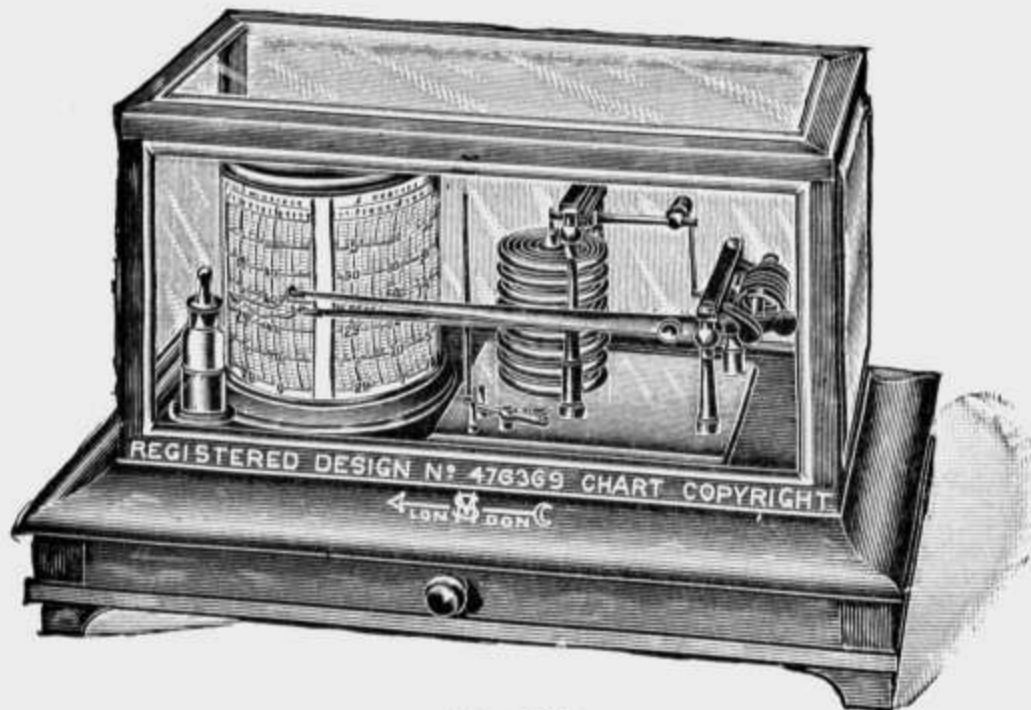
1231. **Barograph.** The illustrated instrument shows No. 1229 Barograph (with drawer) with metal dial aneroid attachment. For range and description of movement see No. 1229.....Duty free \$ 40.00



No. 1232.

1232. **Thermograph (Recording Thermometer).** A most accurate thermometer which will not vary its standard for years. A complete record is given by a pen upon a printed chart for an entire week, and by its form an exact thermometric reading can be seen at any moment, as well as the varying line traced by the pen for the time preceding. The charts are changed at the beginning of each week and can be retained as a record for the entire year. Mechanism consists of a spiral lamina of non-rusting material, which is exposed to the atmosphere at the end of the case. It is extremely sensitive and, having no levers in its construction, is very rigid. In copper case, with glass front and screened openings on three sides about the lamina. With handle. Range -62 to +128 degrees F. Complete with full directions for use, charts for one year, pen and ink.....Duty free 28.00  
**Certificate from Kew Observatory, extra..... 7.50**  
 1232A. **Thermograph Charts**, for use with No. 1232, per box containing a year's supply. (Style No. 46)..... 2.50  
 1232B. **Thermograph Charts**, for use with low drum thermographs. (Style No. 37)..... 2.25





No. 1234.

1234. **Baro-Thermograph (Recording Barometer and Thermometer Combined)**, a recent improvement whereby both barometric and thermometric tracings are made on the same chart, records being made by two pens in different colored inks (blue for the barograph and green for the thermograph). Range of the barograph is from 28 to 31 inches, while the thermograph shows a range of 0 to 120 degrees F. in 2 degree lines. In Mahogany case, with glass sides and top . . . . .Duty free \$ 50 00
- 1234A. **Baro-Thermograph Charts**, for use with No. 1234, per box containing one year's supply . . . . . 2 50



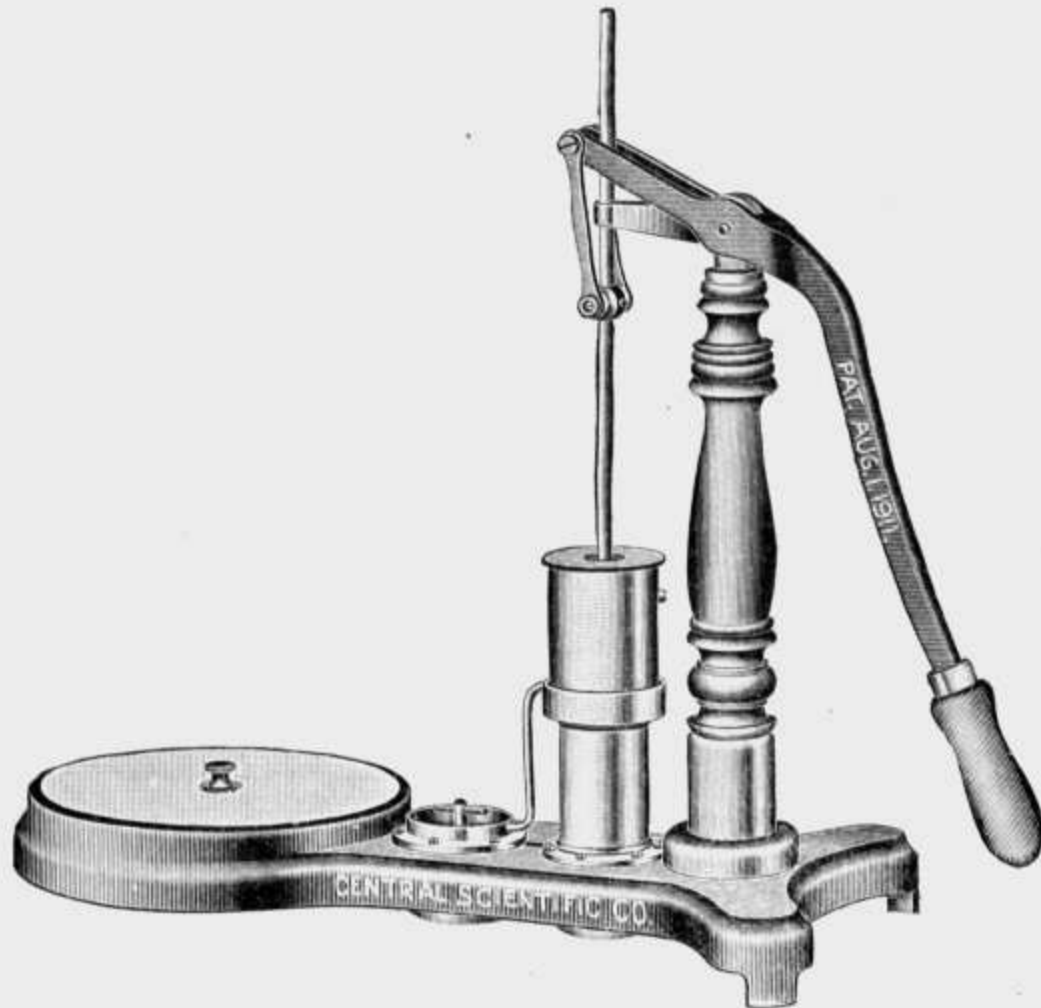
No. 1235.



No. 1236.

1235. **Shelter.** The latest pattern Weather Bureau Instrument Shelter. Sufficiently large to hold Barograph or Thermograph and the two instruments shown in the cut. Made of best quality white pine wood, painted three coats lead paint, swing door provided with lock and key. Complete with screws for mounting. Shipped "knocked down" . . . . .Net 20 00
1236. **Sunshine Recorder.** This instrument records the duration and intensity of sunshine for twenty-four hours on a specially prepared photographic chart, which merely requires washing in cold water to become permanent. The chart being divided into hours, an exact record is thus obtained with the minimum of trouble. Complete with divided arc for adjustment of instrument to any latitude, with 100 charts and directions for use . . . . .Duty Free 15 00
- 1236A. **Extra Charts for Above**, per 100 . . . . . 3 35
1238. **Ink, purple**, for Barographs and Thermographs. Per ounce bottle . . . . . 50

**AIR PUMPS AND ACCESSORIES.**



No. 1300.

1290-6. **Rotary Mercury Air Pumps.** See Catalog K for description.

1300. **Air Pump, Automatic and Oil Sealed.** This laboratory air pump embodies the necessary features of a highly efficient pump, namely, automatic valve action and oil sealed connections and valves.

**Automatic Valve.** The automatic valve action is dependent wholly upon the mechanical operation of the lever and not on the receding air, which is incapable of opening the valve after a partial vacuum is secured.

**Oil Sealed.** Metal air cock and solder joints are not absolutely air tight, but become so when entirely surrounded with heavy oil. On this pump all joints, where leakage might occur, are sealed with oil.

**Quick Action.** The cylinder is 2½ inches diameter with 6 inch strokes, securing exhaustion much quicker than the Geryk and other pumps with small cylinders.

**Base.** The heavy cast iron base insures stability, and as it brings the working parts closer to the table it lightens the labor of using the pump.

**Plate.** The pump plate consists of a ground glass plate sealed into the base, with a smooth working surface of full 10 inches diameter, large enough for all bell jars.

**Vacuum.** We guarantee this pump to produce a vacuum within 1 mm. of perfect

		\$ 27.75
1302.	<b>Vacuum Wax.</b> The best preparation on the market for using on apparatus in connection with the Air Pump, especially where high vacua are desired. Will not injure the pump plate or apparatus. Will not harden and can therefore be easily removed. Superior to vaseline, tallow or heavy oil. Put up in 4 oz. jars. Each.....	.33
1303.	<b>Oil Can,</b> filled with fine sperm oil.....	.22
1303A.	<b>Pump Oil,</b> a high grade oil specially adapted for lubricating air pump cylinders and for use on oil sealed pumps such as No. 1300 above and the Geryk. Put up in ½ pint screw cap cans.....	.28
1304.	<b>Leather Washers,</b> as used on Air Pumps. Outside diameter, ⅞ inch; hole, ⅞ inch. Per dozen.....	.11



No. 1305.



No. 1307.

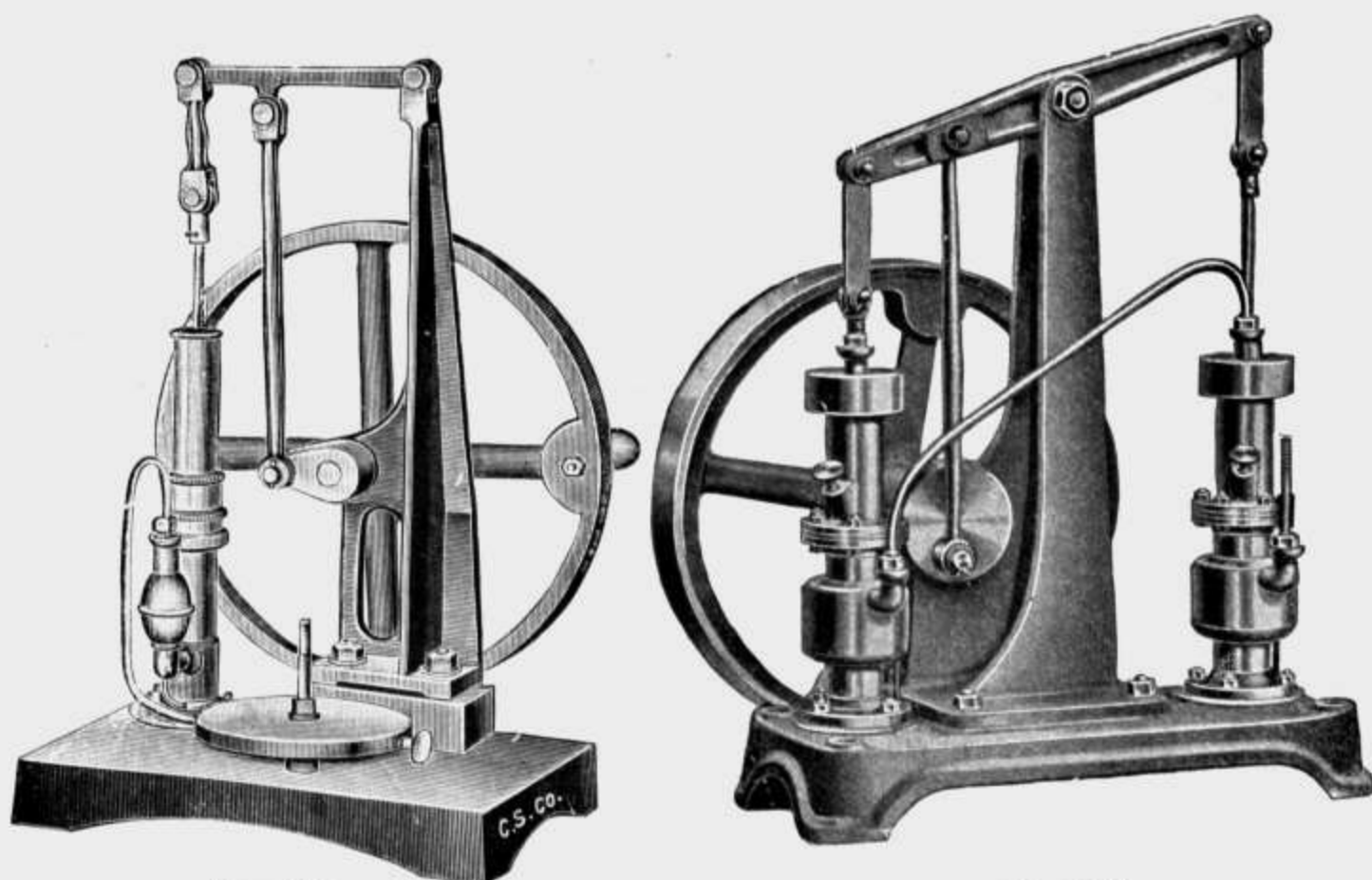
No. 1309.

- 1305. **Air Pump**, lever action, with two valves; polished brass cylinder,  $2\frac{1}{4}$  inches diameter, stroke  $6\frac{1}{2}$  inches; air pump plate of glass, 10 inches in diameter, ground plane and resting in a cast iron mold, with guard plug and vent screw; base and pillar of polished hardwood, mahogany finish..... \$ 19.50
- 1307. **Air Pump**, exhaustion and compression cylinder of brass. Useful in elementary work in the laboratory and where only a partial vacuum is desired. Cylinder is 11 inches long by 1 inch in diameter. Mounted on tripod base..... 3.60
- 1308. **Extra Valve** for No. 1307 Air Pump..... .05
- 1309. **Pump Plate** for No. 1307, of iron, 8 inches in diameter, cast in one piece to minimize danger of leakage. Ground plane and provided with brass stopcock and 2 feet of rubber compression tubing..... 4.45



No. 1309A.

- 1309A. **Pump Plate**, of heavy plate glass, 10 inches in diameter; ground plane and firmly cemented in a low form tripod base of iron. The base is cast in one piece to minimize danger of leakage and provided with brass stopcock and brass connecting tube with oil-sealed taps for inlet of air and for manometer. Finest workmanship throughout ..... 10.00
- 1309B. **Pump Plate**, same as No. 1309A, but without stopcock; specially adapted for use with Geryk Pump..... 9.00
- 1312. **Air Pump and Tank**, page 492.



Nos. 1315 and 1317.

No. 1321.

### “THE GERYK” MECHANICAL AIR PUMP FOR HIGH VACUA.

This is an English pump (Fleuss' patents) and is a strictly mechanical device with no valves in the usual sense of the word; the pistons work in oil, which continually follows and seals the inlets and outlets, so that leakage is impossible. There are no inside working parts to wear out, replace or adjust.

#### POINTS OF SUPERIORITY.

**Vacuum.** Equal to the Sprengel or Geissler pump.

**Efficiency.** Will hold its vacuum for any length of time—hence, may be worked as slowly as desired; the quantity of air removed at each stroke is positive.

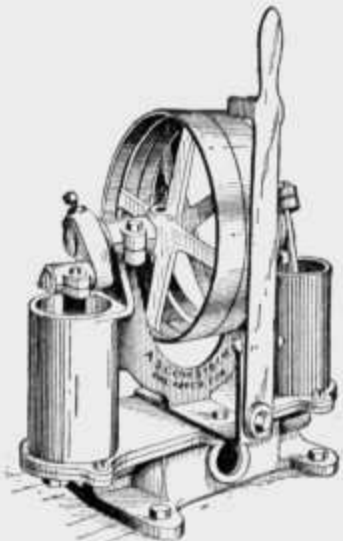
**Ease of Operation.** There being practically no friction, very little power is required.

**Rapidity.** At least fifty fold that of the mercury pumps and in largest sizes one hundred to five hundred fold.

**Reliability.** Always ready for immediate use, even after months of idleness.

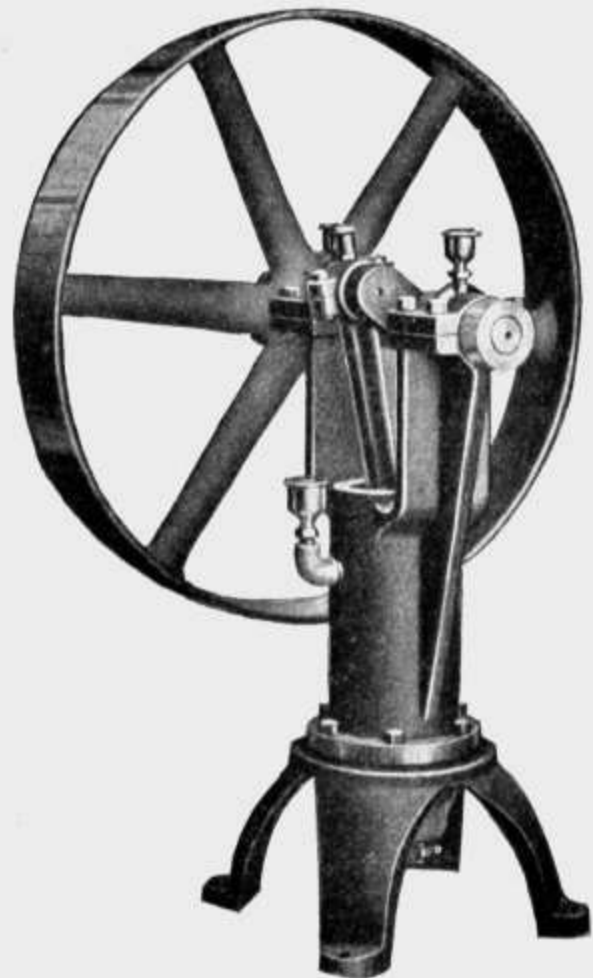
**Simplicity.** Nothing to go wrong; all working parts practically frictionless and immersed in oil.

- |   |          |
|---|----------|
| 1315. Geryk Pump No. 0. Furnished with 7 inch plate and vacuum gauge. With this pump all the ordinary phenomena can be produced. Guaranteed vacuum of 0.3 of a millimeter.....Duty free   | \$ 30 00 |
| 1316. Geryk Pump No. 1. For hard laboratory service. Has larger cylinder than No. 0 and hence is more rapid. Guaranteed vacuum of 0.14 of a millimeter.....Duty free  | 33 50    |
| 1317. Geryk Pump No. 1, with vacuum plate 8 inches in diameter. Duty free   | 40 00    |
| 1318. Geryk Pump No. 2, same as No. 1, but larger.....Duty free   | 48 60    |
| 1319. Geryk Pump No. 2, with vacuum plate 9 inches in diameter..Duty free   | 58 60    |
| 1320. Geryk Pump, Duplex No. 1. For research and industrial laboratories. Two 2 inch cylinders with 5 inch stroke.....Duty free   | 95 00    |
| 1321. Geryk Pump, Duplex A, same as Duplex No. 1, but with walking beam and connecting rod driven by flywheel, to be operated by motor of 1/8 H. P.....Duty free  | 120 00   |
| 1309B. Pump Plate of heavy plate glass, 10 inches in diameter, ground perfectly plane and provided with brass connecting tube, with oil sealed taps for inlet of air and for manometer. Specially adapted for Geryk Pump where the use of stopcocks is not advisable..... | 9 00     |



No. 1323.

1323. **Twin Cylinder Air Pump** for power. Bore of cylinders 2.5 inches, stroke 2 inches; to be run at speeds of 150 to 200 R. P. M. The pulleys are 8 inches in diameter for 1-inch belt. This pump should not be used for pressures over 15 pounds, in which case an efficiency is claimed of 30% above that of rotary blowers. Designed for fastening to floor or shelf. Furnished with shift lever for rapidly starting or stopping .....Net \$ 15.00

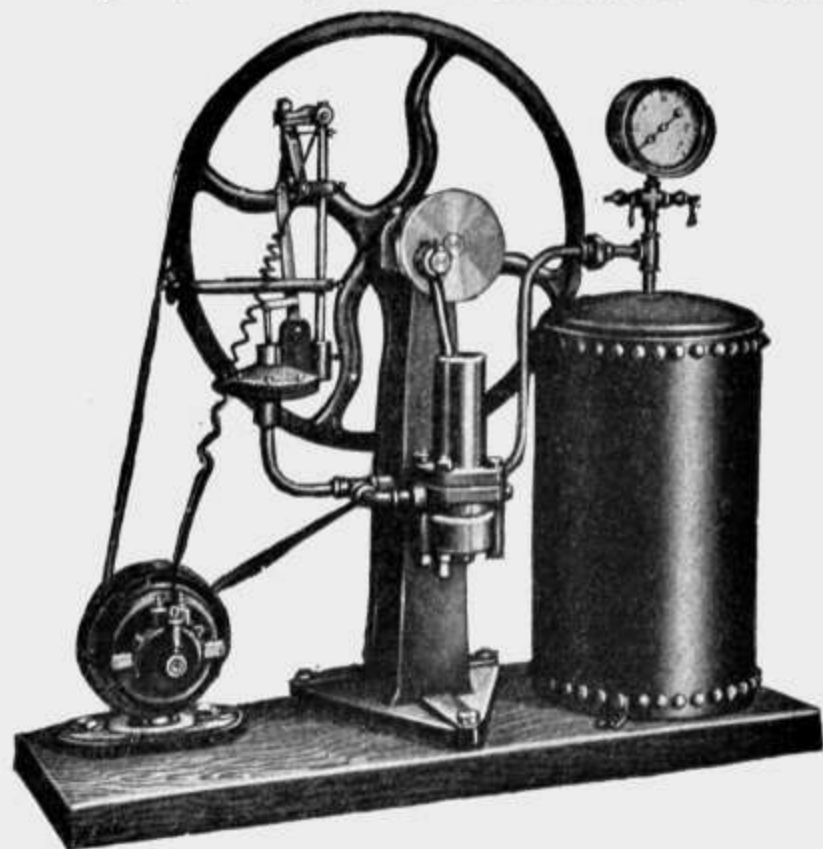


No. 1323B.

1323A. **Tank**, heavy galvanized iron, of 12 gallons capacity, with 50 pound pressure gauge; pet cock on upper end, and two 1/2-inch iron pipe size bushings in the side for making connections.....Net 7.00

1323B. **Exhaust and Compression Pump Combined**. Bore of cylinder 3 1/4 inches, stroke 4 inches. Capacity, 3.8 cubic feet at 200 R. P. M. against a pressure of 125 pounds. Pulley 20 inches in diameter, 3 inches wide. Height of pump over all, 28 1/2 inches; weight, 86 lbs. This will be found an excellent pump for any laboratory.....Net 45.00

1323C. **Automatic Electric Air Compressor and Exhaustion Pump Combined**, for pressures up to 40 pounds and vacuum up to 13 pounds; provided with switch for automatic starting and stopping of the motor at variations of pressure. This switch operates only when the pump is used for pressures and the tank is connected only with the pressure outlet of the pump. Suction is obtained by attaching a tube to a hose nipple at the base of the cylinder. The machine has a capacity of 1 1/2 cu. ft. of air at the normal speed of 200 R. P. M. Complete with 4-gallon tank and pressure gauge; 110-volt, series wound, D. C. motor of 1/8 H. P. Compactly mounted on one base, 10x30 inches....Net 57.00

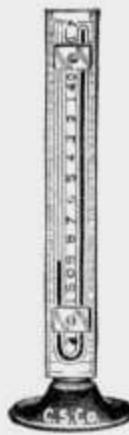


No. 1323C.

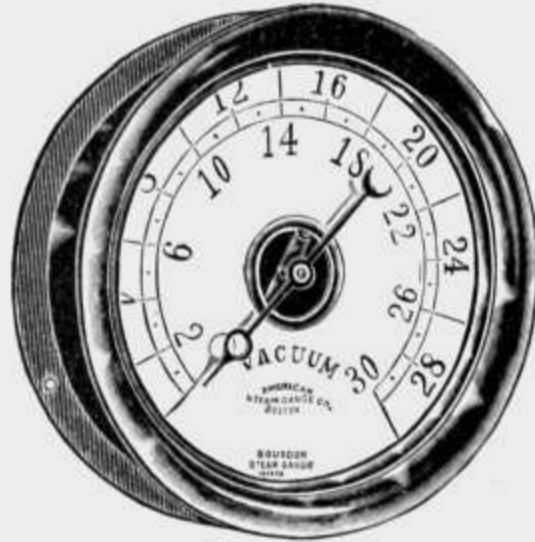
- 1323D. **Automatic Electric Air Compressor and Exhaustion Pump Combined.**  
Same as No. 1323C, but with 220 volt series wound D. C. motor of  $\frac{1}{8}$  H. P. ....Net \$ 59.00
- 1323E. **Automatic Electric Air Compressor and Exhaustion Pump Combined.**  
Same as No. 1323C, but with 110-115 volt 60 cycle A. C. motor of  $\frac{1}{8}$  H. P., complete with centrifugal clutch pulley, and self-starting up to 25 pounds pressure. ....Net 85.25



No. 1325.



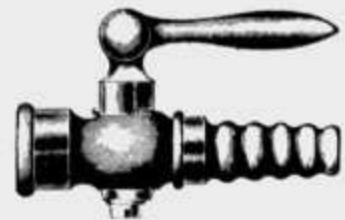
No. 1326.



No. 1327A

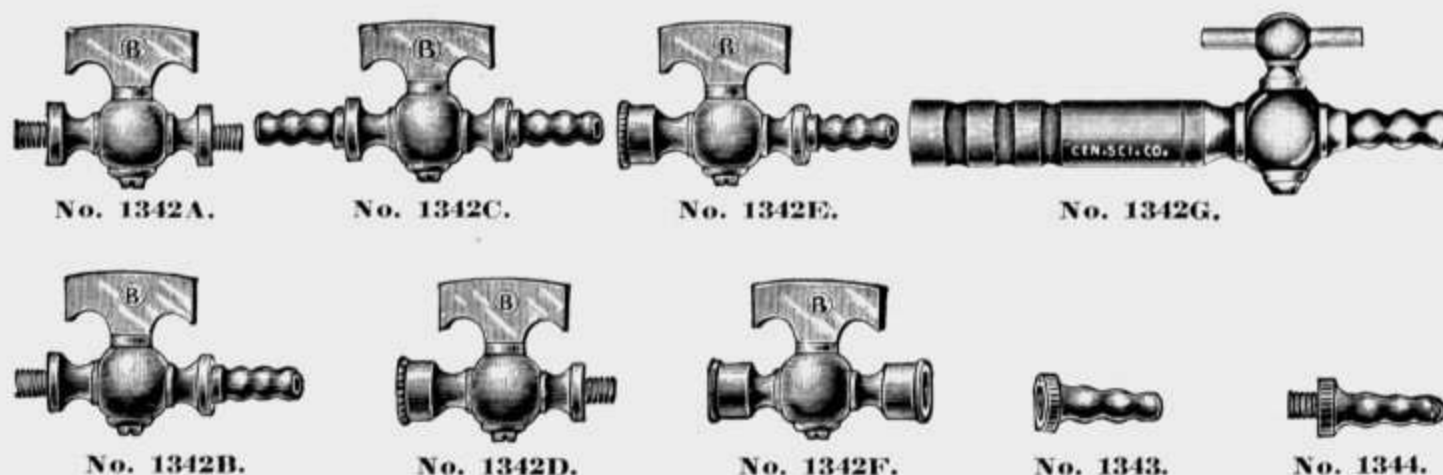
Nos. 1339, 1339A and 1339B. Gas Cocks, see page 493.

1325. **Vacuum Gauge (Manometer)**, for use with air pumps which are provided with a  $\frac{7}{16}$ -inch opening tapped with 16 threads to the inch. Enclosed in glass tube with oxidized scale graduated in millimeters. Filled with mercury, ready to attach to pump. .... 5.55
1326. **Vacuum Gauge.** To be used under a bell jar. Tube is mounted on a base with millimeter scale. Filled with mercury, ready for use. .... 1.40
1327. **Pressure Gauge**, commercial type, improved single spring form, for air, steam or water pressure; iron case with nickel plated trimming, 3 $\frac{1}{2}$ -inch dial, range 0 to 30 pounds per square inch. Provided with stopcock and nipple for attaching hose. .... 3.60
- 1327A. **Vacuum Gauge**, same type and description as No. 1327, range 0 to 30 inches ..... 3.60
- 1327B. **Compound Pressure and Vacuum Gauge**, combining Nos. 1327 and 1327A, showing both pressure and vacuum on one dial; 3 $\frac{1}{2}$ -inch dial, in iron case with nickel trimmings. .... 6.75
- 1327C. **Combination Pressure and Altitude Gauge**, especially valuable for work in hydraulics, for indicating the height and pounds pressure per square inch of water in pipe or reservoir. Provided with stopcock and nipple for attaching hose.  
To raise a column of mercury 2.04 inches or to raise a column of water 27.67 inches requires one pound pressure.  
Iron case with nickel trimming, 4 $\frac{1}{2}$ -in. dial, 0 to 30 lbs. and 0 to 70 ft. .... 7.00
1340. **Gas Cock**, of brass, nickel plated, with long taper hose end for  $\frac{1}{4}$  to  $\frac{3}{8}$  inch rubber tubing; male thread for attaching to gas pipe coupling. Not for water.  
Inside diameter of gas pipe....  $\frac{3}{8}$  in.       $\frac{1}{2}$  in.  
Size of thread..... $\frac{3}{8}$  in. I. P.     $\frac{1}{2}$  in. I. P.  
Each ..... .33                      .38
1341. **Gas Cock**, same as No. 1340, but with female thread for attaching to gas pipe.  
Inside diameter of gas pipe....  $\frac{3}{8}$  in.       $\frac{1}{2}$  in.  
Size of thread..... $\frac{3}{8}$  in. I. P.     $\frac{1}{2}$  in. I. P.  
Each ..... .33                      .38



No. 1341.

## STOP COCKS FOR AIR PUMPS.



The following stop cocks and nipples are accurately made of brass, polished and lacquered, and in order that they may be capable of the greatest service in the laboratory we have not threaded them for use with iron pipe fittings, but have used the same threads as are used on all our Air Pump plates and Air Pump accessories ( $\frac{7}{16}$  inch in diameter and 16 threads to the inch). Stop cocks are  $\frac{1}{8}$  inch bore; nipples,  $\frac{1}{4}$  inch bore.

1342A. Stop Cock, double male screw.....	\$	0.55
1342B. Stop Cock, one end for tubing, the other with male screw.....		.55
1342C. Stop Cock, both ends for tubing.....		.55
1342D. Stop Cock, one male and one female screw.....		.70
1342E. Stop Cock, one end for tubing, the other with female screw.....		.70
1342F. Stop Cock, both ends with female screws.....		.90
1342G. Stop Cock, with connector, $\frac{5}{8} \times 2\frac{1}{2}$ inches, for gas bags.....		.80
1343. Nipple, of brass, female screw.....		.20
1344. Nipple, of brass, male screw.....		.20

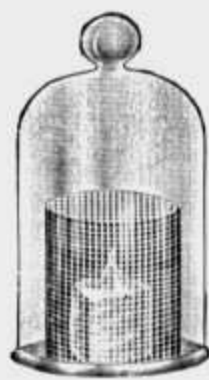
Glass Stop Cocks, see Nos. 5301 to 5309.



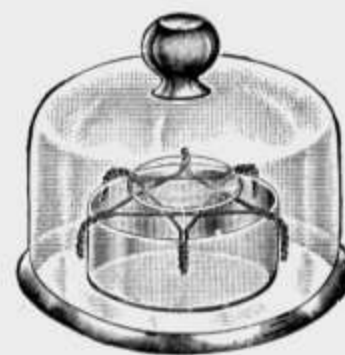
No. 1345.



No. 1347.



No. 1348-9.



No. 1350.

1345. Bell Glass, with Brass Cap, to receive stop cock or sliding rod. Sold without stop cock or rod. Capacity, 1 gallon.....	2.50
1346. Sliding Rod, with ball, hook and packing screw, for use with No. 1345.....	1.00
1347. Bell in Vacuo. A large glass bottle with rubber stopper and stop cock, and containing a small bell mounted on a flexible handle so that its vibrations are not transmitted to the bottle. Superior to the forms with electric bells, which we have discarded.....	2.75
1348. Bursting Cubes, to illustrate crushing effect of atmospheric pressure. Imported German glass, approximately 3x3x3 inches. Per dozen....	2.25
1349. Wire Guard, for use with No. 1348 to protect bell jar.....	.45
1350. Freezing Apparatus, illustrating freezing by the rapid evaporation of ether. Complete with No. 1381 Bell Glass.....	1.40
1351. Freezing Apparatus, same as No. 1350, without bell glass.....	.33



Nos. 1355-1360.



Nos. 1361-1364.



No. 1365.



Nos. 1367-1369.

**Bell Glasses, white glass, straight form with knob top, flange ground, reground and tested.**

<b>Number</b> .....	1355	1357	1359	1360
Diameter inside, inches.....	5	6	7	8½
Height inside, inches.....	9	11	15	15
Capacity, gallons .....	½	1	2	3
Each .....	\$0.95	1.20	1.65	2.25

**Bell Glasses, swelled form of clear white glass, knob top, flange ground, reground and tested.**

<b>Number</b> .....	1361	1363	1364
Diameter inside at bottom, inches.....	5	6	7
Height inside, inches.....	8	10	12
Capacity, gallons .....	½	1	2
Each .....	1.00	1.25	1.65

- 1365. **Bell Glass, straight form, clear white glass, top for No. 0 rubber stopper, flange ground and tested. Capacity, 1 gallon. Inside diameter, 6½ inches; height, 11 inches.....** \$ 1.25
- 1367. **Bell Glass, straight form, clear white glass, ground glass stopper, flange ground and tested. Capacity, ½ gallon. Inside diameter, 5 inches; height, 8 inches.....** 1.25
- 1369. **Bell Glass, same as No. 1367. Capacity, 1 gallon. Inside diameter, 6 inches; height, 10 inches.....** 1.50



No. 1370.



Nos. 1373-1377.



Nos. 1379-1383.



No. 1385.

- 1370. **Bell Glass, tall form, for use with a full length barometer tube in studying effect of reduced pressure on the barometric column .....** 3.00

**Bell Glasses, clear white glass, swelled form, open top, flange ground and tested.**

<b>Number</b> .....	1373	1375	1377
Diameter inside, inches.....	5	6	7
Height inside, inches.....	8	10	12
Capacity, gallons .....	½	1	2
Each .....	1.00	1.25	1.65

**Bell Glasses, clear white glass, low form, knob top, flange ground and tested.**

<b>Number</b> .....	1379	1381	1383
Diameter inside, inches.....	4	6	8
Height inside, inches.....	2¼	4	5
Each .....	.60	1.00	1.40

- 1385. **Hand and Bladder Glass, both flanges ground, medium size.....** 1.00
- 1387. **Glass Plate, 6x6 inches, ground to fit open top Bell Glasses above.....** .10
- 1389. **Rubber Dam, pure gum, per square foot.....** .33
- 1390. **Rubber Dam, pure gum, 36 inches wide, per linear foot.....** .95
- 1391. **Parchment Paper, vegetable, 18x24 inches, per sheet.....** .11
- 1392. **Parchment Paper, genuine animal product, 17x22 inches, per sheet...** 1.10
- 1393. **Bladder, prepared and clean, for bursting and covering bladder glasses** .11





No. 1403.



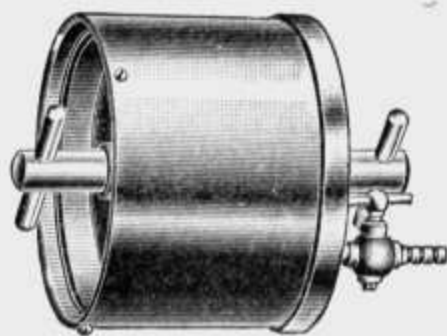
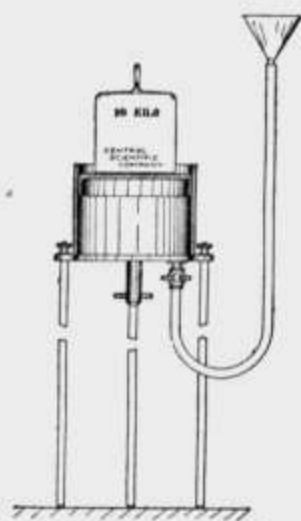
No. 1413.



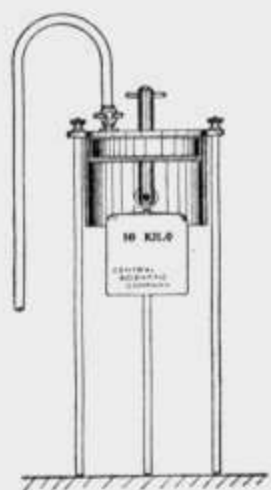
No. 1415.

1403. **Mercury Shower**, for illustrating the porosity of wood. Mercury is poured into a funnel, which is placed over a bladder glass as illustrated. Air pressure being removed from the bladder glass, mercury speedily seeks its way through invisible pores and drops into the glass cup. Without bladder glass or cup..... \$ 0.70
1413. **Magdeburg Hemispheres**, japanned iron, 4-inch, with handles and stopcock, mounted on round base for protection when not in use. Improved method of construction makes joint between hemispheres perfectly air tight ..... 3.35
1415. **Bacchus Illustration**. Two bottles connected by a bent glass tube. Air may be exhausted from one bottle, which causes the water in the other to be transferred, owing to the reduction of the atmospheric pressure ..... .50

See also No. 1081 Reaction Apparatus.

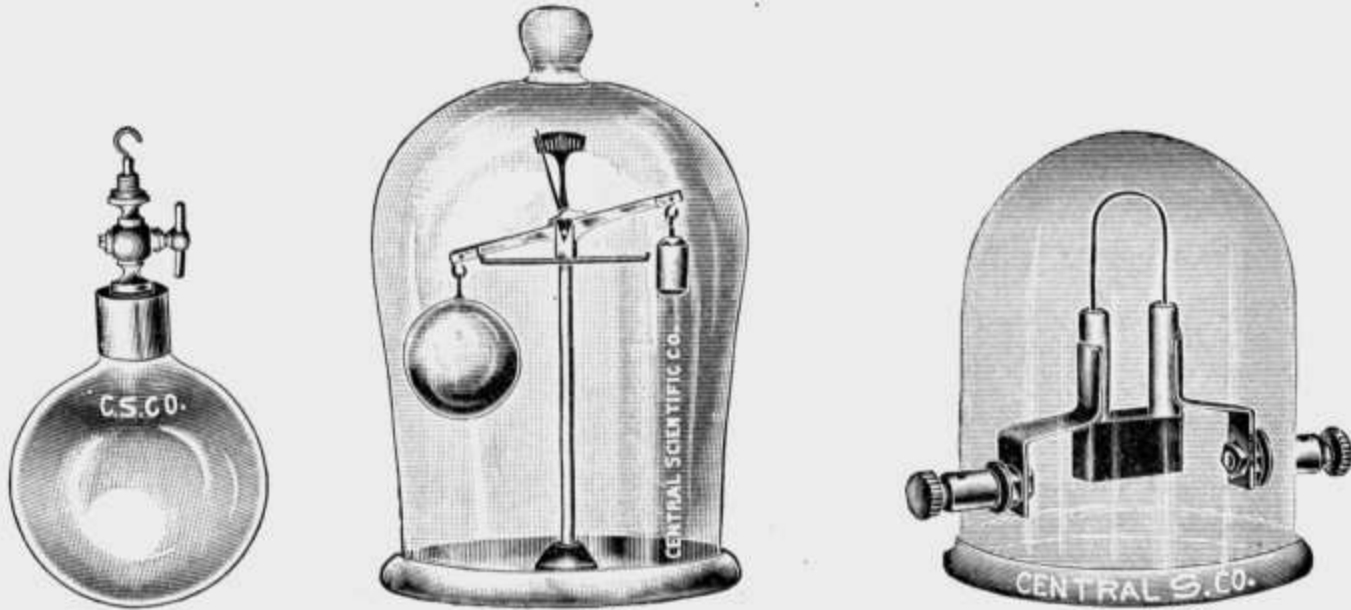


No. 1417.

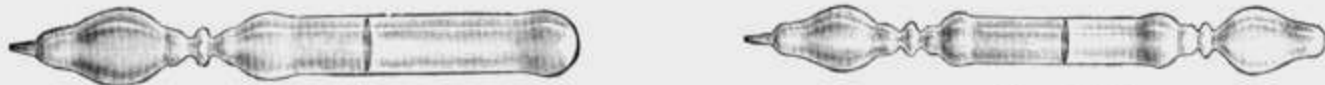


No. 1420.

1417. **Seven-in-One Apparatus (Spirometer)**. New form consists of the cylinder shown in the center illustration fitted with reversible legs which support it in either of the positions shown in the diagrams. The cylinder is of heavy seamless brass tubing, six inches in diameter, provided with a close-fitting piston so packed as to make it air and water tight. The handle on the piston is detachable for convenience in some experiments. In the position shown in the left-hand illustration the spirometer may be used as a Hydraulic Press, Hydrostatic Bellows, or a Pneumatic Lift (by blowing through the tube or by use of No. 1307 Air Pump). The right-hand diagram illustrates its use as an Upward Pressure Apparatus. May also be used as a substitute for the Magdeburg Hemispheres; to show approximately the equality of air pressure in all directions; to show the elasticity of air. Complete with reversible legs, rubber tube and funnel..... 7.75
1420. **Globe for Determining Weight of a Gas**. Air may be exhausted from globe by air pump and gas then introduced through tube connection and stopcock. Most convenient and practical form. Capacity of globe, about 1 liter..... 5.00



- No. 1421.
- No. 1424.
- No. 1426.
- 1421. **Weight of Air Globe**, of polished brass, 4 inches in diameter, with stop cock and removable hook..... \$ 2.50
- 1424. **Baroscope**. 4-inch hollow brass globe with counterpoise, mounted on a polished brass sensitive beam balance with brass support and stand. Complete with No. 1364 Bell Glass..... 8.30
- 1425. **Baroscope**, same as No. 1424, without Bell Glass..... 6.65
- 1426. **Demonstration Incandescent Lamp**, according to Prof. Hans Hartl. A heavy glass globe carefully ground to fit a'r pump plate, with two binding posts hermetically sealed into the sides, connected with two springs which hold a piece of ebonite, to which are attached two steel mercury cups. Without carbon filaments. (See below.)..... 3.50
- 1426B. **Carbon Filaments** to fit No. 1426, for 110 volts pressure. Per dozen... .17

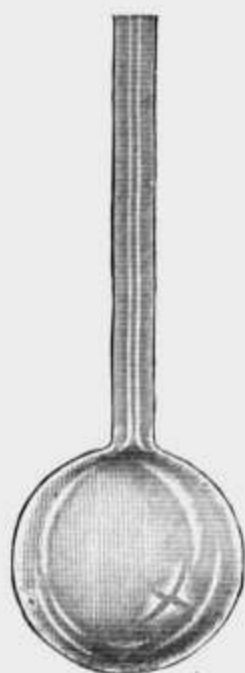


- No. 1427.
- No. 1429.
- 1427. **Water Hammer**, all glass, one bulb, length 25 centimeters. Illustrating that water enclosed in vacuum falls as if solid, and on striking the bottom of the glass tube, emits a click as if glass was struck with a solid substance..... .60
- 1429. **Water Hammer**, two bulb, extra quality. In addition to click emitted by No. 1427, will emit musical tones..... 1.10

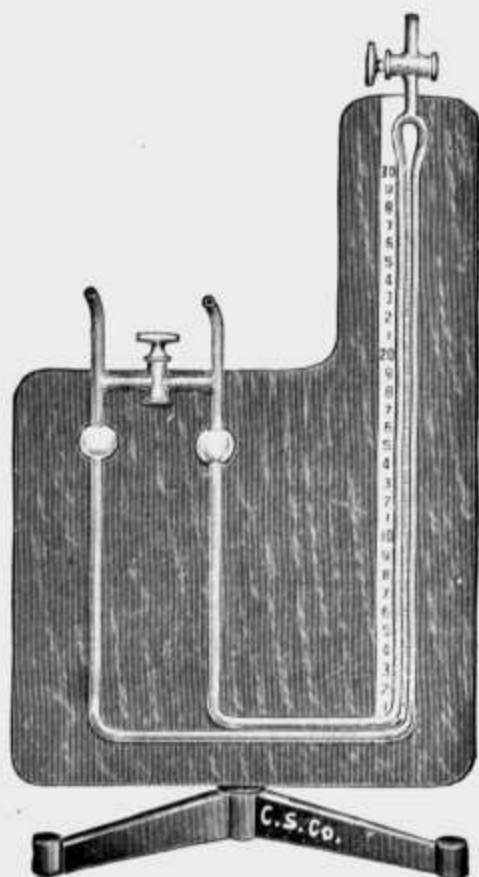


- No. 1435.
- 1435. **Guinea and Feather Tube, Aurora Tube and Fountain in Vacuo Tube** combined. Over 100 cm. long, with brass caps, one being removable so that the tube may easily be cleaned. Provided with brass stop cock with male thread for attaching to Air Pump. Can be used as follows:
  - (1) **Guinea and Feather Tube**. Exhaust air from tube, close stop cock and detach tube from pump. By rapidly inverting the tube, it may be shown that both the metal disc and the feather fall with the same velocity. If air is admitted, the metal disc falls the more rapidly.
  - (2) **Aurora Tube**. Exhaust air and connect metal knob and stop cock to the two terminals of a static machine or an induction coil.
  - (3) **Fountain in Vacuo**. Exhaust air and dip end having stop cock under water. Open stop cock and water will rush violently into the tube, rising the whole length of the tube.
 Complete with metal disc, feather and tripod support..... 5.50
- 1437. **Rubber Balloon**, pure gum, diameter about 2 inches..... .07
- 1439. **Rubber Balloon**, pure gum, diameter about 7 inches..... .65
- 1441. **Collodion Balloon**, for hydrogen, 1 liter capacity..... .75
- 4209. **Balloon**, 50 c.c., of glass, Dumas', for determining sp. gr. of vapors.. .28
- 4210. **Balloon**, of very thin glass, for weighing gases, with two tubes..... .83
- 4210A. **Balloon**, same as No. 4210, but with two glass stopcocks..... 2.10

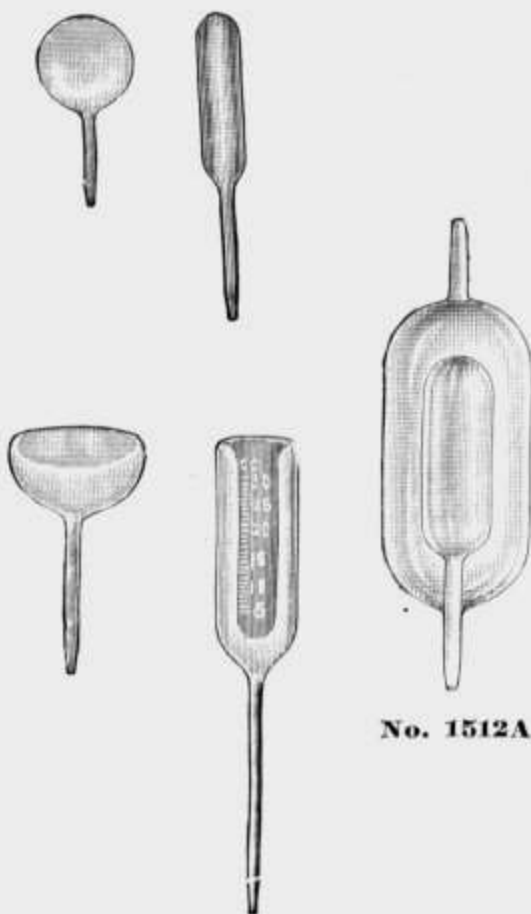
# HEAT



No. 1511.



No. 1512.



No. 1512A.

- 1509. Air Thermometer, of glass, 5 cm. bulb, 30 cm. stem..... \$ 0.17
- 1511. Air Thermometer, same as No. 1509, with capillary tube..... .25
- 1512. Rendtorff Thermoscope, for observing and measuring heat reactions, and comparing two sources of heat.

We publish and send with each thermoscope a manual descriptive of 97 different experiments possible with this instrument covering experiments in Mechanics and Thermal Changes, in Expansion and Compression, Absorption, Conductivity, Change of State, Specific Heat, Ebullition and Vapor Pressure, Radiant Heat, Electrical and Chemical Reactions, the majority of which may be quantitative.

Complete on standard with four accessory bulbs of different shapes as illustrated ..... 9.00

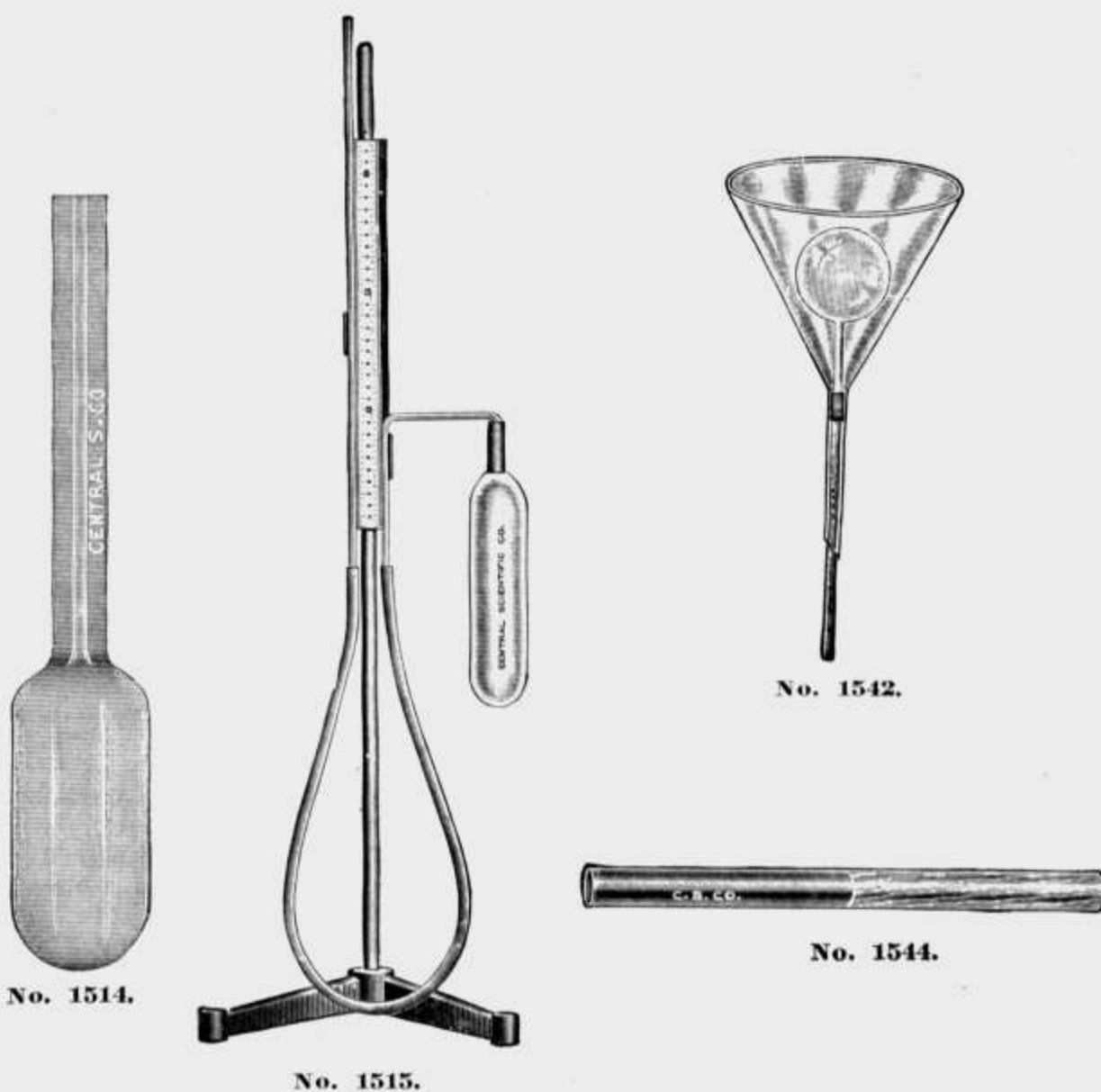
Note.—For convenient support for accessory bulbs use No. 5325 Tripod (Medium) and either No. 4711 Clamp or No. 4718 Clamp with holder No. 4725.

- 1512A. Double Bulb, 7 cm. in diameter, for use with No. 1512 to demonstrate the cooling of a gas by expansion, conductivity of gases, effects of the density of a gas on its conductivity and principle of the Dewar bulb and the Thermos bottle..... 2.75

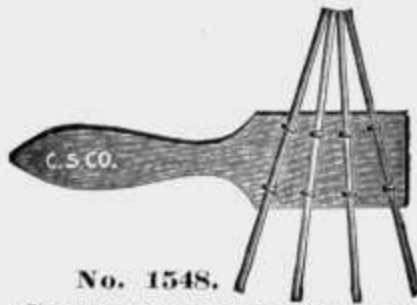
- 1513. Metallic Thermometer, Demonstration Form, with glass back to show the internal mechanism, which consists of a strip of two metals soldered together and connected with an index hand by a multiplying lever. Diameter 6 inches. Range, — 50 to 150 degrees F. 4.45



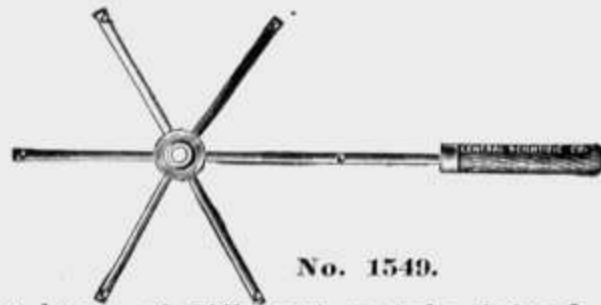
No. 1513.



- |        |   |         |
|--------|---|---------|
| 1514.  | <b>Weight Thermometer</b> (according to Ames and Bliss), for the determination of temperature by the weight of mercury overflow. Unfilled   | \$ 0.25 |
| 1515.  | <b>Air Thermometer.</b> To show expansion of air or of a gas, and to prove the laws governing expansion. The glass parts are attached to the sides of a scale graduated in millimeters which is adjustably clamped upon an upright rod with tripod base. Capacity of bulb about 175 c. c.....   | 3.00    |
| 1515B. | <b>Air Thermometer.</b> Same as No. 1515, without tripod or rod.....  | 1.65    |
| 1523.  | <b>Ungraduated Thermometers,</b> for student use in thermometry. White enameled back, stem for graduation from 0° to 100° C., filled with mercury, but with no graduations. Per dozen.....  | 6.00    |
|        | For House Thermometers see Nos. 1175 to 1179.   |         |
|        | For Chemical Thermometers see Nos. 5407 to 5411.  |         |
| 1542.  | <b>Conductivity of Water Apparatus.</b> Consists of No. 1509 Air Thermometer mounted in a funnel with the space between the funnel tube and the thermometer stem made watertight. When the funnel is filled with water to a small depth above the thermometer bulb and alcohol poured on the surface of the water and ignited, the heat fails to expand the water in the thermometer bulb, thus showing the non-conducting nature of water..... | .55     |
| 1544.  | <b>Conductivity Comparator,</b> consists of a wood cylinder and brass tube joined end to end. When paper is wrapped about the junction and held in a flame, the part of the paper around the wood burns; that around the brass does not burn, since the heat is so rapidly conducted away by the metal.....   | .45     |

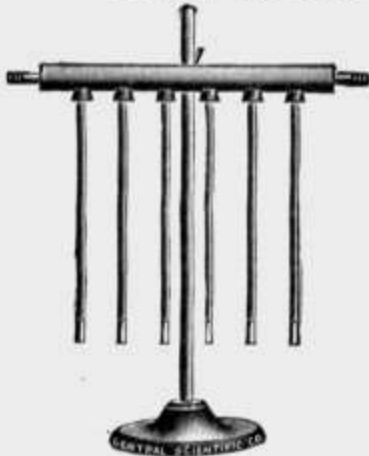


No. 1548.

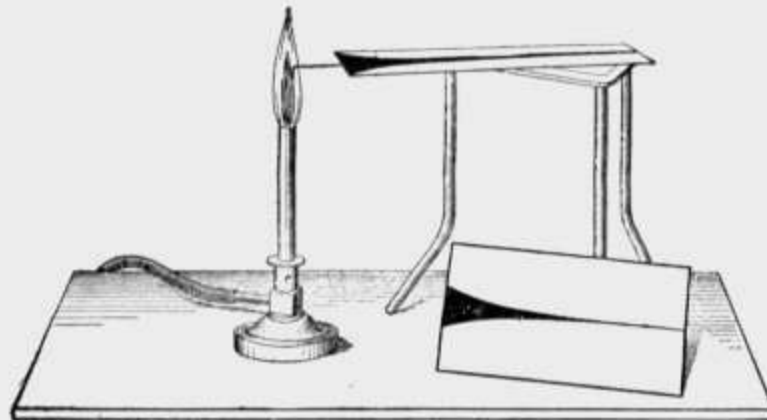


No. 1549.

1548. **Conductometer**, four wires 5.5 inches long, of different metals, joined at one end and fastened to a board with handle..... \$ 0.28
1549. **Conductometer**, consists of 6 rods of different metals extending from a common metal center, one of these rods being longer than the others and provided with a wooden handle. The rods each have a hollow for phosphorus at points equally distant from the center.... .90



No. 1550A.



No. 1550B (shown in use).

- 1550A. **Conductometer**. In this new conductometer rods of six different metals project downward from a metal tube in which their upper ends are inserted through rubber stoppers. The rods are coated with a special paint with the exception of a short distance at the lower end where the material of the rod is exposed to view. When steam is passed through the pipe through the inlet and outlet tubes at either end the progress of the heat conduction is shown in a very striking manner by a change of color which the paint undergoes when heated. Complete with support as illustrated..... 4.00

1550B. **Heat Indicating Paper**. A specially prepared paper which changes color when heated and hence is very valuable in experiments on Conductivity and Radiation of heat. It is so durable that drawings may be made on it in pencil and erased; and it may be used over and over again, since it almost immediately recovers its sensitiveness after use. The following are a few of the experiments in which it may be used.

1. Temperature gradient of a wire heated at one end.
2. Relative conductivities of both metallic and non-metallic substances.
3. Relative conductivity of wood along and across the grain.
4. To show that radiant heat travels in straight lines.
5. To show that radiant heat may be reflected and focused.
6. To determine absorptive powers of various substances.

Full directions for using this paper are given in pamphlet No. 1550C, the purchase of which is recommended.

Sheets 11x3½ inches, each 0.17. Per dozen..... 1.65

- 1550C. **"Heat Shadows,"** a pamphlet describing many experiments for the use of No. 1550B Heat Indicating Paper.....Net .35



No. 1551.



No. 1553.

1551. **Ball and Ring**, illustrating expansion of metals with application of heat. The ball when heated will not pass through the ring. Made of brass with hardwood handles..... 1.00
1553. **Compound Bar**, illustrating unequal expansion of metals. Made of steel and copper welded together by a special process so that rivets are unnecessary. Hardwood handle..... .55
1554. **Adjustable Thermostat**, page 493.



No. 1555.



No. 1556.

1555. **Pulse or Palm Glass**, two glass bulbs, with connecting tube, holding colored liquid in partial vacuum. One bulb warmed in palm of hand will transmit heat to the contained air and force the liquid into the other bulb ..... \$ .35

1556. **Ice Bomb**, bottle form. Made of iron with tight-fitting screw plug. When filled with water and put in freezing mixture, water freezes and expands, causing the bomb to burst ..... .55

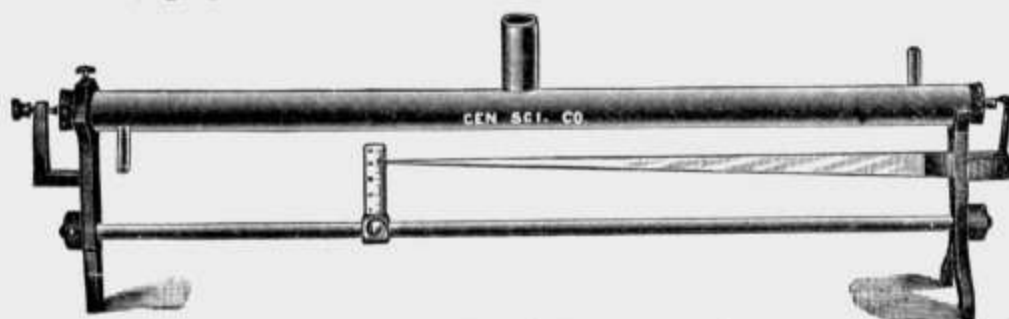
1557. **Cryophorus**, illustrating principle of freezing by rapid evaporation ..... 1.10

1558. **Candle Bomb**. Consists of glass bulb filled with water and sealed. Upon application of heat, steam is formed, which fills more space than water and causes the bomb to burst. Per dozen ..... .40

873. **Count Rumford's Experiment**, for boiling ether or alcohol by friction as suggested by Prof. Tyndall. With this apparatus ether or alcohol will, in a moment's time, boil sufficiently to blow a cork from the tube. For use with Rotator. (See illustration, page 85.) ..... 1.35

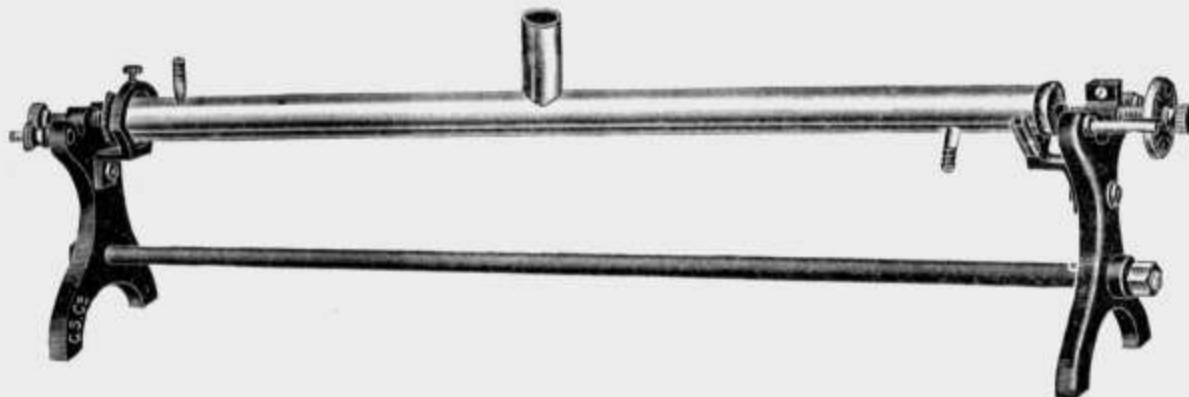


No. 1557.



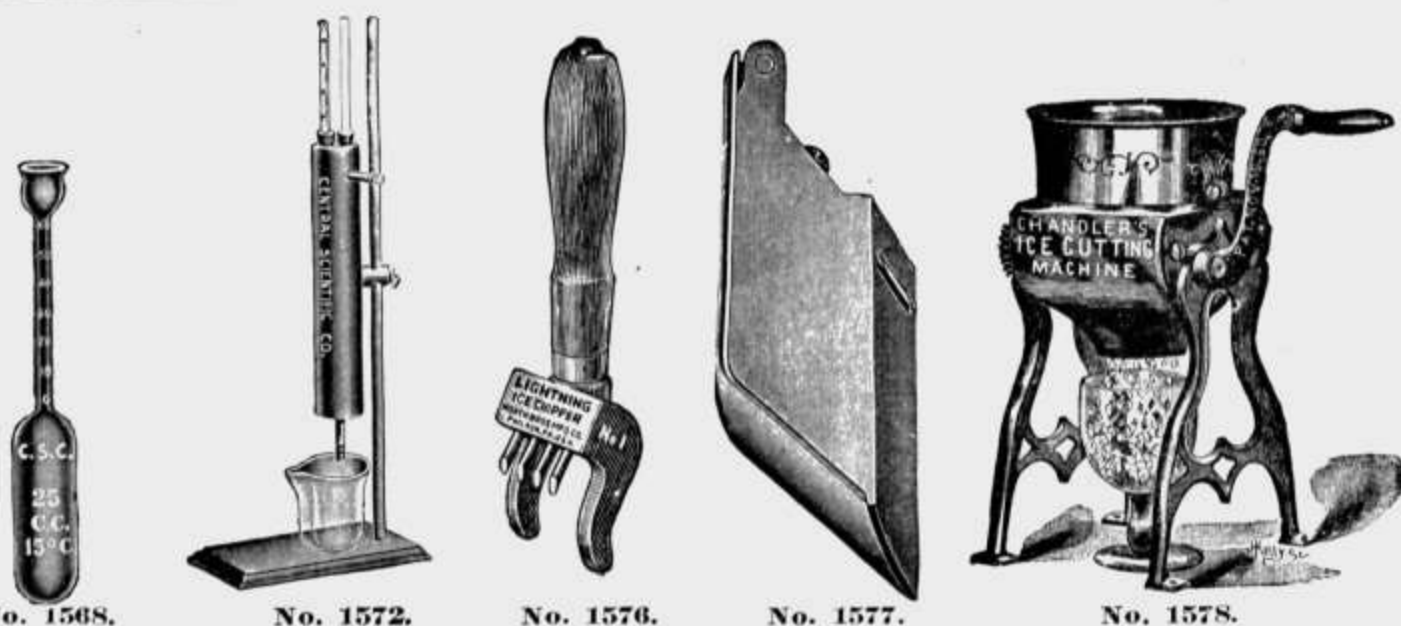
No. 1559.

1559. **Linear Expansion Apparatus**, lever form. Improved design, made entirely of metal. The steam jacket is a nickel plated brass tube with side tubes for inlet and outlet of steam and for thermometer. It is prevented from turning by means of a convenient clamping screw. Complete with steel rod 60 cm. long. .... 2.65

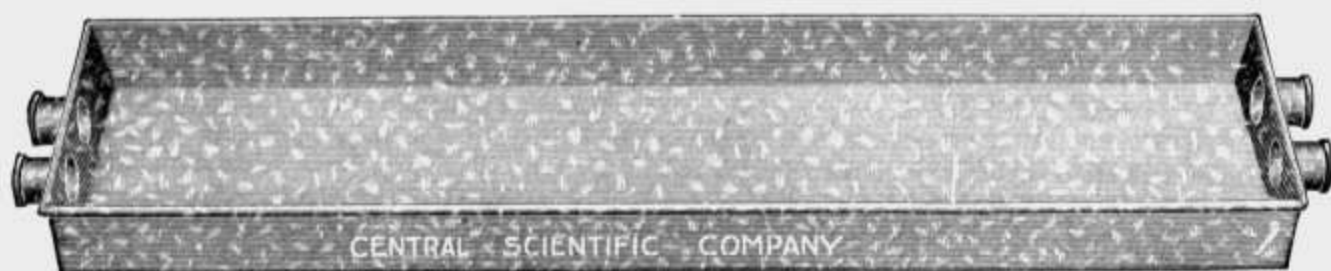


No. 1561.

1561. **Linear Expansion Apparatus**. Similar to No. 1559, but with a micrometer screw reading to .01 mm. instead of the lever device, and with binding posts for electrical connections, carefully insulated. Complete with 60 cm. steel rod and clamping screw. .... 4.50
- 1561A. **New Expansion Apparatus**, page 493.
1562. **Linear Expansion Apparatus**, vertical form. See Catalog K for description ..... 11.00
1563. **Aluminum Rod**, for No. 1559 or No. 1561. .... .20
1564. **Copper Rod**, for No. 1559 or No. 1561. .... .25
1565. **Brass Rod**, for No. 1559 or No. 1561. .... .20
1566. **Nickel-Alloy Rod**, expansion coefficient practically nil, for No. 1559 or No. 1561. .... 1.65
1567. **German Silver Rod**, of 18% German Silver, for No. 1559 or No. 1561... For Steam Generators, see Nos. 1586-7. .... .80



- 1568. **Cubical Expansion Apparatus**, for liquids. Consists of bulb of known volume, provided with capillary neck graduated in 100ths of c. c. The rise of the liquid in the neck is observed for a given rise in temperature ..... \$ 1.25
- 1572. **Expansion Apparatus, for fluids.** Nickel plated cylinder 4.5x25 cm., one end provided with outlet tube, the other end with three openings, for inlet tube, for thermometer, and for a glass tube closed at one end for receiving liquid to be tested. This tube is graduated in millimeters for 30 cm. Complete with support, but without thermometer and beaker..... 4.00
- 1576. **Ice Chipper**, for use in quickly chipping ice to small bits of a size convenient for calorimetric determinations. Tinned iron frame, wood handle ..... .67
- 1577. **Ice Shaver**, for shaving ice, coarse or fine, as may be desired; of tinned iron with removable steel cutter..... .40
- 1578. **Ice Cutting Machine.** Height 15 inches, weight 14 pounds. Hopper 4½x6 inches by about 4 inches deep. A compact, simple and strong machine which cuts ice into small diamond shaped pieces with ease and rapidity..... 8.50



No. 1579.

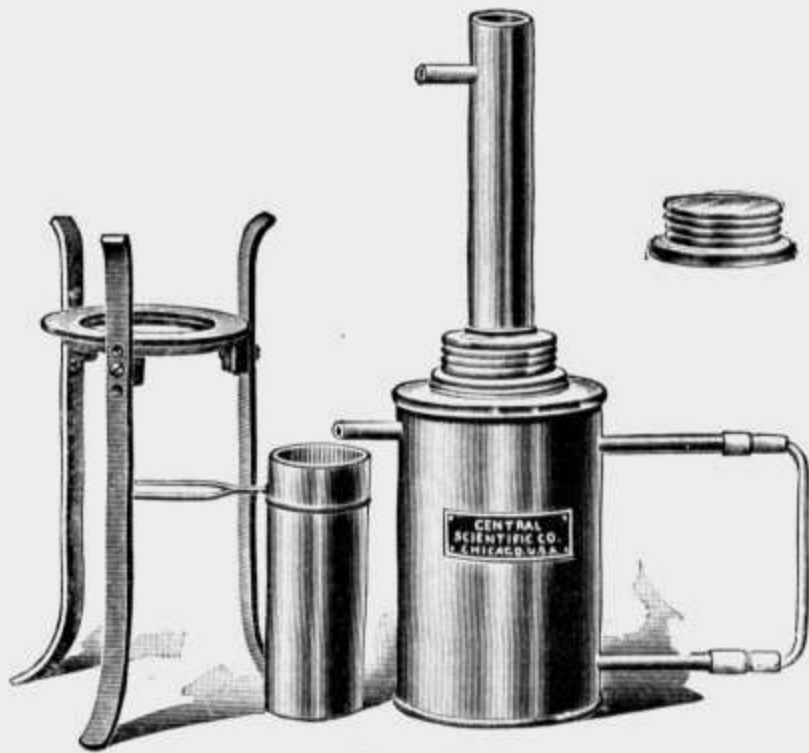
- 1579. **Ice Tray**, of galvanized iron, 60x15x5 cm., with four tubulatures..... 1.10
- 1580. **Ice Bag**, of heavy canvas, 20x38 cm., for breaking ice..... .17



No. 1585.

- 1583. **Mechanical Equivalent of Heat Apparatus.** See Catalog K for description .....Duty free 90.00
- 1583A. **Extra Thermometer** for No. 1583.....Duty free 6.00
- 1584. **Mechanical Equivalent of Heat Apparatus.** See Catalog K for description .....Net 30.00
- 1584A. **Hand Wheel** for No. 1584. See Catalog K for description.....Net 5.00
- 1585. **Tube for Mechanical Equivalent of Heat** (Millikan and Gale, Exp. 20). Consists of a tube 1 meter long made up of a number of layers of heavy brown paper securely fastened together. The rise in temperature is secured by allowing shot to fall a number of times through the length of the tube..... .28

**CALORIMETRY.**



No. 1586.

1586. **Apparatus A (Hypsometer) Improved Form.** Made of heavy polished copper, tinned inside, with durable water-tight joints and seams. The bottom of the boiler is concave to retain the flame, and is double seamed and soldered. The brass tubes are securely attached and will not break away from the boiler. This new model is superior to others in both construction and design. Invaluable in heat experiments, such as calorimetry, specific heat, thermometry, expansion, etc. Complete apparatus consists of boiler, thermometer tube, copper dipper, screw cap, water gauge and separate tripod.....\$2.25



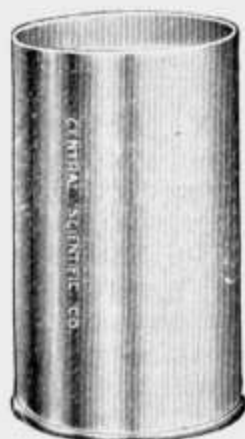
No. 1586A.

No. 1586B.

No. 1587.

- |  |       |
|--|-------|
| 1586A. Mercury Gauge, for steam pressure, to be used with No. 1586. Without mercury .....  | .11   |
| 1586B. Water Trap, of glass, to catch condensation. For use with No. 1586..  | .25   |
| 1587. <b>Calorimetric Outfit.</b> Consists of boiler, steam jacket with pressure gauge, tripod support, calorimeter with inner cup and fiber ring, wood cover, stirrer, metal cover and dipper. The steam jacket is double walled to prevent radiation, the inner tube receiving the steam from the boiler. A thermometer suspended in this tube is subjected to the live steam, which then passes to the outer jacket, from which the part not condensed passes through an upright tube into the air, while the condensed portion is drained through another tube back into the boiler..... | 15.00 |
| 1588. <b>Calorimetric Outfit.</b> See Catalog K for description.....   | 33.30 |





No. 1589.



No. 1590.



No. 1592.



No. 1594.

- 1589. **Calorimeter**, of thin brass, nickel-plated and finely polished. 3 inches in diameter, 5 inches high. Capacity about 575 c. c. . . . . \$ 0.40
- 1590. **Calorimeter**, of heavy copper, 2 inches in diameter, 3 inches high, with uniform internal dimensions. Capacity about 125 c.c. May also be used in measurement experiments. . . . . .33
- 1590A. **Calorimeter**. Same as No. 1590 with the addition of a square glass cover. . . . . .40
- 1592. **Calorimeter**, double-walled of heavy spun copper nickel-plated. Outer vessel of one liter capacity, inner vessel of 300 c. c. capacity, supported and insulated from the outer by a fiber ring. Complete with wood cover and stirrer. . . . . 2.55
- 1592A. **Wood Cover** only of No. 1592. . . . . .33
- 1592B. **Stirrer** only of No. 1592. . . . . .22
- 1593. **Calorimeter**. Same as No. 1592, without cover or stirrer. . . . . 2.00
- 1594. **Heating Coil Attachment**, mounted on a fiber cover for use with Nos. 1592 and 1593 Calorimeters. A coil of fine platinum wire, wound on a block of heat-resisting material, is fastened at the ends to two brass rods, which support the coil from the fiber cover and connect it with the binding-post terminals. A special stirrer with insulating handle is included. . . . . 4.50



No. 1595.



No. 1599.



No. 1601.

- 1595. **Ice Calorimeter**, after Bunsen. Glass part only. For determination of specific heat of small quantities of solids or liquids. . . . . 1.25
  - 1599. **Calorimeter** for determining the heating effect of the electric current and Joule's law. Simple form, after Gage, including thermometer. . . . . 2.25
  - 1600. **Calorimeter**, after Ames and Bliss. See Catalog K for description. . . . . 6.65
  - 1601. **Thermos Bottle**, keeps hot liquids hot and cold liquids cold. The lowest priced genuine Thermos Bottle on the market; reinforced in the vacuum chamber the same as the highest priced Thermos Bottle. A large size drinking cup is securely fastened to the case, holding the cork tightly in the bottle and preventing leakage of the contents. Red japanned finish, nicked top and base, American glass. Pint, Net 1.00; quart. . . . . Net 2.00
  - 1601A. **Filler** for No. 1601 Thermos Bottle. Pint, Net 0.85; quart. . . . . Net 1.75
- For **Electric Calorimeters** see Nos. 2467-8.



No. 1603.

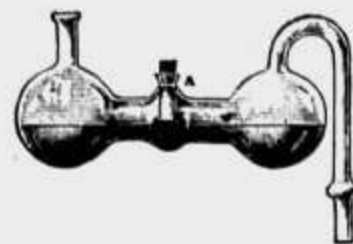


No. 1604.



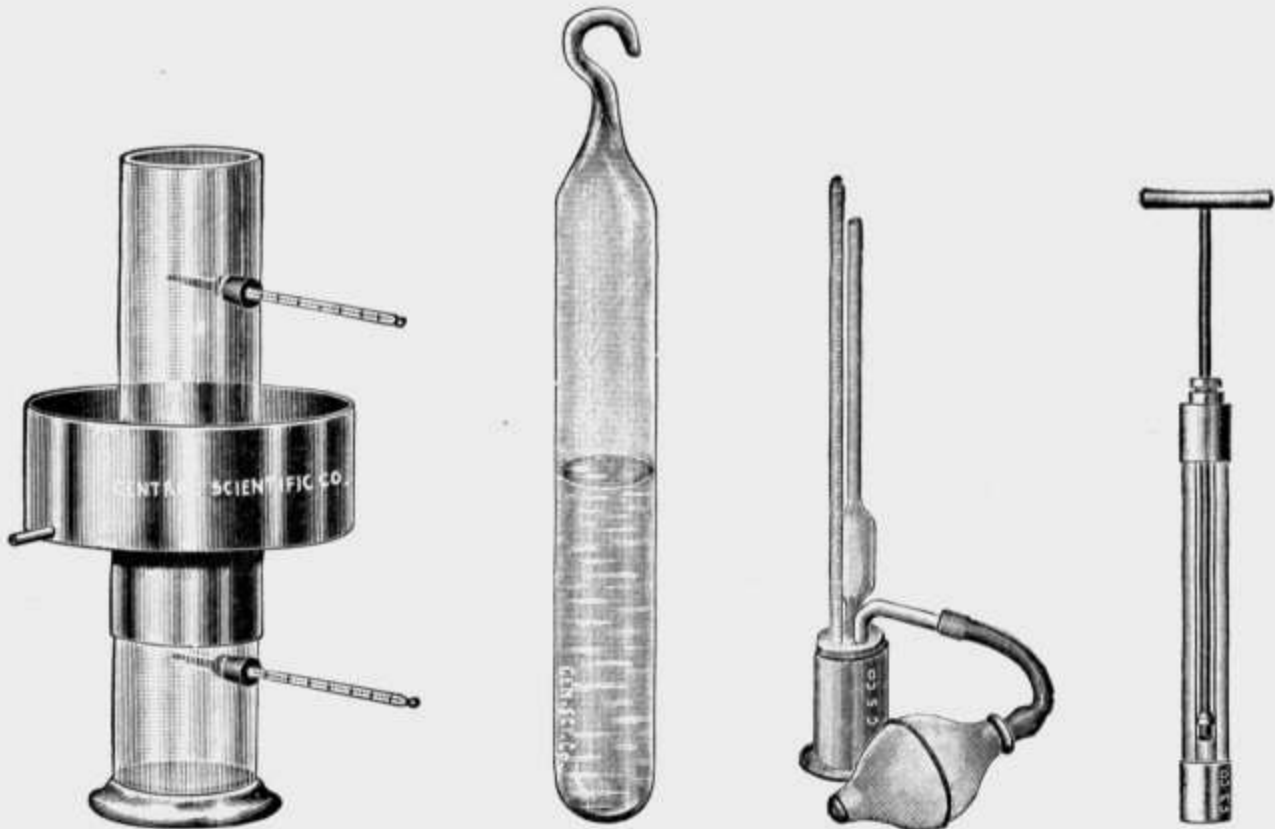
No. 1613.

1603. **Junker Calorimeter**, Mann's modification for determining the heat units of a burner from a given amount of gas consumed. Consists of a double walled copper vessel provided with a number of tubes or flues so arranged as to receive the heat from a Bunsen flame. These tubes coming in contact with water which is running continuously through the Calorimeter give up their heat. A thermometer placed in the orifice at the top registers the temperature of water at delivery, a second thermometer placed in orifice at the bottom registers the temperature at entrance. Any convenient gas measuring apparatus will give the amount of gas supplied the burner. (See No. 1604 Thorpe Gauge.) A vessel placed to catch water delivered gives amount of water passing through the Calorimeter. Complete with tripod support, but without gas meter or thermometers..... \$ 10.00
1604. **Thorpe Gauge**, a convenient means of measuring both the pressure and the rate of flow of gas. When the gas supply is attached to the inlet and the cap is screwed down over the outlet at top, the index reads on left hand scale the pressure in inches of water. When testing the consumption of a burner, the pressure cap is unscrewed and the burner screwed in its place. The indicator then registers on the right hand scale the number of cubic feet of gas consumed per hour 13.35
1605. **Laws of Cooling**. See Catalog K for description..... 9.40
1608. **Lead Shot**, for use in specific heat experiments.....Per pound .16
1609. **Copper Shot**, for use in specific heat experiments.....Per pound .45
1610. **Glass Beads**, for use in specific heat experiments.....Per pound 1.00
1611. **Aluminum Shot**, for use in specific heat experiments.....Per pound .75
1612. **Steel Shot**, for use in specific heat experiments.....Per pound .17
1613. **Tyndall's Specific Heat Apparatus**. Complete with metal plate, paraffine cake, tripod support and five balls of different metals with holder. The balls are supported on the holder and heated in boiling water. Then, when placed on the paraffine cake, they will melt their way through it at different rates depending on their specific heats. The metal plate is used as a mold to form the paraffine cake and also to catch the balls on their fall..... 1.55

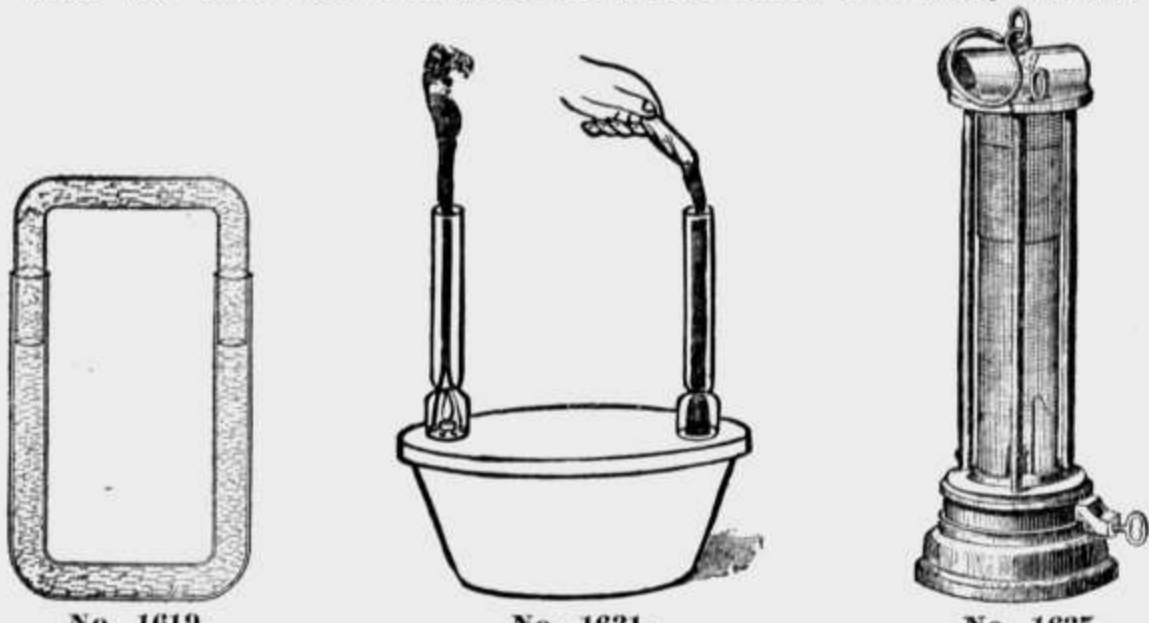


No. 1614.

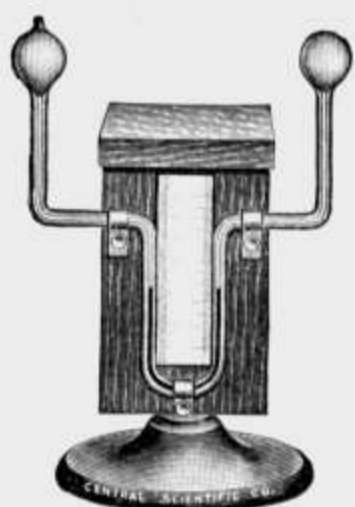
1614. **Ice Machine**, after Carré. Small fused in test tube is half filled with ether and the apparatus one-third filled with sulphuric acid (C. P.). The projecting neck tube is fitted air-tight to a flask filled one-third with water to be frozen, the other tube is connected air-tight to an aspirator or air pump by means of a stopper and tubing. Air exhausted from apparatus causes rapid evaporation of the water in the flask, freezing it and the absorption of the water vapor by the sulphuric acid generates heat sufficient to boil the ether, blowing out the stopper..... 2.25



- No. 1615.**  
 1615. **Maximum Density of Water Apparatus**, glass jar with heavy polished copper reservoir for freezing mixture, without thermometers..... \$ 5.00
- No. 1616.**  
 1616. **Critical Tube** for showing the phenomena which occur when a liquid changes to a gas at its critical temperature. A stout glass tube 9 cm. long, about half filled with ether. May be used with a projection lantern. With directions..... 1.40
- No. 1617.**  
 1617. **Dew Point Apparatus** according to Prof. Millikan. By means of a bulb, air is blown through ether contained in a small nickel plated brass vessel. Complete, without thermometer..... .66
- No. 1618A.**  
 1617A. **Alluard's Dew Point Hygrometer.** See Catalog K. ....Net 26.00  
 See also No. 1350 **Freezing Apparatus** to show cooling by evaporation.
1618. **Fire Syringe**, brass cylinder with piston and piece of tinder. Improved construction. Illustrates generation of heat due to air compression 2.00
- 1618A. **Fire Syringe, Glass Cylinder.** This type of Fire Syringe has a heavy glass cylindrical barrel 3 cm. x 25 cm. with a 1 cm. piston. On account of the improved method of construction sure results are possible with this instrument, and the phenomenon is entirely visible. 6.65



- No. 1619.**  
 1619. **Circulation Apparatus** (convection of liquids), improved form..... 1.20
- No. 1621.**  
 1621. **Convection Apparatus** (convection of gases). A metal vessel, with holes to surround a candle near one edge and a hole on the opposite edge. Complete with two student lamp chimneys..... 1.10
1624. **Touch Paper**, in sheets about 24 cm. square. Per sheet..... .11
1625. **Davy's Safety Lamp**, as used in mines..... 2.50



No. 1630.

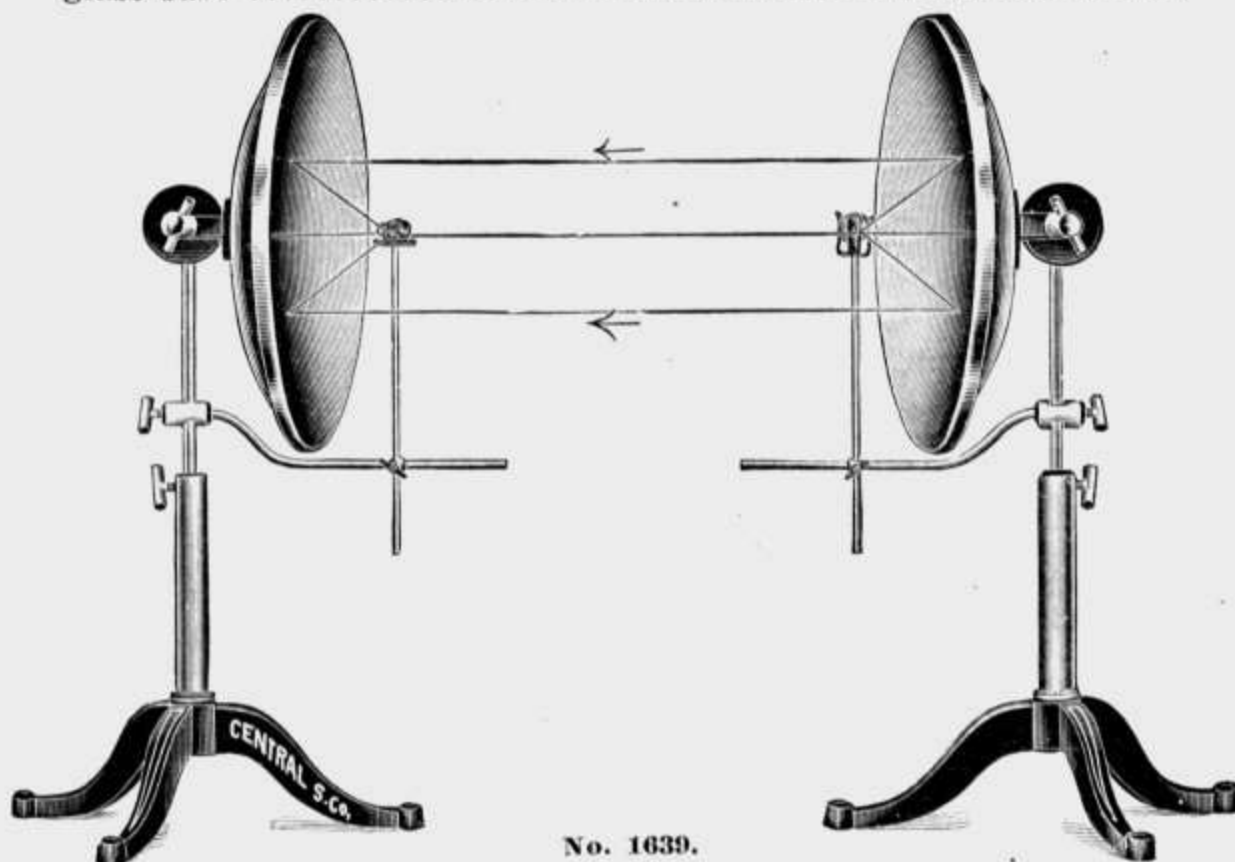


No. 1633.



No. 1636.

- |       |  |    |      |
|-------|--|----|------|
| 1630. | Differential Thermometer, for showing differences of temperature between two neighboring positions. This form, designed for the convenient manipulation of Leslie's cubes, the platform being provided especially for the purpose, may also be used in all experiments where Leslie's thermometers are used..... | \$ | 3.00 |
| 1631. | Differential Thermometer (Leslie's), on stand with scale, German form .....  |    | 1.55 |
| 1633. | Leslie's Cube, for illustrating laws of radiation. Has four polished faces of different metals. Complete with one-hole rubber stopper for thermometer. Without thermometer.....  |    | 1.65 |
| 1635. | Leslie's Cube, painted in four different colors with three-sided protecting case. Complete with one-hole rubber stopper for thermometer. Without thermometer.....  |    | 1.35 |
| 1636. | Radiometer, illustrating phenomena of radiant heat. Mounted on glass base .....  |    | 1.55 |



No. 1639.

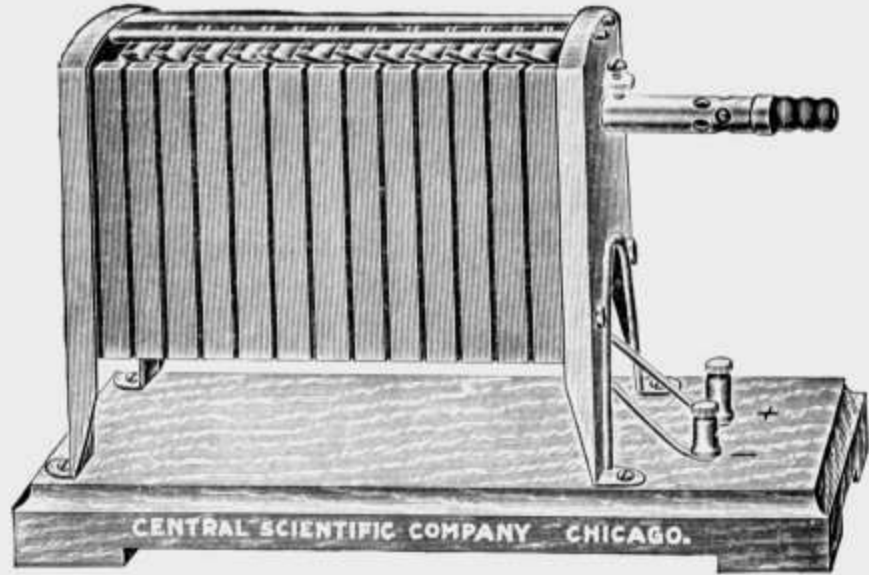
- |       |  |  |       |
|-------|--|--|-------|
| 1637. | Parabolic Reflectors, a pair 10 inches in diameter mounted on tripod stands. The backs of our reflectors are not fastened by a clamp, but held by the rims by a special spring device. This arrangement obviates all danger of destroying the parabolic surfaces by any strain at the back or by accidentally dropping the reflectors. Highly polished surfaces, accurately constructed..... |  | 6.00  |
| 1639. | Parabolic Reflectors, a pair of same general construction as No. 1637, but 12 inches in diameter and provided with ball holder and phosphorus holder, completely adjustable.....   |  | 13.50 |



No. 1645.



No. 1651.



No. 1655.

1641. Melloni's Apparatus. See Catalog K for description.....	\$ 90.00
1643. Absorption Bottle. A bottle with flat sides for testing the absorption of heat by different liquids. Capacity, 6 ounces.....	.11
1645. Thermo-Electric Pair, simple pair, brass and German silver.....	.45
1651. Thermo-Multiplier, twenty-four pairs of bismuth and antimony, on adjustable brass stand with one brass cone.....Duty free	13.50
1653. Thermo-Multiplier, same as No. 1651, but sixty pairs.....Duty free	25.00

**THERMO-ELECTRIC BATTERIES.**

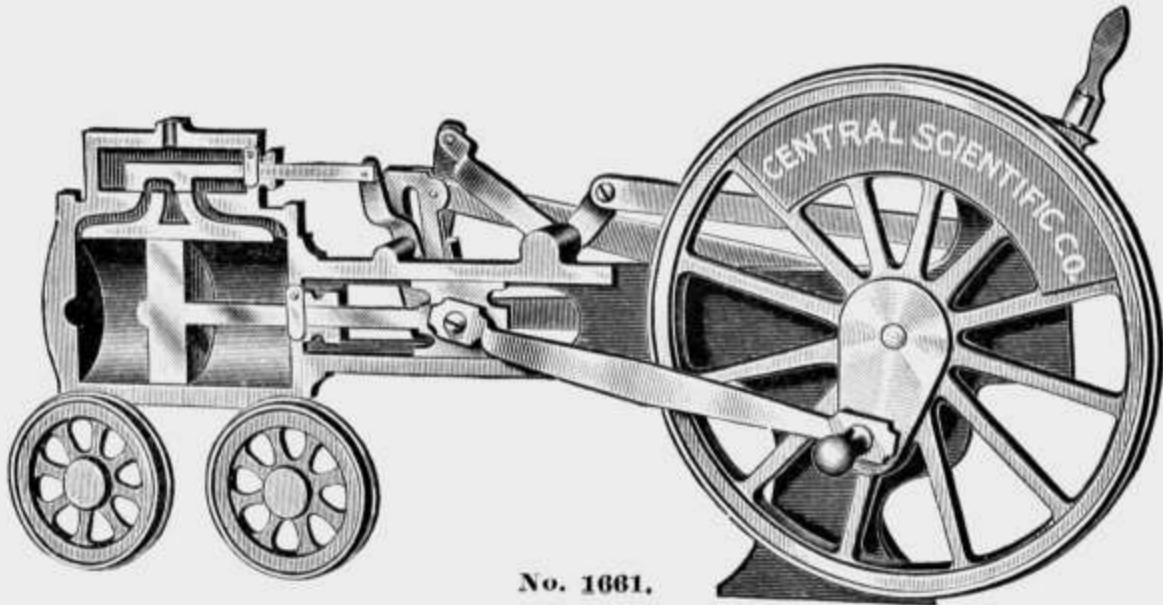
These new thermo-electric batteries are of convenient construction, low priced and of high efficiency, illustrating in a clear manner the comparatively unknown thermo-electricity. They are especially desirable where galvanic elements must be avoided on account of the injury done by the fumes. With the larger sizes one can operate Induction Apparatus, small Electrical Apparatus such as motors, a number of small incandescent lamps, and charge small storage batteries. They are also especially adapted for Electrolytic Experiments for both Physics and Chemistry. They can be put in operation almost instantly and need practically no attention. These batteries have been well received at all the European Universities. The University of Berlin has especially called attention to their high efficiency.

- 1655. Will give small continuous currents for experiments.
- 1656. Will light 3 small 2 volt incandescent lamps.
- 1657. Will light five 2 volt incandescent lamps.
- 1658. Will light eight 2 volt incandescent lamps.

Catalog Number.....	1655	1656	1657	1658
Number of Elements.....	26	38	50	50
Dimensions, cm. ....	11 x 17 x 26	11 x 17 x 33	11 x 17 x 39	14 x 19 x 45
Voltage .....	1.8 to 2.2	2.8 to 3.2	3.8 to 4.2	4 to 4.5
Mean Average Voltage.....	1.1 to 1.3	1.4 to 1.6	1.9 to 2.1	2 to 2.25
Amperage, short circuit.....	3 to 4	3 to 4	3 to 4	4 to 5
Available Watts.....	1.5	2.4	3.8	4.5
Internal Resistance, ohms.....	0.45	0.75	1.	0.9
With gas burner, Duty free....	\$6.60	\$9.90	\$13.50	\$18.00
Catalog Number.....	1655A	1656A	1657A	1658A
With alcohol lamp, Duty free..	8.40	11.70	15.90	21.00

**Twin Thermo-Electric Batteries.** Same as the preceding, but with two batteries mounted side by side for convenience.

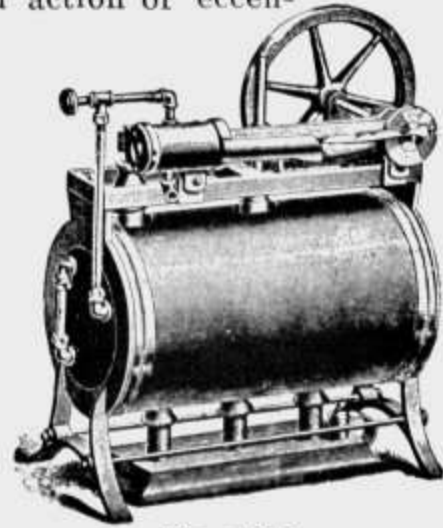
Catalog Number.....	1659	1660
Number of Elements.....	76	100
Dimensions, cm. ....	21 x 17 x 33	21 x 17 x 40
Voltage .....	5.4 to 6	7.4 to 8
Amperage, short circuit.....	3 to 4	3 to 4
With gas burner, Duty free....	\$19.20	\$25.80
Catalog Number.....	1659A	1660A
With alcohol burner, Duty free	22.20	28.80



No. 1661.

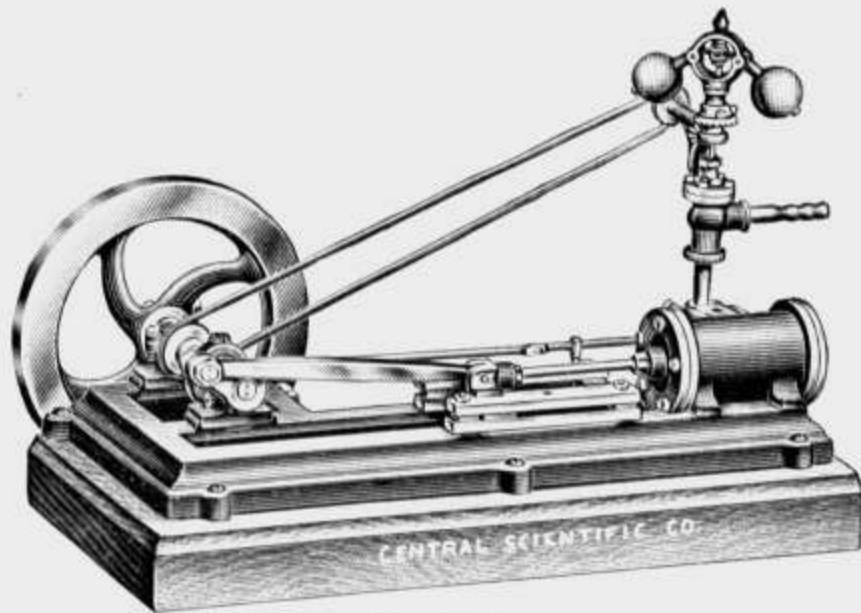
1661. **Steam Engine Model, (large size).** A complete model of the locomotive engine showing a section through the steam chest with the piston and valve connected to their proper parts. Excellent illustration of link motion; use of reversing gear and action of eccentric clearly shown. Model stands 7 inches high and is 15 inches long. Each part is carefully made and adjusted.

Improved methods of manufacture make it possible for us to offer this large size model which we formerly listed as No. 1663, for the exceedingly low price of..Net \$ 3.00



No. 1665.

1665. **Horizontal Steam Engine and Boiler.** A perfect working model, exceptionally well built, containing all the essential parts of an engine and boiler. Height over all, 9¾ inches; length over all, 9½ inches; weight, about 5 lbs.. 7.50

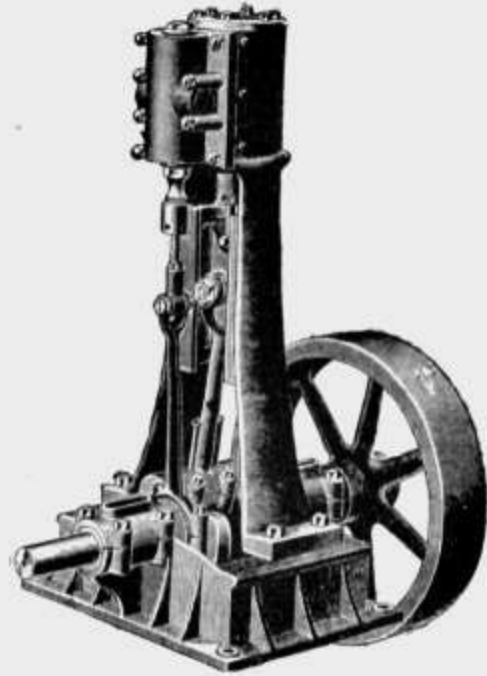


No. 1666.

1666. **Horizontal Steam Engine.** A perfect working engine, ½ H. P., with cylinder of 3 inch stroke and 1½ inch bore. Fly wheel 7.5 inches in diameter. Size over all, 19 inches long by 13 inches high by 11 inches wide. Provided with a perfect working governor and eccentric. This engine is especially suited for demonstration purposes, as it is readily taken apart and all working parts exposed to view. Will run on either compressed air or steam at pressures of from 2 or 3 pounds up to 60 or 70 pounds, requiring the latter pressure to develop its full power..... 50.00

**STEAM ENGINES.**

The engines listed below are of the famous SIPP make, and are without doubt the best small engines on the market. They are of the latest and most approved designs, complete in all their parts and made of the same materials as a large engine. They are compact and light, yet strong and substantial, and capable of heavy duty, being provided with large bearings, adjustable for wear, and excellent provision for oiling. Prices are for the complete finished engine.



No. 1670.

Catalog No.	Type.	H. P.	Bed, inches.	Cylinder, inches.	Flywheel, inches.	Net Price, F. O. B. Factory.
1667	Horizontal	1/8	7 x12	1 1/8 x2	6x2	\$ 20.00
1668	Horizontal	1/2	13 1/2 x23 1/2	1 3/4 x3	10x2	50.00
1669	Vertical	1/4	10 x12	1 1/2 x1 5/8	8x2	35.00
1670	Vertical	1	8 x10	2 x2 3/4	10x2 1/2	60.00

**BOILERS.**

These boilers are of the same make as the above engines. They are of the vertical tubular type, having 3/4-inch seamless, drawn brass tubes (except those in 1677-1677A, which are of steel), with a water firebox. The shell is of wrought iron, lap welded; the casing and stack are of blued steel. Each boiler is tested to 250 pounds, cold water pressure, and is safe to run at 80 pounds steam pressure.

The STEAM GAUGE is of the very best.

The SAFETY VALVE is made of the best steam metal, and will not rust or corrode tight.

There is also a WATER GAUGE and three GAUGE COCKS, all of steam metal, and STEAM and WATER PIPES with VALVES.

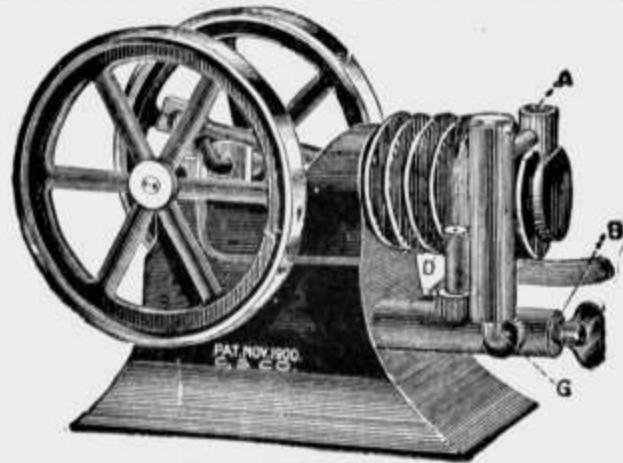
Nos. 1675, 1676 and 1677 Boilers can be fired with hard coal or charcoal.

Nos. 1675A, 1676A and 1677A Boilers can be fired with coal gas or natural gas.

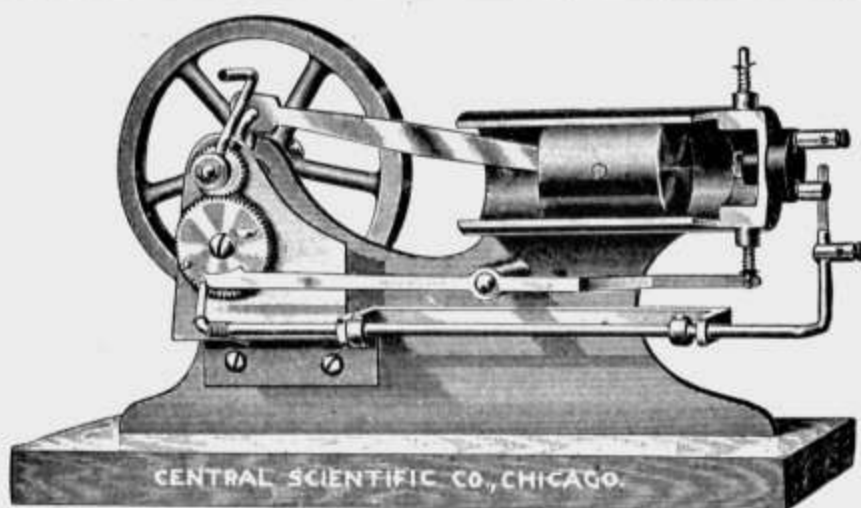
Catalog No.	Horse Power	Number Tubes	Total Height, Inches.	Diameter at Base, Inches.	Net Price, F. O. B. Factory, With Grate or Burner.
1675	1/4	20	21	10	\$ 26.50
1675A	1/4	20	21	10	31.50
1676	1/2	32	31	16	43.00
1676A	1/2	32	31	16	55.00
1677	1 1/2	51	41	21	100.00
1677A	1 1/2	51	41	21	115.00

1678. Gas Engine, working model for illuminating gas only. (Cannot be used with natural gas.) Made of iron and brass, enameled and nickel plated, six inches long, three inches wide, weight three pounds. Runs with an explosion at each revolution. Speed varies from 200 to 700 R. P. M.

This engine makes an excellent demonstration model and is fully guaranteed. Easily operated and perfectly safe. With directions ..... 3.35

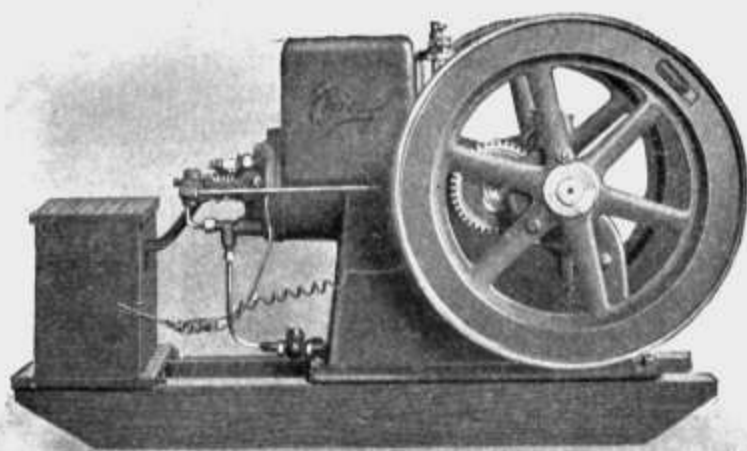


No. 1678.



No. 1680.

1680. **Gas Engine Model.** This model is an exact reproduction, in section, of the 4-cycle commercial gas engine. All parts are adjusted to their proper position, and exhaust and intake valves, piston head and spark plug are all shown to their best advantage. It is easily demonstrated how compression and exhaustion is accomplished, and if the secondary of an induction coil is connected in series with the spark plug the spark may be shown at the proper time of compression ..... \$ 7.50



No. 1684A.

The 1 and 2 H. P. use jump spark, while the larger sizes operate with make and break in cylinder. With each engine is furnished one standard size pulley, the necessary battery and coil, muffler, oil can, necessary wrenches and gas bag. Mounted on skids, ready to run.

**GAS ENGINES.**

To run all kinds of machinery from light to heavy, according to size selected. Four-cycle type, high grade, simple and durable. Cylinder is hopper cooled, with valves in cages, easily removable for regrinding.

The 1 H. P. has adjustable governor on fly-wheel, while the larger sizes have spark advance and retard, which permits changing speed while running.

Catalog No.	Actual H. P.	Bore-Stroke, inches	Normal Speed, R. P. M.	Diam. Fly-Wheel, inches	Driving Pulley, Diam.-Face, inches	Floor Space, inches	Shipping Weight, pounds	Price, Net
1683A	1	3x3½	500	16	4x4	17x36	250	\$ 55.00
1683B	2	4x4½	450	18	6x4½	22x46	400	71.00
1683C	5	5x6	400	30	12x5	27x56	750	157.00
1683D	8	6x8	375	32	14x5	30x72	1500	241.00

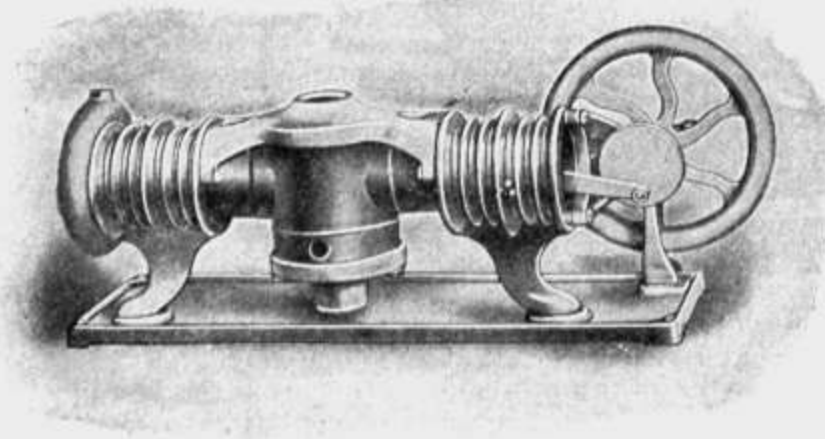
**GASOLINE ENGINES.**

Similar to the gas engines above, but without gas bag, and having a special carburetor instead of the gas mixing valve. Gasoline is stored in the base of the engine, and fed by pump attached to engine frame.

Catalog No.	Actual H. P.	Bore-Stroke, inches	Normal Speed, R. P. M.	Diam. Fly-Wheel, inches	Driving Pulley, Diam.-Face, inches	Floor Space, inches	Shipping Weight, pounds	Price, Net
1684A	1	3x3½	500	16	4x4	17x36	250	\$ 50.00
1684B	2	4x4½	450	18	6x4½	22x46	400	66.50
1684C	5	5x6	400	30	12x5	27x56	750	150.00
1684D	8	6x8	375	32	14x5	30x72	1500	231.00



HOT AIR ENGINES.



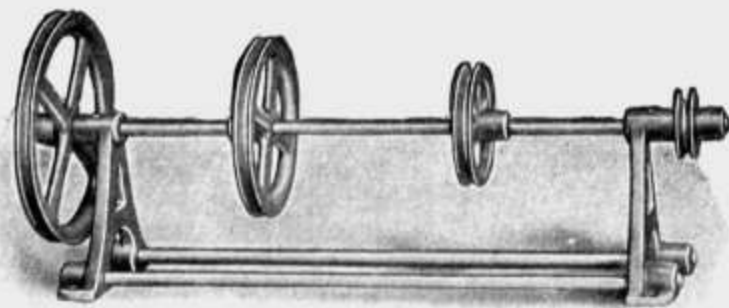
No. 1690.



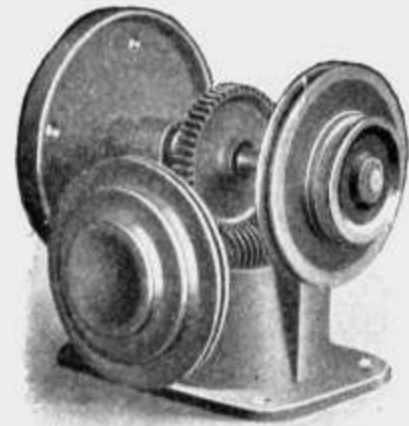
No. 1694.

These engines are operated by the alternate heating and cooling of the same volume of air contained in the cylinder. There are no valves to get out of order, no inlet to become clogged, and no noisy exhaust. The air is heated by means of a small flame of gas or alcohol in a special burner, and the engine will continue to run as long as the heat is supplied. These engines will be found valuable in the laboratory for demonstrations, and for running such machinery as may be suited to their power, as they are always ready, require little attention and will run indefinitely at a very small cost.

- 1690. **Hot Air Engine**, air-cooled, has a speed of 400 R. P. M., is about  $\frac{1}{40}$  H. P.; has adjustable bearings, runs silently. Size, 6x18 inches; weight, 16 pounds. The fly wheel is 6 inches in diameter and has belt pulley  $1\frac{1}{4}$  inches in diameter. Consumes 3 cubic feet of gas per hour. Complete with both gas and alcohol burners..... \$ 16.65
- 1694. **Hot Air Engine**. Water cooled, height 26 in., has a speed of 300 R. P. M. and is about  $\frac{1}{16}$  H. P. Weight 65 pounds. The fly wheel is 10 inches in diameter and has belt pulleys  $2\frac{1}{2}$  and 4 inches in diameter for  $\frac{7}{32}$ -inch round belt. Consumes 8 cubic feet of gas per hour. With gas burner..... 38.90
- 1694A. **Hot Air Engine**, same as No. 1694, but with burner for gasoline gas.. 44.50



No. 1698.



No. 1699.

- 1698. **Countershaft**  $\frac{1}{4}$  inch in diameter and 12 inches long, with bearings and pulleys 1, 2, 3 and 4 inches in diameter. The pulleys are bored and grooves turned true with the shaft, to which they are fastened with set screws, so that their position on the shaft may be changed. Used in connecting small engines and motors with other machinery 2.00
- 1699. **Speed Reducing Gear**. An improved device by which the high speed of an engine or motor is converted into a slow, powerful motion. The round plate may be removed if desired, and direct connection made to shaft. Geared 48 to 1. The fast running pulley has three grooves with diameters 2, 3 and 4 inches, and the slow running pulley two grooves with diameters 2 and 4 inches, thus giving a wide range of speeds..... 6.65

# MAGNETISM



No. 1701.



No. 1702.

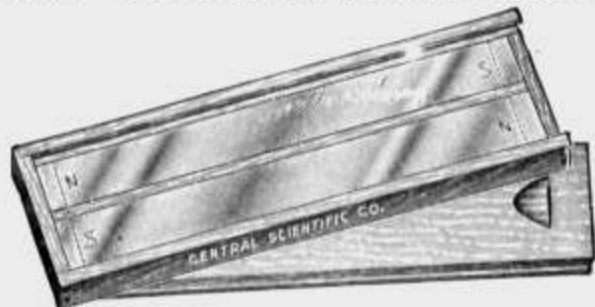


No. 1702A.

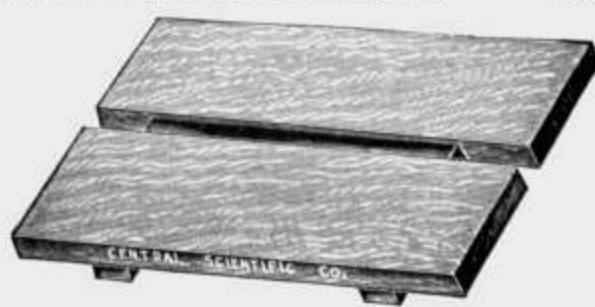


No. 1704.

- |        |  |    |      |
|--------|--|----|------|
| 1701.  | Lodestone or Natural Magnet.....   | \$ | 0.22 |
| 1702.  | Soft Iron Rod of Norway Iron, 6x $\frac{1}{2}$ inch.....   |    | .11  |
| 1702A. | Soft Iron Horseshoe Core of $\frac{5}{16}$ inch round iron. Length 2 $\frac{1}{8}$ inches, opening 1 $\frac{1}{8}$ inches..... |    | .10  |
| 1703.  | Magnet, small, 2x $\frac{1}{4}$ x $\frac{1}{4}$ inch, dead black finish.....   |    | .11  |
| 1704.  | Bar Magnet, polished steel, 6x $\frac{3}{4}$ x $\frac{1}{4}$ inch.....   |    | .17  |
| 1705.  | Bar Magnet, polished steel, 8x $\frac{3}{4}$ x $\frac{1}{4}$ inch.....   |    | .22  |



No. 1706.

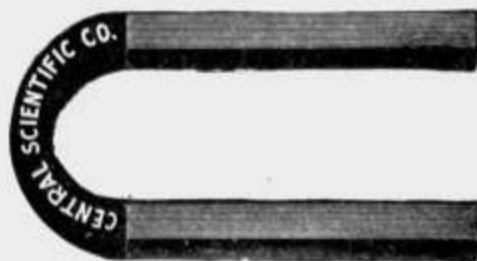


Nos. 1707-1708.

- |        |   |  |     |
|--------|---|--|-----|
| 1706.  | Bar Magnets, polished steel, pair of 6 inch in box with keepers.....  |  | .50 |
| 1707.  | Bar Magnet, black finish, 6x $\frac{3}{8}$ x $\frac{3}{8}$ inch, for use with No. 1708 board..  |  | .17 |
| 1707A. | Bar Magnet, black finish, 12x $\frac{3}{8}$ x $\frac{3}{8}$ inch.....   |  | .66 |
| 1708.  | Board of finely finished hardwood, 12x8 $\frac{1}{2}$ inches, with groove for No. 1707 Magnet for plotting magnetic lines of force (No. 1729 Iron Filings, No. 1730 Shaker and No. 1731 Blue Print Paper also needed) |  | .33 |
| 1709.  | Stirrup of heavy wire, for suspending bar magnets, friction rods, etc. For Magnets of special sizes, see under No. 6060 Magnet Steel.   |  | .10 |



No. 1713.



No. 1716.



No. 1723.



No. 1724.

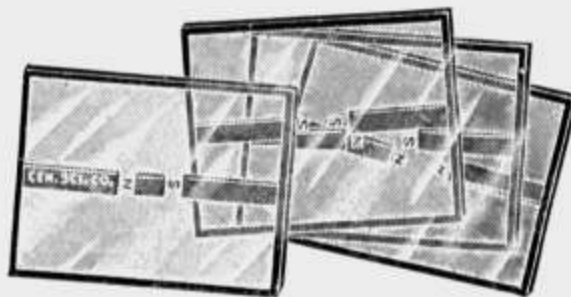


No. 1717.

- |       |   |      |
|-------|---|------|
| 1710. | Horseshoe Magnet, 3 inches long.....  | .10  |
| 1711. | Horseshoe Magnet, 4 inches long.....  | .13  |
| 1713. | Horseshoe Magnet, 6 inches long.....  | .25  |
| 1715. | Horseshoe Magnet, 8 inches long.....  | .80  |
| 1716. | U Magnet, 5 $\frac{1}{2}$ inches long, poles $\frac{3}{4}$ x $\frac{1}{2}$ inch; 2 inches between poles..   | .28  |
| 1717. | Horseshoe Magnet, Compound, consists of two 6 inch magnets.....   | 1.50 |
| 1719. | Horseshoe Magnet, Compound, consists of four 8 inch magnets.....  | 4.50 |
| 1720. | Darning Needles, 3 inches long, 25 in paper, per paper.....   | .06  |
| 1722. | Knitting Needles, per dozen.....  | .11  |
| 1723. | Breaking Magnet, 4x $\frac{1}{4}$ x $\frac{1}{4}$ inch, notched for four pieces.....  | .22  |
| 1724. | Tube with Iron Filings, for illustrating the molecular nature of magnetism. A glass tube 10 cm. long closed at both ends, with bulb at one end. When the filings are in the narrow part of the tube and the tube is stroked by a magnet, the tube becomes a magnet temporarily; after the filings are shaken up in the bulb and then replaced in the stem, the magnetism will be found to have disappeared..... | .33  |



No. 1726.



No. 1728.

- 1725. Floating Magnets, set of six..... \$ 0.22
- 1726. Set of Bar Magnets for showing distribution of magnetism. 24 small bar magnets, each on a separate pivot, mounted on a base. Duty free 7.20
- 1728. Magnet Combinations, for illustrating magnetic fields. The different combinations are mounted between transparent plates, 3 1/4 x 4 1/4 inches, for use with the vertical attachment of a projection lantern. The following fields may be shown with iron filings: Single magnet; fields between two adjacent north poles, two adjacent south poles, a neighboring north and south pole, a north and south pole with a piece of soft iron between. Per set of five..... 2.50

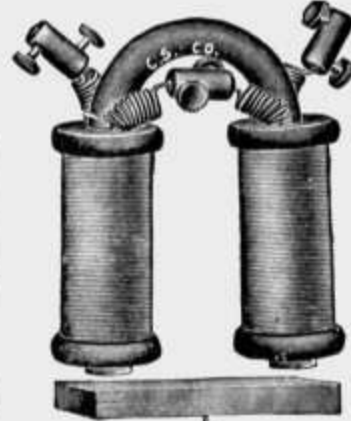
- 1729. Iron Filings, fine, per 1/4 pound carton .... .11
- 1730. Shaker, japanned tin, about 75 mm. diam. by 85 mm. high, with screw top; 2 to 2.5 mm. holes. For sprinkling iron filings. .11



No. 1730.



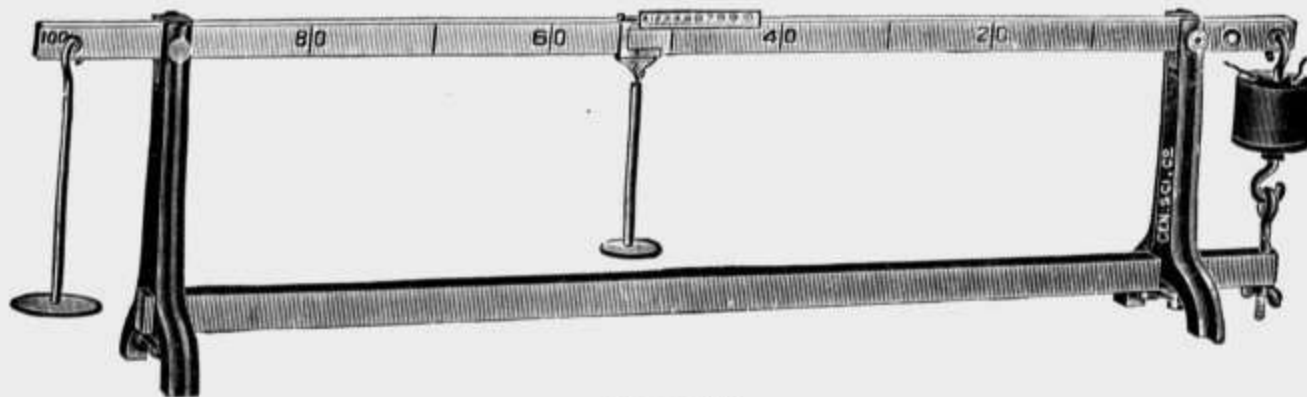
No. 1732.



No. 1733.

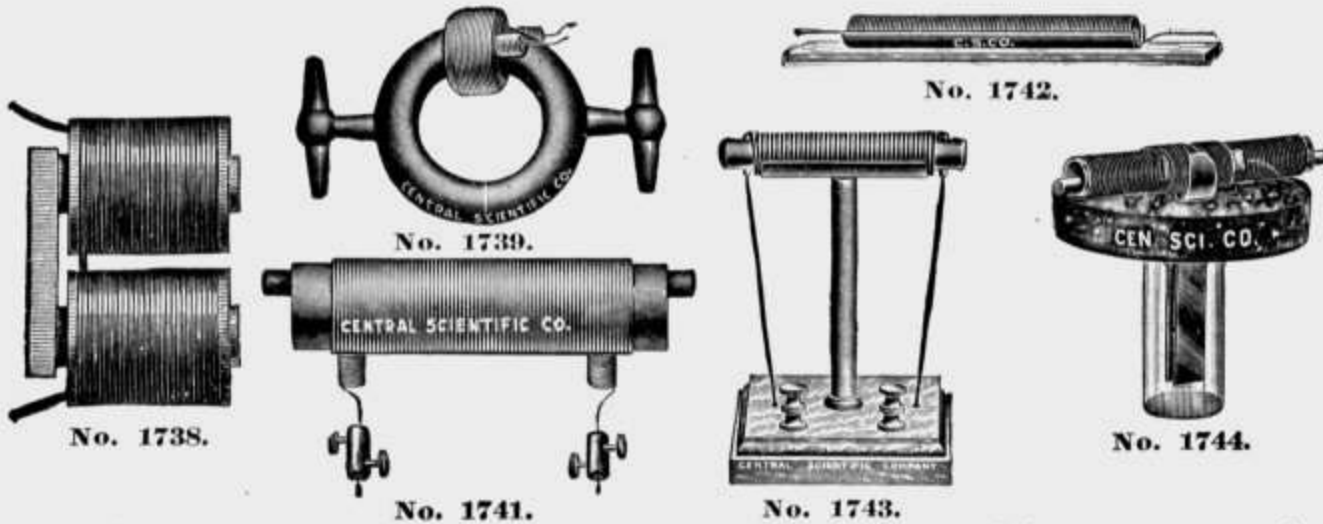
- 1731. Blue Print Paper, for taking prints of the magnetic field. 24 sheets, 4x5, in light proof pkg... .17  
For other sizes, see No. 6263.
- 1732. Lifting Magnet, after design by Prof. H. W. Harmon, of Grove City College. A model of the electro-magnets used in machine shops and foundries. Has a removable, well-insulated coil of 300 turns of copper wire. The armature pulls off squarely. Much more efficient than a U-shaped magnet, as the magnetic leakage is reduced to a minimum. 2.25

- 1733. Electro Magnet, 4.5 in. long; helices removable; soft iron armature.. 1.50



No. 1734.

- 1734. Electro-Magnet Tester, after design by Prof. H. W. Harmon. Has a mounted steel bar with knife edge for weight hanger at one end and for No. 1732 Lifting Magnet at the other. The beam is graduated every 10 cm., and has a sliding weight hanger with an auxiliary scale for determining its position upon the beam to the millimeter. In use, the armature of the magnet is fastened to the base of the apparatus and a current is passed through the magnet coil. Weights are placed on the weight hangers and adjusted until, as the slider is moved along the beam, a point is found at which the magnet is pulled away from its armature. From a series of such tests, the characteristics of the magnet may be determined. Constructed entirely of metal. (For weights, use No. 3939 Set of Weights.)..... 16.65
- 1734A. Accessories for converting No. 1734 into No. 765D Jack Screw Tester. 6.65
- 1736. Electro-Magnet, large size. See Catalog K for description.....Net 100.00



- |       |  |    |      |
|-------|--|----|------|
| 1738. | <b>Electro-Magnet</b> , 5 ohm resistance, for instrument making.....   | \$ | 0.70 |
| 1739. | <b>Helix and Ring, or Magic Circle</b> . Consists of two semi-circles of soft iron with large handles and helix of insulated copper wire.....  |    | 1.50 |
| 1741. | <b>Helix or Solenoid</b> , 12.5x3.5 cm. with movable core about 18x1 cm., and connectors, unmounted .....  |    | .90  |
| 1742. | <b>Helix or Solenoid</b> . A simple coil about 17 cm. long by 15 mm. in diameter. Mounted on a wood base.....  |    | 1.00 |
| 1743. | <b>Helix</b> , 7.5 cm. long, with fixed core, mounted on stand. The ends of the core project sufficiently to enable the power of the magnet to hold small nails, etc., in suspension to be clearly shown.....  |    | 2.25 |
| 1744. | <b>Floating Battery</b> . A small glass cup with simple elements and a solenoid with core attached. Designed to float on the surface of water in a large vessel, and to illustrate by the directive action of the earth's field the magnetic property of a solenoid..... |    | 1.33 |



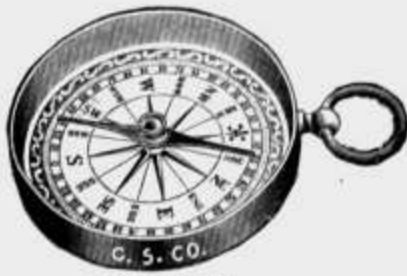
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|-------|---|------|
| 1745. | <b>Magnetic Needle</b> , 6-inch, brass cap, on stand.                   | .60  |
| 1747. | <b>Magnetic Needle</b> , 6-inch, agate cap, on stand..                  | .90  |
| 1749. | <b>Astatic Needle</b> , 6-inch, brass cap, on stand.....                | 1.40 |
| 1751. | <b>Dipping Needle</b> , 3-inch, on brass stand with graduated arc ..... | 2.25 |

1755. **Declination and Inclination Needle**. A high-grade instrument of finest finish and workmanship. The magnetic needle, 8.5 cm. long is supported on adjustable agate bearings at the center of a circle 11 cm. in diameter and 13 mm. wide, graduated in degrees on its inner edge. This circle may be rotated about a horizontal axis and is supported by a brass pillar which in turn rests upon a tripod provided with three leveling screws. At the bottom of the pillar and attached to it is a metal disc 7.5 cm. in diameter, graduated on its outer edge in degrees. Mounted upon the pillar is an adjustable spirit level. This method of mounting the magnetic needle permits of adjustments by which the needle can be brought into any conceivable plane and the two graduated circles permit of its position being read with accuracy....Net

No. 1755.

No. 1751.

17.50



No. 1761.



No. 1763.



No. 1765.

1761. **Compass**, brass case, card dial, beveled glass; the three larger sizes with ring.  
 Diameter .... 10 mm. 16 mm. 25 mm. 40 mm. 50 mm.  
 Each ..... .08 .11 .17 .25 .33

1763. **Compass**, brass case, brass dial, agate cap needle, beveled glass with cover, full circle divisions.  
 Diameter ..... 40 mm. 50 mm.  
 Each ..... 1.05 1.10

1764. **Compass**, brass case, raised card dial with full circle divisions, agate cap needle, beveled glass top. Diameter 45 mm. Similar to No. 1765 but without pointer..... \$ 0.60

1765. **Compass**, brass case, raised metal dial with full circle divisions, agate cap needle with 37 mm. aluminum pointer, stop for needle. Useful in building apparatus. Diameter 50 mm..... 1.45

1767. **Sight Compass**, watch case form, 50 mm. diameter, with raised dial and full circle divisions. Bar needle 30 mm. long, with agate cap. Sights and spring cover.... 6.65

1770. **Bismuth Spiral**. See Catalog K for description.....Duty free 15.00

- 1770A. **Bismuth Spiral**. See Catalog K for description.....Duty free 15.00

1771. **Magnetoscope**, small jar form.... 1.10



No. 1767.

No. 1771



No. 1773.

1773. **Magnetometer**, for measuring relative strengths of magnets. Compass No. 1765, mounted in mahogany finish hardwood frame, with meter scale and bar magnet..... 4.00  
 1774. **Magnetometer**. See Catalog K for description..... 20.00  
 1774A. **Magnetometer**. See Catalog K for description..... 22.00  
 1774B. **Magnetometer System**. See Catalog K for description..... 4.00  
 1774C. **Supports**. See Catalog K for description..... 4.45

1776. **Earth Inductor**, has 1,000 turns of wire, of about 250 ohms resistance, wound on a mahogany ring 22 centimeters in diameter, and capable of rotation about its diameter. On releasing the catch *S*, a spring causes the coil to rotate through 180 degrees, when it is caught and held by a second catch *S'*. The length of throw of the spring may be regulated by means of the screw *A*, so that the coil strikes the rubber buffer at the end of its half-turn without appreciable shock 19.50

See also No. 905 **Earth Induction Apparatus**.

- 1778A. **Field Tray**. See Catalog K for description 4.45

- 1778B. **Potential Points**. See Catalog K for description. Set of three..... 1.50

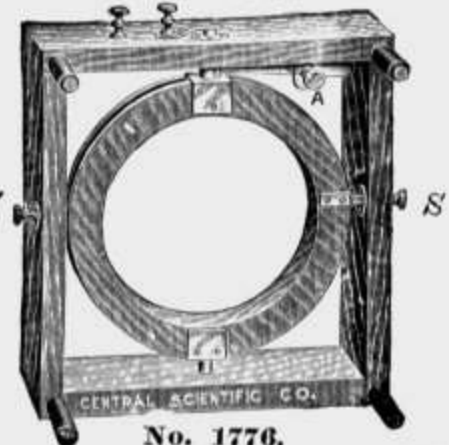
- 1778C. **Equipotential Seeker**. See Catalog K for description..... .55

- 1778D. **Induction Coil**. See Catalog K for description..... 6.00

1779. **Rowland's Apparatus for Distribution of Magnetism**. See Catalog K for description ..... 9.00

- 1779A. **Hysteresis Apparatus**. See Catalog K for description..... 7.50

1780. **Permeameter**. See Catalog K for description..... 27.75



No. 1776.

# ELECTROSTATICS



No. 1782.

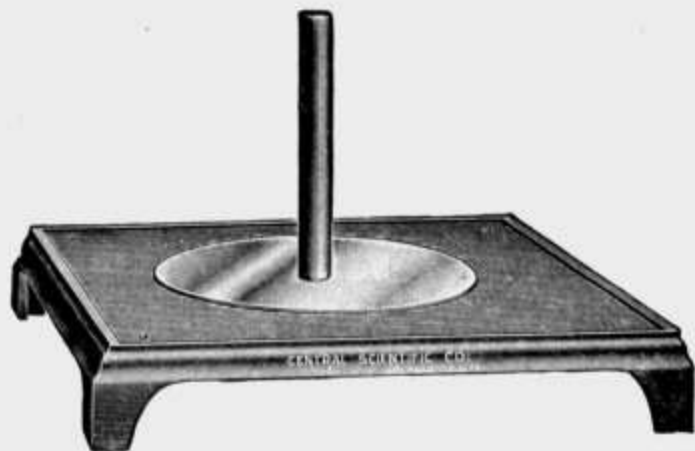


No. 1785.

- 1781. Friction Rod, of glass, 10x $\frac{3}{8}$  inches..... \$ 0.11
- 1782. Friction Rod, solid glass, 12x $\frac{1}{2}$  inches, one end ground, other polished.  
Will show positive charge on one end and negative on other when rubbed ..... .35
- 1783. Friction Rod, of wax ..... .11
- 1785. Friction Rod, of vulcanite,  $\frac{1}{2}$ x9 $\frac{1}{2}$  inches..... .40
- 1786. Flannel Cap, with silk cord attached, for use with No. 1785 Friction Rod to illustrate equality of the opposite charges produced by friction ..... .15
- See also No. 1882 Ebonite Strips.
- See No. 1709 Stirrup for suspending rods horizontally.
- 1787. Silk Pad, for exciting..... .40
- 1789. Flannel Pad, for exciting..... .25
- 1791. Cat Skin (half skin), for exciting..... .55
- 1792. Cat Skin (whole skin), for exciting..... 1.10
- 1793. Pith Balls, colored, very fine, per dozen..... .25
- 1794. Pith Balls, with silk cords, each..... .08
- 1795. Pith Balls, covered with aluminum paint, which is superior to tin foil, very sensitive, with silk cords, each..... .11
- 1796. Pith Images, per pair ..... .40

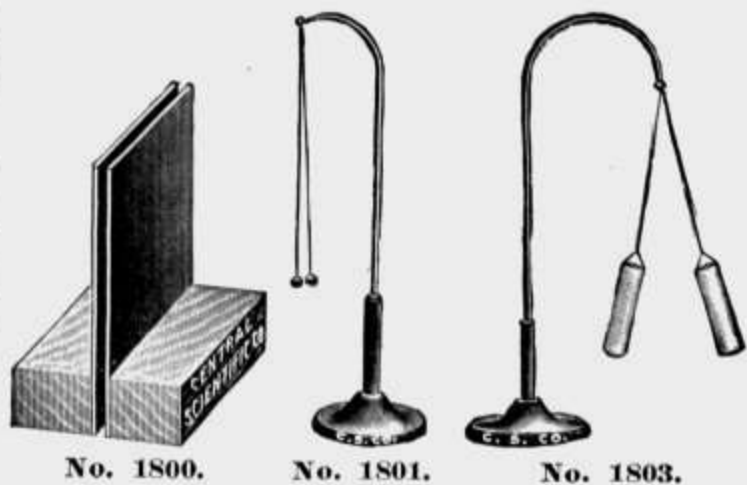


No. 1797.



No. 1799.

- 1797. Electrophorus, mounted rubber plate, with 4-inch nickel plated brass disc ..... 1.25
- 1799. Electrophorus, large rubber plate, mounted on a substantial metal base, 8-inch nickel plated brass disc with rubber handle..... 2.77
- 1800. Condenser Plates. Metal plates 10 cm. square, mounted on wooden bases. Per pair.. .25
- 1801. Electrical Pendulum. Consists of a pair of pith balls, mounted on stand ..... .55
- 1803. Electroscop. A pair of special hollow pith cylinders,  $\frac{3}{4}$ x4 inches, suspended by silk thread from an insulated support. This is an exceedingly sensitive electroscop on account of the large surface and small weight of the cylinders, and is especially adapted for demonstrating the fundamental phenomena of electrostatics before a class, as the large cylinders can be seen from all parts of a good-sized room. Complete with support as illustrated ..... 2.00
- 1803A. Hollow Pith Cylinders, of No. 1803, with cords, but without support. Per pair ..... 1.00



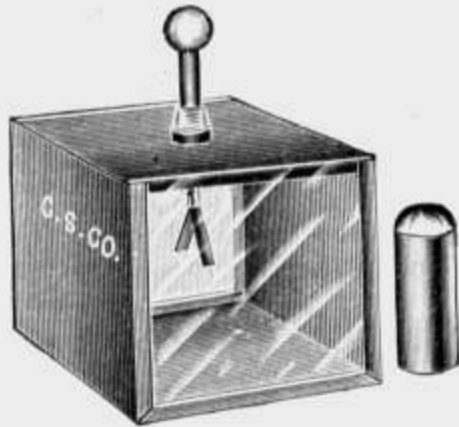
No. 1800.

No. 1801.

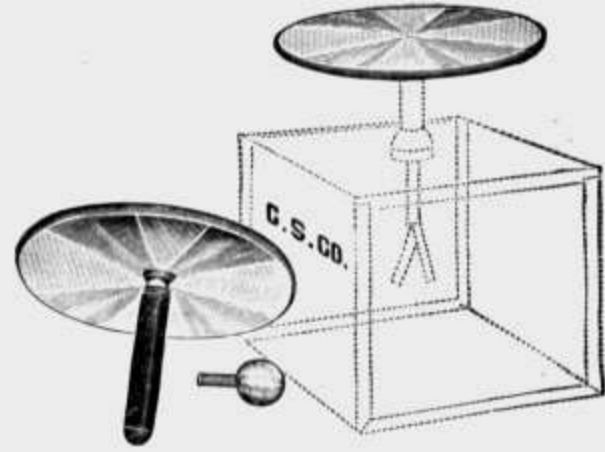
No. 1803.



No. 1805.



No. 1808.



No. 1808A.

- 1805. **Electroscope**, flask form, aluminum leaves, nickel plated rod and knob \$ 0.50
- 1806. **Electroscope**. Similar to No. 1805, but with rod insulated from the cork by amber. Will retain its charge for hours. Recommended as the best low-priced electroscopes on the market..... 1.25
- 1808. **Electroscope, Box Form**. Consists of a metal box 4x4x4 inches with removable glass front and back. The brass rod carrying the strips of gold-foil is insulated by pure amber, giving the best insulation possible. To obviate radio-active influences, a metal cap is provided to fit over the collar on top of the box and enclose the projecting rod. A knob is provided for the top of the rod which may easily be removed and No. 1808A Plates attached. This electroscopes will retain its charge for from 6 to 8 days..... 3.00
- 1808A. **Condenser Attachment** for No. 1808 Electroscopes, for demonstrating that the plates of a galvanic cell are statically charged. Consists of two heavy brass plates, one of which is provided with an insulating handle, the other with a rod for attaching to the electroscopes. By use of these plates it may easily be shown to a large class that a positive charge is always found on the copper electrode and a negative on the zinc electrode..... 2.25

**Braun Electrometers.** See Catalog K for description.

Catalog No. ....	1809.	1809A.	1809B.	1809C.
Price .....Duty free	\$15.60	12.30	17.40	19.50



No. 1809D.



No. 1809E.

- 1809D. **Braun Electroscope**. A light aluminum vane about 12 cm. long; is mounted on cone bearings in a metal frame of such shape that when a charge of electricity is given to it the vane is repelled and stands at an angle to the upright part of the frame. The size of this angle is used to measure the quantity of the electric charge. The electroscopes is supported on an insulating base from which it is removable for use with No. 1809E Conducting Rod..... 3.35
- 1809E. **Conducting Rod**. A wooden rod about one meter long mounted on insulating supports, provided with a binding post at each end, and with holes for the insertion of from one to five No. 1809D Electroscopes. When this rod is slightly moistened and one end connected to a static machine terminal wire, the other being grounded; the fall of potential along the rod may readily be seen by means of the different angles at which the electroscopes vanes stand..... 3.00

- 1810. **Precision Electroscope.** See Catalog K for description....Duty free \$ 55.00
- 1810A. **Electrometer.** See Catalog K for description.....Duty free 75.00
- 1810B. **Electrometer.** See Catalog K for description.....Duty free 60.00
- 1810C. **Ionization Cylinder.** See Catalog K for description.....Duty free 6.00
- 1810D. **Charging Rod.** See Catalog K for description.....Duty free 4.50
- 1810E. **Collection of Radio-Active Preparations.** See Catalog K...Duty free 30.00
- 1810F. **Fontactoscope.** See Catalog K for description.....Duty free 75.00

1810K. **Spinthariscopes**, for demonstrating **Radium Energy**, pocket form, consisting of a tube 1½ inches long, with a fluorescent screen at one end, a movable pointer carrying radium salt placed over it, and an adjustable magnifier at the other.

With this instrument scintillations produced by the constantly emanating alpha particles as they strike the screen are made visible in the most marvelous manner. In order to observe this phenomenon in the day-time, the observer should remain in a darkened room for a short time, so that the eye may become sufficiently sensitive. The screen should then be carefully focused by pulling out the lens end of the instrument.....



9.00

No. 1810K.

1810P. **Cloud Apparatus**, as designed by Prof. Chas. T. Knipp of the University of Illinois. This is a simple piece of apparatus for use in performing the celebrated experiment of Prof. C. T. R. Wilson on the production of clouds. The apparatus consists of a glass bulb, with graduated tube, having two openings. To one, the larger, is attached a stiff rubber bulb, to the other a nipple for the introduction of the gases, etc., to be investigated.

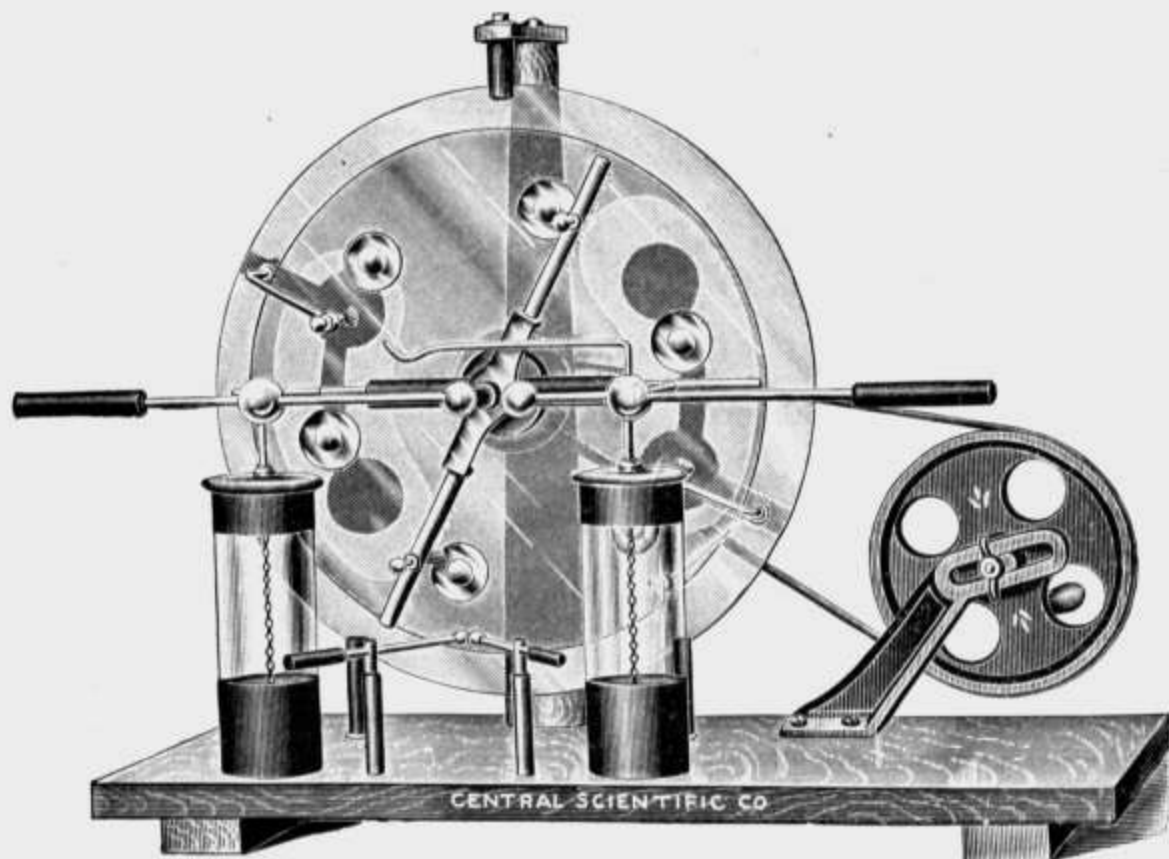
To operate, fill the hand bulb and the tube with water to some convenient mark on the graduation, and close the nipple by a rubber tube and clamp. Now by compressing the rubber bulb moderately and then releasing suddenly, a dense cloud, in general, will be formed in the glass bulb. Repeated compressions and expansions will bring down clouds of rapidly diminishing densities. Having freed the condensing chamber of dust particles, a dense cloud can again be formed by compressing the bulb firmly and then releasing. The apparatus is now ready for the performance of a number of interesting and striking experiments. The formation of a single drop in the expansion chamber is not an uncommon sight. As is well known when the drops are few they are of large size and fall rapidly, while dense clouds formed in dust-laden air, or in dust-free air exposed to an ionizing agent, are composed of small drops, exhibit color effects and often may be quite opaque. This cloud settles slowly. The effect of the dust is shown in a marked way of drawing into the glass bulb a whiff of air laden with chalk dust. An exceedingly opaque cloud is obtained by presenting the nipple to a burning match and drawing in some of the particles of carbon. It requires some twenty or thirty expansions to free the bulb of these particles. Dense clouds are formed by drawing in the gases through which an electric discharge is passing. The ionized air from the active side of a Roentgen ray bulb gives a marked effect. These cloud effects can be projected readily on a screen. The graduations permit qualitative as well as quantitative experiments to be made. (For full description see "Science," Dec. 24, 1909.).....



No. 1810P.

3.35





No. 1811.

## 1811. "Mars" Toepler-Holtz Static Machine, improved form.

The ESSENTIAL FEATURES of this machine are: Simplicity in construction, certainty of operation, rapidity of discharge and length of spark. These have been combined in a very satisfactory manner.

The CONSTRUCTION is so simple that there can be no trouble in putting it together; all parts are interchangeable.

The DRIVING WHEEL is equipped with our improved belt tightener, and the machine works very easily and without noise.

The BRUSHES are made of tinsel, which has been found to be much superior to wire.

The CONDENSERS are of the best Leyden jar glass and their size well proportioned to that of the machine.

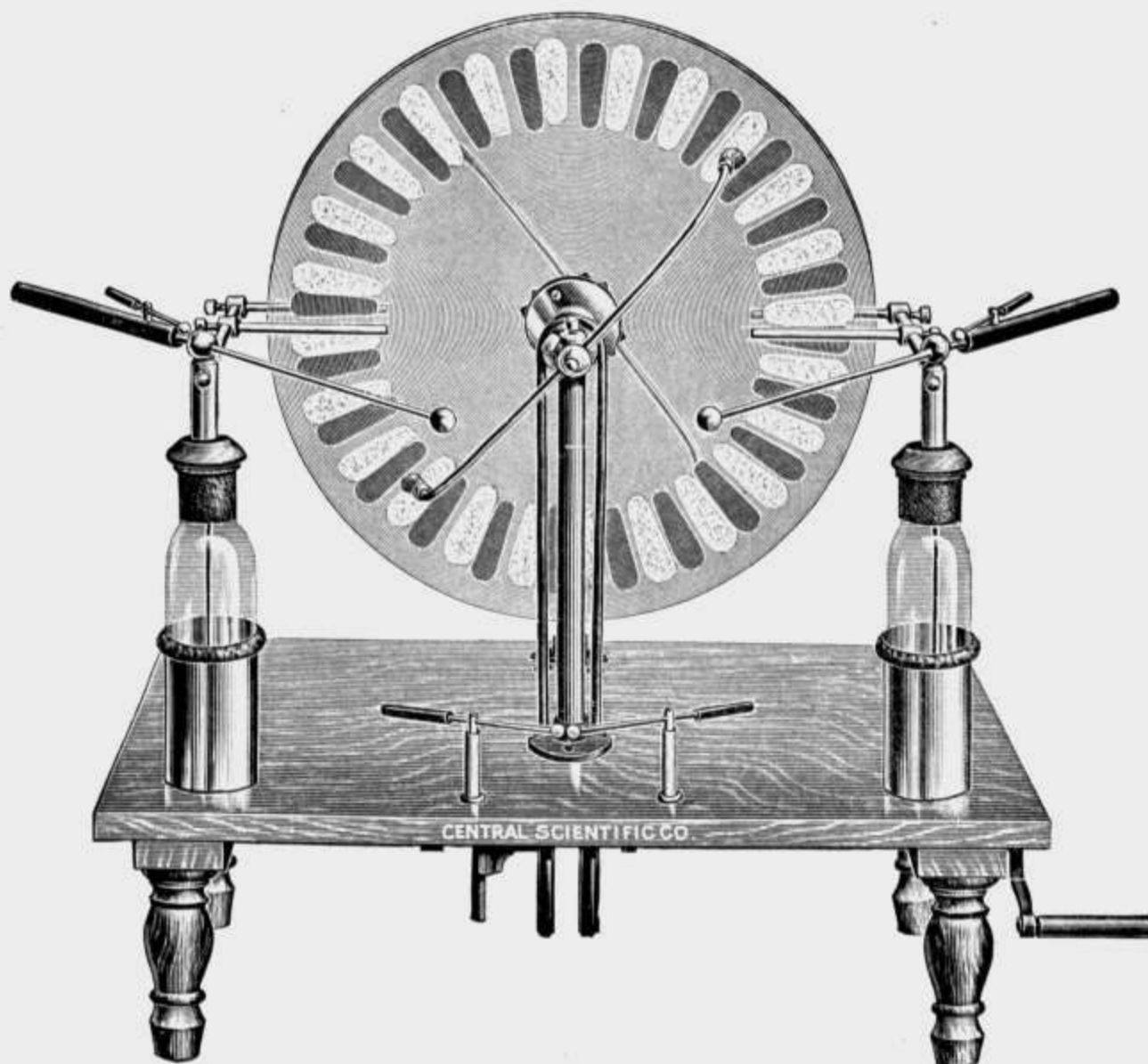
The PLATES are treated in the most approved manner to obviate trouble from moisture and imperfections.

The BASE and PILLAR are of polished hardwood, the driving wheel of japanned iron, the brass parts are all nickel plated and the insulation is of pure vulcanite, highly polished.

The machine is equipped with a CURRENT BREAKER, which admits of varying the intensity and rate of discharge; a pair of nickel plated shocking handles and chains, and an attachment for holding accessories, such as bell chimes, image plates, etc.

Will give a SPARK of from 3 to 6 inches, depending upon weather conditions and care used in adjustment. Revolving plate 12-inch, stationary plate 14-inch..... \$ 19.00

For Repairs for Static Machines, see Nos. 1921 to 1959.



No. 1816.

1816. **Wimshurst Self-Charging Static Machine**, new design. This type of static machine is regarded by leading scientists, both in Europe and America, as a considerable advance over all forms of static generators now in general use.

The Wimshurst type is very slightly affected by moisture or atmospheric changes and works **WITHOUT CHANGE OF POLES**. This fact alone makes the use of this machine much more satisfactory than that of a machine (such as the Toepler-Holtz) in which the poles may reverse at any moment. For this reason the Wimshurst machine is much better suited for X-Ray work than any other type. In addition, the machine is provided with a **SPARK GAP ATTACHMENT**, especially adapting it to X-RAY WORK.

The machine is provided with a **CURRENT BREAKER**, by means of which the outer coats of the Leyden Jars may be either connected or disconnected, thus allowing either an intermittent spark discharge or a continuous discharge to be taken from the instrument. It is practically without exception **ALWAYS READY FOR IMMEDIATE USE**, and will give sparks from  $\frac{1}{4}$  to  $\frac{1}{2}$  the plate's diameter.

It is of the finest construction, being built of the best materials, with mahogany-finish hardwood base, japanned iron support, nickel plated brass parts and pure rubber insulation.

The **PLATES** are of glass carefully treated to obviate trouble from moisture and imperfections, and are 20 inches in diameter..... \$ 50.00

1818. **Wimshurst Static Machine**, with hard rubber plates 8 inches in diameter, mounted on a lacquered iron base. Spark length about 2½ inches ..... 10.00

1819. **Static Machine**, for heavy currents. See Catalog K.....Duty free 150.00

1819A. **Static Machine**, for heavy currents. See Catalog K.....Duty free 184.00

1820. **Static Machine**, for heavy currents. See Catalog K.....Duty free 195.00

1820A. **Static Machine**, for heavy currents. See Catalog K.....Duty free 240.00

For Repairs for Static Machines, see Page 150.



No. 1821.



No. 1827.



No. 1831.



No. 1835.

1821.	Handles for shocking, nickel plated. Per pair.....	\$ 0.45
1823.	Brass Chains, with ring and snap for connecting accessories to static machine. Per pair.....	.17
1825.	Brass Chain, per yard.....	.06
1827.	Insulated Stool, hardwood, 12x14 inches, with glass legs.....	3.00
1829.	Leyden Jar, pint size, special glass, hardwood top, nickel plated brass rod and ball; jar 3 inches in diameter, 6 inches high.....	1.50
1831.	Leyden Jar, same as No. 1829, quart size; jar 4 inches in diameter, 7½ inches high.....	1.65
1833.	Leyden Jar, same as No. 1829, two-quart size; jar 5 inches in diameter, 9¼ inches high.....	2.00
1835.	Leyden Jar, quart size, with movable coatings.....	2.90



No. 1845.



No. 1849.



No. 1851.

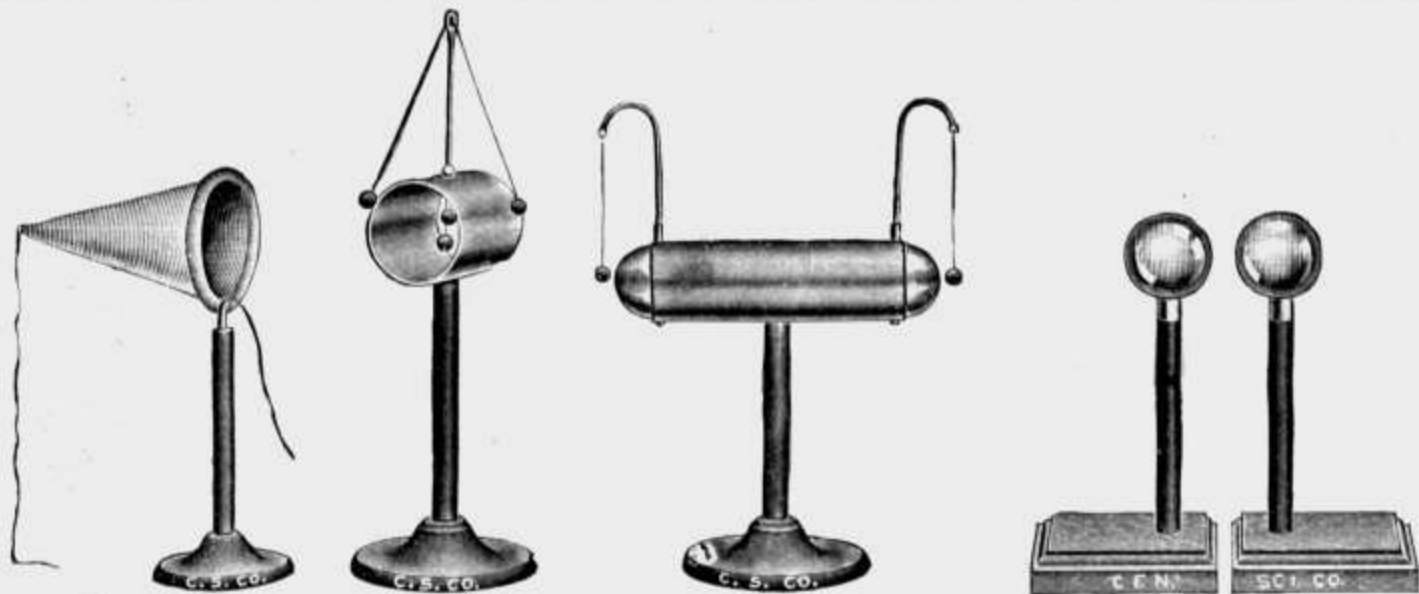


No. 1861.

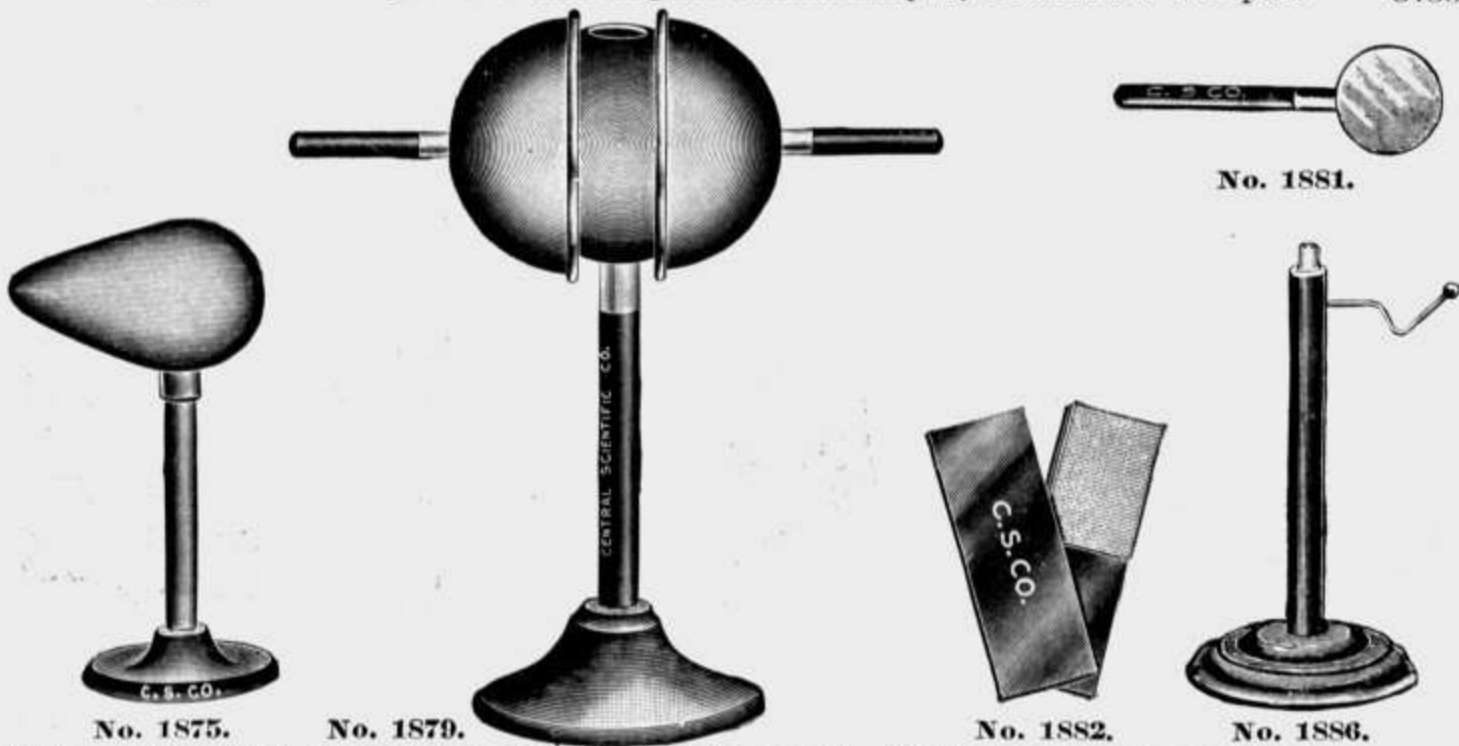


No. 1866.

1843.	Discharger, rubber handle, plain form, fixed arms.....	.66
1845.	Discharger, 7½ inch arms, jointed, rubber handle.....	1.50
1849.	Ether Spoon.....	.75
1851.	Powder Bomb, of wood.....	1.25
1855.	Egg Shell, covered with aluminum paint (superior to tin foil), and suspended by a silk thread.....	.25
1859.	Image Plates, nickel plated, 15 cm. in diameter, one with handle, the other with hook, for hanging from support of the static machine. When pith images are placed between the charged plates the images commence to dance. Without images.....	1.35
1861.	Image Plates, on adjustable stand, without images..... For Pith Images, see No. 1796.	2.50
1866.	Faraday's Wire Cylinder. A cylinder of wire gauze 20 cm. by about 11 cm. in diameter, closed with wire gauze at one end. Useful for protecting Nos. 1805 and 1806 Electroscopes from external electric fields and for other similar purposes..... For Support for No. 1866, see Nos. 5367-9.	.45



- No. 1867. Faraday's Bag. When the bag is charged and pulled inside out, the static charge always remains on the outside. On insulating stand.. \$ 1.10
- No. 1871. Hollow Cylinder, brass, nickel plated, 6.3 cm. in diameter by 7.5 cm. long, on an insulating stand, with pith balls, showing that electricity resides only on the outer surface of bodies..... 2.00
- No. 1873. Induction Cylinder, brass, nickel plated, 5 cm. in diameter by 20 cm. long, on insulating stand, with removable pith ball holders..... 2.75
- No. 1874. Induction Spheres of brass, nickel plated, 5 cm. in diameter, so mounted on insulating supports that they can be brought into contact. Useful in connection with No. 1873 Cylinder for showing the separation of positive and negative electricity by induction. Per pair 3.35



- No. 1875. Ellipsoidal Conductor, brass, nickel plated, 10x15 cm., on insulating stand, showing unequal distribution..... 4.00
- No. 1879. Hollow Globe, of brass, nickel plated, on insulating stand, with hole for proof plane, to show that a charge resides only on the outside.. 1.80
- No. 1881. Proof Plane. A metal disc on 15 cm. vulcanite handle for transporting a charge from one body to another..... .22
- No. 1882. Ebonite Strips. One plain, the other with half of one face covered with flannel. For illustrating equality of positive and negative charges produced by friction. Size, 3x1 inches..... .50
- No. 1886. Universal Support, about 20 cm. high, for holding electrostatic accessories. Consists of a hard rubber rod mounted on a japanned iron base. At the top is a metal piece which fits a socket in the base of the accessories, and to which is connected a hook for attaching a chain from a static machine..... .80

See also No. 1786 Flannel Cap.



No. 1887.



No. 1888.



No. 1891.

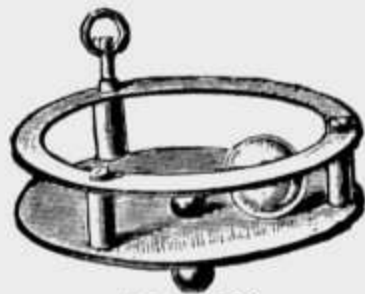


No. 1893.

- |       |   |    |      |
|-------|---|----|------|
| 1887. | <b>Electrical Chimes</b> , five bells. Illustrates attraction and repulsion of charges. Designed to fit No. 1886 Support.....   | \$ | 2.75 |
| 1888. | <b>Electrical Chime</b> , two bells. Illustrates attraction and repulsion of charges. To suspend from the static machine attachment.....  |    | .90  |
| 1891. | <b>Volta's Hail Storm or Dancing Balls</b> . Disc charged from static machine causes balls to dance rapidly. Designed to fit No. 1886 Support....   |    | 2.75 |
| 1893. | <b>Smoke Condenser</b> . The glass shade is filled with smoke from a punk candle, which is condensed upon the glass, when a charge from a static machine is applied. Designed to fit No. 1886 Support. Including three smoke candles..... |    | 2.75 |
| 1895. | <b>Smoke Candles</b> , three in tin box, for use with No. 1893.....   |    | .11  |



No. 1897.



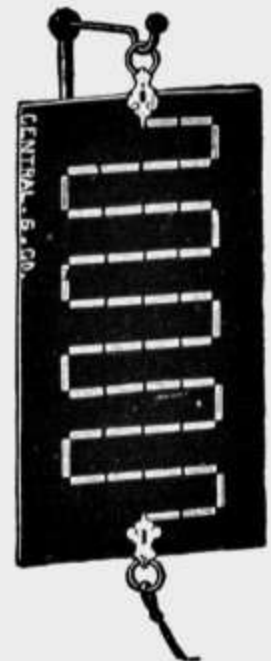
No. 1899.



No. 1901.



Nos. 1903 & 2005. Nos. 1903 & 1905.



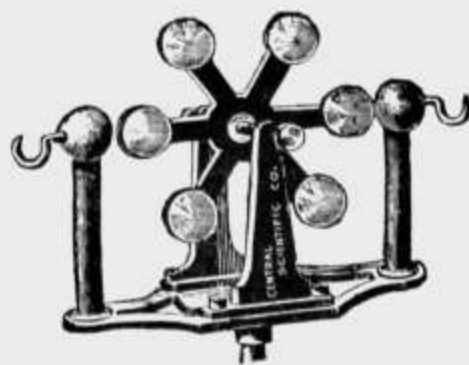
- |       |  |  |      |
|-------|--|--|------|
| 1897. | <b>Electrical Whirl or Flier</b> . When the whirl receives a charge, it rotates rapidly. Illustrates great density of charge at a point. Designed to fit No. 1886 Support.....   |  | .67  |
| 1898. | <b>Electrical Whirl or Flier</b> , complete with simple stand.....   |  | .90  |
| 1899. | <b>Electrical Circus or Racing Ball</b> . When connected with a static machine the glass ball will race around the plate. Designed to fit No. 1886 Support .....   |  | 1.75 |
| 1901. | <b>Electrical Plume</b> , of paper, illustrating repulsion. When attached to a static machine the strips of paper will repel each other and spread far apart. Designed to fit No. 1886 Support.....                          |  | .50  |
| 1903. | <b>Holder</b> for Geissler tubes and lightning plate. Designed to fit No. 1886 Support. Without tube.....  |  | .50  |
| 1905. | <b>Lightning Plate</b> , of vulcanite, about 10x20 cm. A charge sent across the plate through the foil, in which are several air gaps, will spark across the gaps. For suspension from No. 1903 Holder. Without holder ..... |  | 1.10 |



No. 1906.

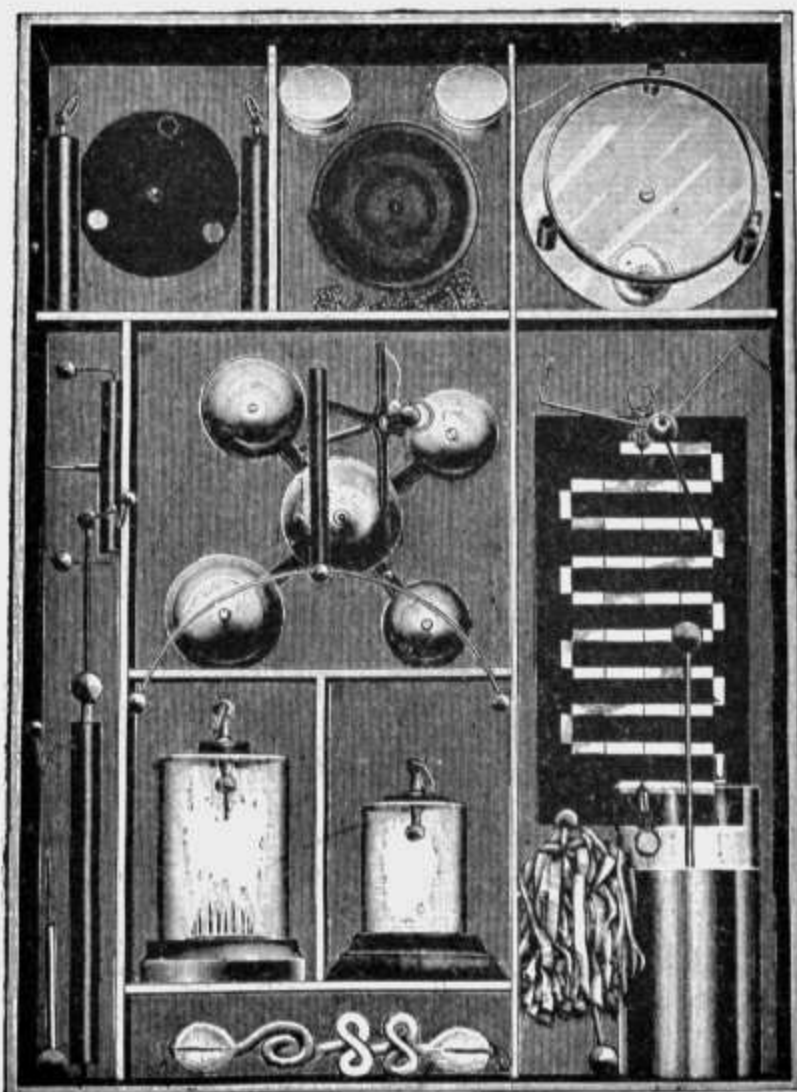


No. 1907.



No. 1913.

- |       |  |         |
|-------|--|---------|
| 1906. | <b>Spiral Tube.</b> A charge sent through the tube will show a series of sparks where it crosses the gaps. Total length of tube about 30 cm. Designed to fit No. 1886 Support..... | \$ 1.10 |
| 1907. | <b>Rotating Disc.</b> Will rotate rapidly when connected to static machine. Disc about 8 cm. in diameter. Designed to fit No. 1886 Support....                                     | 1.50    |
| 1913. | <b>Electrostatic Motor.</b> Will rotate at high speed when connected to static machine. Designed to fit No. 1886 Support.....  | 5.55    |



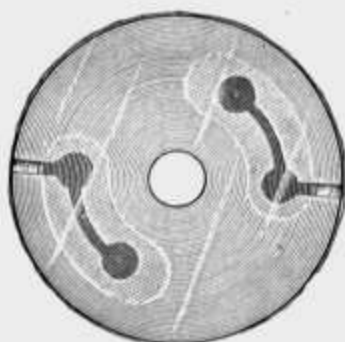
No. 1915.

- |       |   |       |
|-------|---|-------|
| 1915. | <b>Electrostatic Demonstration Outfit,</b> consisting of Universal Support - No. 1886 and the accessory apparatus Nos. 1887, 1891, 1893, 1895, 1897, 1899, 1901, 1903, 1905, 1907 and also 6-inch Geissler Tube No. 2001, Brass Chains No. 1823, Leyden Jar No. 1829, Discharger No. 1843 and Handles No. 1821. Put up in a strong cardboard compartment box. This set, together with a Static Machine, forms a very complete outfit covering Static Electricity..... | 17.50 |
|-------|---|-------|

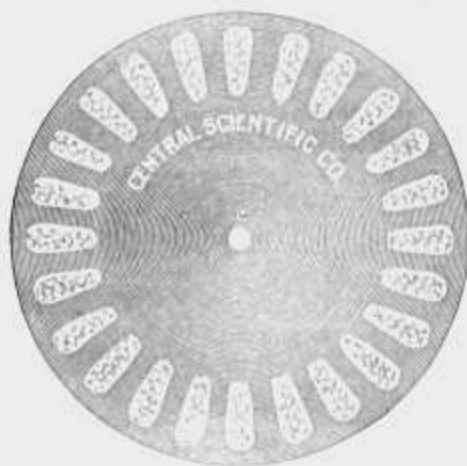
REPAIRS FOR STATIC MACHINES.



No. 1921.



No. 1923.



No. 1932.

1921.	Revolving Glass Plate for No. 1811, 12 inch, finished; 1 inch center hole .....	\$ 1.50
1923.	Stationary Glass Plate for No. 1811, 14 inch, finished; 2½ inch center hole .....	2.00
1925.	Revolving Glass Plate, 10½ inch, finished; 1 inch center hole.....	1.40
1927.	Stationary Glass Plate, 12 inch, finished; 2 inch center hole.....	1.80
1929.	Revolving Glass Plate, 14 inch, finished; 1 inch center hole.....	2.00
1931.	Stationary Glass Plate, 16 inch, finished; 2¾ inch center hole.....	2.25
1932.	Glass Plate for No. 1816, 20 inch, finished; ¾ inch center hole.....	6.65



No. 1937.



No. 1939.



No. 1942.



No. 1943.



No. 1947.

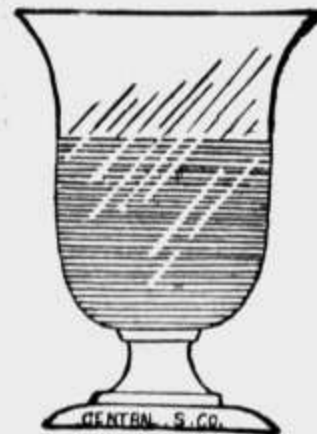
1937.	Leyden Jar for No. 1811, 2⅛ inches diam., 6¼ inches high, tin foiled..	.45
1939.	Leyden Jar for No. 1816, 2⅞ inches diam., 8 inches high, tin foiled...	.66
1942.	Brush Arm with washer and rubber nut to fasten to No. 1923 Stationary Plate .....	.40
1943.	Brush Holder with Brush for No. 1811.....	.27
1945.	Brush, refilling only.....	.06
1947.	Disc and Button, one piece, of metal, ½ inch disc, 1⅜ inch button, for Revolving Plates .....	.08
1953.	Tin Foil, pure, for coatings. Thickness, 0.0005 inch. One pound equals about 50 square feet. Per square foot, 0.10; per pound.....	1.45
1954.	Tin Foil, pure, for coatings. Thickness, 0.0015 inch. One pound equals about 16 square feet. Per square foot, 0.17; per pound.....	1.25
1955.	Leather Belting, round. Diameter, inches .....	1/8      7/32      5/8
	Per foot.....	.06      .07      .10
1959.	Amalgam, per ounce bottle.....	.30

VACUUM TUBES AND ACCESSORIES.

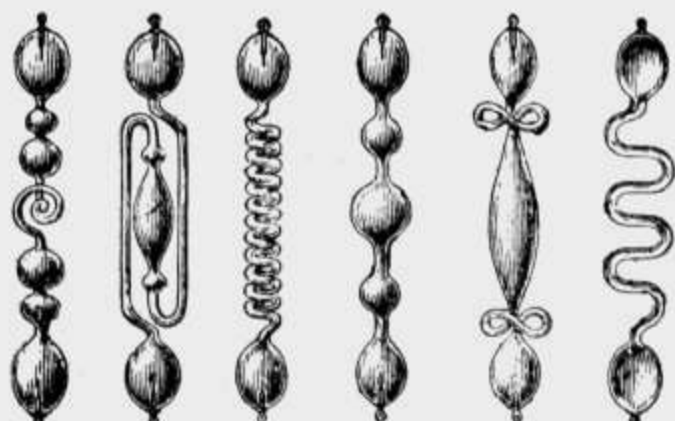


No. 1993.

1993.	Aurora Tube, 12 inches long, with platinum electrodes. When a spark is passed through tube a beautiful colored glow is observed....	1.35
	Aurora Tube combined with Guinea and Feather Tube, see No. 1435.	
1994.	Vacuum Tube, 8 inches long, for exhausting. In shape similar to No. 1993.....	1.00
1995.	Gassiot's Cascade for showing the effect of atmospheric pressure on an electric discharge..	1.65



No. 1995.



No. 2003.



No. 2009.



No. 2017.

Geissler Tubes Nos. 2001-2007 are filled with highly attenuated air and are made in a variety of designs of uranium, iron and lead glass, showing both the effect of design in illumination and the effect of the kind of glass. The glass has a fluorescence as follows:  
 Uranium—Yellow.      Iron—Green.      Lead—Blue.

2001.	Geissler Tube, six-inch.....	\$	0.45
2003.	Geissler Tubes, six-inch, set of six assorted in box.....		2.50
2005.	Geissler Tube, eight-inch.....		.70
2007.	Geissler Tubes, eight-inch, set of six assorted in box.....		4.00
2009.	Geissler Tube, Demonstration Form, 11 inches high, with uranium glass spiral in bulb, complete with leaded base.....		3.00
2017.	Fluorescent Tube, eight inches long. This is a double tube, the inner one being of a variety of shapes of uranium glass, the outer being filled with a fluorescent liquid such as eosine, quinine, kerosene, aesculine and uranine. Each.....		.80



No. 2018A.



No. 2018B.



No. 2018C.



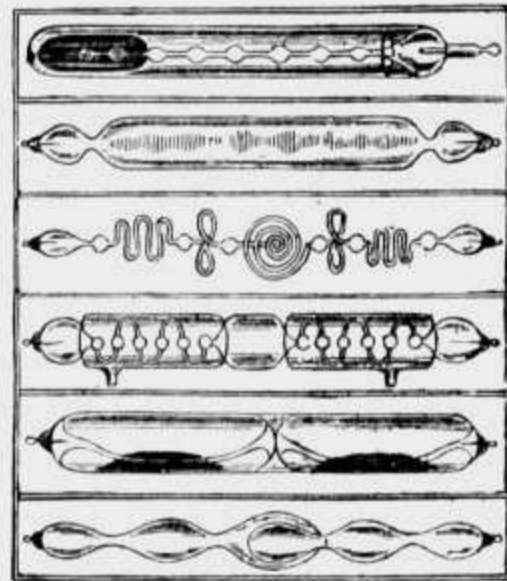
No. 2020.

Geissler Tubes, Nos. 2018A, B and C, are made entirely of glass and are very attractive in design. The tubes are filled with colored fluorescent liquids, such as eosine, quinine, aesculine and uranine.

2018A.	Geissler Tube. Is oval in shape, six inches high, mounted on glass foot.....	1.65
2018B.	Geissler Tube. Consists of four vertical tubes of various designs, five inches high, mounted on glass foot.....	2.50
2018C.	Geissler Tube. Consists of two vertical tubes of different designs, seven inches high, mounted on glass foot.....	1.90
2019.	Phosphorescent Tube, eight inches long. Contains crystalline salts (sulphides) which phosphoresce under the action of an electrical discharge, showing how radiant matter may produce visible light..	1.00
2020.	Phosphorescent Tubes, after Lenard. A set of six sealed glass tubes containing substances of strong phosphorescent power. The chemical formula of each substance is indicated on the glass tube. These tubes give strong phosphorescent effects after exposure to radium rays, X-rays or ultra-violet rays. They are enclosed in a velvet lined case in the cover of which is set a glass plate coated on the lower side with phosphorescent paint.....Duty free	4.50
2021.	Phosphorescent Mercury Tube, eight-inch, with which no static machine or coil is needed, the friction resulting from mercury falling on globules of glass, producing a beautiful phosphorescent glow....	1.50



2023. **Lecture Set of Geissler Tubes.** A set of six 10-inch tubes, including one double Induction Tube containing oxygen and nitrogen, one Phosphorescent Tube, one Fluorescent Tube, one Nitrogen Scroll Tube, one Hydrogen Stratification Tube and one Mercury Tube, complete, in a neat compartment box ..... \$ 11.00



No. 2023.

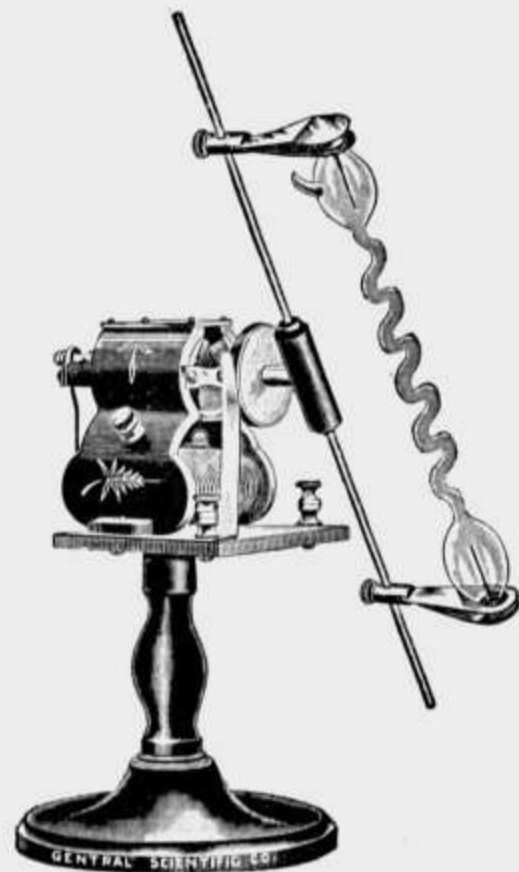


No. 2025.

2025. **Spectrum Tube**, for spectrum analysis, 10 inches long, filled with OXYGEN GAS ..... 1.65
- 2025A. **Spectrum Tube**, same as No. 2025, but filled with HYDROGEN GAS.. 1.65
- 2025B. **Spectrum Tube**, same as No. 2025, but filled with NITROGEN GAS.... 1.65
- 2025C. **Spectrum Tube**, same as No. 2025, but filled with CARBONIC ACID GAS ..... 1.65
- 2025D. **Spectrum Tube**, same as No. 2025, but filled with WATER VAPOR... 1.65
- 2025E. **Spectrum Tube**, same as No. 2025, but filled with IODINE VAPOR.... 1.65
- 2025F. **Spectrum Tube**, same as No. 2025, but filled with BROMINE VAPOR. 1.65
- 2025G. **Spectrum Tube**, same as No. 2025, but filled with CHLORINE GAS... 1.65
- 2025H. **Spectrum Tube**, same as No. 2025, but filled with MERCURY VAPOR. 1.65

For other Spectrum Tubes, see Catalog K.

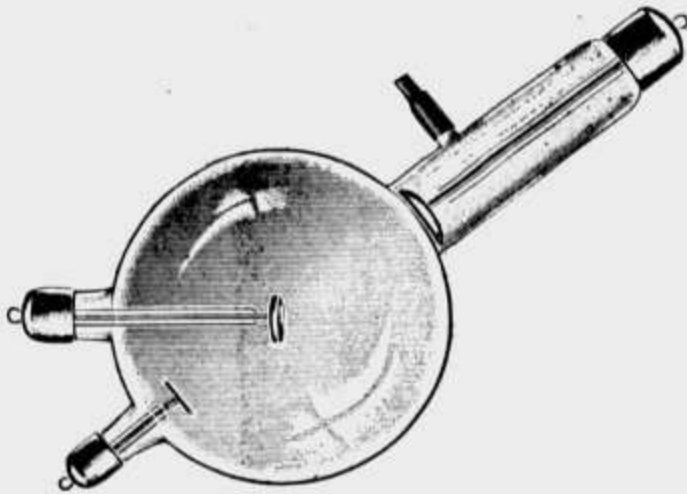
2027. **Geissler Tube Rotator.** A standard Porter motor, No. 2,  $\frac{1}{90}$  H. P., mounted upon a heavy iron standard, with binding posts, etc., for connecting terminals of tube to induction coil. Will carry any tube listed in this catalog, and requires very little battery power, a one-quart Grenet cell being sufficient to operate the motor. This Rotator may also be used to rotate color discs, siren discs, etc., and an attachment for holding discs is included. Complete.. 13.30



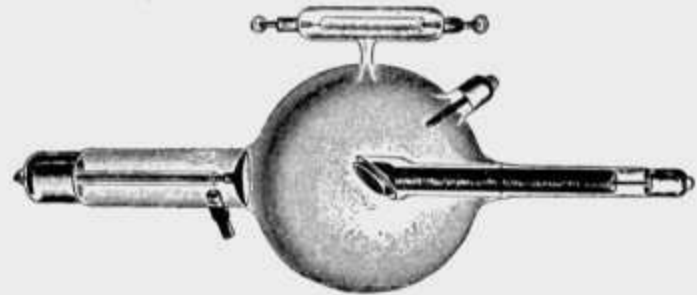
No. 2027.

### X-RAY TUBES.

All our X-Ray Tubes are of the celebrated Gundelach make and are tested for the size of Static Machine or Coil indicated in the description.

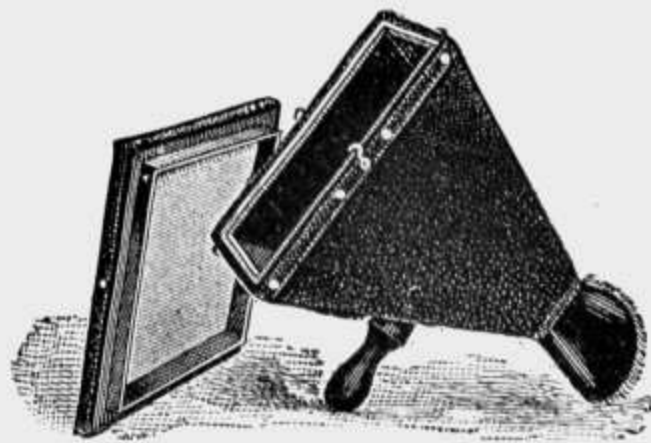


No. 2035.



No. 2042.

- |        |   |        |       |
|--------|---|--------|-------|
| 2035.  | <b>X-Ray Tube</b> , adjusted for No. 1816 Static Machine, or any other Static Machine giving a thick, fat spark 4 inches long.....  | Net \$ | 6.00  |
| 2036.  | <b>X-Ray Tube</b> , same as No. 2035, but with Osmium Regenerating Device . . . . .   | Net    | 7.50  |
| 2037.  | <b>X-Ray Tube</b> , for large Static Machine giving a thick, fat spark from 4 inches to 6 inches long.....  |        | 6.40  |
| 2038.  | <b>X-Ray Tube</b> , same as No. 2037, but with Osmium Regenerating Device   |        | 9.50  |
| 2041.  | <b>X-Ray Tube</b> , adjusted for an Induction Coil giving a 6-inch spark..  | Net    | 10.00 |
| 2041A. | <b>X-Ray Tube</b> , same as No. 2041, but with Osmium Regenerating Device   |        | 10.85 |
| 2042.  | <b>X-Ray Tube</b> , with heavy anode. This type is necessary when an electrolytic interruptor is used, and will give better service with an ordinary 6-inch induction coil than No. 2041. Supplied with Electrical Regenerating Attachment..... | Net    | 15.00 |
| 2042A. | <b>X-Ray Tube</b> , same as No. 2042, but larger; for use with 8-inch spark coil . . . . .  | Net    | 16.00 |
| 2042B. | <b>X-Ray Tube</b> , same as No. 2042, for use with 10-inch spark coil.....  | Net    | 26.00 |
| 2042C. | <b>X-Ray Tube</b> , same as No. 2042, for use with 12-inch spark coil.....  | Net    | 28.00 |
- For Tube Stand, use No. 5345.

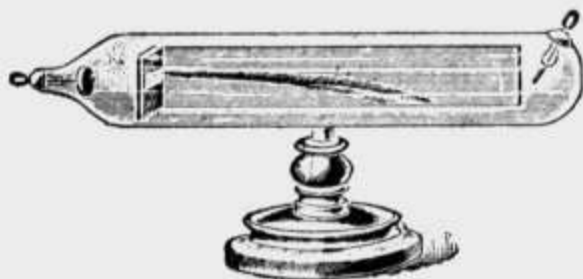


No. 2045.

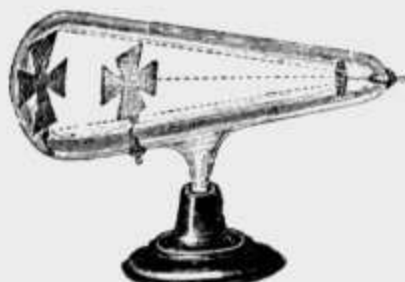
- |        |   |                                 |       |
|--------|---|---------------------------------|-------|
| 2045.  | <b>Fluoroscope</b> , with removable 4x5-in. Platinum Barium Cyanide Screen  |                                 | 9.00  |
| 2045A. | <b>Platinum Barium Cyanide Screen</b> only, of No. 2045, mounted in frame ready for insertion in Fluoroscope..... |                                 | 6.65  |
| 2047.  | <b>Fluoroscope</b> , with removable 5x7-in. Platinum Barium Cyanide Screen  |                                 | 12.50 |
| 2047A. | <b>Platinum Barium Cyanide Screen</b> only, of No. 2047, mounted same as No. 2045A. . . . .                       |                                 | 10.50 |
| 2053.  | <b>Cramer X-Ray Plates for Radiographs</b> , recognized as the best plate for this purpose on the market.         |                                 |       |
|        | Size, inches . . . . .  | 5x7      6x8½      8x10         |       |
|        | Per dozen . . . . .   | Net \$ 1.40      2.10      3.00 |       |
- For Static Machine for X-Ray work, see No. 1816.  
For Induction Coils for X-Ray work, see Nos. 2240 to 2243J.



No. 2061.



No. 2063.



No. 2065.



No. 2067.



No. 2069.



No. 2070.

- 2061. **Crookes' Tube**, for showing heating effect of cathode rays. The negative electrode is concave and a piece of foil is placed in the center of the sphere of which the cathode is a section. The rays come to a focus upon the foil and heat it white hot..... \$ 7.75
- 2063. **Crookes' Tube**, for showing deflection of cathode rays by a magnet. At one end is a mica screen with a slit which allows a definite beam of rays to pass through it. The path of these rays is traced by fluorescence produced upon a prepared screen, and the deflection of this fluorescent line upon the approach of a magnet is readily seen. 6.65
- 2065. **Crookes' Tube**, for showing shadow of a cross. A metal cross is placed in the path of the cathode rays and casts a shadow in the fluorescence produced where the electrons strike the walls of the tube. This form of the tube may also be used to show the deviation of the cathode rays by an electromagnet. Without electromagnet... 7.50
- 2067. **Crookes' Tube** containing several minerals which phosphoresce with different colors under the influence of the discharge..... 2.25
- 2069. **Vacuum Tube**, spherical shape with four electrodes, low vacuum. In this tube the path of the discharge may be traced by its colored light from the cathode to whichever of the other three electrodes is made the anode..... 4.00
- 2070. **Vacuum Tube**, spherical shape with four electrodes, high vacuum. In this tube the discharge shows no visible path between cathode and anode but the cathode rays travel in straight lines from the cathode, and cause fluorescence of the walls of the tube directly opposite.. 5.50



No. 2073.



No. 2075.

- 2073. **Holtz' Tube**. This tube has a series of partitions provided with funnel-shaped openings to show that the discharge will pass in but one direction through such openings..... 2.50
- 2075. **Lenard's Tube**, original form, for showing power of cathode rays to penetrate an aluminum window. Ready to attach to an air pump, but not exhausted.....Duty free 9.90
- 2080. **Vacuum Scale**. Set of six tubes 50 cm. long, to show the effect of different degrees of exhaustion upon the electrical discharge.
  - No. 1. 40 mm. vacuum. Gives a violet band at the anode and a small point of light at the cathode. No. 2. 10 mm. vacuum. Shows the beginning of the cathode dark space. No. 3. 6 mm. vacuum. The tube is nearly filled with light and the cathode dark space is longer than in No. 2. No. 4. 3 mm. vacuum. Shows stratification and beginning of the second dark space. No. 5. 0.14 mm. vacuum. Shows considerable green fluorescence where the cathode rays strike the glass. No. 6. 0.03 mm. vacuum. So-called Roentgen vacuum. The greenish fluorescence is very marked and X-rays are given off.
 Complete with support frame and connectors.....Duty free 10.80

# CURRENT ELECTRICITY



No. 2095.

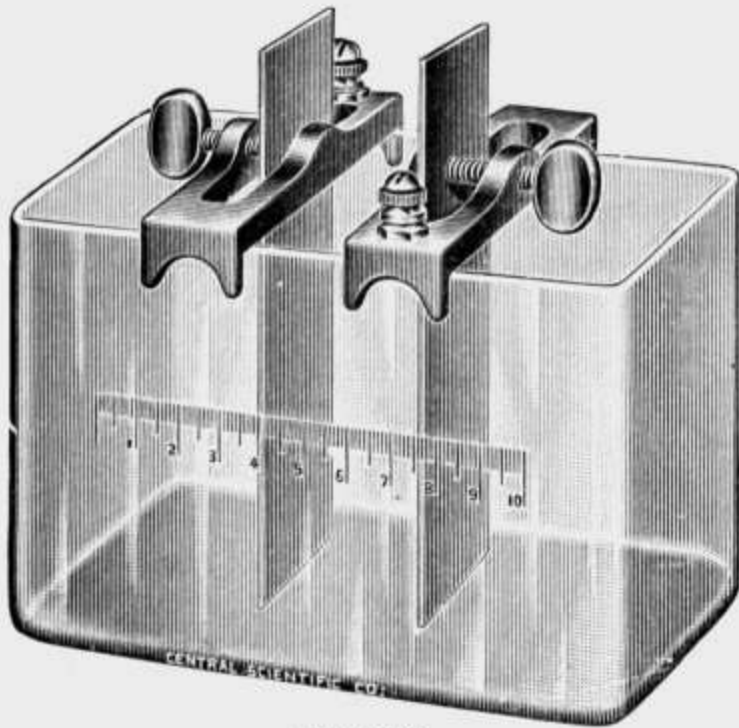


No. 2100.



No. 2110.

2095. **Polarity Indicator.** Indicates instantly the negative and positive poles when connected in circuit. Size, 1x3½ in. Nickel plated shell which covers and protects the glass tube from injury. For voltages up to 50.... \$ 1.66
2096. **Polarity Indicator.** Same as No. 2095, but for voltages from 50 to 600 ..... 1.66
2099. **Pole-Indicating Paper.** When two electrical leads, or terminals, are placed close together upon a piece of the moistened paper, the negative pole shows a red stain. Per book of 25 strips..... .05
2100. **Simple Copper Element,** strip 12.5 cm. long, with wire attached..... .06
2101. **Simple Zinc Element,** strip 12.5 cm. long, with wire attached..... .06
2102. **Tumblers,** 60 to 65 mm. in diameter at the top, for simple cell, each.. .05
2105. **Zinc Element,** 10x2.5x.06 cm., with wire attached..... .11
2106. **Copper Element,** 10x10 cm., with wire attached..... .11
2110. **Student's Demonstration Battery.** An excellent battery for studying the laws of the voltaic cell, such as internal resistance, effects of amalgamating the zinc, use of various solutions, etc.  
 With a complete set of elements (See No. 2110½), the various forms of batteries in common use are readily assembled, namely: Simple Voltaic, Bunsen, Grenet, Daniell, Gravity and LeClanche.  
 The cap which fits the glass tumbler is made of porcelain, which is acid proof and will not warp.  
 The clamps will hold either flat or round elements and, as they are attached to the cap by a swivel joint, the distance between the elements can be varied at will.  
 The clamps are insulated from each other so that there can be no short circuit between the elements. The elements can be removed without disconnecting the lead wires.  
 Cell, complete, including No. 2110S Cap, No. 2102 Tumbler, No. 2110D Zinc and No. 2110E Copper Elements..... .55
- 2110½. **Student's Demonstration Battery,** complete, with No. 2102 Tumbler, No. 2110S Cap, No. 2110A Porous Cup, and all the elements listed below from B to L. With this outfit a very complete ELECTRO-MOTIVE SERIES may easily be determined..... 1.33
- 2110A. **Porous Cup,** 3x7.5 cm. inside..... .11
- 2110B. **Zinc Pencil,** 14x1x1 cm..... .05
- 2110C. **Carbon Pencil,** 14x0.6 cm..... .05
- 2110D. **Zinc Element,** flat, 12.5x2 cm..... .05
- 2110E. **Copper Element,** flat, 12.5x2 cm..... .05
- 2110F. **Lead Element,** flat, 12.5x2 cm..... .05
- 2110G. **Iron Element,** flat, 12.5x2 cm..... .05
- 2110H. **Aluminum Element,** flat, 12.5x2 cm..... .05
- 2110J. **Carbon Element,** flat, 12.5x2 cm..... .05
- 2110K. **Tin Element,** flat, of pure block tin, 12.5x2 cm..... .10
- 2110L. **Nickel Element,** flat, 12.5x2 cm..... .22
- 2110S. **Porcelain Cap** with clamps for No. 2110 Demonstration Battery. Fits No. 2102 Tumbler..... .45



No. 2107.



No. 2109R.

2107. **Gotham Demonstration Cell.** Consists of a pair of No. 2109S Element Holders made of **non-corrosive**, Victor vanadium metal; No. 2109T Glass Jar, 5½ inches long by 3 inches wide by 4 inches deep, inside measure, with a millimeter scale etched on the front side of the jar for convenience in measuring the separation of the elements; No. 2109D Flat Copper Element; and No. 2109K Flat Zinc Element.

The advantage of having the metal parts of this cell made of non-corrosive metal must be apparent to everyone who has used the ordinary demonstration cell. Much of the difficulty in former types of cells has been caused by the sticking of the screws due to corrosion and this is entirely obviated in the Gotham Cell. It will be noted that the element holders are movable along the top of the glass jar so that the effect of the separation of the elements upon the current may readily be noted by simply sliding the holders toward or away from each other.....Net \$

2107. Gotham Demonstration Cell. Same as No. 2107 but with No. 2109R Porous Cup and all the elements listed below from No. 2109A to No. 2109L inclusive .....	Net	2.10
2109A. Aluminum Element, flat, 5x1½x1/32 inches.....	Net	.05
2109B. Carbon Element, flat, 5x1½x1/4 inches.....	Net	.05
2109C. Carbon Element, round, 5 inches x ½ inch diameter.....	Net	.05
2109D. Copper Element, flat, 5x1½x1/32 inches.....	Net	.06
2109E. Iron Element, flat, 5x1½x1/32 inches.....	Net	.05
2109F. Lead Element, flat, 5x1½x1/16 inches.....	Net	.05
2109G. Nickel Element, flat, 5x1½x1/32 inches.....	Net	.30
2109H. Tin Element, flat, 5x1½x1/32 inches.....	Net	.10
2109K. Zinc Element, flat, 5x1½x1/32 inches.....	Net	.05
2109L. Zinc Element, square rod, 5x¼x¼ inches.....	Net	.05
2109R. Porous Cup, rectangular, ¾x2¾x3½ inches.....	Net	.60
2109S. Holder for Elements, each .....	Net	.35
2109T. Jar, with etched scale.....	Net	.60

**BURN-BOSTON PRIMARY BATTERY.****Features.**

- (1) Yields from three to twelve times the service of dry cells.
- (2) Will never leak or burst.
- (3) Can be stored, fully charged, for any length of time and in any climate.
- (4) Will yield all of its phenomenal electrical content whether the period of use is three months or three years.

**No. 2112.****General Description.**

A square, durable, moisture-proof case encloses a strong zinc shell which contains an exact balance of active elements, zinc, carbon, and salt solution.

Current is produced through destruction of the elements. In dry cells the process goes on continuously, whether used or not. In the Burn-Boston this process is arrested while the current is not being used. This is why the Burn-Boston lasts indefinitely.

A liquid electrolyte is of itself an advantage, but in the Burn-Boston the design is such as to insure rapid circulation, allowing for excessive overloads and obtaining an even distribution of wear throughout all parts of the current-producing material. This is the cause of our extraordinary current capacity.

The zinc shell, being insulated from the electrolyte, cannot be acted upon by it. Except for a pin hole vent the cell is tightly sealed. All sources of leakage are thus done away with.

The liquid is non-freezing, is harmless, and gives out no fumes.

The zinc connection is flexible wire permanently soldered, and cannot break loose, while the carbon terminal is a positively acting lock nut.

It is impossible to connect the cells wrongly or to damage them by handling vibration, or exposure.

**Size.**  $7\frac{1}{2} \times 2\frac{11}{16} \times 2\frac{11}{16}$  inches.

**Voltage.** 1.5 volts per cell.

**Amperage.** 20 amperes. Moderate amperage prevents wasteful discharge.

2112. Burn-Boston Primary Battery, each.....Net \$0.75

Gentlemen:—

In reply to your favor of the 28th inst., we are pleased to state that in every instance we know of where the Burn-Boston battery has been given a fair chance, the results have been entirely satisfactory.

The only instance we can recall where we know the exact length of time that Burn-Boston Batteries have lasted is in the Lorin L. Dame School, Medford, Mass., where we completed an installation of clocks on Sept. 7, 1909, using Burn-Boston Batteries, and these lasted and gave satisfaction until December, 1911, nearly two and a quarter years, which we think especially good.

Yours very respectfully,

THE E. HOWARD CLOCK COMPANY,

(Signed) E. S. Bigelow, Treas.



No. 2111.



No. 2113.

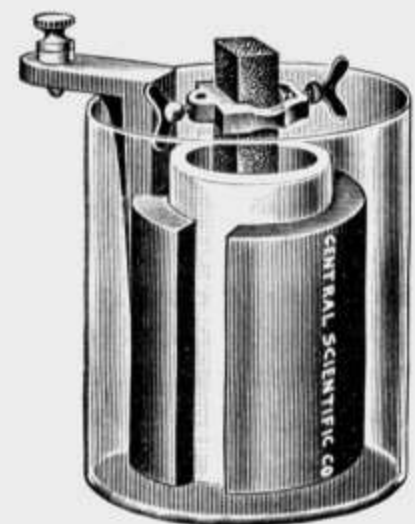


No. 2115.

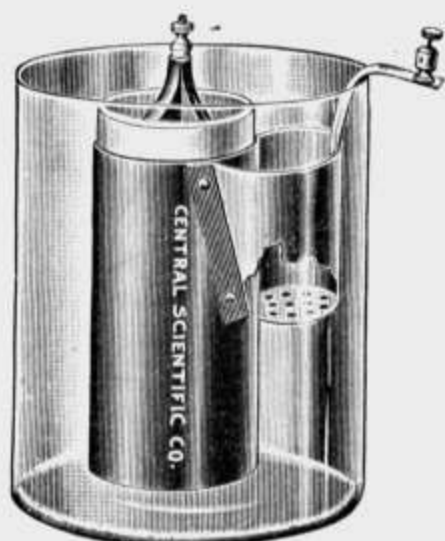


No. 2119.

2111. Dry Battery, "Columbia." The best dry cell on the market. Prof. F. R. Nichols of the Richard T. Crane Manual Training High School of Chicago has made a thorough test of dry cells, and the Columbia gave the best results: E. M. F. on open circuit, 1.5; internal resistance, 0.10; E. M. F. after delivering 1/2 ampere for thirty minutes, 1.26.....	\$ 0.28
2113. Carbon Cylinder Battery for "open circuit work." Well adapted for all telephone and bell service. E. M. F. about 1.4 volts. Cell complete, with chemicals.....	.45
2113A. Carbon for No. 2113.....	.33
2116. Zinc Rod with binding screw for No. 2113.....	.05
2113B. Jar for No. 2113.....	.25
2115. LeClanche Battery for "open circuit work," as in No. 2113, with practically the same E. M. F. Cell complete, with chemicals.....	.45
2115A. Porous Cup, sealed, for No. 2115, complete, with carbon.....	.33
2115B. Jar for No. 2115.....	.17
2116. Zinc Rod with binding screw for No. 2115.....	.05
2117. Samson Battery, No. 1. The most popular battery for "open circuit" work. It is the best, most durable and effective of all cells of the carbon cylinder type. Recuperates very quickly. E. M. F., 1.44; internal resistance, about .14. Cell complete, with chemicals.....	1.25
2117A. Zinc Cylinder for No. 2117.....	.28
2117B. Corrugated Carbon Cylinder for No. 2117.....	.83
2117C. Jar for No. 2117.....	.20
2119. Samson Battery, No. 2. Larger than No. 2117. E. M. F., 1.47; internal resistance, .11 ohm. Cell complete, with chemicals.....	1.50
2119A. Zinc Cylinder for No. 2119.....	.30
2119B. Corrugated Carbon Cylinder for No. 2119...	1.00
2119C. Jar for No. 2119.....	.25
2121. Bunsen Battery for "open circuit" work. A powerful two-fluid cell of about 1.9 volts E. M. F. and 1.86 ohms internal resistance. An excellent cell for operating induction coils, motors, etc., and for electrolysis of water. Quart size, complete.....	1.35
2121A. Zinc Cylinder with binding post for No. 2121	.75
2121B. Carbon for No. 2121.....	.11
2121C. Clamp for Carbon No. 2121B.....	.20
2121D. Porous Cup, 2x4 inches, for No. 2121.....	.15
5027A. Jar, 4x5 inches, for No. 2121.....	.17



No. 2121.



No. 2128.



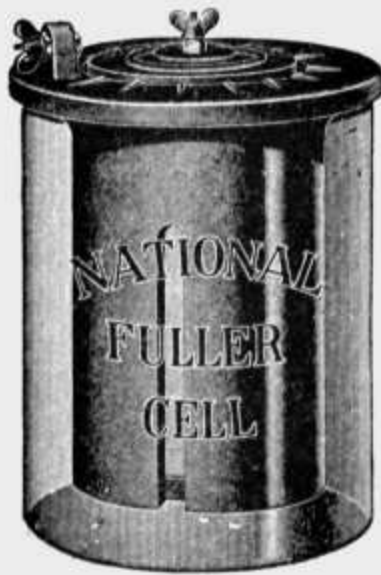
No. 2129.



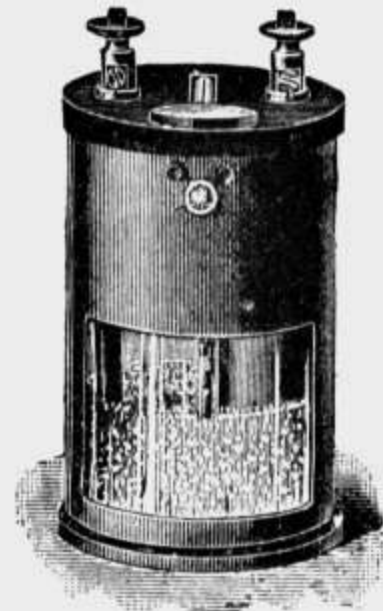
No. 2133.

2127. Daniell Battery, quart size. Consists of No. 2105 Zinc, No. 2106 Copper, No. 2121D Porous Cup and No. 5027A Jar. An excellent battery for student use with constant E. M. F. of about 1.08 volts. Complete without chemicals .....	\$ 0.50
2128. Daniell Battery, gallon size. This has been the standard cell for many years for "open" or "closed circuit" work. The best for all laboratory work in electrical measurements. Next to the standard cells, it gives the most constant E. M. F., about 1.08 volts, which remains the same during the life of the cell. With new form riveted copper pocket for holding copper sulphate crystals. Complete without chemicals .....	1.50
2128A. Zinc, weight about two pounds, with binding screw attached, for No. 2128 .....	.40
2128B. Copper, New Form, with riveted copper pocket, for No. 2128.....	.65
2128C. Porous Cup, 3x7 inches, for No. 2128.....	.17
5027C. Jar, 6x8 inches, for No. 2128.....	.27
2129. Grenet Battery (French Type). Most convenient form for use on lecture table, giving very powerful current for a short time. The E. M. F. is 2 volts at the start. Small internal resistance. Height of cell 8 inches, capacity 1 pint. Complete without chemicals.....	1.65
2129A. Zinc for No. 2129.....	.15
2129B. Carbon for No. 2129, each.....	.17
2129C. Jar for No. 2129.....	.60
2130. Grenet Battery (French Type), 10 inches high, capacity one quart. Complete without chemicals.....	2.25
2130A. Zinc for No. 2130.....	.17
2130B. Carbon for No. 2130, each.....	.22
2130C. Jar for No. 2130.....	.80
2131. Grenet Battery (French Type), 12 inches high, capacity two quarts. Complete without chemicals.....	3.35
2131A. Zinc for No. 2131.....	.28
2131B. Carbon for No. 2131, each.....	.33
2131C. Jar for No. 2131.....	1.00
2133. Gravity Battery (Crowfoot Type), especially adapted for "closed circuit" work. Standard type for telegraph companies. E. M. F. about 1.1 volts; internal resistance from 1 to 5 ohms. Gallon size complete without chemicals.....	.90
2133A. Crowfoot Zinc, with connector, for No. 2133.....	.45
2133B. Copper for No. 2133.....	.17
5027C. Jar, 6x8 inches, for No. 2133.....	.27





No. 2135.



No. 2140.

2135. **Fuller Battery**, improved form, for open or closed circuit work. Generally adopted in the Chicago High Schools. E. M. F. about 2 volts; initial internal resistance about 0.40 ohms. Gallon size, complete without chemicals ..... \$ 1.65
- 2135A. **Carbon and Cover** for No. 2135..... .83
- 2135B. **Zinc** for No. 2135 (same as No. 2128A)..... .40
- 2135C. **Porous Cup** for No. 2135 (same as No. 2128C)..... .17
- 5027C. **Jar**, 6x8 inches, for No. 2135..... .28
2140. **Clark Standard Cell**. Mounted in brass case, with certified thermometer. Furnished with certificate of accuracy from the German Reichsanstalt .....Duty free 12.50
- For Normal Cells, see page 434.

**EDISON PRIMARY BATTERIES.**



**Edison-Besco Battery.**

**Edison-Besco Renewal.**

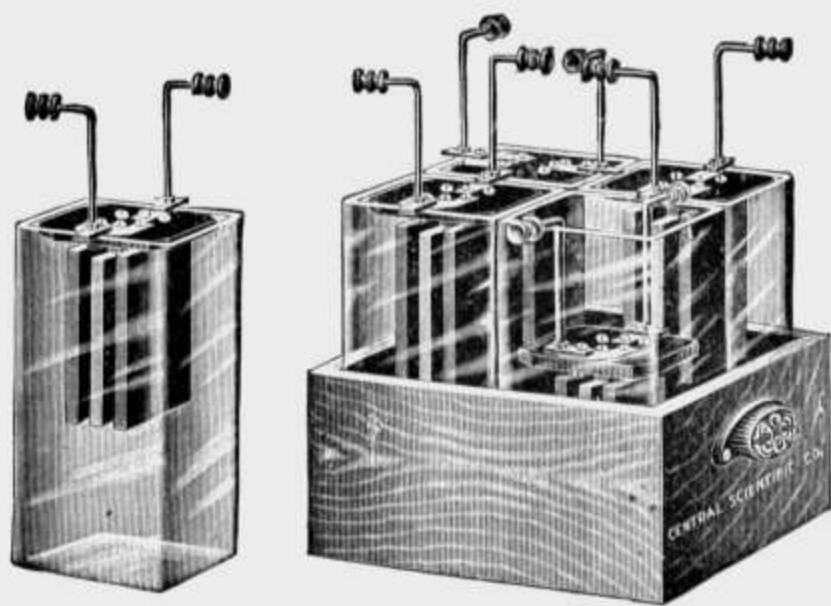
The batteries listed below are of the EDISON-BESCO type—the latest successor to the well-known EDISON-LALANDE.

The chief points of superiority in cells of this type are:

- Constant E. M. F.
- No wasteful local action while the cell is idle.
- Extremely low internal resistance.
- No polarization.
- Convenience of form and freedom from noxious fumes and chemical deposits.

The distinctive feature of the new EDISON-BESCO batteries is the fact that in each cell or renewal, the copper oxide plate, zinc plates, supporting frame, connecting wire, and combined suspension bolt and positive binding post are furnished as a unit, all parts being assembled at the factory. It is thus possible to place the plates very close together without danger of short circuiting, thereby reducing the internal resistance and increasing the available voltage and productive capacity. The capacity of these cells is now 33 1/3% greater than that of older types of the same size while the efficiency is approximately 20% higher. These cells are equally suitable for open or closed circuit work. The electrolyte is a solution of sodium hydroxide in water. The size of the plates and the quantity of electrolyte furnished are so proportioned to each other that when the zinc plate is eaten through the remaining parts are also exhausted. We, therefore, do not carry separate parts, but only complete renewals. No. 2149 is recommended for laboratory use.

2144. **Edison-Besco Primary Battery**, No. 208. Size over all 6x9 inches, capacity 200 ampere-hours. Complete with chemicals.....Net 2.20
- 2144A. **Complete Renewal** for No. 2144.....Net 1.50
2149. **Edison-Besco Primary Battery**, No. 309. Size over all 5 3/4 x 12 3/4 inches, capacity 300 ampere-hours. Complete with chemicals.....Net 3.30
- 2149A. **Complete Renewal** for No. 2149.....Net 1.80



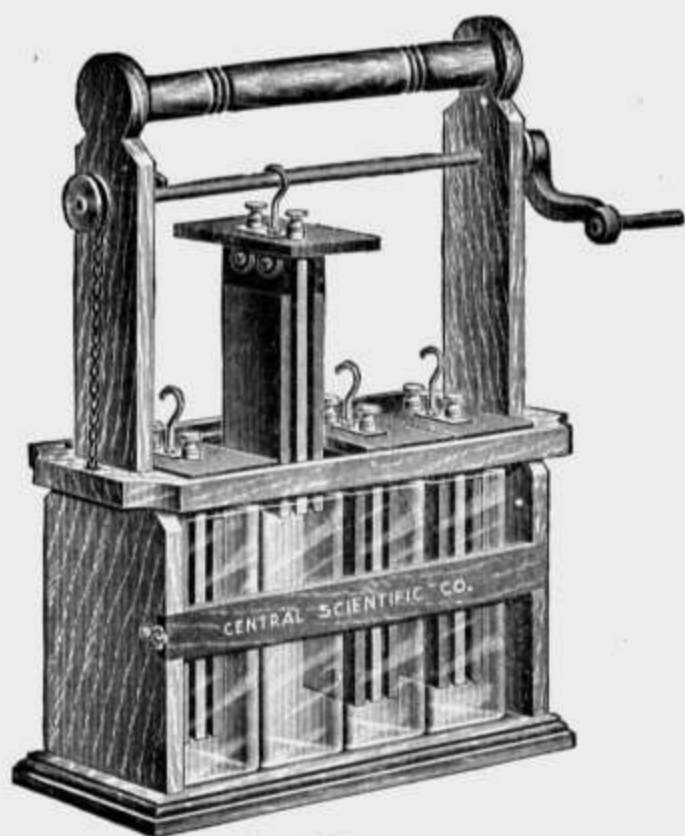
No. 2150.

No. 2152.

**THE CENTRAL PLUNGE BATTERY.**

A powerful, compact form of the bichromate battery, expressly designed for laboratory and lecture table work. Elements can quickly be lifted out of the solution when not in use. Vulcanite top, with nickel plated brass trimmings. Large zinc and carbon elements placed close together, reducing the internal resistance to a minimum.

2150. Central Plunge Battery, single cell.....	\$ 2 50
2151. Central Plunge Battery, two cells, in case with handles.....	5 00
2152. Central Plunge Battery, four cells, in case with handles.....	10 00
2153. Central Plunge Battery, six cells, in case with handles.....	15 00
2154. Zinc Plate for Central Plunge Battery, 4 1/4 x 3 x 1/4 inches, each.....	27
2155. Carbon Plate for Central Plunge Battery, 4 x 3 x 1/4 inches, each.....	22
2156. Glass Jar for Central Plunge Battery, 4 x 4 x 8, each.....	33



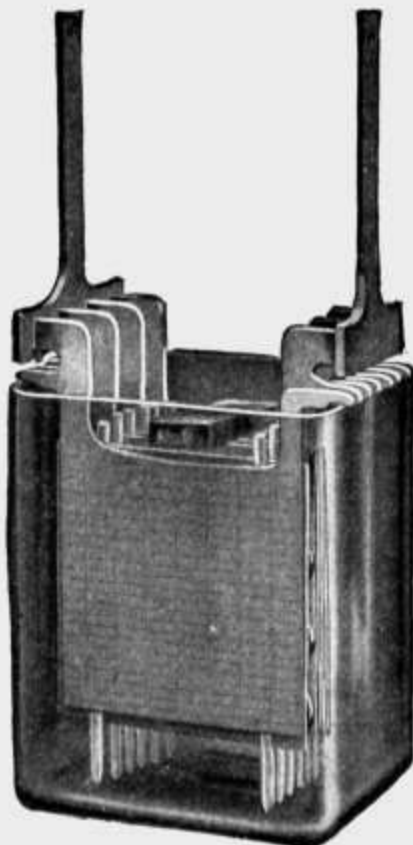
No. 2160.

**HIGH SCHOOL PLUNGE BATTERY.**

Similar in construction to the Central Plunge Battery described above, the essential difference being in the elements, which are larger, and the case, which has an easy lifting motion, with a deadfall catch not liable to slip. The elements are quickly removed from the solution. Each cell may be used singly, two or more in series, or in parallel. Any cell which is not required for use can be suspended by the hook from the axle. All parts are interchangeable. Unquestionably the best battery for the lecture table.

2160. High School Plunge Battery, four cells, complete, with case.....	\$ 13 35
2161. High School Plunge Battery, six cells, complete, with case.....	18 00
2162. Zinc Plate for High School Plunge Battery, 6 1/4 x 2 1/2 x 1/4 inches, each....	28
2163. Carbon Plate for High School Plunge Battery, 6 1/2 x 2 1/2 x 1/4 inches, each.	25
2165. Glass Jar for High School Plunge Battery, 2 1/2 x 4 1/4 x 7 inches, each.....	28
2166. Elements Complete, with fiber top, binding post and hook.....	1 65

## CHLORIDE ACCUMULATORS.



No. 2171A.

These Batteries are extensively used in scientific laboratories, both in this country and Europe. We guarantee them to give good service at the capacities designated.

The voltage of each cell of all capacities is slightly above two volts on open circuit, and during discharge at the eight-hour rate varies from that point at the beginning to 1.75 volts at the end.

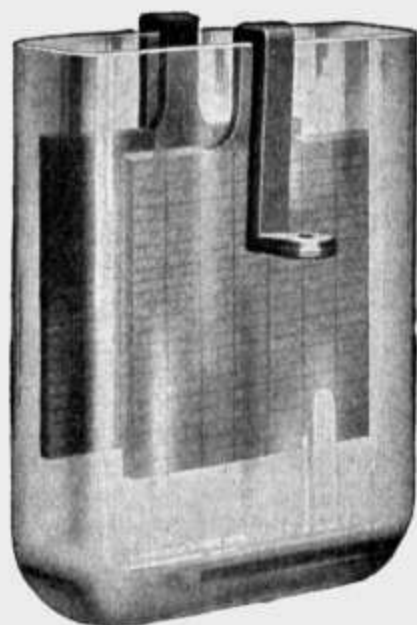
We have selected types that are adapted to the various laboratory demands. Other sizes will be quoted upon application.

Cells in rubber jars are designated by letter "R." All other cells are in glass jars. The prices given include the electrolyte, but no connecting bolts. (See No. 2174.)

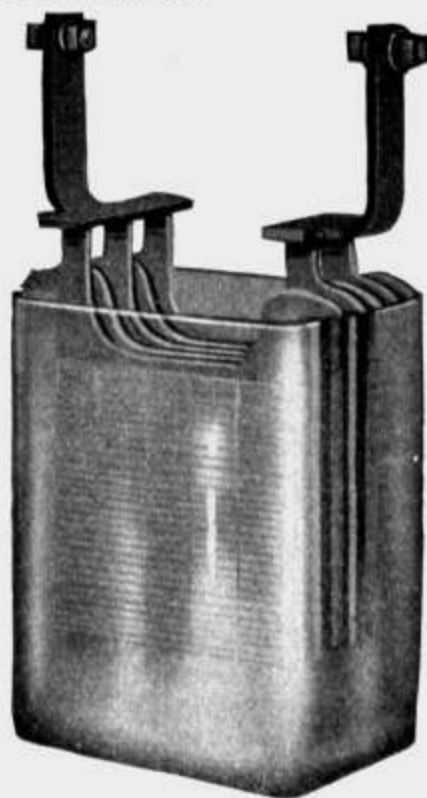
Catalog No.	Type	No. of Plates	Size of Plates	Normal Charging Rate in Amperes	Normal Rate of Discharge in Amperes for			Outside Dimensions of Jar, Inches			Height of Complete Cell, inches	Net Price Complete Not Charged
					8 Hours	5 Hours	3 Hours	Length	Width	Height		
2170	ET	2	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	6 $\frac{1}{2}$	9	2 $\frac{1}{4}$	8 $\frac{3}{4}$	11	11 $\frac{3}{8}$	\$ 5.40
2170R	ET	2	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	6 $\frac{1}{2}$	9	2	8 $\frac{1}{2}$	11	11 $\frac{3}{8}$	6.60
2171A	D	7	6 x 6	7 $\frac{1}{2}$	7 $\frac{1}{2}$	10 $\frac{1}{2}$	15	6 $\frac{1}{2}$	7 $\frac{7}{8}$	9 $\frac{1}{2}$	18	9.70
2171AR	D	7	6 x 6	7 $\frac{1}{2}$	7 $\frac{1}{2}$	10 $\frac{1}{2}$	15	3 $\frac{7}{8}$	6 $\frac{1}{2}$	9	10 $\frac{1}{2}$	11.10
2171B	D	9	6 x 6	10	10	14	20	8 $\frac{3}{4}$	8	9 $\frac{1}{2}$	18	12.20
2171BR	D	9	6 x 6	10	10	14	20	5	6 $\frac{1}{2}$	9	10 $\frac{1}{2}$	14.40
2172A	E	5	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	10	10	14	20	5 $\frac{1}{2}$	9 $\frac{1}{8}$	11 $\frac{3}{8}$	20	12.00
2172AR	E	5	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	10	10	14	20	2 $\frac{7}{8}$	8 $\frac{1}{2}$	11	12 $\frac{1}{2}$	14.00
2172B	E	7	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	15	15	21	30	6 $\frac{3}{4}$	9 $\frac{1}{8}$	11 $\frac{3}{8}$	20	15.75
2172BR	E	7	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	15	15	21	30	3 $\frac{7}{8}$	8 $\frac{1}{2}$	11	12 $\frac{1}{2}$	18.75
2172C	E	9	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	20	20	28	40	8	9 $\frac{1}{8}$	11 $\frac{3}{8}$	20	20.00
2172CR	E	9	7 $\frac{3}{4}$ x 7 $\frac{3}{4}$	20	20	28	40	5	8 $\frac{1}{2}$	11	12 $\frac{1}{2}$	24.00

2174. **Connecting Bolts.** For Nos. 2170 and 2170R two bolts are required for each row of cells; for the other numbers one more bolt will be needed than the number of cells in a row. Each.....Net \$ 0.25

## CENCO STORAGE BATTERIES.



No. 2181.



No. 2185A.

These batteries, which are made for us by one of the most reliable manufacturers, have been used extensively for ten years with increasing satisfaction in all classes of service. They are made in both Planté and Faure type of plate and each type represents the highest grade of American and European battery construction. The Faure type are best adapted for laboratories, house lighting and other work where the battery will be charged two or three times per week, and will be sent unless otherwise specified.

The different sizes in each class have the same plate construction, the only difference being in the size and capacity of the plates or elements.

Each battery is guaranteed against electrical or mechanical defects, and within the discharge rates specified they will give their full rated capacities.

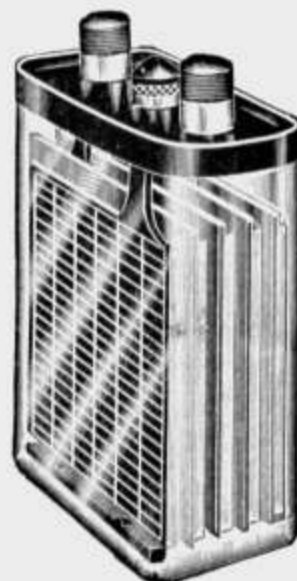
When charged at the normal rate given for 8-hour discharge rate the cells will be charged in 9 hours.

Full directions will be sent with each battery for its charging and proper care.

Catalog No.	No. of Plates	Size of Plates	Ampere Hours at Normal Rate	Discharge in Amperes		Outside Dimensions of Jar, inches			Price Complete, with Glass Jars, Net
				8 Hours	5 Hours	Length	Width	Height	
2181	2	3 x4	8	1	1½	1¾	3¾	7	\$ 1.15
2182	2	5 x5	16	2	3	2¼	6¼	8	2.10
2183	2	7 x5	24	3	4½	2¼	6¼	10	3.05
2184	2	8¾ x5	32	4	6	2¼	6¼	12	3.95
2185A	5	5¾ x6	64	8	10	4¾	7¾	9½	9.50
2185B	7	5¾ x6	96	12	15	6¾	7¾	9½	12.75
2185C	9	5¾ x6	128	16	20	7¾	7¾	9½	15.80
2186A	7	7¾ x7¾	180	22½	30	6½	9½	11½	17.60
2186B	9	7¾ x7¾	240	30	40	7¾	9½	11½	22.20
2186C	11	7¾ x7¾	300	37½	50	8¾	9½	11½	26.85
2186D	13	7¾ x7¾	360	45	60	11	9½	11½	31.85



No. 2189.



No. 2190.

**CENCO PORTABLE STORAGE BATTERIES.**

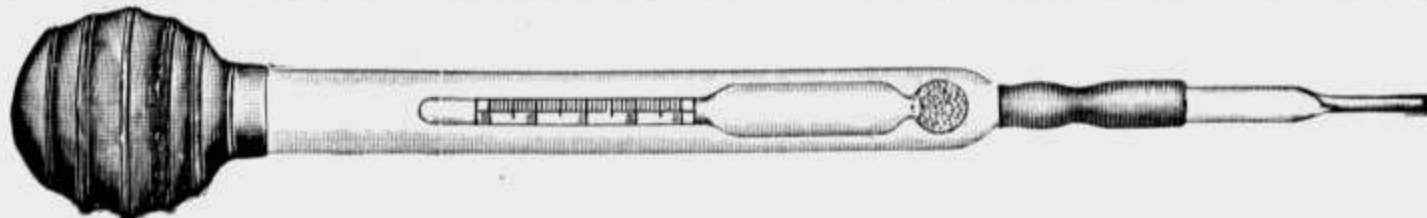
These batteries are of the same general type as the Cenco Storage Batteries described on the preceding page, but are especially made to stand transportation. Under ordinary conditions they should last for at least five years, and they are guaranteed for one year against everything except abusive handling. The jars are of the best vulcanite, and are enclosed in hardwood cases provided with a handle and finished with acid-proof paint. Strength is added to the jar when placed in the case by entirely surrounding it with an elastic sealing compound. Short circuiting is prevented by an exceptionally wide distance between the plates. The acid cannot spill under any ordinary conditions of service.

Catalog No.	Voltage	Ampere Hours	Length, Inches	Width, Inches	Height, Inches	Weight, Pounds	Price, Net
2189A	6	40	8 $\frac{7}{8}$	4 $\frac{7}{8}$	8 $\frac{1}{8}$	22	\$ 9.90
2189B	6	60	10 $\frac{1}{2}$	5 $\frac{3}{4}$	9 $\frac{1}{8}$	30	13.50
2189C	6	80	12	6 $\frac{1}{4}$	9 $\frac{1}{8}$	50	22.50
2189D	6	120	17 $\frac{1}{4}$	7 $\frac{3}{4}$	9 $\frac{1}{2}$	62	31.50

**CENCO SEALED STORAGE BATTERIES.**

These batteries are contained in glass jars, sealed with a smooth and strong compound, and are ideal for isolated and portable work where care in handling may be given. They are especially desirable for clock and bell systems, and for demonstration work. Each cell is made up with a negative plate on either side of the positive, giving equal action on each side and preventing buckling and sulphation. The sealing compound prevents evaporation of the electrolyte and keeps the cell clean at all times. The batteries are shipped completely assembled and charged ready for immediate use.

Catalog No.	Voltage	Ampere Hours	Discharge for 8 Hours, Amperes	Length, Inches	Width, Inches	Height, Inches	Price, Net
2190A	2	8	1	3 $\frac{7}{8}$	2 $\frac{1}{2}$	7 $\frac{1}{2}$	\$3.25
2190B	2	16	2	6 $\frac{1}{4}$	3	10	4.90
2190C	2	36	4 $\frac{1}{2}$	6 $\frac{1}{4}$	3	10	5.95
2190D	2	56	7	6 $\frac{1}{4}$	3	10	6.95



No. 2191.

2191. **Battery Tester, or Syringe Battery Hydrometer.** A very convenient form of battery hydrometer, which eliminates the spilling of acid when making a battery test. The pointed tube is inserted into the battery and the electrolyte drawn up into the hydrometer containing tube by means of the rubber bulb. After the reading is obtained the fluid is ejected back into the battery. Complete table showing relation between specific gravity and battery strength included. .Net

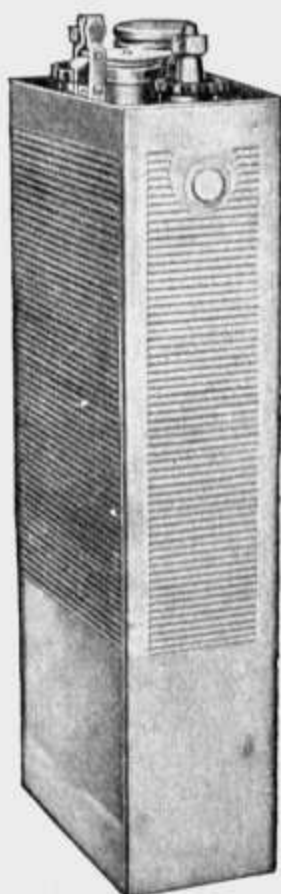
1.65



No. 2192B.



Plates of No. 2192B.



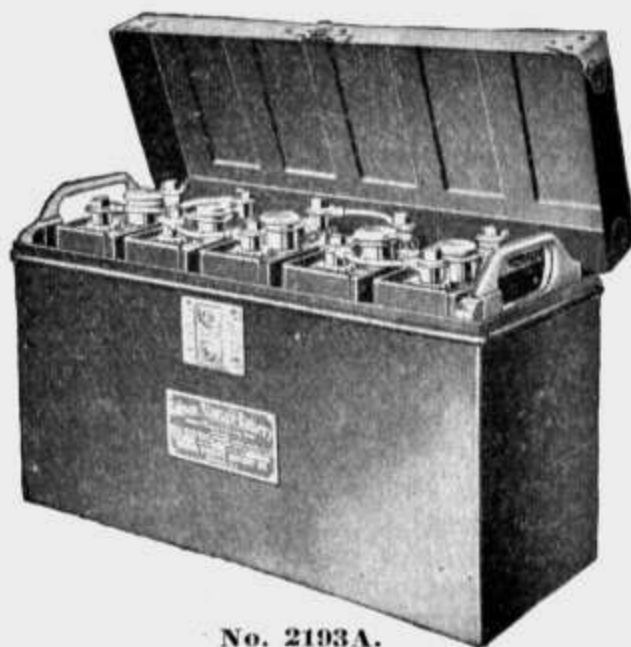
No. 2192D.

## EDISON STORAGE BATTERIES.

These batteries are composed of negative plates of iron oxide and positive plates of nickel oxide immersed in an alkaline solution. The retaining cans are of corrugated sheet steel, welded at the seams, and electroplated with nickel, which protects the steel from rust and gives each cell an attractive appearance. They are made in two types: Type "A" for traction and industrial purposes, Type "B" for lighter work, such as for ignition and in small lighting outfits. These batteries are guaranteed for five years if directions are carefully followed.

### PRICE LIST OF SINGLE CELLS.

Catalog No.	Type	Voltage	Normal Ampere Hour Output	Rate of Charge, Amperes for 7 Hours	Normal Rate of Discharge, Amperes	Weight, Pounds	Price, Net
2192A.	B-2	1.2	40	8	8	4.6	\$ 6.00
2192B.	B-4	1.2	80	16	16	7.35	8.00
2192C.	B-6	1.2	120	24	24	10.5	11.50
2192D.	A-4	1.2	150	30	30	13.5	13.50
2192E.	A-6	1.2	225	45	45	19.2	20.00

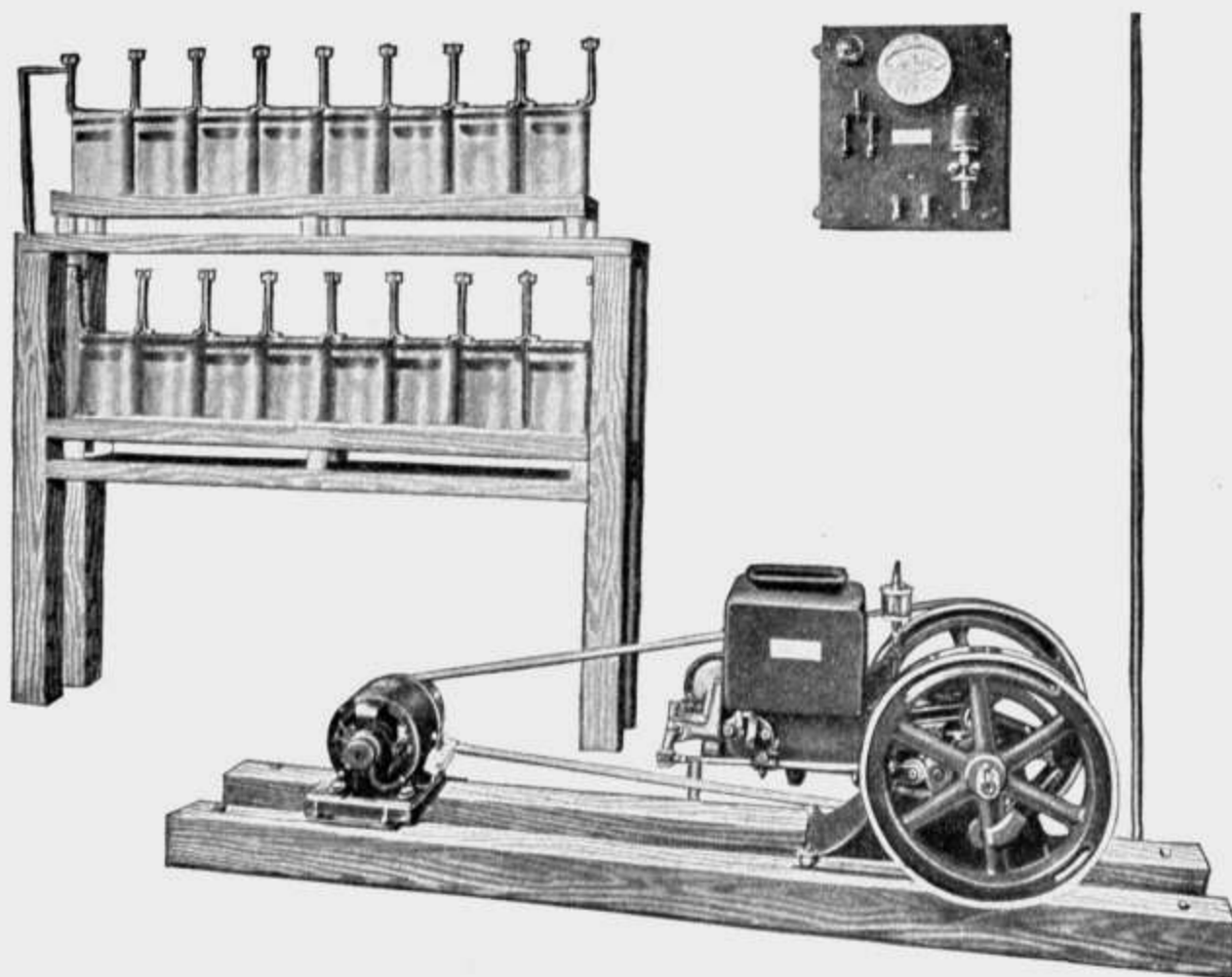


No. 2193A.

### PRICE LIST.

Assembled in standard suspension trays, contained in a steel battery box.

Catalog No.	Type	No. of Cells	Volts	Normal Ampere Hour Output	Weight, Lbs., in Tray	Height, Inches	Width, Inches	Length, Inches	Price, Net
2193A.	B-2	5	6.5	40	27 $\frac{3}{4}$	10 $\frac{1}{4}$	7 $\frac{1}{4}$	11 $\frac{3}{4}$	\$32.50
2193B.	B-4	5	6.5	80	43 $\frac{1}{2}$	10 $\frac{1}{4}$	7 $\frac{1}{4}$	17 $\frac{1}{4}$	42.50



No. 2197.

#### CENCO STANDARD ELECTRIC POWER SYSTEMS.

For the convenience of those who are situated so that electric power is not available, we are listing the following two power systems. These are guaranteed in every way and will come up to their rated capacity. No. 2198 can be used with arc light for the projection lantern.

2197. **Cenco Power System.** Consists of a  $1\frac{1}{4}$  H. P. gasoline engine with hopper cooling system, a Special Battery Charging Generator, patented, giving 6-10 amperes at 32-40 volts, a 16-cell storage battery with a capacity of 56 ampere hours and a finely finished switchboard with all necessary instruments, mounted on iron brackets so that it can be screwed directly to the wall. The generator requires no rheostat, as it automatically generates just enough electricity to charge the battery, or if lights are burning at the same time that the battery is being charged, it will furnish the current needed for the lights and charge the battery also. The storage cells are of the sealed type and it is therefore necessary to add water only about once every two months. This system will burn fifteen 12-candle power Tungsten lights eight hours on one charge of the battery. Complete with battery, connectors, insulators, and trays, rubber belt, skids, and hydrometer bulb and tube.....Net \$ 325.00
2198. **Cenco Power System.** Similar to No. 2197, but with a  $2\frac{1}{2}$  H. P. engine and a battery of 34 cells, having a voltage of 65 volts, and a capacity of 56 ampere hours; will burn twenty-five 12-candle power Tungsten lights. The switchboard is one of the most complete ever furnished with a private power system. Complete with battery, connectors, insulators, trays, rubber belt, skids, and hydrometer bulb and tube .....Net 512.00
- 2198A. **Cenco Lighting System.** Same as No. 2198, but with Self Starter for engine .....Net 532.00

## BATTERY DIRECTIONS.

**Amalgamating.** A good method for amalgamating the zinc element is to dip it into acid, then pour a few drops of mercury on the surface and rub in with a piece of cloth attached to a stick. This is perhaps the best and quickest method although the most expensive.

**Amalgamating Fluid.** Two-ounces mercury, 1 ounce aqua regia, 10 ounces water. Dip zinc into solution and then wash with water. No need of brush or rag.

**Le Clanche Cell.** Place 6 ounces Ammonium Chloride into jar and fill with water to two-thirds its capacity. Stir well until the salt is entirely dissolved. Place elements with zinc outside porous cup as illustrated.

**Carbon Cylinder Cell.** Directions furnished under Le Clanche cell apply to this type of cell, except that zinc rod is placed inside carbon cylinder.

**Samson Cell.** Directions furnished under carbon cylinder cell apply to this type of cell.

**Grove Cell.** Outer cell contains amalgamated zinc plate dipping into dilute sulphuric acid (by weight 10 parts water to 1 part acid). In inner porous cup, a piece of platinum dips into nitric acid of full strength. Obnoxious nitrogen oxide fumes may be suppressed in a large measure by the addition of a small quantity of Potassium Dichromate.

**Bunsen Cell.** This cell is merely a modification of the Grove cell, in which the expensive platinum is replaced by an electrode of gas carbon.

### In Both the Grove and Bunsen Cells the Nitric Acid May Be Replaced by a Chromic Acid Solution.

**Grenet Cell.** In this cell, the zinc plate between two carbon plates dips into a chromic acid solution. (See below.) When this cell is exhausted, the rich reddish color of chromic acid will be replaced by a muddy dark green color.

**Chromic Acid Solution.** There are many different formulae, but the most convenient method of making a generally useful acid is by simply dissolving prepared chromic acid salt in water.

A useful formula is, 30 parts Sodium Dichromate, 100 parts water and 23 parts sulphuric acid (sp. gr. 1.845); all by weight.

**Plunge Battery.** Elements and directions under Grenet type apply to this type of battery.

**Daniell Battery.** The zinc element is placed in a porous cup containing sulphuric acid (1 part acid to 20 parts water, by weight). The copper element encircles a porous cup and dips into saturated solution copper sulphate, kept continually saturated by the addition of an excess of copper sulphate crystals on bottom of jar. Solution is more effective by addition of few cubic centimeters sulphuric acid.

(In our No. 2128 a pocket is provided for holding excess crystals of copper sulphate.)

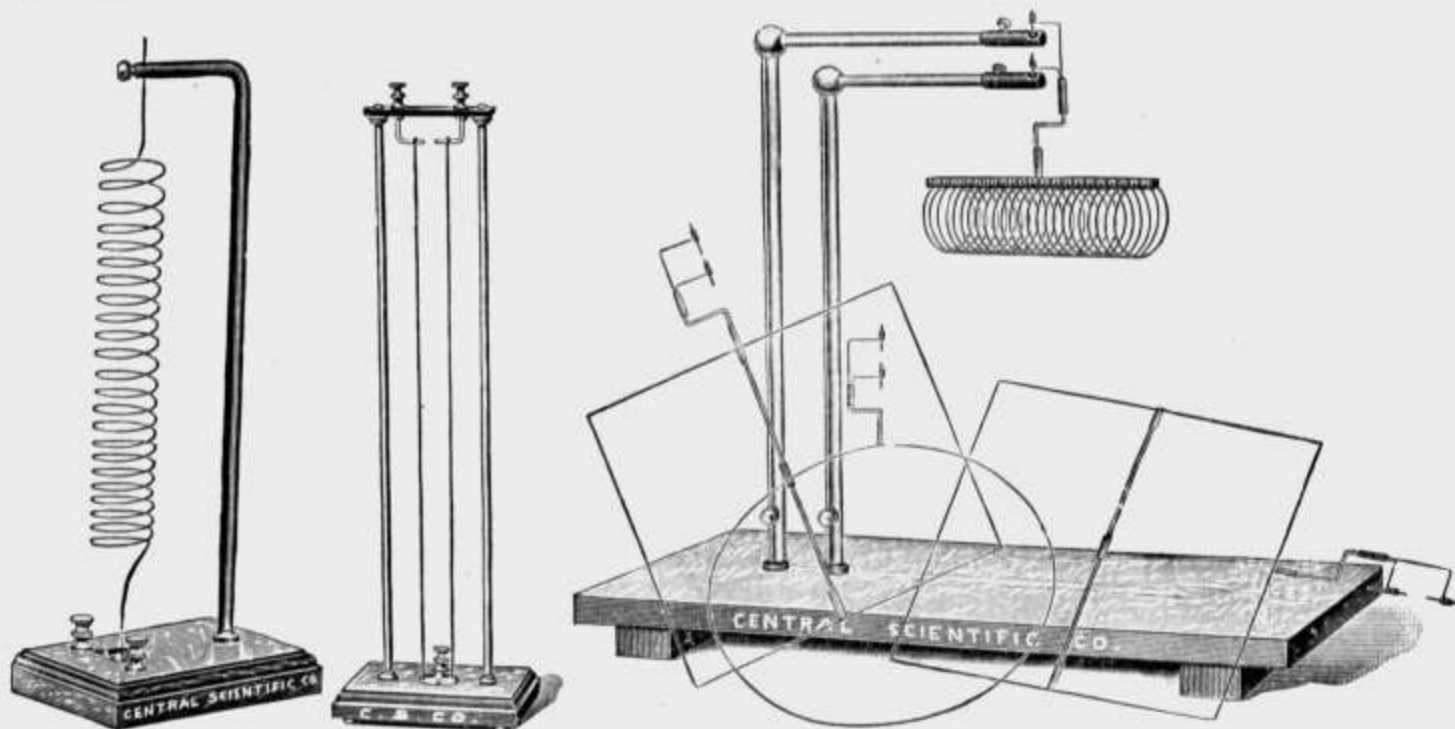
**Gravity Battery.** This type of battery is merely a form of Daniell cell, where the two solutions are kept separate by their difference in gravity. Place 2 pounds copper sulphate crystals in bottom of jar with copper element. Add clear water to fill the jar when elements are in position. Allow to stand for 2 hours, unless desired for use at once, in which case add 1 ounce zinc sulphate to solution and suspend zinc over edge of jar when liquids are sufficiently separated.

**Fuller Cell.** Fill glass jar half full of chromic acid solution, place 1 teaspoonful mercury and 2 tablespoons full of common salt in the porous cup and fill with water to  $1\frac{1}{2}$  inches of top. The carbon element containing the porous cup is then placed in the glass jar, the zinc is placed in the glass jar and the cover over it. The solution should fill the glass jar to within an inch of the top.

**Edison Cell.** Dissolve contents of can of caustic soda in jar filled with water to mark. Insert the elements, taking care that the copper oxide plate is at least 1 inch below the surface of the liquid. Carefully pour contents of bottle of oil on surface of solution. Oil excludes all air and keeps salts from forming.

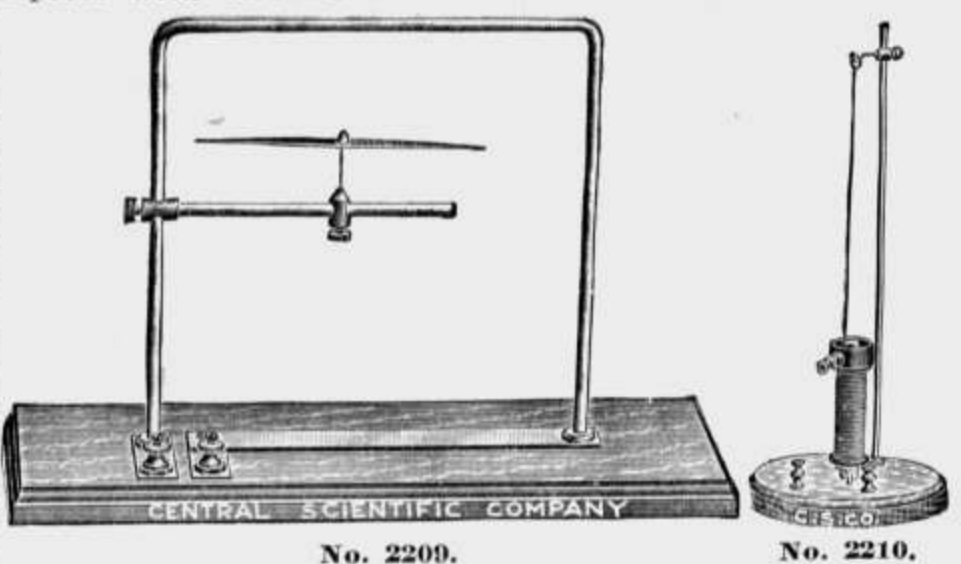
**Storage Cells.** These cells make the most convenient source of electrical supply, providing the laboratory is equipped for charging. Full directions for use and for charging accompany each cell.





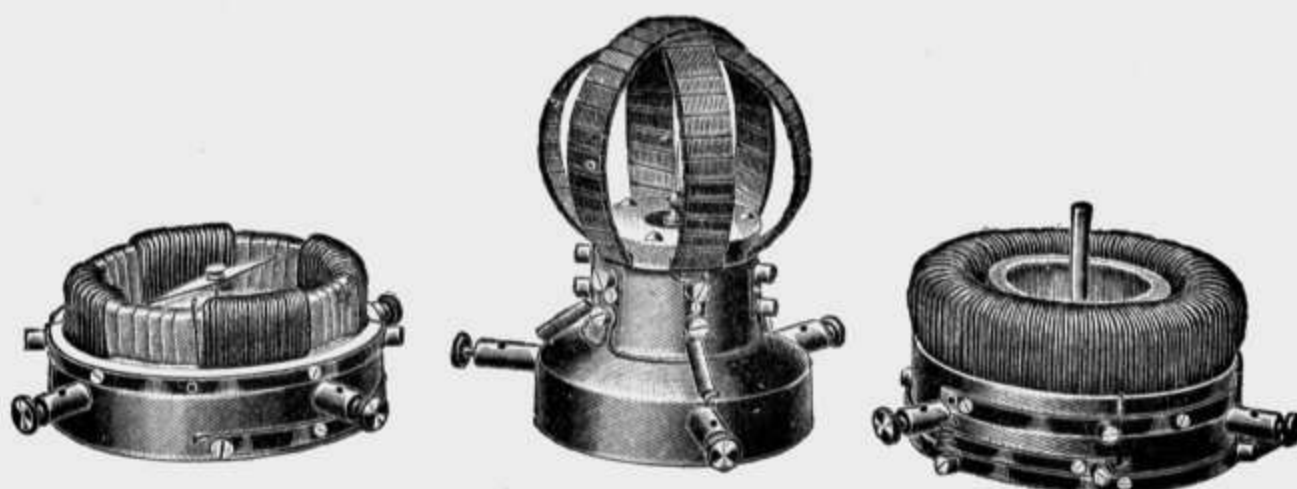
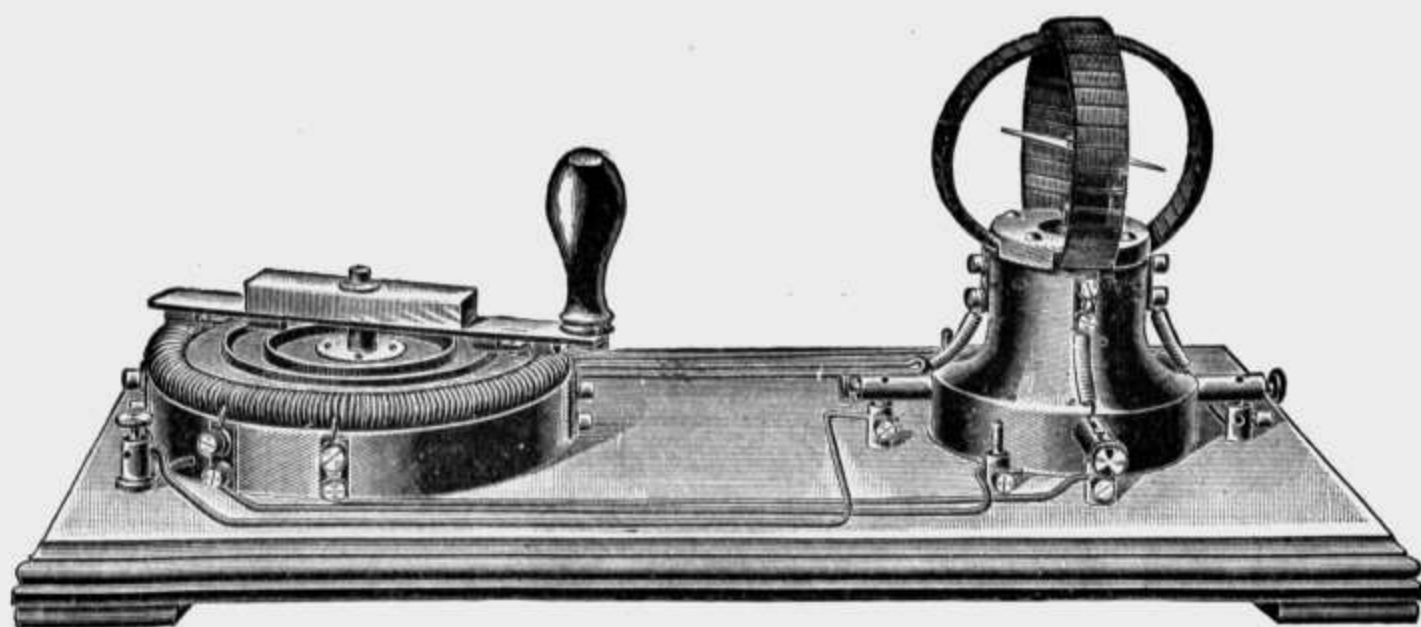
- No. 2201. **Contracting Helix**, improved form, as illustrated. The current passing through the spiral causes a contraction owing to the attraction between successive turns. This breaks the current, the spiral resumes its former length, thus making the circuit and causing contraction again ..... \$ 1.35
- No. 2203. **Parallel Current Apparatus**, mounted on base and support as shown. To demonstrate laws of attraction and repulsion of parallel currents ..... 2.00
- No. 2205. **Ampere's Frame**, consists of a hardwood base, brass pillars, and arms, with steel mercury cups, a set of five forms of aluminum wire, to illustrate the effect of magnets and solenoids upon currents, the action of terrestrial magnetism, and the action of currents upon currents. Complete with directions..... 10.00

2209. **Oersted's Law Apparatus.** A 6 inch needle is pivoted on an adjustable support, so that the needle can be placed parallel to and above, below or on either side of the horizontal wire, and with either its north pole or its south pole close to and on any side of the vertical wire. A single dry cell gives sufficient current to show a marked deflection or dip of the needle, thus enabling the direction of the magnetic field about a wire to be mapped out before a large class.....



- No. 2209. **Oersted's Law Apparatus.** ..... 3.35
- No. 2210. **Magnetic Rotation Apparatus**, to demonstrate the rotation of a wire carrying a current around the pole of an electromagnet. Consists of an electromagnet on a base and carrying at its top a shallow mercury cup. A suspended wire which forms part of the circuit through the apparatus dips into this cup and rotates rapidly about the upper magnet pole when a current is passed through the instrument..... 4.50
2213. **Dynamo Analysis Apparatus.** See Catalog K for description..... 23.35
2214. **Apparatus for Inductive Repulsion.** See Catalog K for description .....Duty free 45.00
- 2214A. **Magnetizing Iron Ring.** See Catalog K for description....Duty free 6.00
- 2214G. **Apparatus for Showing Tesla's Experiments.** See Catalog K for description .....Duty free 57.00

See also No. 903 Arago's Magnetic Rotations.  
For Compasses, Magnetic Needles, Helices, etc., see pages 137 to 140.



No. 2215.

**2215. Alternating Current Demonstration Apparatus.**

This is a simple set of apparatus for showing the essential principles of an induction or alternating current motor, for either two-phase or three-phase currents. It demonstrates very clearly and simply the rotating magnetic field, which is the fundamental principle of such motors. The study of such apparatus is of great value, inasmuch as the alternating current is in almost universal use for the long distance transmission of electrical power.

The current of two dry cells is passed into a transformer representing the A. C. generator of a power plant. Here the direct current of the cells, by a simple device, is divided into either two-phase or three-phase alternating currents of essentially the same phase relations as the currents from a two-phase or three phase commercial generator.

This current passes through the proper windings of the coils representing the field coils of the motor. The rotating magnetic field produced by these coils may be shown by means of iron filings, a mounted magnetic needle, or a metal disc and a closed circuit armature. The disc, needle and core will rotate synchronously with the rotation of the "generator" by hand.

The rotating parts are mounted with agate caps and steel bearing points, and all wiring is plainly indicated by different colors and by placing the connections on top of the base. Complete with full directions . . . . .Duty free \$ 35.00

Transformers, pages 183-4.

Arc Lamps, page 185.

Electro Dynamic Charts, page 222.

Burns Alternating Current Apparatus, page 181D.



No. 2217.

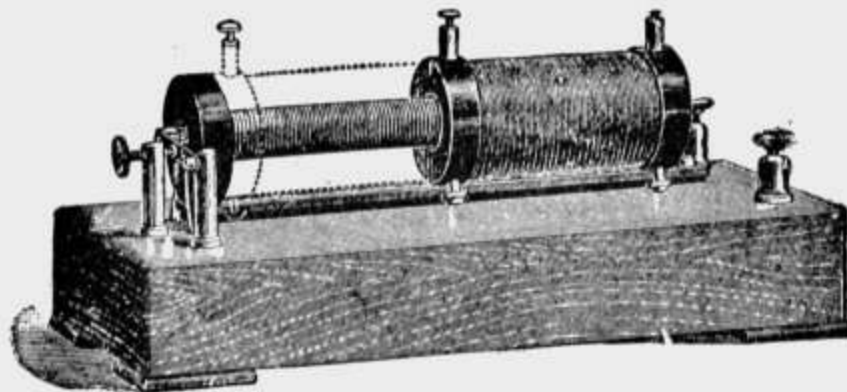


No. 2219.



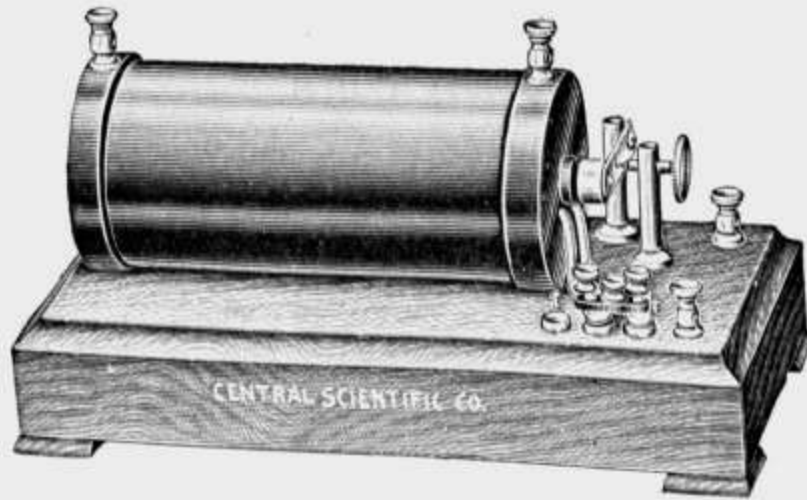
No. 2221.

2217. **Coil for Current Induction.** A form wound coil 10 inches in diameter with flexible leads and connectors. When a single coil is connected in series with our No. 2421 or other sensitive galvanometer, interesting experiments showing the earth's magnetic field and other induction phenomena may be made. The purchase of a pair of coils is recommended, as they will be found especially useful for work in induced currents. Each..... \$ 7.75
2219. **Induction Coil.** A simple coil wound on a brass spool. Illustrates conveniently and in the simplest manner the induction of a current in a coil by proximity to another coil carrying a current, as well as other phenomena of electro-magnetic induction. For use with No. 1702 Soft Iron Core and No. 1707 Magnet..... .55
- 2219A. **Induction Coil.** Similar to No. 2219, but with a hole sufficiently large for a 3/4x1/4 inch bar magnet (No. 1704)..... 1.00
2221. **Primary and Secondary Coil.** Mounted on two hardwood spools, the outer one provided with a base and the inner one completely removable. A soft iron core is also provided. Total height, 7 1/2 inches 3.35



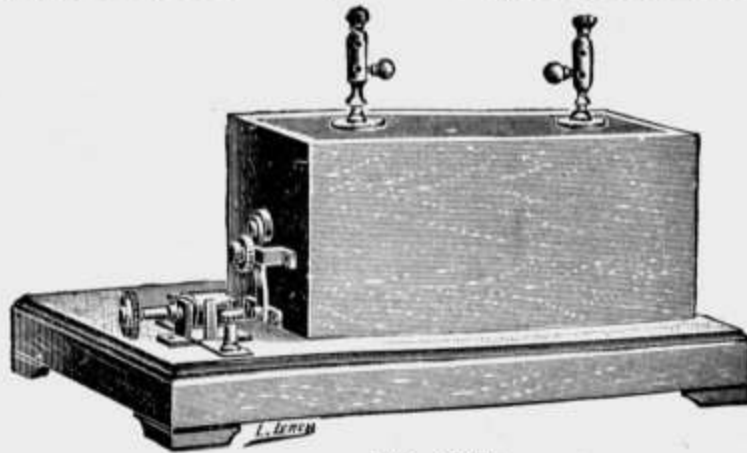
No. 2223.

2222. **Variable Standard of Self Induction.** See Catalog K for description.....Duty free 150.00
- 2222A. **Variable Standard of Self Induction.** See Catalog K for description.....Duty free 72.00
- 2222B. **Standard of Self Induction.** See Catalog K for description..Duty free 9.00
- 2222C. **Standard of Self Induction.** See Catalog K for description..Duty free 9.00
- 2222D. **Standard of Self Induction.** See Catalog K for description..Duty free 10.00
- 2222E. **Standard of Self Induction.** See Catalog K for description..Duty free 13.50
- 2222F. **Standard of Self Induction.** See Catalog K for description..Duty free 27.50
- 2222G. **Standard of Induction Flux.** See Catalog K for description. Duty free 27.50
- 2222H. **Self Induction Coil.** See Catalog K for description..... 3.35
2223. **Induction Coil, Demonstration Form,** with sliding secondary, mounted on polished mahogany box with condenser, 6 mm. spark..... 5.00
- 2223A. **Induction Coil,** dissectible. See Catalog K for description...Duty free 14.50



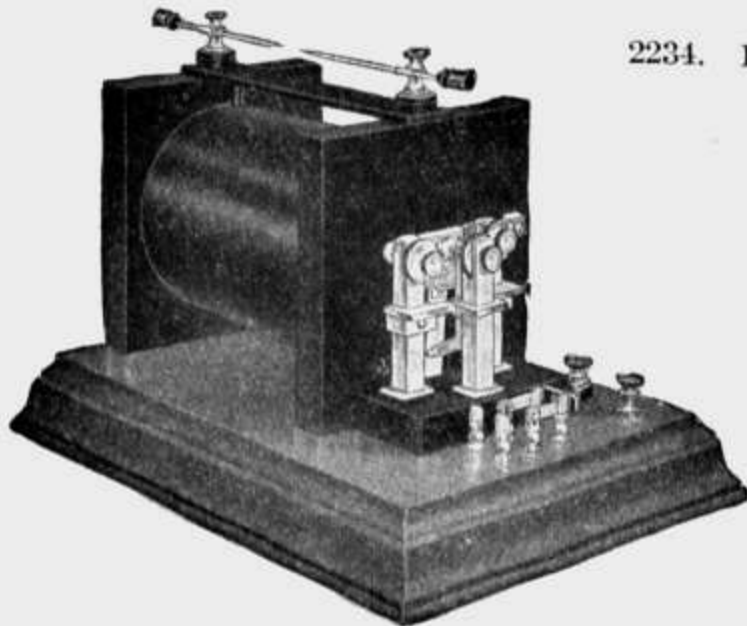
No. 2225.

- |       |  |    |       |
|-------|--|----|-------|
| 2225. | <b>Induction Coil</b> , with adjustable vibrator or interruptor, commutator and condenser, wound with insulated wire. (The coils ordinarily sold are French coils wound with bare wire.) Mounted on finely polished mahogany box, 6 mm. spark..... | \$ | 4.50  |
| 2227. | <b>Induction Coil</b> , same as No. 2225, 13 mm. spark.....  |    | 8.00  |
| 2228. | <b>Induction Coil</b> , same as No. 2225, 18 mm. spark.....  |    | 12.00 |
| 2229. | <b>Induction Coil</b> , same as No. 2225, 25 mm. spark.....  |    | 15.00 |



No. 2230.

- |       |   |           |       |
|-------|---|-----------|-------|
| 2230. | <b>Induction Coil</b> with special rapid adjustable vibrator or interruptor, commutator and condenser, wound with insulated wire; coil entirely enclosed in a finely polished mahogany case. 50 mm. spark ..... | Duty free | 22.00 |
| 2231. | <b>Induction Coil</b> , same as No. 2230, 75 mm. spark.....   | Duty free | 30.00 |
| 2232. | <b>Induction Coil</b> , same as No. 2230, 100 mm. spark.....  | Duty free | 40.00 |



No. 2234.

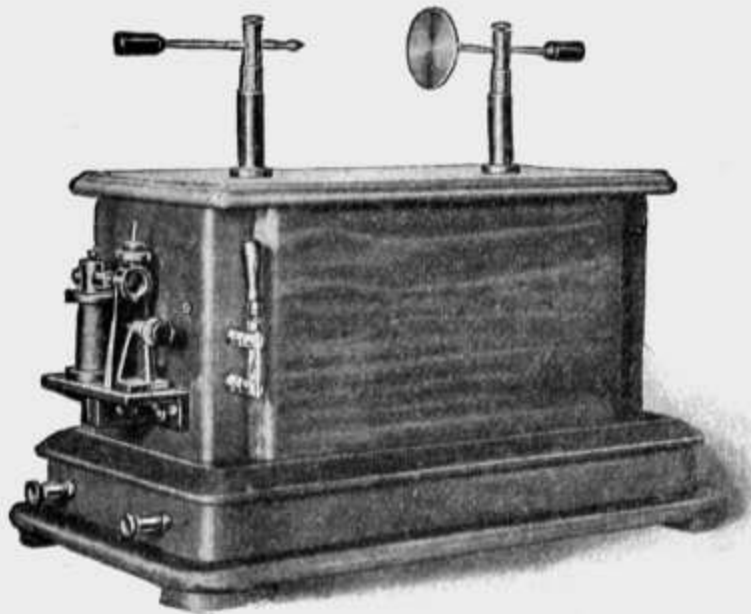
- |        |   |     |       |
|--------|---|-----|-------|
| 2234.  | <b>Induction Coil</b> , equipped with a patented mechanical circuit breaker, which is mounted independently on a heavy piece of enameled slate. This makes the construction very rigid and increases the efficiency of the coil. The secondaries are built in sections and each section is wound in layers. Silk insulated wire is used throughout. Three special means of adjustment are provided, allowing a wide range of regulation, so that the coil is adapted for a large variety of work. Complete with a double pole, double throw knife switch and wound to operate on from 6 to 8 volts, 150 mm. spark.... | Net | 61.20 |
| 2234A. | <b>Induction Coil</b> . Same as No. 2234, but for 75 mm. spark.....   | Net | 31.50 |
| 2234B. | <b>Induction Coil</b> . Same as No. 2234, but for 50 mm spark.....  | Net | 24.30 |

## X-RAY COILS.

We are selling agents for the Standard Scheidel-Western Coil, a high grade coil offering many desirable features in mechanical and electrical construction. The primary windings are divided into sections. The secondary windings are also divided into a number of sections, and embedded in a flexible insulating compound. Being wound with wire of ample cross section, the internal resistance of this coil is very low in proportion to the high potential obtained. The ends of the primary are covered with protective housings, thus maintaining the finished appearance for which this coil has no equal. Each instrument is sold under a guarantee. Only very best material is used in the construction; adjustment is perfect, and workmanship and finish are of the highest quality. The coil is entirely inclosed in a handsome mahogany case.

A full set of instructions, illustrated by diagrams and drawings, accompanies each apparatus, enabling anybody to install and operate the instrument without previous knowledge in this line of work.

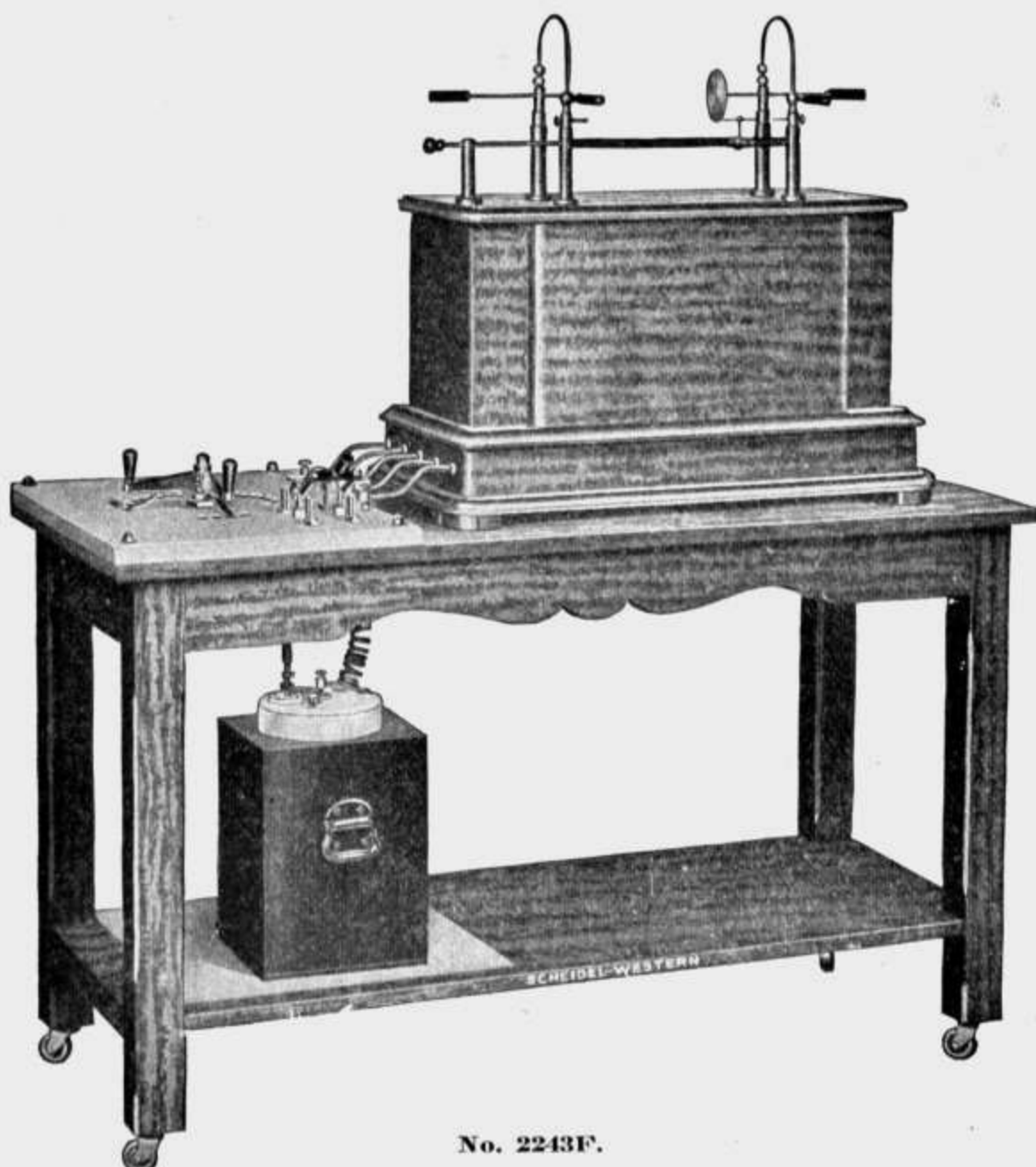
Each apparatus is subjected to a series of most severe tests, of which complete records are kept.



No. 2246.

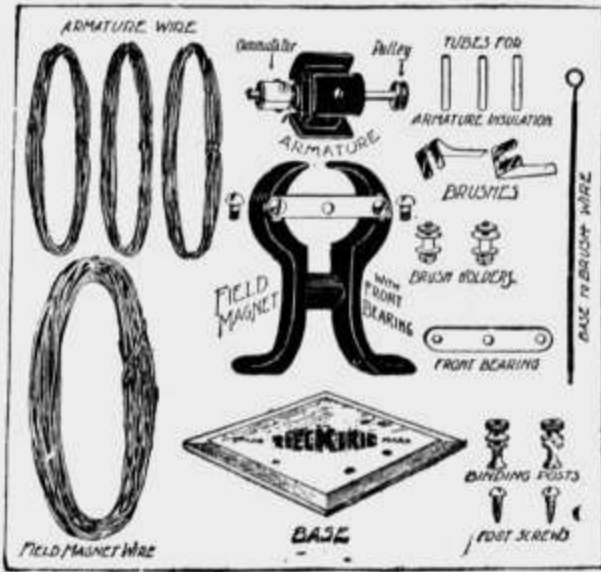
2240.	<b>Induction Coil</b> , operating on a 4 cell storage battery to give a 6 inch spark. Supplied with vibrator having all necessary adjustments, and provided with platinum iridium contact points. The condenser is built into the base of the instrument.....Net	\$ 75.00
2241.	<b>Induction Coil</b> , same as No. 2240, but operating on a 6 cell storage battery to give an 8 inch spark.....Net	125.00
2242.	<b>Induction Coil</b> , same as No. 2240, but operating on 8 cell storage battery to give a 10 inch spark.....Net	150.00
2242A.	<b>Induction Coil</b> , same as No. 2242, without vibrator, but provided with a variable inductance, rheostat, and No. 2244 Electrolytic Interrupter, complete for use with 110 volt direct current.....Net	200.00
2242B.	<b>Induction Coil</b> , same as No. 2242A, but for 220 volt direct current..Net	200.00
2242C.	<b>Induction Coil</b> , same as No. 2242A, but with No. 2244A Mercury Turbine Interrupter instead of No. 2244 Electrolytic Interrupter...Net	250.00
2242D.	<b>Induction Coil</b> , same as No. 2242C, but for 220 volt direct current..Net	250.00
2243A.	<b>Induction Coil</b> , same as No. 2242A, but to give a 12 inch spark...Net	225.00
2243B.	<b>Induction Coil</b> , same as No. 2242B, but to give a 12 inch spark...Net	225.00
2243C.	<b>Induction Coil</b> , same as No. 2242C, but to give a 12 inch spark...Net	275.00
2243D.	<b>Induction Coil</b> , same as No. 2242D, but to give a 12 inch spark...Net	275.00

NOTE.—When these coils are to be used with alternating current, a current rectifier will be necessary. See No. 2270 Nodon Valve.



No. 2243F.

- 2243F. **Induction Coil**, same as No. 2243A, with the addition of a table, a illustrated. This table is of finely finished hardwood and is mounted on large casters for convenience in moving from place to place. On the left end of the table is the controlling rheostat, built into the table in the most permanent and compact manner. The main switch controlling the current supply for the whole equipment serves also as a pole changer and is placed on the top of the table .....Net \$ 250.00
- 2243G. **Induction Coil**, same as No. 2243B, with the addition of the table described above .....Net 250.00
- 2243H. **Induction Coil**, same as No. 2243C, with the addition of the table described above .....Net 300.00
- 2243J. **Induction Coil**, same as No. 2243D, with the addition of the table described above .....Net 300.00
- NOTE.—When these coils are to be used with alternating current, a current rectifier will be necessary. See No. 2270 Nodon Valve.
2244. **Electrolytic Interrupter**. Built in the most substantial and compact manner, provided with platinum point of liberal proportions, which have been determined under actual working conditions. It is provided with water cooling jacket, thus insuring immunity from noise and all disturbances arising from overheating.
- When ordering, it is necessary to state the type of coil with which the interrupter is to be used, as well as the properties of the electric current, so that the proper type of interrupter, with correct instructions, diagrams, etc., can be selected.....Net 25.00
- 2244A. **Mercury Turbine Interrupter**, complete with 1-10 H. P. 110 volt direct current motor .....Net 75.00
- 2244B. **Mercury Turbine Interrupter**, same as No. 2244A, but for 220 volt direct current .....Net 75.00



No. 2245.



No. 2246.

2245. **"Little Hustler" Dissected Motor.** Included in the apparatus for the revised requirements for college admission is a dissected motor, by means of which the student may, in a practical way, demonstrate the principles he has studied, by constructing his own motor. The "Little Hustler" will prove satisfactory if the instructions which accompany it are carefully followed.

The armature has three poles, so that the motor will start without assistance when the current is applied. The motor is fitted with pulley for running toys, etc. One cell of any standard type of battery will run the motor.

Diagrammatic instructions for winding and assembling accompany each instrument ..... \$ 1.00

N. B.—If sent by mail, remit 15 cents postage additional.

2246. **Little Hustler Finished Motor.** Consists of above parts put together and mounted ready for use..... 1.25  
N. B.—If sent by mail, remit 15 cents postage additional.

2247. **Little Hustler Fan,** 4¼-inch diameter..... .30

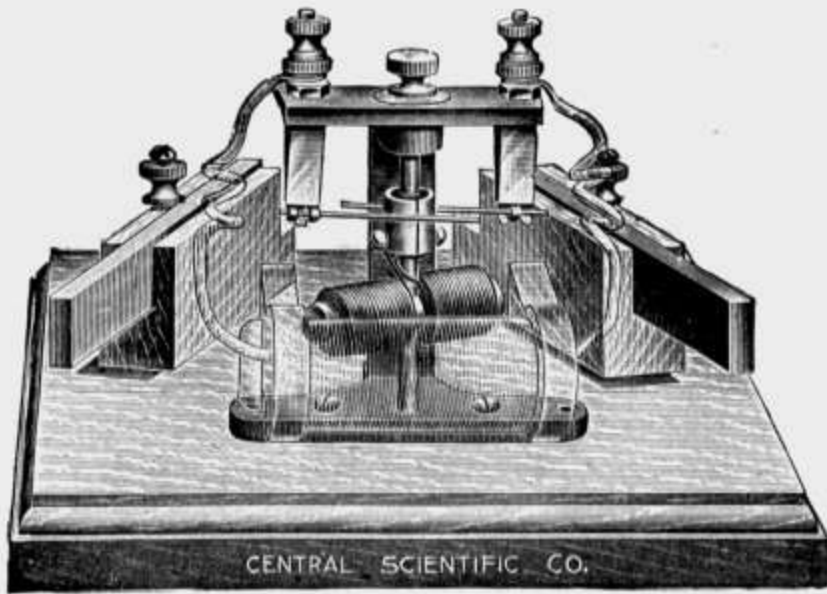
2248. **Little Hustler Complete Outfit,** consisting of No. 2246 Finished Motor, No. 2247 Fan, No. 2113 Battery and Wire, complete..... 2.35

N. B.—This outfit cannot be sent by mail.

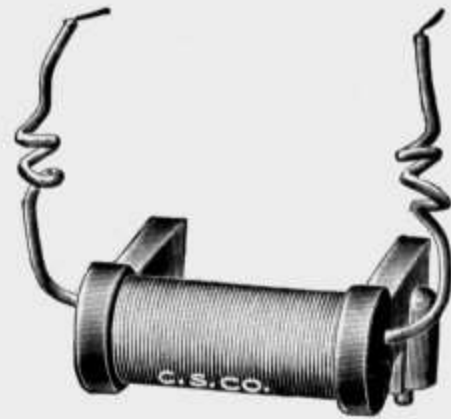
2249. **Motor Parts, Large Size.** In accordance with a number of requests for a dissected motor larger than the "Little Hustler," we have had made a motor similar in design to No. 2246, but 5 inches high, weighing 2 lbs. The iron parts are japanned and with all machine work done; all screws, washers, bearings, etc., are nickel plated. Complete, ready for assembling, with the exception of wire and wooden base ..... 1.77

For Fan for No. 2249, see No. 2254A, 4¾-inch.

2249A. **Wooden Base** for No. 2249, with sufficient wire for winding field and armature ..... .77



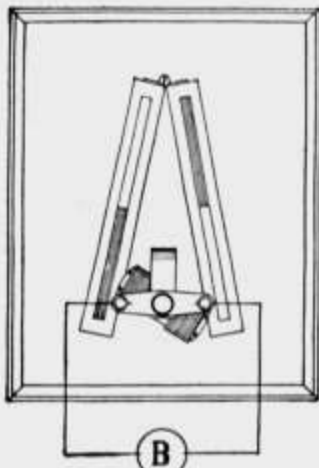
No. 2250.



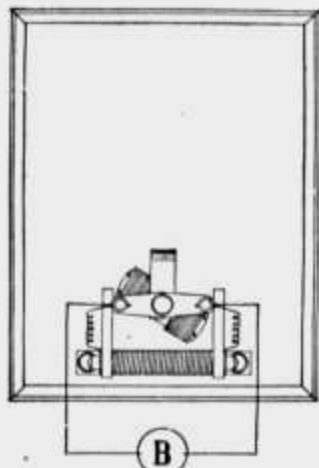
No. 2250A.

2250. **St. Louis Motor.** This apparatus is a dissectible motor that may also be operated as a dynamo. The model was suggested by the physics teachers of the St. Louis High Schools and has proved a very valuable and popular piece of apparatus for the laboratory. The salient features are:

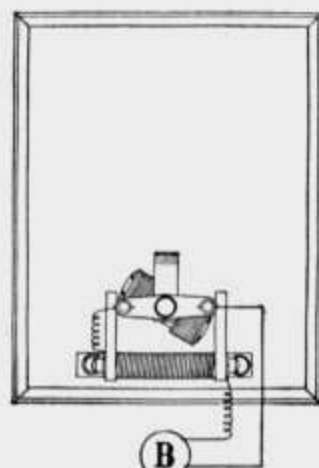
1. **DISSECTIBILITY.** Parts are of good construction and go together accurately and rigidly. Not easily put out of adjustment.
2. **ALL PARTS ARE PLAINLY VISIBLE** when at rest and in motion.
3. **INDIVIDUAL LABORATORY WORK** on motor and dynamo is made possible.



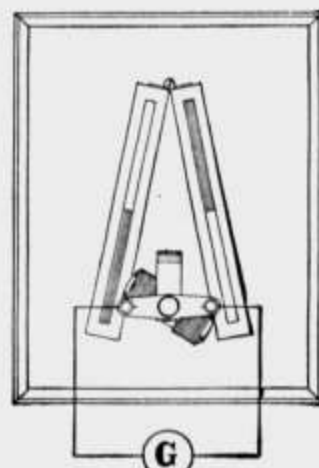
No. 1.  
Motor; Bar Magnet Fields.



No. 2.  
Shunt Motor; Electro Magnet Fields.



No. 3.  
Series Motor; Electro Magnet Fields.



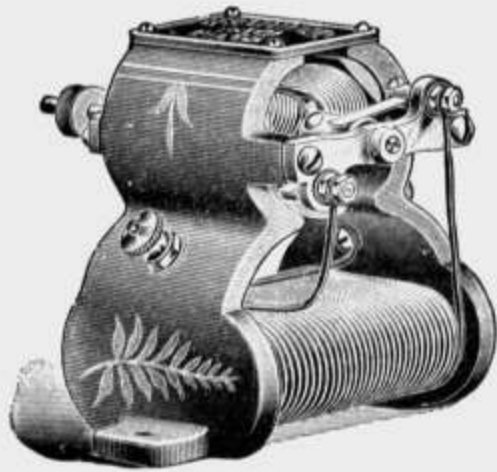
No. 4.  
Dynamo; Bar Magnet Fields.

The following points may be studied with a test needle:

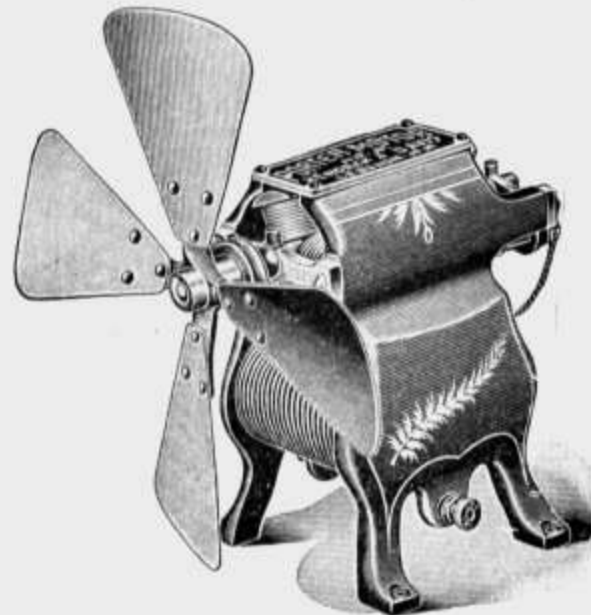
- I. **FIELD MAGNETS (PERMANENT).** See illustration 1.
  - A. Strength of bar magnet field at different distances from armature.
  - B. Effect of two like poles, etc.
- II. **ELECTRO MAGNET FIELD** in shunt or series connection. See illustrations 2 and 3. (No. 2250A **Electro-Magnet Attachment** also needed here.)
- III. **POLARITY** of armature at different points in its revolution. **POLARITY** of field.
- IV. **DIRECTION OF CURRENT** in armature and field.
- V. **COMMUTATION**, position of armature, commutator and brushes.
- VI. **MOTOR** characteristics, operated by one dry cell.
- VII. **DYNAMO** characteristics, turned by hand. See illustration 4.

St. Louis Motor, mounted on base, with two 6 inch bar magnets and full directions .....	\$ 2.25
2250A. <b>Electro-Magnet Attachment</b> , for use with No. 2250.....	.55





No. 2251.



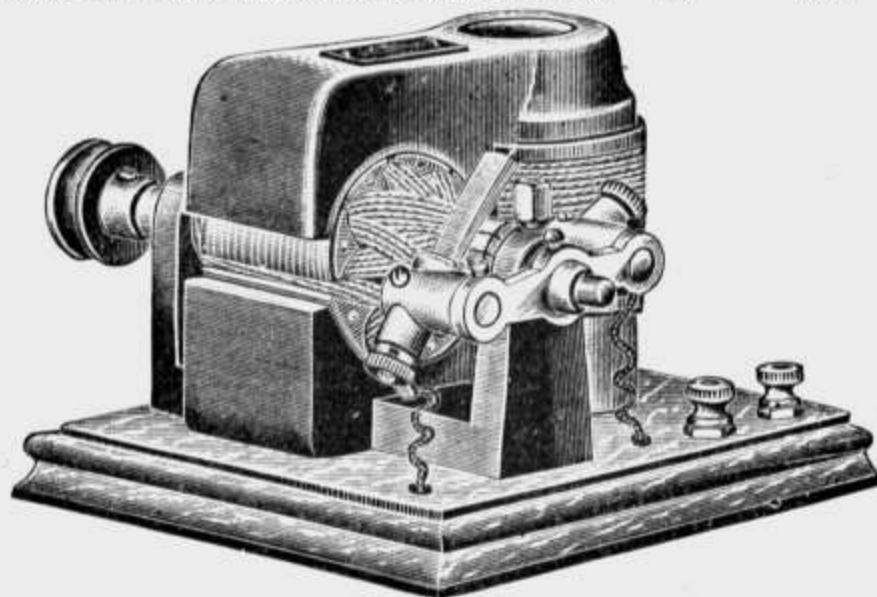
No. 2254.

**Porter Battery Motors.** These motors have a well-earned reputation and are recognized as standard articles. They are perfect in every detail of design and construction and accurately made. Nicely finished in black enamel. Without fan.

Catalog No.	Motor No.	H. P.	Volts	Amperes	R. P. M.	Size, in.	Weight, lbs.	Size of fan, in.	Price
2251.	1	1-100	1.5-3	1.5	5500	3 1/4 x 3 1/4 x 3 1/4	1 1/2	4 3/4	\$ 3.35
2252.	2	1-90	3 -5	2	4000	3 3/4 x 4 x 4 1/4	2 3/4	5 1/2	5.55
2253.	3	1-80	6	1.6	3600	5 1/2 x 4 x 5 1/2	6 1/2	8	8.90
2254.	4	1-70	6	1.6	3000	6 x 4 1/2 x 6	8	8	10.00

For Rheostat for speed regulation, see No. 2258.

2254A.	Fans for Porter Motors.	Diameter, inches.....	4 3/4	5 1/2	8
		For shaft diameter, inches.....	1/8	3/8	3/8
		Each .....	.40	.80	1.00



No. 2255.

**2255. Dynamo-Motor.** As a dynamo it has an output of from 12 to 20 watts when run at speeds of from 3,000 to 4,000 R. P. M. and will light small incandescent lamps, run motors, explode gas, decompose water, etc. With 4,000 R. P. M. it gives between 8 and 9 volts on closed circuit, with a current of about 2.4 amperes. As a motor it can be run on a battery of 2 volts or more according to the power and speed desired. With 6 volts it gives about 600 R. P. M., and with 16 volts, about 1,100 R. P. M. This machine has brass bearings, steel shaft, oil cups and 12-section commutator. It has a rocker arm brush holder, by means of which excessive sparking at the brushes may be prevented. Finished in black enamel, mounted on a 4.5x5-inch polished wood base; total height, 3.75 inches. Complete with binding posts, switch, and 1-inch grooved pulley..... \$ 6.65

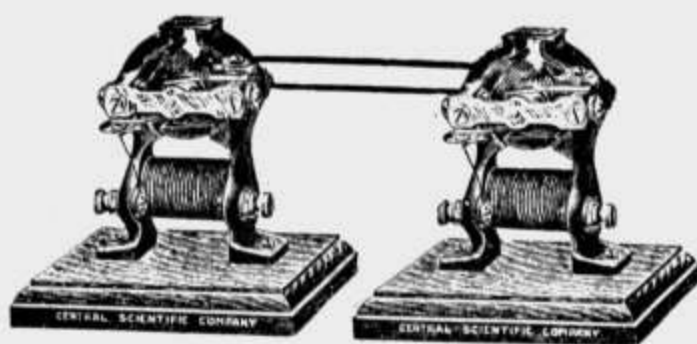
See No. 842 Pulley for a means of running the above dynamo.

See Nos. 829 and 830 for Motor Rotators.

See also No. 1048 Water Motor and Dynamo.



No. 2255A.

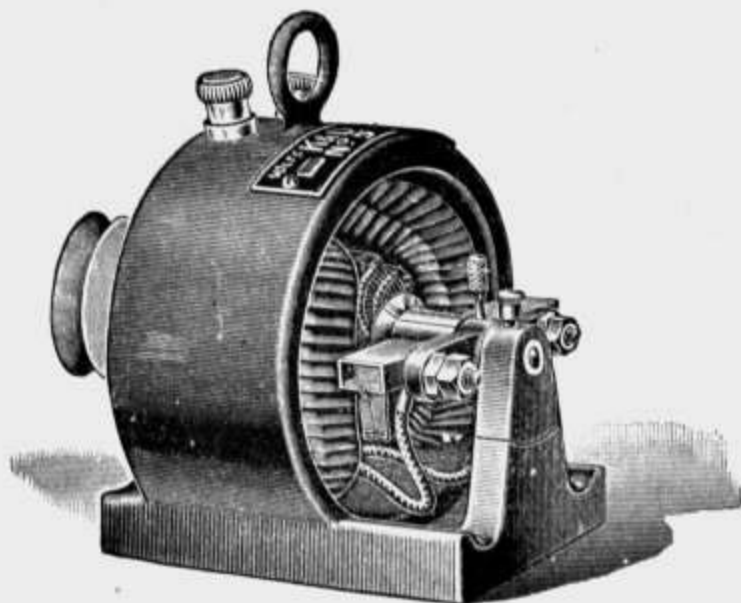


No. 2256.



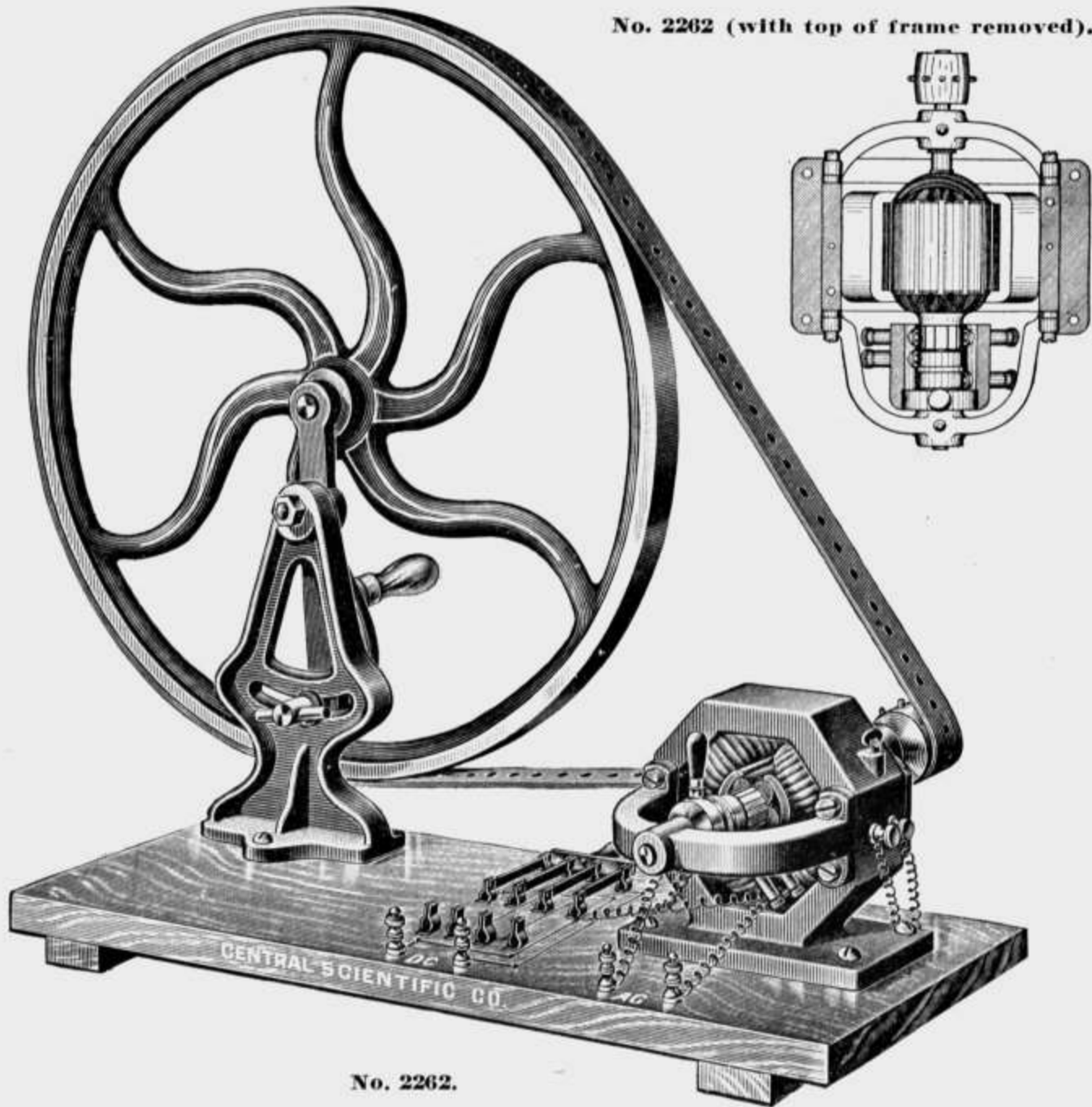
No. 2258.

- 2255A. **Universal Motor.** This motor may be used on either 110 volt Alternating (60 cycle) or Direct Current Circuit. Will develop approximately  $\frac{1}{30}$  H. P., is efficient and will not heat up when operating on either circuit. It is constructed in a substantial manner, having laminated fields and armature and a twelve-section copper commutator. It uses a  $\frac{3}{16}$ -inch carbon brush and is equipped with compression grease cup and bronze bearings which assure perfect lubrication.
- It weighs  $4\frac{1}{4}$  pounds, is 5 inches high and consumes about the same amount of current as one 8 C. P. lamp..... \$ 6.65
2256. **Dynamo and Motor,** of simple construction, for demonstrating the complete transformation of energy, the motor being run on two cells, to furnish power which will operate the dynamo, thereby giving a current which is indicated by a galvanometer..... 2.77
2258. **Battery Rheostat,** for regulating the speed of small motors, as listed on page 174, and also for use with miniature battery lamps. This rheostat is nicely finished with nickel trimmings and rubber handle. Resistance, 0 to 5 ohms..... 1.10
2259. **Dynamo.** A shunt-wound dynamo particularly desirable for experimental purposes. It will light to full power twelve 6 volt 3 C. P. lamps. The field is of the ring type, cast solid with the frame. The coils are form wound, carefully taped and shellacked; they are entirely safe from mechanical injury or breakdown. The armature is of the drum type, laminated, slot wound—it does not heat. The commutator is of hard copper, carefully insulated with mica. The brush holders are of new design, of the radial type, mounted on an adjustable yoke. The brushes are of woven wire, self-adjusting—they do not spark. The bearings are of hard bronze, nicely fitted; workmanship throughout the best. Finished in black enamel. Fitted with  $1\frac{1}{2}$ -inch grooved pulley. Length of shaft, 6 inches. Weight, 9 pounds. Occupies space  $6 \times 4\frac{3}{4} \times 6$  inches. At speed of 2200 R. P. M., the output is 36 Watts (6 volts, 6 amperes)... 10.50
- See No. 842 **Pulley** for a means of running the above dynamo.



No. 2259.

No. 2262 (with top of frame removed).



No. 2262.

2262. **Dissectible Dynamo**, new design. This dynamo has been developed to meet the demand for a more modern machine to demonstrate the laws of dynamo-electric machinery. Its design and construction is practically the same as that of the commercial multipolar machines used for lighting and power. This one machine will demonstrate the principle of the following machines: series dynamo, shunt dynamo, separately excited dynamo, shunt motor, series motor, rotary converter and alternator.

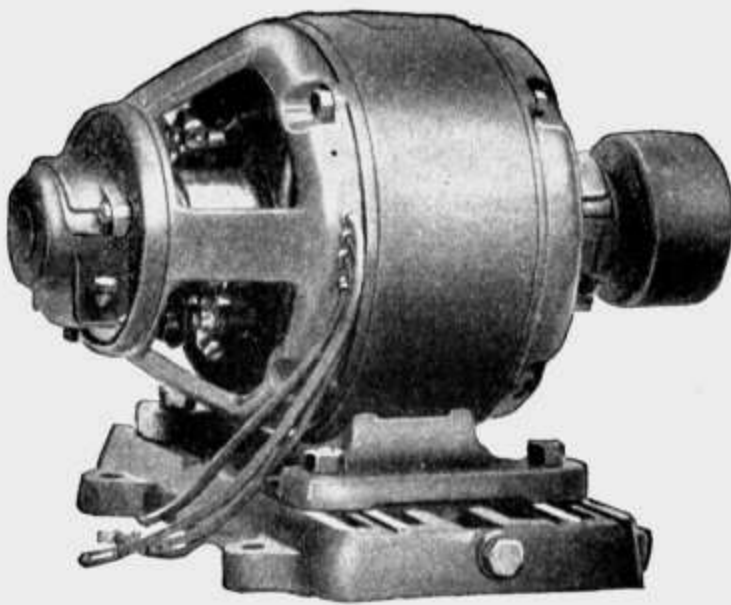
The **FIELD FRAME** is octagonal in shape and contains **FOUR POLES**. It is so constructed that by unscrewing two thumb screws on the sides of the frame the top half of the frame can be removed from the balance of the machine. This permits perfect inspection and demonstration of all members of the machine, as shown in the small illustration. The **FIELD COILS** are form wound and are held in place by means of pole shoes securely fastened to the pole pieces, a construction similar to that used in large dynamos. The connections to the field coils are arranged in such a manner as to permit the machine to be operated as either a shunt or a series dynamo, by means of a four-pole double-throw switch.

The **ARMATURE** is of the slotted drum type with imbedded coils. The **COMMUTATOR** is made from hard drawn copper and insulated throughout with mica. On the same end of the shaft with the commutator is located a set of collecting rings and brushes for taking off alternating current. The brushes are mounted on a rocker arm, which permits adjustment of the brushes to the neutral point of commutation. The **OUTPUT** of the machine depends greatly upon its speed of rotation and the resistance of the external circuit. It is wound for an E. M. F. of 12 volts and an output of 70 watts when operated at a speed of 1800 R. P. M.

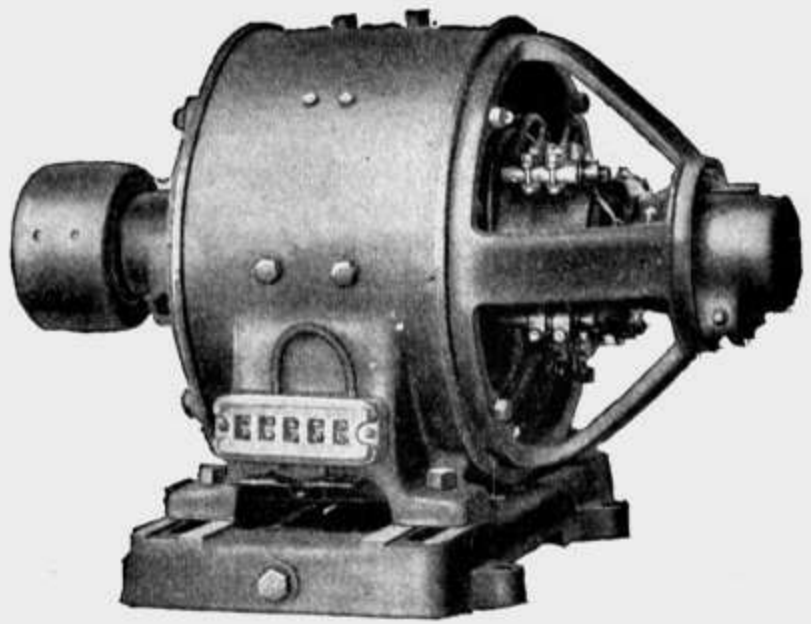
- Complete dynamo mounted on a substantial wooden base with adjustable driving wheel and belt.....Net \$ 35.00
- 2262A. **Dynamo**, same as No. 2262, mounted on base without driving wheel, but supplied with belt for use with motor, which may be attached to the same base.....Net 30.00

## DIRECT CURRENT GENERATORS.

## SHUNT WOUND.



Nos. 2263A—2263EE.

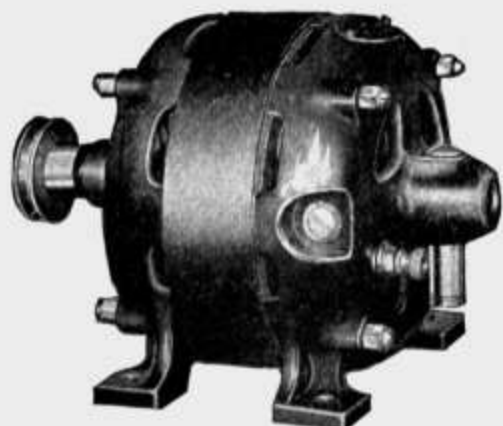


Nos. 2263G—2263KK.

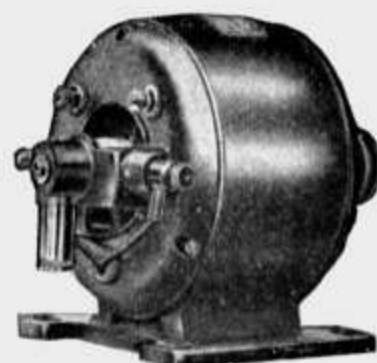
The following General Electric Dynamos are adaptable for all kinds of electrical lighting purposes, charging batteries, etc., etc., and are guaranteed to be free from mechanical or electrical defects. The  $\frac{1}{4}$  to  $1\frac{1}{2}$  K. W. Dynamos, inclusive, are of approved bi-polar construction, while the 2 K. W. and 3 K. W. Dynamos are of the inter-pole or regulating-pole type, insuring perfect commutation. The prices below include the Dynamos complete with Field Rheostat, Sliding Base and Standard Pulley.

Catalog No.	K. W.	Volts.	No. of 25 Watt Lamps.	Speed, R. P. M.	Pulley.		Shipping Weight.	Price, Net, F. O. B. Chicago.
					Diam.	Face.		
2263A.	$\frac{1}{4}$	110	10	2600	$2\frac{1}{2}$	2	75	\$43.90
2263AA.	$\frac{1}{4}$	220	10	2600	$2\frac{1}{2}$	2	82	46.10
2263B.	$\frac{1}{2}$	110	20	2300	$3\frac{1}{2}$	2	161	54.45
2263BB.	$\frac{1}{2}$	220	20	2300	$3\frac{1}{2}$	2	168	56.65
2263C.	$\frac{5}{8}$	110	25	2000	$3\frac{1}{2}$	$2\frac{1}{2}$	173	57.75
2263CC.	$\frac{5}{8}$	220	25	2000	$3\frac{1}{2}$	$2\frac{1}{2}$	173	61.10
2263D.	$\frac{7}{8}$	110	35	1600	$4\frac{1}{2}$	$2\frac{1}{2}$	223	63.80
2263DD.	$\frac{7}{8}$	220	35	1600	$4\frac{1}{2}$	$2\frac{1}{2}$	223	66.65
2263E.	$1\frac{1}{2}$	110	60	2300	$4\frac{1}{2}$	$2\frac{1}{2}$	223	70.00
2263EE.	$1\frac{1}{2}$	220	60	2300	$4\frac{1}{2}$	$2\frac{1}{2}$	223	73.35
2263G.	2	110	80	1550	$4\frac{1}{2}$	$3\frac{1}{2}$	375	118.85
2263GG.	2	220	80	1550	$4\frac{1}{2}$	$3\frac{1}{2}$	375	118.85
2263K.	3	110	120	2100	$4\frac{1}{2}$	$3\frac{1}{2}$	375	122.25
2263KK.	3	220	120	2100	$4\frac{1}{2}$	$3\frac{1}{2}$	375	122.25

## DIRECT CURRENT MOTORS.



Nos. 2263M—2263YY.



Nos. 2264A—2264DD.

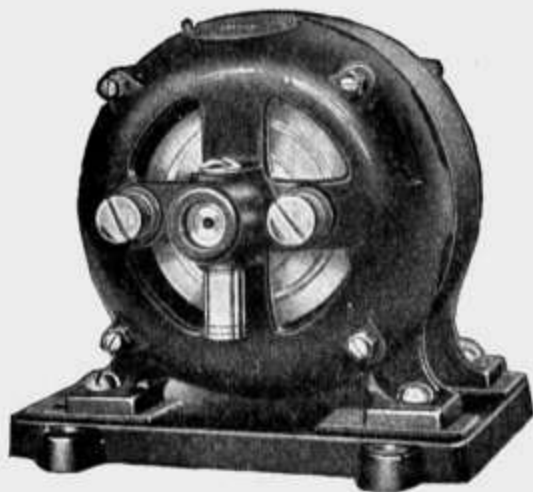
### GENERAL ELECTRIC DIRECT CURRENT SMALL POWER MOTORS.

For Constant Speed and Continuous Service.

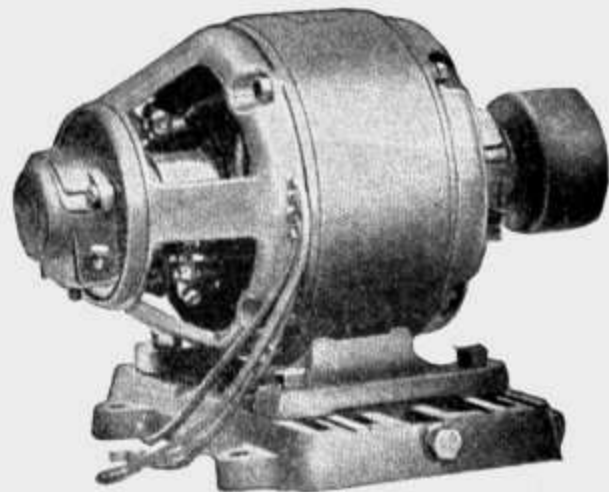
Catalog No.	H. P.	Volts.	Speed, R. P. M.	Shipping Weight.	Winding.	V Groove Pulley.	Net Price, F. O. B. Chicago.
2263M.	$\frac{1}{50}$	110	1100	22	Shunt.	1 $\frac{1}{4}$ inch.	11.00
2263MM.	$\frac{1}{50}$	220	1100	22	Shunt.	1 $\frac{1}{4}$ inch.	12.00
2263N.	$\frac{1}{30}$	110	1700	22	Shunt.	1 $\frac{1}{4}$ inch.	11.00
2263NN.	$\frac{1}{30}$	220	1700	22	Shunt.	1 $\frac{1}{4}$ inch.	12.00
2263P.	$\frac{1}{30}$	110	1100	22	Shunt.	1 $\frac{1}{4}$ inch.	12.00
2263PP.	$\frac{1}{30}$	220	1100	22	Shunt.	1 $\frac{1}{4}$ inch.	13.00
2263R.	$\frac{1}{20}$	110	1100	25	Shunt.	1 $\frac{1}{2}$ inch.	13.00
2263RR.	$\frac{1}{20}$	220	1100	25	Shunt.	1 $\frac{1}{2}$ inch.	14.00
2263S.	$\frac{1}{15}$	110	1700	23	Shunt.	1 $\frac{1}{2}$ inch.	12.00
2263SS.	$\frac{1}{15}$	220	1700	23	Shunt.	1 $\frac{1}{2}$ inch.	13.00
2263T.	$\frac{1}{10}$	110	1700	25	Shunt.	1 $\frac{1}{2}$ inch.	13.00
2263TT.	$\frac{1}{10}$	220	1700	25	Shunt.	1 $\frac{1}{2}$ inch.	14.00
2263V.	$\frac{1}{10}$	110	1200	28	Compound.	1 $\frac{3}{4}$ inch.	15.00
2263VV.	$\frac{1}{10}$	220	1200	28	Compound.	1 $\frac{3}{4}$ inch.	16.00
2263W.	$\frac{1}{8}$	110	1700	28	Compound.	1 $\frac{3}{4}$ inch.	15.00
2263WW.	$\frac{1}{8}$	220	1700	28	Compound.	1 $\frac{3}{4}$ inch.	16.00
2263Y.	$\frac{1}{8}$	110	1200	31	Compound.	2 inch.	17.00
2263YY.	$\frac{1}{8}$	220	1200	31	Compound.	2 inch.	18.00

### CENCO DIRECT CURRENT MOTORS.

Catalog No.	H. P.	Volts.	Speed, R. P. M.	Net Weight.	Winding.	Price, Net.
2264A.	$\frac{1}{20}$	110	1800	12	Series.	\$ 9.40
2264AA.	$\frac{1}{20}$	220	1800	12	Series.	10.00
2264B.	$\frac{1}{16}$	110	2000	12	Series.	10.15
2264BB.	$\frac{1}{16}$	220	2000	12	Series.	10.95
2264C.	$\frac{1}{12}$	110	1800	14	Series.	10.95
2264CC.	$\frac{1}{12}$	220	1800	14	Series.	11.80
2264D.	$\frac{1}{8}$	110	1800	17 $\frac{1}{2}$	Shunt.	13.15
2264DD.	$\frac{1}{8}$	220	1800	17 $\frac{1}{2}$	Shunt.	14.50



Nos. 2264E—2264MM.



Nos. 2264N—2264TT.

## GENERAL ELECTRIC DIRECT CURRENT MOTORS.

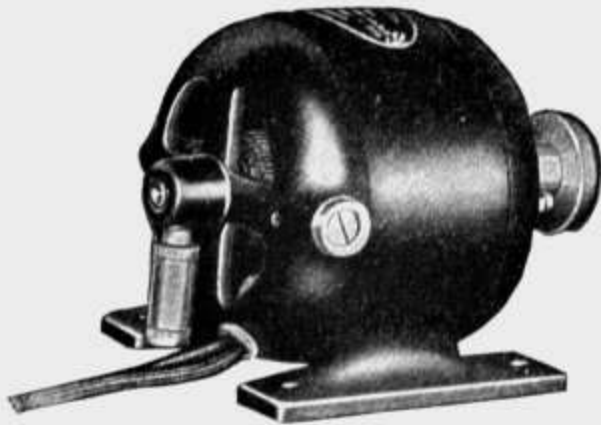
The following D. C. Power Motors are compound wound and require no starting box. Motors are complete with sliding base and standard pulley.

No. Catalog	H. P.	Volts.	Speed, R. P. M.	Shipping Weight.	Pulley,		Net Price, F. O. B. Chicago.
					Diam.	Face.	
2264E.	$\frac{1}{6}$	110	1700	31	2	V	\$18.25
2264EE	$\frac{1}{6}$	220	1700	31	2	V	19.25
2264F	$\frac{1}{6}$	110	1100	42	$2\frac{1}{2}$	$1\frac{1}{2}$	24.50
2264FF	$\frac{1}{6}$	220	1100	42	$2\frac{1}{2}$	$1\frac{1}{2}$	25.50
2264G	$\frac{1}{4}$	110	1750	42	$2\frac{1}{2}$	$1\frac{1}{2}$	24.50
2264GG	$\frac{1}{4}$	220	1750	42	$2\frac{1}{2}$	$1\frac{1}{2}$	25.50
2264H	$\frac{1}{4}$	110	1100	42	$2\frac{1}{2}$	$1\frac{1}{2}$	26.00
2264HH	$\frac{1}{4}$	220	1100	42	$2\frac{1}{2}$	$1\frac{1}{2}$	27.00
2264J	$\frac{1}{3}$	110	1700	42	$2\frac{1}{2}$	$1\frac{1}{2}$	27.00
2264JJ	$\frac{1}{3}$	220	1700	42	$2\frac{1}{2}$	$1\frac{1}{2}$	28.00
2264K	$\frac{1}{3}$	110	1100	46	$2\frac{1}{2}$	$1\frac{1}{2}$	28.50
2264KK	$\frac{1}{3}$	220	1100	46	$2\frac{1}{2}$	$1\frac{1}{2}$	29.50
2264L	$\frac{1}{2}$	110	1700	70	$3\frac{1}{2}$	2	44.00
2264LL	$\frac{1}{2}$	220	1700	70	$3\frac{1}{2}$	2	45.00
2264M	$\frac{1}{2}$	110	1100	70	$4\frac{1}{2}$	$2\frac{1}{2}$	48.00
2264MM	$\frac{1}{2}$	220	1100	70	$4\frac{1}{2}$	$2\frac{1}{2}$	49.00

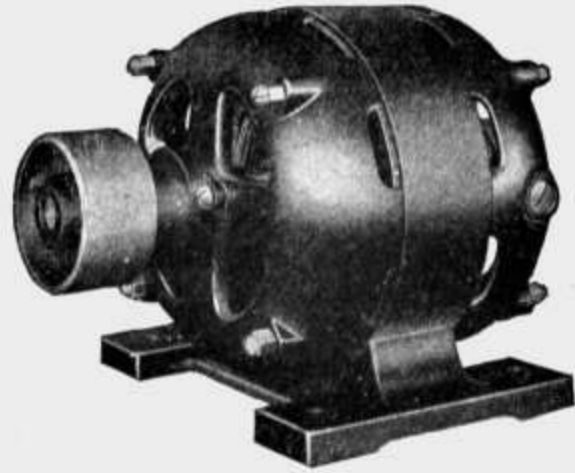
The following D. C. Power Motors are compound wound, constant speed, continuous service, oil ring bearing type, complete with "no voltage" release starting rheostat, sliding base and standard pulley.

No. Catalog	H. P.	Volts.	Speed, R. P. M.	Shipping Weight.	Pulley,		Net Price, F. O. B. Chicago.
					Diam.	Face.	
2264N.	$\frac{3}{4}$	110	1700	163	$3\frac{1}{2}$	$2\frac{1}{2}$	\$49.00
2264NN.	$\frac{3}{4}$	220	1700	163	$3\frac{1}{2}$	$2\frac{1}{2}$	50.00
2264P.	$\frac{3}{4}$	110	1475	175	$3\frac{1}{2}$	$2\frac{1}{2}$	52.00
2264PP.	$\frac{3}{4}$	220	1475	175	$3\frac{1}{2}$	$2\frac{1}{2}$	53.00
2264R.	1	110	2000	175	$3\frac{1}{2}$	$2\frac{1}{2}$	53.00
2264RR.	1	220	2000	175	$3\frac{1}{2}$	$2\frac{1}{2}$	54.00
2264S.	1	110	1150	225	$4\frac{1}{2}$	$2\frac{1}{2}$	64.00
2264SS.	1	220	1150	225	$4\frac{1}{2}$	$2\frac{1}{2}$	65.00
2264T.	2	110	1700	225	$4\frac{1}{2}$	$2\frac{1}{2}$	69.00
2264TT.	2	220	1700	225	$4\frac{1}{2}$	$2\frac{1}{2}$	70.00

## ALTERNATING CURRENT MOTORS.



Nos. 2264W—2264YY.



Nos. 2265H-2265Q.

## GENERAL ELECTRIC INDUSTRIAL FRACTIONAL POWER MOTOR.

The application of small power motors in industrial and domestic lines has increased to such enormous extent that small motors, of exceptional quality and lightness, are now available at low prices. They are "series" wound for continuous service, and will not develop an excessive speed when the entire load is thrown off. The A. C. motors operate on 110 volts 60 cycles, and will also operate on 110 volt direct current. The D. C. motors will operate **only** on 110 volt direct current.

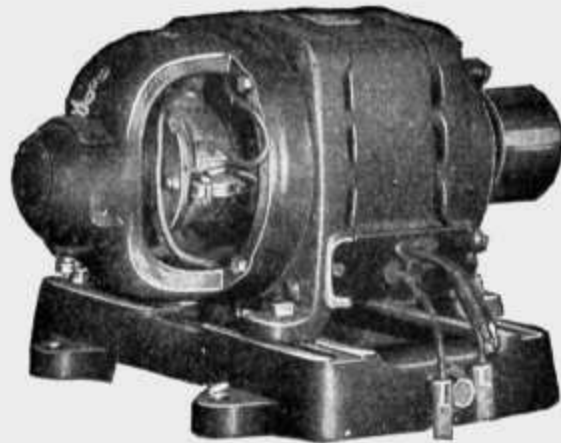
Catalog No.	H. P.	Volts.	Current.	Speed, R. P. M.	V Groove Pulley.	Weight. Net	Net Price, F. O. B. Chicago.
2264W.	$\frac{1}{100}$	110	A. C.	2200	$\frac{5}{8}$ inch.	4	\$8.25
2264WW.	$\frac{1}{100}$	110	D. C.	2200	$\frac{5}{8}$ inch.	4	8.25
2264Y.	$\frac{1}{50}$	110	A. C.	1800	$1\frac{1}{4}$ inch.	5	9.50
2264YY.	$\frac{1}{50}$	110	D. C.	1800	$1\frac{1}{4}$ inch.	5	9.50

## GENERAL ELECTRIC ALTERNATING CURRENT MOTORS.

## 110 Volt, Single Phase, 60 Cycle.

The following A. C. Power Motors are constant speed and for continuous service.

Catalog No.	H. P.	Speed, R. P. M.	Pulley.		Shipping Weight.	Price, Net, F. O. B. Chicago.
			Diam. in.	Face, in.		
2265	$\frac{1}{50}$	1200	$1\frac{1}{4}$	Grooved for $\frac{1}{4}$ inch belt, round.	20	\$ 12.00
2265 $\frac{1}{2}$	$\frac{1}{30}$	1750	$1\frac{1}{4}$		20	12.00
2265A.	$\frac{1}{15}$	1750	$1\frac{1}{2}$		24	17.50
2265B.	$\frac{1}{15}$	1150	$1\frac{1}{2}$		26	20.00
2265C.	$\frac{1}{10}$	1750	$1\frac{1}{2}$		26	20.00
2265D.	$\frac{1}{10}$	1150	$1\frac{1}{2}$		31	22.25
2265E.	$\frac{1}{8}$	1750	$1\frac{1}{2}$		31	22.25
2265F.	$\frac{1}{8}$	1150	$1\frac{1}{2}$		34	25.50
2265G.	$\frac{1}{6}$	1750	$1\frac{1}{2}$		34	25.50
2265H.	$\frac{1}{6}$	1150	$2\frac{1}{2}$		$1\frac{1}{2}$	48
2265K.	$\frac{1}{4}$	1750	$2\frac{1}{2}$	$1\frac{1}{2}$	48	29.50
2265L.	$\frac{1}{4}$	1150	$2\frac{1}{2}$	$1\frac{1}{2}$	48	32.50
2265M.	$\frac{1}{3}$	1750	3	$2\frac{1}{2}$	48	30.50
2265P.	$\frac{1}{2}$	1750	$4\frac{1}{2}$	$2\frac{1}{2}$	75	45.00
2265Q.	$\frac{1}{2}$	1150	$4\frac{1}{2}$	$2\frac{1}{2}$	75	50.00

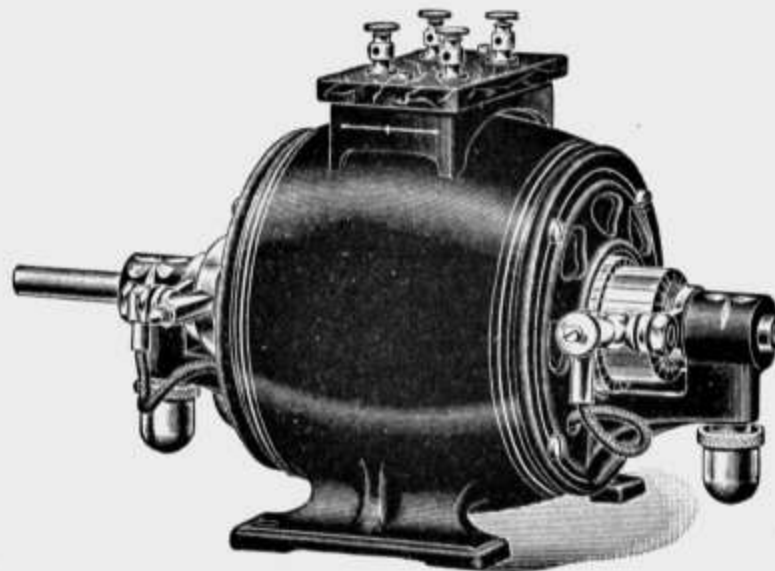


Nos. 2265R—2265S.

The following Alternating Current Power Motors are of the repulsion induction type especially adapted to loads requiring heavy starting torque and have the same high operating characteristics as a D. C. Compound Motor. They are provided with sliding base as shown in illustration above. They can be used on either 110 or 220 Volt, 60 Cycle, Alternating Current.

Catalog No.	H. P.	Speed, R. P. M.	Pulley,		Shipping Weight.	Price, Net, F. O. B. Chicago.
			Diam. in.	Face in.		
2265R.	1	1780	4½	2½	172	\$65.00
2265S.	1	1175	4½	3½	196	75.00

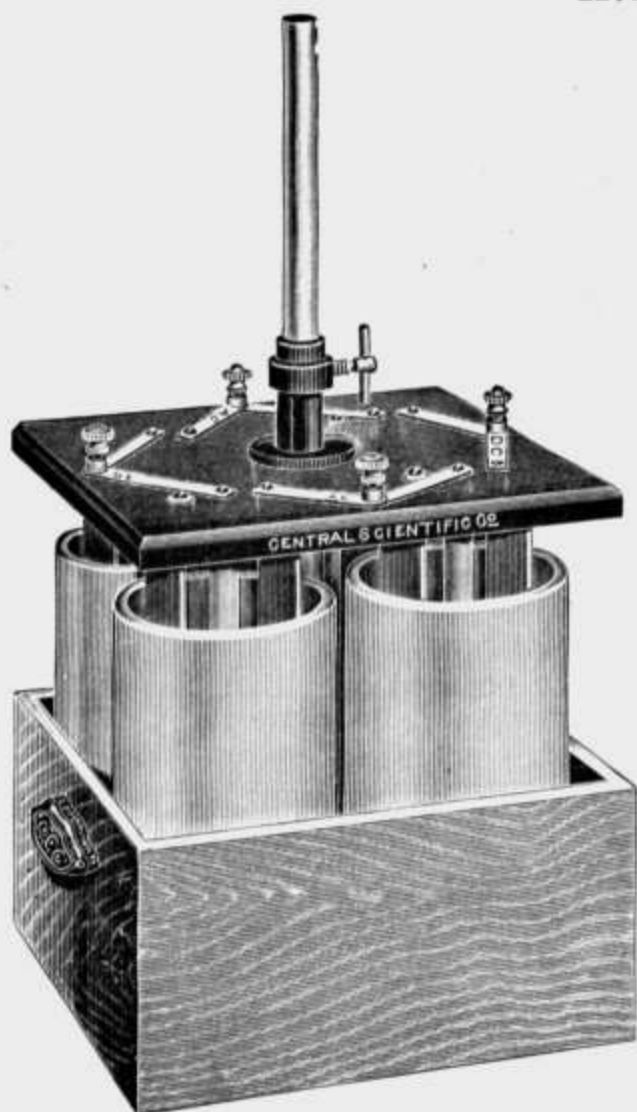
**ROTARY CONVERTERS.**



No. 2267.

- 2267. **Rotary Converter.** This machine converts the direct to an alternating current. The motor can be used for furnishing power for any purpose not requiring more than 1/8 H. P. Complete for 110 volt current. . . . .Net \$ 30.00
- 2267A. **Rotary Converter.** Same as No. 2267, but for 220 volt current. . . . .Net 30.00
- 2268. **Rotary Converter.** Same as No. 2267; 1/4 H. P. for 110 volt current. Motor can be used to operate a static machine and should then be used in connection with a rheostat. . . . .Net 45.50
- 2269. **Rotary Converter.** Same as No. 2268, for 220 volt current. . . . .Net 47.00
- Starting Box and Regulating Rheostat** for Nos. 2268-2269, extra. . . . .Net 9.00





No. 2270.

D. C. terminal, so that the current flows in the same direction through the D. C. circuit, on both alternations in the A. C. circuit. This valve, though not as efficient as a Motor Generator, may adequately take its place in any science laboratory. It may be used on either 110 or 220-volt alternating circuit with a moderately high efficiency. Currents of from 5 to 8 amperes may be obtained for laboratory use, and for short periods of time, much larger currents may be drawn from the valve. For electrolysis experiments, running small motors, and induction coils, etc., it is most convenient, being always ready for use. Many teachers have run connections from the rectifier to each student's desk, thus obviating the use of all primary batteries for ordinary physical and chemical experiments. Those teachers who have been dependent upon primary batteries with their inconvenience, annoyance and expense, and who have only an alternating current at their disposal, will find this rectifier very satisfactory.

The following extract from a letter from one of our customers (whose name we will furnish on request) shows some of the possibilities in the use of the Nodon Valve:

"I am more than pleased with the Nodon Valve. I connected it with my lantern, with the same resistance in the alternating circuit which I have been using, and the intensity of the light was as great, there apparently being no loss in the rectifier. I have charged my storage batteries with the current taken through the valve; can run my direct current motor with it, and even use it to run No. 3036 Tuning Fork by placing resistance in the direct, as well as in the alternating circuit. With this rectifier and plenty of resistance (I use wire rheostats) at my disposal, ordinary and even storage batteries will be largely displaced in my laboratory."

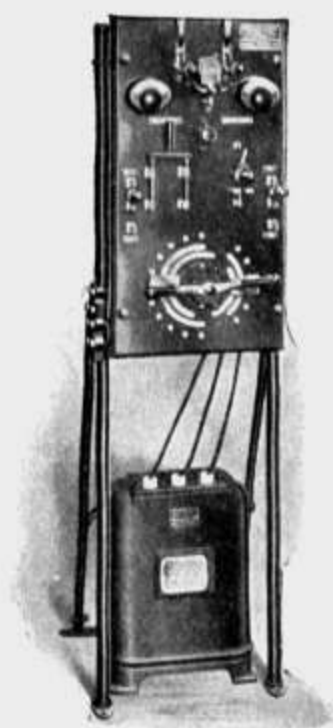
Complete with full directions.....Net \$ 15.00  
 Chemicals for No. 2270, per complete charge.....Net .50

#### 2270. Electrolytic Rectifier or Nodon

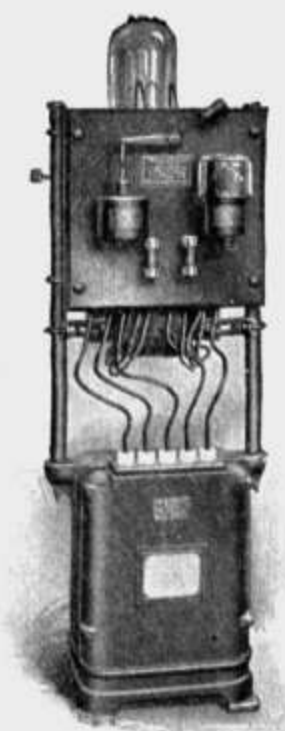
**Valve.** This rectifier consists of four electrolytic cells with electrodes of lead and aluminum, and depends for its action on the fact that an electric current will not enter the electrolyte from the aluminum electrode, but will pass freely into the electrolyte from the lead. The electrodes are fastened at their upper ends to a substantial top of non-conducting material, to which are attached binding posts for both A. C. and D. C. circuits. The connections between the binding posts and the electrodes are made by straps of metal, so that the path of the current is readily traced.

Alternating current leads are attached to binding posts marked A. C. in series with some lamps connected in parallel. (Our No. 2453 Lamp Rheostat is excellent for this purpose.) The direct current is taken directly from posts marked D. C. If it is desired, a resistance may also be used in the direct current circuit. On an examination of the connections it will readily be seen that whichever A. C. terminal happens to be the positive one, the current always flows through the valve to the same D. C. binding post, which is therefore always the positive

**MERCURY ARC RECTIFIERS.**



No. 2270A.



No. 2270J.

This well known type of rectifier will be found useful in charging storage batteries, and in operating a lantern, where a direct current is desired.

**Battery Charging Type.** 25-60 cycles. Complete with voltmeter and ammeter, regulating switch, rheostat, one mercury tube, and accessories. The efficiency varies from 70% at 60 volts D. C. to 80% at 175 volts D. C.

Catalog No.	D. C. Amperes.	Range, D. C. Volts.	A. C. Volts.	Ammeter Scale.	Voltmeter Scale.	Battery Charging Capacity.		Shipping Wt., lbs.	Prices, Net.
						Lead Cells.	Edison Cells.		
2270A.	15-30	15- 45	110	40	75	8-17	9-25	590	\$ 226.80
2270B.	15-30	45- 75	220	40	75	22-28	38-40	590	226.80
2270C.	8-30	15- 45	110	40	75	8-17	9-25	640	270.00
2270D.	8-30	45- 75	220	40	75	22-28	38-40	640	270.00
2270E.	20-40	15- 45	110	60	75	8-17	9-25	635	307.80
2270F.	20-40	45- 75	220	60	75	22-28	38-40	635	307.80
2270G.	20-40	15- 45	110	60	120	8-17	9-25	690	307.80
2270H.	20-40	45-120	220	60	120	22-46	38-64	690	307.80

**Projection Apparatus Type.** Direct current is capable of better regulation than alternating and gives a clearer, whiter and steadier light, with less waste of energy.

Catalog No.	Frequency.	A. C. Volts.	D. C. Amperes.	D. C. Volts.	Shipping Wt., lbs.	Prices, Net.
2270J.	25	110	30	40-70	550	\$ 162.00
2270K.	25	220	30	40-70	550	162.00
2270L.	60	110	30	40-70	550	162.00
2270M.	60	220	30	40-70	550	162.00

**EXTRA MERCURY ARC RECTIFIER TUBES.**

2270S. Tube, for Nos. 2270A to 2270D, 30 D. C. Amperes.....Net \$ 18.00  
 2270T. Tube, for Nos. 2270E to 2270M, 40 D. C. Amperes.....Net 30.00

**EDISON ALTERNATING CURRENT RECTIFIER.**

**A New and Inexpensive Device for Charging Storage Batteries from an Alternating Current Circuit and for Operating Other Direct Current Apparatus.**



Patent Applied For.

Charges storage batteries, including Edison and lead-acid of all types, from an alternating current circuit.

Simple of connection and operation; a child can operate it. Just connect to an electric lamp socket, turn a snap switch and the battery is charging.

Sturdy of construction with no parts subject to deterioration from continuous use. The vibrating contacts are made of carbon and copper, which will not "arc" and "freeze" as will metal contacts.

Frequent adjustments, repairs or replacement of parts not necessary; cost of up-keep, a prohibitive factor with other and more expensive types of charging apparatus, need not, therefore, be considered.

Guaranteed high efficiency and small current consumption, only one-half of A. C. wave being utilized.

Heretofore all types of storage batteries have been open to the expense and inconvenience of sending the battery out at regular intervals for recharging or the necessity of installing an expensive and delicate charging apparatus. This objection has been completely removed by the invention and commercial development of the Edison Alternating Current Rectifier.

It is in theory and in fact, a simple electro-mechanical valve which allows current waves of only one polarity to pass through it from an A. C. circuit to the battery which is to be charged.

The method of operating it is as simple as the turning off and on of an ordinary electric light. An indicating snap switch of the usual form controls the starting and stopping of the charging current. The Rectifier will run continuously giving any desired charging rate of current within its rate of capacity.

Upon failure of the main A. C. current, the charging circuit is automatically opened, thus preventing the storage battery from discharging through the Rectifier. Upon resumption of the main A. C. current, the Rectifier starts automatically.

The cost of charging four ordinary storage batteries of 40 ampere-hour capacity connected in multiple with current costing as high as 10c per K.W. hour would be only 29c, or about 7c per battery.

Owing to the greater care required with batteries of the lead-acid type, we advise the use of a regulating rheostat and ammeter in the charging circuit. We can furnish these two instruments separately or as illustrated, combined on one panel.

All Rectifiers are provided with terminals for connecting a rheostat in the charging circuit.

This apparatus does not require an expert's services to keep it in good running condition as there are no complicated parts nor special starting devices.

#### PRICE LIST AND SPECIFICATIONS.

Size.	Primary or A. C. Volts.	Cycles.	Charging or D. C. Volts.	Amperes D. C.	Each, Net.
B-2	110-125	60	2-10	3- 8	\$65.00
B-2	110-125	40	2-10	3- 8	65.00
B-2	110-125	25	2-10	3- 8	72.00
B-4	110-125	60	2-10	6-16	80.00
B-4	110-125	40	2-10	6-16	80.00
B-4	110-125	25	2-10	6-16	90.00
Rheostat for controlling charging current.....					4.50
Ammeter for indicating charging current.....					12.00
Controlling switchboard with rheostat and ammeter.....					20.00

#### Note:

Add 10 per cent. net extra for 220 volt A. C. primary winding.

Always give the make of battery, number of cells and required charging current.

When the rectifier is to be used without a regulating rheostat and ammeter or current indicator, it is always adjusted before shipment for the charging current specified.

When a regulating rheostat is used, the full range of charging current given in the above table will be obtained.

**2270W. ALTERNATING CURRENT RECTIFIER.****No. 2270W.**

The rectifier proper consists of an electromagnet, the armature of which is a flat spring held rigidly at one end, but free at the other to vibrate in front of the core of the magnet. The magnet is so connected that it attracts the armature once for every cycle of the supply frequency and at every attraction a contact is made which allows part of the alternating current wave to go through. The release of the armature breaks the connection and stops the reverse current wave.

The rectifier is supplied with a lamp cord and plug to attach to any lamp socket, as the current is not sufficient to damage fixture wiring. No further attention is needed after once attaching, for even if voltage should fail no harm is done, as the armature will remain in open position and upon the return of current will commence to work automatically. Neither is any harm done to the battery by allowing it to remain connected longer than necessary, as when the charge is complete the current is reduced to a very small percentage of the normal charging rate. **In ordering specify amperage and voltage of direct current desired.**

Rectifiers for 110 volt, 60 cycle, alternating current, to be used with Lead Batteries.

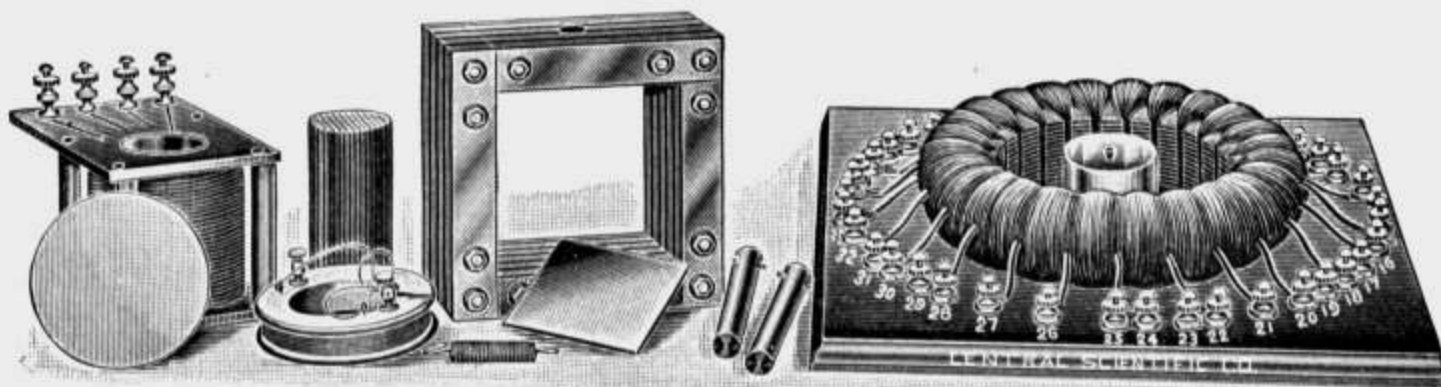
Amperes.	Volts.	Number Cells.	Net Price, Without Ammeter.
3	6	3	\$26.25
3	8	4	26.25
5	6	3	26.25
5	8	4	30.00
7½	6	3	33.75
7½	8	4	37.50
10	6	3	37.50
10	8	4	41.25
5	12	6	41.25
7½	12	6	50.75
15	6	3	45.00
15	8	4	50.75
15	10	5	52.50

Rectifiers for 110 volt, 60 cycle, alternating current, to be used with Edison Batteries.

Amperes.	Volts.	Number Cells.	Net Price, Without Ammeter.
7½	6.5	5	\$37.50
15	6.5	5	41.50
15	9	7	50.75

**Note**—If an **Ammeter** is desired, add \$7.50 net to the above prices.

**BURNS' ALTERNATING CURRENT APPARATUS.**



**No. 2216.**  
(Patent Applied For.)

**Designed by Elmer E. Burns, Instructor in Physics, Joseph Medill High School, Chicago.**

**2216. Complete Student's Set.** Consists of No. 2216A Simplified Transformer Set, and No. 2216L Gramme Ring Coil as described below. Complete directions for setting up the apparatus and making all connections to secure results mentioned above are furnished with each set. Directions for laboratory and lecture experiments with the apparatus are given in Burns' "Experimental Course in Alternating Currents," Joseph G. Branch Publishing Co., Chicago....Net \$ 45.00

**2216A. Simplified Transformer Set.** The transformer is of the shell type with separable coil, laminated core, and frame. When the primary is connected to a 110 volt circuit, 220 volts will be developed at the secondary terminals, or by reversing the coils 55 volts. All transformer tests such as for **power losses, efficiency, power factor, and self-adjustment of transformer to its load** may be made with the apparatus in this form. With the two windings connected in series, the auto transformer is illustrated.

When the frame is removed, the coil with its core forms a choke coil suitable for inductance and reactance tests and measurements. In series with lamps it acts as a dimmer.

The magnetic permeability of specimens of iron may be tested by using the coil and frame as a permeameter. An iron plate is furnished to fit under the coil for making close contact with the test rod. Test rods of soft iron and steel are also furnished.

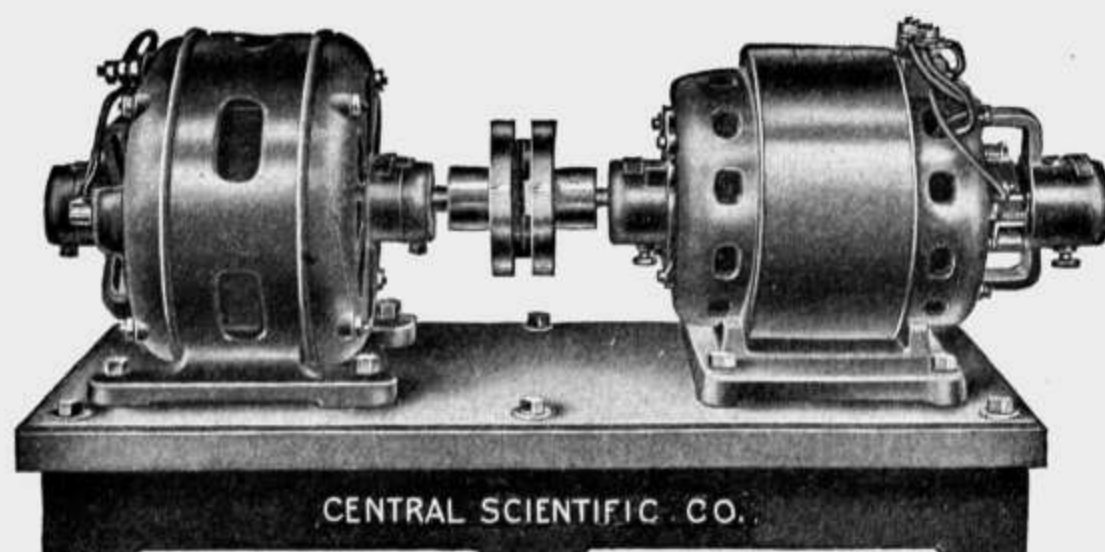
The apparatus may also be arranged to show the repulsion test, illustrating Lenz's Law. For this purpose an auxiliary coil with spring for suspension is included with the apparatus. This coil is repelled when the circuits of both coils are closed. (Using 110 volt A. C. current.) An aluminum disc is furnished, which when laid on top of the transformer coil will be thrown forcibly away when the circuit is closed. If the disc is held on the coil, it heats rapidly, showing the heating effects of induced currents. The coil with one of the test rods and the spring can be used as a solenoid and plunger.

Complete as described .....Net 20.00

**2216L. Gramme Ring Coil.** This coil, seen at the right of the illustration of No. 2216, may be used in performing a large number of valuable and interesting experiments. (1) It serves as a rotating field coil illustrating the principle of the induction motor in a large variety of arrangements. (2) It may be used to illustrate a two phase or a three phase voltage transformer in teaching the principles of the polyphase transformer. (3) It illustrates the action of a phase transformer. (4) It serves to compare voltage and current relations of star and delta circuits. In using this coil as a rotating field coil, an ordinary single phase circuit may be used. A non-magnetic metal cup with a support is furnished with the coil and when placed on its support in the coil, will rotate at high speed on account of the currents induced in it by the rotating magnetic field.

Complete with cup and support on a nicely finished wooden base..Net 25.00

## MOTOR GENERATORS.

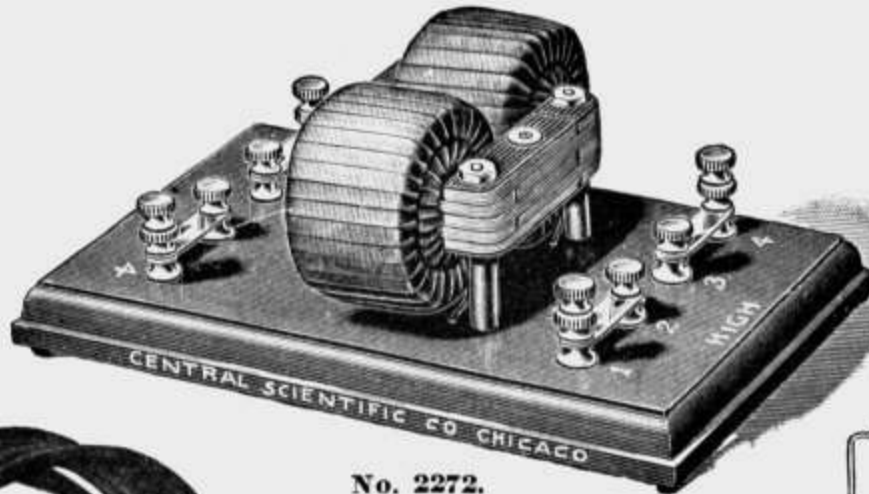


No. 2271.

A great many school laboratories have available an alternating current at 110 or 220 volts. For such schools the motor generator is the most satisfactory machine for producing the proper direct current for laboratory work. These sets consist of an alternating current motor coupled to a direct current generator, as shown in cut. Motor Generators Nos. 2271A or 2271B with a 10 volt direct current generator are especially recommended for school work. The outfit will give 6 amperes and can be used to charge storage batteries, do electro-chemical work, operate induction coils, electro-magnets, small motors, etc. A driving pulley can be placed on the driving shaft next to the coupling without extra charge. In ordering, specify voltage desired on the generator.

Catalog No.	MOTOR Single Phase, 60 Cycle		GENERATOR Shunt Wound		Speed	Price Net F. O. B. Factory
	H. P.	Volts A. C.	Watts Output	Volts D. C.		
2271A	$\frac{1}{6}$	110	60	6 to 125	1750	\$ 72.50
2271B	$\frac{1}{6}$	220	60	6 to 125	1750	73.50
2271C	$\frac{1}{5}$	110	120	6 to 125	1750	98.50
2271D	$\frac{1}{5}$	220	120	6 to 125	1750	99.50
2271E	$\frac{1}{4}$	110	150	6 to 125	1750	100.50
2271F	$\frac{1}{4}$	220	150	6 to 125	1750	101.50
2271G	$\frac{1}{4}$	110	200	6 to 125	1750	107.00
2271H	$\frac{1}{4}$	220	200	6 to 125	1750	108.00
2271J	$\frac{1}{3}$	110	250	6 to 125	1750	118.00
2271K	$\frac{1}{3}$	220	250	6 to 125	1750	118.00
2271L	$\frac{1}{2}$	110	350	6 to 125	1750	137.00
2271M	$\frac{1}{2}$	220	350	6 to 125	1750	137.00

Rheostat included with all outfits above at no extra charge, except with Nos. 2271A and 2271B, where it is not necessary.



No. 2272.



No. 2274.

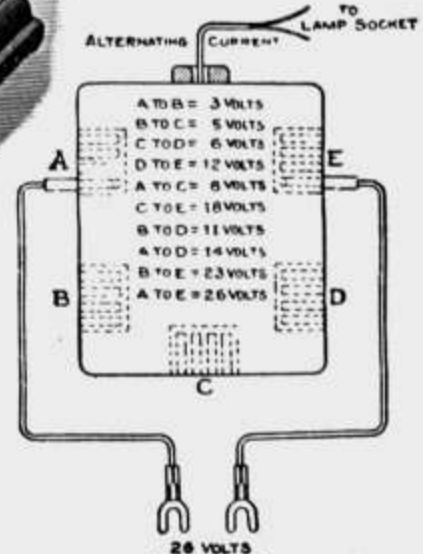
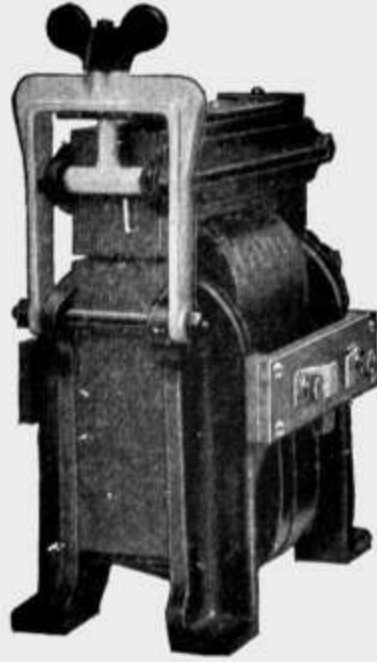


Diagram of Connections.

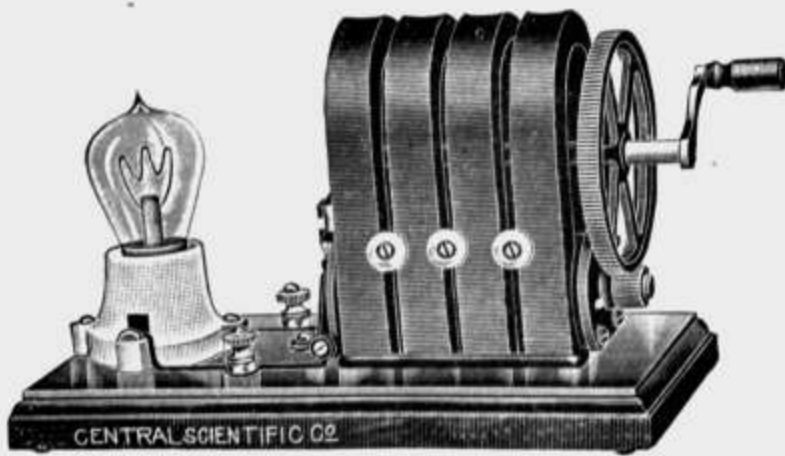
2272. **Model Transformer.** A working model of one of the most important pieces of electrical apparatus used in modern electrical engineering. The separate parts are in plain sight, making possible the tracing of both magnetic and electrical circuits. The magnetic circuit is of the laminated core type, with dovetailed magnetic joints, making the core and the whole transformer dissectible. The low windings consist of two coils of 160 turns each, placed on opposite sides of the square formed by the core. The high windings, often called the primary, consist of two coils of 640 turns each, and are slipped over the low windings. As in the commercial transformer, all coil terminals are brought out separately. The transformer can be used as a "step up" (changing low voltage to higher), a "step down" (changing high voltage to lower), or an auto transformer (either up or down by divided windings). Since the number of turns on the high winding is four times that of the low winding, the ratio of the voltage transformation will be as 4 to 1. Construction is such that connections may be made in either series or parallel. These transformers are designed to stand over 15 volts on each low winding or 30 volts total, and over 60 volts on each high winding, or 120 volts total. Safe carrying capacity, 3 to 5 amperes on the low windings. Complete laboratory report and directions for use furnished with each instrument..... \$ 8.00
2273. **Two 4 C. P. Lamps,** one of 6 volts and one of 22 volts, for visible proofs of transformation..... 1.10
2274. **Transformer** for 110 volt, 60 cycle alternating current. This transformer is enclosed in a steel case and is thoroughly insulated. By its use, alternating current at ten different voltages ranging from 3 to 26 volts may be obtained, which will operate all classes of small direct current apparatus with the exception of the permanent magnet type of motors which are practically obsolete. The different voltages may be used simultaneously, and four separate circuits may be used simultaneously on any one of these voltages. Maximum capacity, 120 watts. With No. 2270 Nodon Valve this transformer will give a low voltage direct current without using a rheostat in the A. C. circuit. Complete with Edison plug and 8 feet of flexible cord .....Net 9.00
- 2274A. **Transformer.** Same as No. 2274 but equipped with binding posts for low voltage connections in place of the pairs of flexible cords ..... Net 6.30
- For Bell Ringing Transformer, see No. 2701.



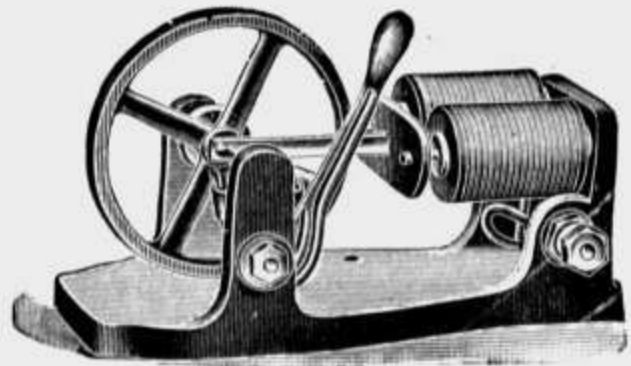


No. 2275.

2275. **Step-up Transformer.** This Transformer represents the highest type of construction, and is perfect in every detail. Constructed with a magnetic shunt and equipped with a regulating device to give instant adjustment. Designed to connect to any alternating current circuit. No impedance coil or other resistance necessary. Can be used for Wireless Work, Generation of Ozone, Testing Insulation, Electrostatic Separation, etc. Regulates from 1 to 7 amperes, with an approximate voltage output of 10,000. Dimensions: 11½ inches high, 8¼ inches long, 6¼ inches wide. Weight, 34½ pounds .....Net \$ 20.00
- 2275A. **Step-up Transformer,** same as No. 2275, but regulates from 2½ to 9 amperes, with an approximate voltage output of 20,000. Dimensions: 13 inches high, 9 inches long, 7¾ inches wide. Weight, 55 pounds. ....Net 25.00

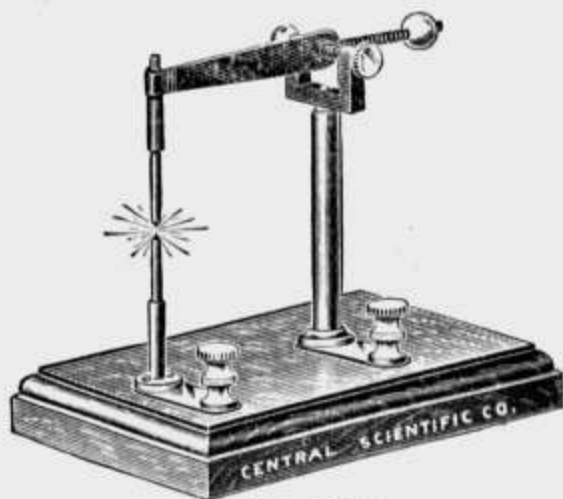


No. 2276.



No. 2278.

2276. **Magneto Electric Generator.** Mounted on a base with an incandescent lamp which can be lighted by the current generated. With the lamp thrown out of circuit this generator may also be used to produce a strong physiological effect..... 5.00
2278. **Electromagnetic Engine,** a new illustration of electromagnetic action. Runs on a single cell of dry battery with the consumption of a small amount of current; provided with a reversing lever. An instructive and interesting piece of apparatus..... .90



No. 2279.



No. 2283.

2279. **Arc Lamp**, with counterpoise adjustment, can be operated by No. 2260 Dynamo or by a Plunge Battery ..... \$ 3.35

2283. **Model Arc Lamp**. This lamp has been designed to meet the demands for a working model arc lamp. It is equipped with automatic feed, consisting of a series magnetic coil and adjustable ring clutch. When used on a battery about 30 volts will be required and the lamp will take from 1 to 1¼ amperes. If used on direct current circuits of 110 volts or higher an outside resistance must be connected in series with the lamp. (Nos. 2453-4 Lamp Rheostats are convenient for this purpose.) All working parts of the lamp are so placed that they may readily be seen ..... 10.00

2284. **Duddell Singing Arc**. See Catalog K for description.....Duty free 114.00



No. 2286.



No. 2287.



No. 2288.

**INCANDESCENT LAMPS.**

In selecting incandescent lamps from those listed below, attention should be paid to the fact that the consumption of carbon filament lamps is approximately 3 watts per candle power, while that of tungsten filament lamps is approximately 1¼ watts per candle power.

2286. **Miniature Incandescent Lamps**, carbon filament, threaded base to fit No. 2288 Receptacle.

Order Letter	A.	B.	C.	D.
Candle Power	1	2	3	4
Voltage	2½	3½	4½	6
Price	.28	.28	.28	.33

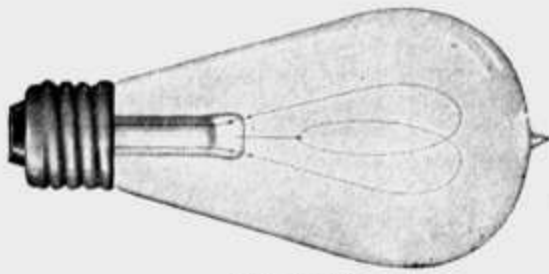
2287. **Miniature Incandescent Lamps**, tungsten filament, threaded base to fit No. 2288 Receptacle.

Order Letter	A.	B.	C.
Candle Power	1	1½	3
Voltage	2½	3½	6
Price	.45	.45	.50

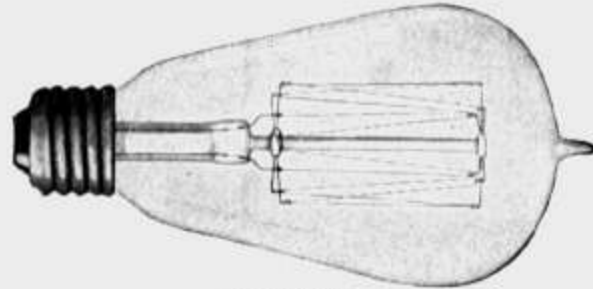
2288. **Porcelain Miniature Receptacle** for Nos. 2286 and 2287..... .10

INCANDESCENT LAMPS—(Continued.)

See Note on Page 185.

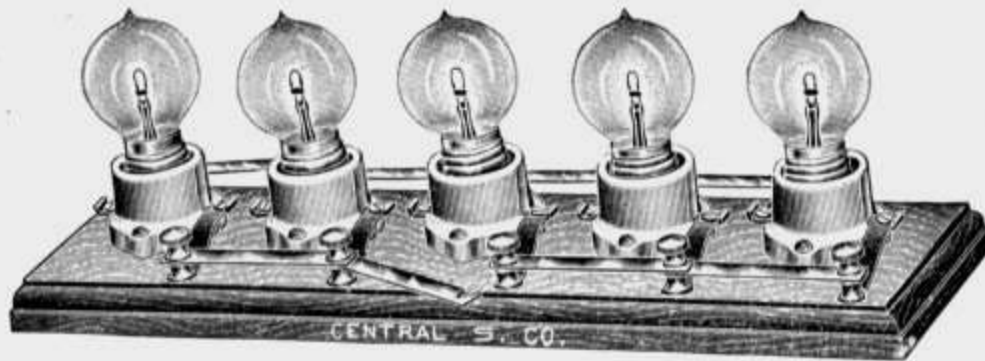


No. 2291.



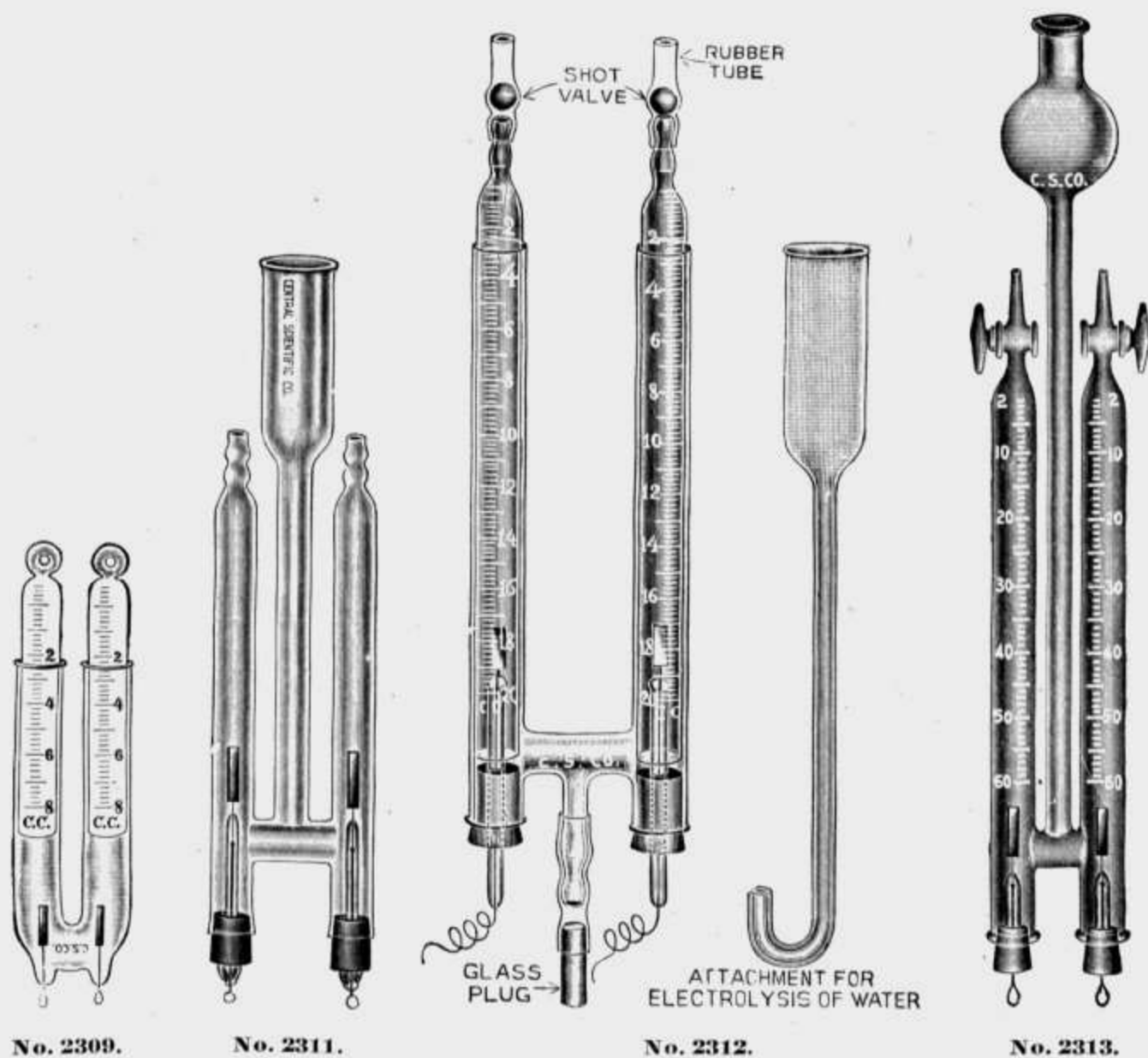
No. 2293.

2291. **Incandescent Lamps**, 110 volt, carbon filament, Edison base, to fit Nos. 2589-91 Receptacles.
- |                    |     |     |     |     |     |
|--------------------|-----|-----|-----|-----|-----|
| Order letter ..... | A   | B   | C   | D   | E   |
| Candle power ..... | 4   | 8   | 16  | 32  | 50  |
| Price .....        | .30 | .30 | .30 | .45 | .60 |
2292. **Incandescent Lamps**, 220 volt, carbon filament, Edison base, to fit Nos. 2589-91 Receptacles.
- |                    |     |     |     |     |
|--------------------|-----|-----|-----|-----|
| Order letter ..... | B   | C   | D   | E   |
| Candle power ..... | 8   | 16  | 32  | 50  |
| Price .....        | .33 | .33 | .60 | .95 |
2293. **Incandescent Lamps**, 110 volt, tungsten filament, Edison base, to fit Nos. 2589-91 Receptacles.
- |                    |     |     |      |      |
|--------------------|-----|-----|------|------|
| Order letter ..... | A   | B   | C    | D    |
| Watts .....        | 25  | 40  | 60   | 100  |
| Price .....        | .75 | .85 | 1.15 | 1.65 |
2296. **Incandescent Lamps**, 110 volt, natural colored glass, not dipped. 16 candle power, Edison base, to fit Nos. 2589-91 Receptacles.
- |                    |       |      |       |      |               |
|--------------------|-------|------|-------|------|---------------|
| Order letter ..... | A     | B    | C     | D    | E             |
| Color .....        | Amber | Blue | Green | Ruby | Frosted White |
| Price .....        | .70   | .45  | .45   | .60  | .40           |
2298. **Incandescent Lamp**, 110 volt, single, straight, carbon filament, glass tube 8 inches long, Edison base on one end to fit Nos. 2589-91 Receptacles ..... \$ 2.25
- For Standard Incandescent Lamps, see page 250.  
 For Incandescent Lamps for No. 2272 Transformer, see No. 2273.  
 For Pocket Flash Lamp, see No. 5055B.



No. 2301.

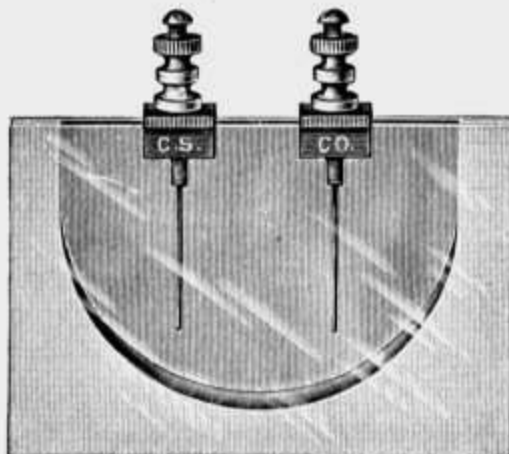
2301. **Lamp System**, consisting of five 3 c. p., 6 volt lamps mounted upon a hardwood base, furnished with connections so that the lamps can be used either in series or multiple. This system is especially adapted for use with No. 2262 Dynamo..... 6.67
- 2301A. **Extra Lamp** for No. 2301. 3 c. p., 6 volts..... .40
2304. **Nernst Lamp**, commercial type. Lamps for even voltages from 200 to 240 volts direct current may be obtained. Specify exact voltage. A one glower lamp with horizontal glower, 4 inch clear ball shade and oxidized copper finish..... 6.50
2305. **Nernst Lamp**, commercial type, for voltages from 100 to 120, alternating current, otherwise same as above..... 5.00



- |   |   |  |
|---|---|--|
| <p>No. 2309.</p> <p>No. 2311.</p> <p>No. 2312.</p> <p>No. 2313.</p> | <p><b>2309. Electrolysis of Water</b>, simple form with sliding graduated tubes and platinum electrodes . . . . .</p> <p><b>2311. Electrolysis of Water</b>, improved form with platinum electrodes that may easily be replaced by copper electrodes or by carbon electrodes for electrolysis of hydrochloric acid. (See Nos. 2316 and 2317.) . . . . .</p> <p><b>2312. Electrolysis Apparatus (Osborne Form)</b>, for study of conductivity of liquids, ionization, electro-plating and electrolysis of water. This apparatus has been constructed to supply the urgent demand for a simple, substantial form of electrolytic apparatus that can be used to demonstrate the principles involved in the theory of electrolytic dissociation. It consists of an outer U tube with graduated sliding tubes, shot valves, glass plug and platinum electrodes, which are easily replaced by carbon or copper electrodes (Nos. 2316-7). It allows immediate change of liquids, permits the introduction of litmus, methyl orange, cloth for bleaching or any other indicator, is readily cleaned, requires least amount of liquid to fill it. Complete as illustrated, with instructions for use. . . . .</p> <p><b>2312A. Support for No. 2312</b>, with binding posts. . . . .</p> <p><b>2313. Electrolysis of Water Apparatus</b>, Hoffman's improved form with graduated tubes, glass stop cocks and removable platinum electrodes. . . . .</p> <p><b>2313A. Support for either No. 2311, No. 2313 or No. 2314</b>, with binding posts. . . . .</p> <p><b>2314. Electrolysis of Water Apparatus</b>, same as No. 2313, but without glass stop cocks . . . . .</p> <p><b>2316. Carbon Electrodes</b>, two rubber stoppers fitted with carbon electrodes and connectors, adapted to Nos. 2311 to 2314, inclusive. . . . .</p> <p><b>2317. Copper Electrodes</b>, two rubber stoppers fitted with copper electrodes and connectors, adapted to Nos. 2311 to 2314, inclusive. . . . .</p> <p><b>2318. Platinum Electrodes</b>, two rubber stoppers with platinum electrodes and connectors, adapted to Nos. 2311 to 2314, inclusive. . . . .</p> | <p>\$ 2.00</p> <p>3.50</p> <p>Net 5.00</p> <p>2.50</p> <p>Net 7.50</p> <p>2.50</p> <p>6.00</p> <p>.55</p> <p>.55</p> <p>1.10</p> |
|---|---|--|



No. 2319.



No. 3723.

- 2319. **Copper Voltmeter**, new construction. Consists of a glass jar in which are suspended three copper plates, two loss plates and one gain plate, each of about 40 square centimeters area. These plates are held by an ingenious clamping device and their construction is such that they may be handled without touching with the fingers..... \$ 4.00
- 2320. **Silver Voltmeter**, same construction as No. 2319, with detachable silver plates ..... 8.00
- Gas Voltmeters, see page 187.
- 3723. **Voltmeter**. Consists of a cell fitted with platinum electrodes and binding posts for the demonstration of electrolytic analysis, chemical action, crystallization. Excellent for lantern projection..... 2 90

For Conductivity Cells, see Nos. 5723 to 5735.



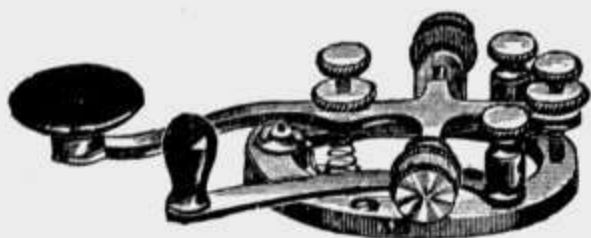
No. 2323.

- 2321. **Electro-Plating Outfit, for copper plating**, consisting of a square glass jar with brass rods fitted with binding posts for supporting anode and objects to be plated. Complete with copper anode, chemicals and full directions..... 1.10
- 2321A. **Copper Anode** only for No. 2321..... .28
- 2321B. **Chemicals** only for No. 2321..... .11
- 2322. **Electro-Plating Outfit, for nickel plating**, same as No. 2321, with pure nickel anode, chemicals, and full directions..... 2.25
- 2322A. **Nickel Anode** only for No. 2322..... 1.40
- 2322B. **Chemicals** only for No. 2322..... .28
- 2323. **Electro-Plating Outfit, for silver plating**, same as No. 2321, with pure silver anode, chemicals, and full directions..... 5.50
- 2323A. **Silver Anode** for No. 2323..... 3.35
- 2323B. **Chemicals** only for No. 2323..... 1.65

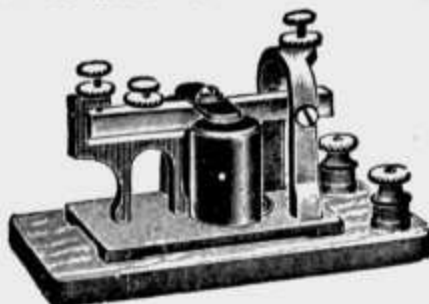
For Electro-Plating Dynamo, see No. 2259.

See Nos. 1050 and 1050A Cenco Water Motors with buffing accessories, page 91.

See also Polishing Heads and accessories, pages 39 and 40.

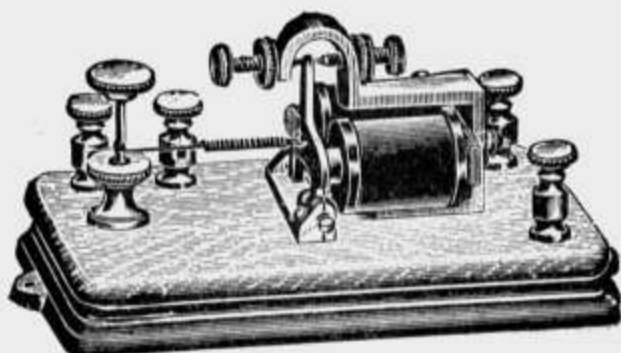


No. 2335.



No. 2339.

- 2335. **Telegraph Key**, standard form of brass, without legs..... 1.25
- 2335A. **Telegraph Key**, dissected, for assembling by students..... .80
- 2336. **Telegraph Key**, students' form, mounted on wooden base..... .67
- 2339. **Telegraph Sounder**, unequalled for quick action, loudness and clear tone. Its proportions are scientifically correct. Resistance, 4 ohms 2.15
- 2339B. **Telegraph Sounder**, dissected for assembling by students..... 1.35
- 2341. **Telegraph Sounder**, same as No. 2339, but with resistance of 20 ohms 2.35
- 2342. **Telegraph Sounder**, students' form..... 1.35



No. 2343.

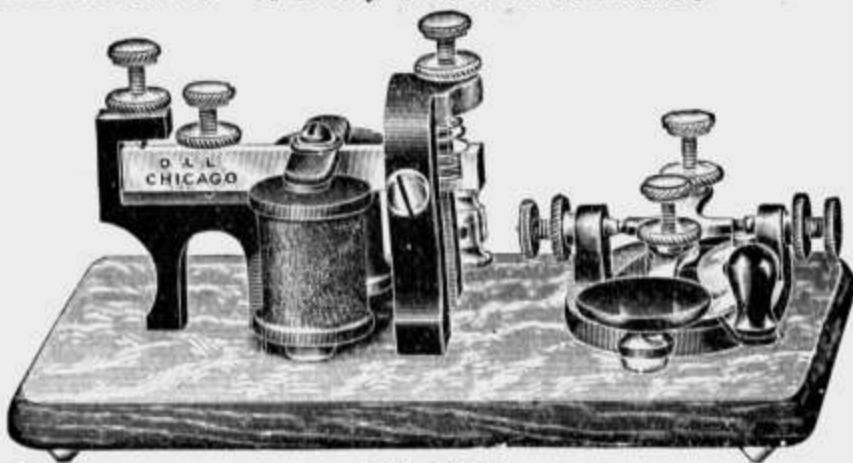
2343. **Telegraph Pony Relay, standard.** Its use will enable work on short lines up to 20 miles in length to be done with perfect ease. Resistance, 20 ohms.....

\$ 2.90

2343A. **Telegraph Relay.** Commercial standard relay. Resistance, 250 ohms

7.50

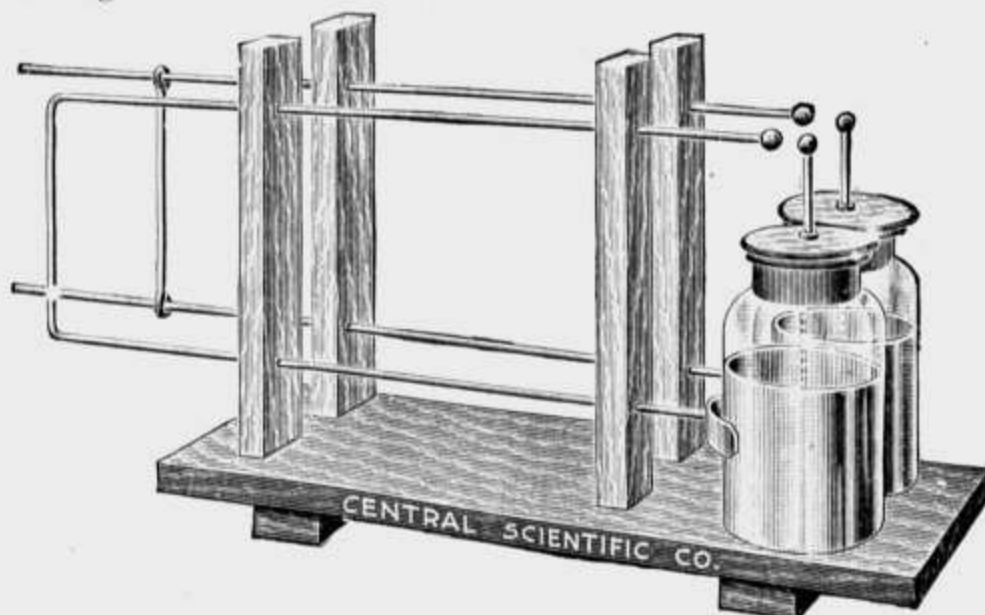
2344. **Polarized Relay,** much more sensitive than the regular types and especially desirable for long distance telegraphy. A very strong, permanent magnet, has electro-magnet spools mounted on one pole, making the polarity of each core the same. A finely balanced armature is hung between the two spools, but never touches the poles of the same. By means of set screws the armature is set so that it is exactly in the center between the poles. This balances the relay. A minute current passing through the electro-magnet will disturb this balance and move the armature. Resistance, 50 ohms....



No. 2345.

2345. **Telegraph Instrument, Key and Sounder Combined on One Base,** for use of beginners. Resistance, 4 ohms.....

2.00

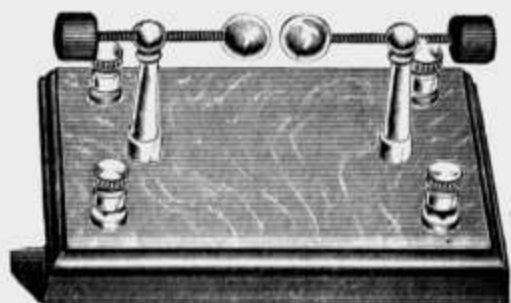


No. 2346.

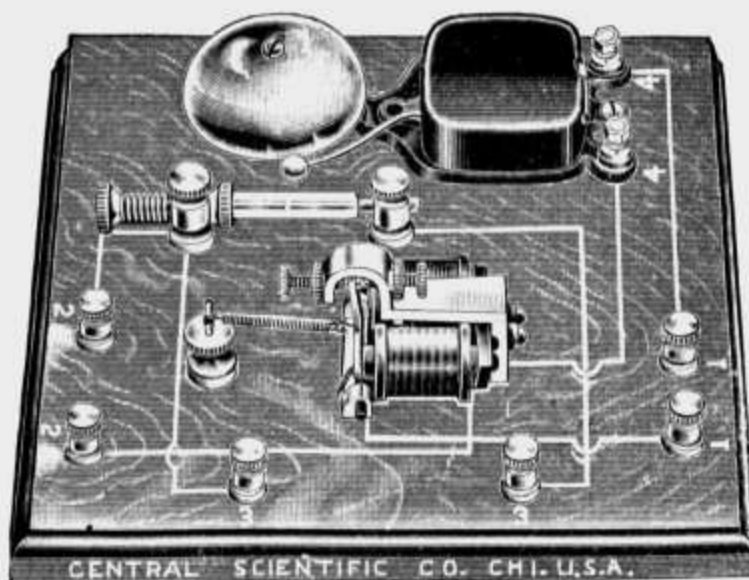
2346. **Resonant Leyden Jars.** A pair of Leyden Jars mounted for proving the oscillatory character of the electric spark. One jar is provided with a wire loop of fixed length, the other with a loop whose size can be varied by means of a sliding cross-piece. When the first jar is successively charged and discharged by means of a static machine or induction coil, a spark will appear at the other jar, provided the areas of the two loops are the same. By making the adjustable loop considerably larger or smaller than the other, the second spark disappears.....

9.00

**WIRELESS TELEGRAPH APPARATUS.**



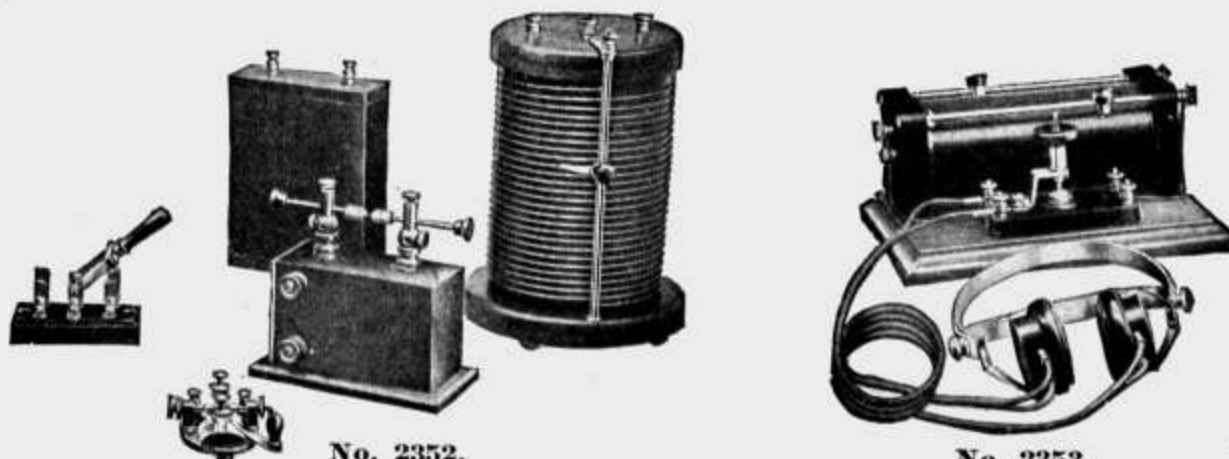
No. 2348.



No. 2349.

2347. **Wireless Telegraph Set**, demonstration form. Consists of No. 2348 Oscillator and No. 2349 Receiving Station, as listed below. In addition to these two pieces there will be needed several dry cells and an induction coil, with which most laboratories are supplied. If, in addition, a telegraph key is used in the transmitting circuit and a sounder in the receiving circuit, the apparatus will be complete for sending wireless telegraph signals by the Morse or other codes. These instruments are all carefully tested and will give perfect satisfaction with 1/4-inch spark induction coil across any ordinary laboratory. With larger induction coils and with the substitution of aerial and ground wires for the aluminum plates, signals may be transmitted to a much greater distance..... \$ 15.60
2348. **Oscillator**, for use with induction coil as a transmitting station for wireless telegraphy. The spark gap is adjustable and is provided with two pairs of binding posts: one for attaching to the secondary of the induction coil, and the other for attaching to aluminum plates which take the place of the condenser and aerial used in larger outfits. With two of these oscillators, the action of the Hertz Spark Gap Resonator may be shown, and the length of electro-magnetic waves determined. Complete with two aluminum plates 3.35
2349. **Receiving Station**. As a detector, we use a standard Lodge coherer mounted adjustably on a finely finished hardwood board in series with a relay. This relay operates an electric bell which answers the double purpose of sounder and decoherer. If a telegraph sounder (see No. 2339) is used in addition, signals may easily be transmitted by the Morse or other codes. To increase the effective decoherence, high resistances are placed in the bell and relay circuits which counterbalance the self induction in these circuits, thus obviating the sparking at the "make" and "break," which is detrimental to perfect decoherence. The base is provided with binding posts for attaching the necessary batteries, the aluminum plates (as described under No. 2348), and a telegraph sounder. Complete with blue prints showing in detail the different circuits and full directions, but without batteries or sounder..... 12.25
- 2349A. **Coherer** of No. 2349 mounted on a wood base. The base is sufficiently large to allow an electric bell to be mounted by the side of the coherer if so desired. Without bell..... 2.25

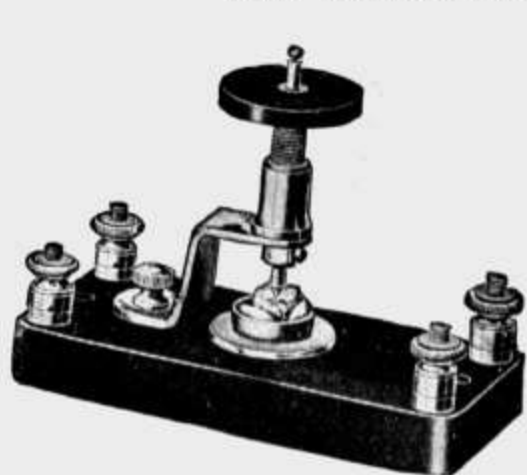
For Induction Coils, see Nos. 2225 to 2232.



No. 2352.

No. 2353.

2350. **Wireless Telegraph Set.** Consists of No. 2352 Transmitting Set and No. 2353 Receiving Set. Operates on the same principles as any of the large commercial stations.....Net \$ 31.50
2352. **Transmitting Set** for wireless telegraphy. Consists of Nos. 2352A, 2352B, 2352C, 2335 and 2634, listed below. The range of transmission, which depends of course upon the size and height of the aerial, the source of current, proper tuning, and atmospheric conditions, is approximately 3 to 5 miles.....Net 16.50
- 2352A. **Induction Coil and Spark Gap.** Built especially for wireless work. Fitted with an excellent vibrator and enclosed in a finely finished hardwood case. For use with from six to twelve good dry cells, or with 12-volt storage battery. 15 watts capacity. The spark gap is adjustable.....Net 6.50
- 2352B. **Sending Condenser.** Highly efficient and durable.....Net 2.00
- 2352C. **Sending Helix,** wound closely and accurately with round copper wire; has an easily operated contact clip and necessary binding posts. The top and bottom are of finely finished hardwood.....Net 4.00
2335. **Key.** A telegraph key of standard form, well finished..... 1.25
2634. **Knife Switch.** A double pole, double throw switch on a porcelain base, for alternate connections and disconnections of transmitting and receiving sets..... .82
2353. **Receiving Set** for wireless telegraphy. Consists of Nos. 2353C and 2353D, listed below. Signals may be received with a good aerial from strong stations at a distance of upwards of 100 miles.....Net 15.00



No. 2353A.



No. 2353D.

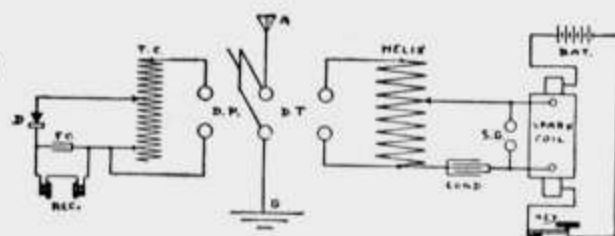


Diagram of Connections for Nos. 2352-3

- 2353A. **Detector,** crystal type, with a fixed receiving condenser sealed in the base. The cup that holds the metallic crystal is provided with set screws so that other specimens, such as carborundum, nickel, silicon, etc., can be substituted for the special crystal supplied with this detector .....Net 3.50
- 2353B. **Tuning Coil.** A straight coil wound with 200 turns of bare copper wire on a non-shrinkable core and provided with two sliding contacts. Used in connection with an aerial of good length, this coil will permit of tuning for waves up to 1500 meters in length....Net 4.00
- 2353C. **Detector and Tuning Coil.** Nos. 2353A and 2353B mounted on base. .Net 8.00
- 2353D. **Receivers.** Two light-weight telephone receivers with adjustable head band, five-foot worsted covered cord and a receiver connection block. Total resistance, 2000 ohms.....Net 7.50

For other Receivers, see next page.

For Crystals and similar supplies, see under Minerals.





No. 2355.



No. 2357.

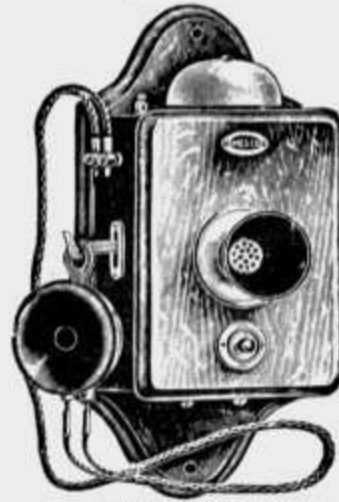


No. 2358B.

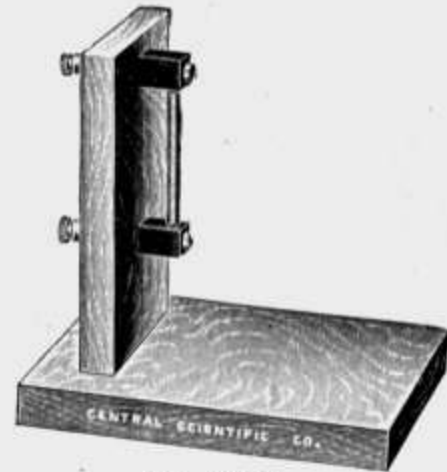
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|---|---------|
| 2355. Telephone Receiver, demonstration form. This type of receiver, in addition to being readily dissected for demonstration purposes, can be used on any line and for any distance, as it is the standard commercial form of the latest type and is very generally used in modern telephone systems. It is of the two-pole variety..... | \$ 1.35 |
| 2357. Telephone Receiver, watch case form. This receiver has short magnets and is the form frequently used on inside telephone systems and also for instrument use and testing in the laboratory.....   | .80     |
| 2358. Telephone Receiver, head band form; a single receiver especially adapted to wireless telegraph work. Windings of silk covered copper wire; magnets of special steel; cores of proper height to give permanent adjustment. Resistance, 500 ohms. Complete with six feet of green silk cord.....                                      | 5.00    |
| 2358A. Telephone Receiver, head band form. Same as No. 2358, but with resistance of 1000 ohms.....  | 6.00    |
| 2358B. Telephone Receiver, head band form. Same as No. 2358, but with two receivers and a resistance of 1000 ohms.....  | 11.00   |
| 2358C. Telephone Receiver, head band form. Same as No. 2358B, but with resistance of 3000 ohms .....  | 14.00   |



No. 2359.

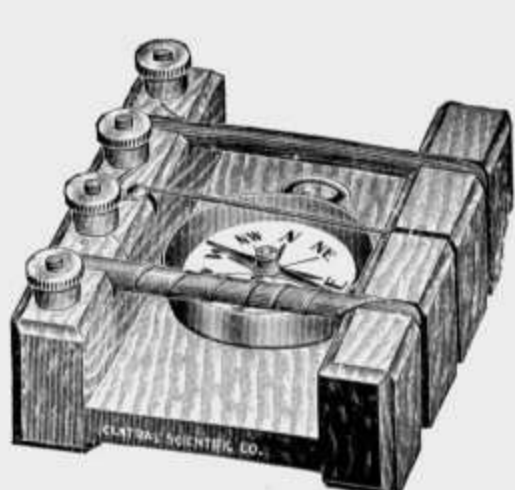


No. 2365.

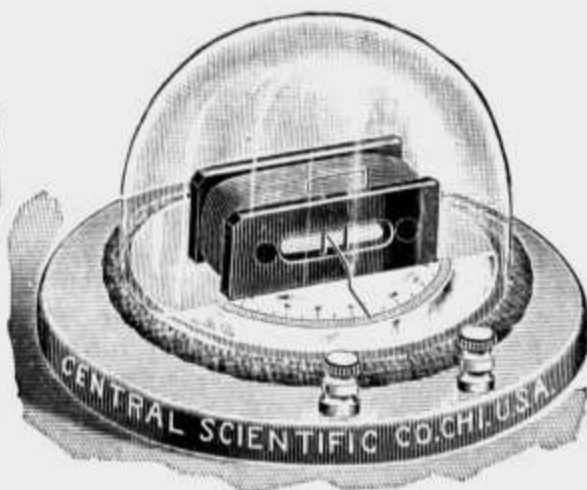


No. 2369.

- |   |                 |
|---|-----------------|
| 2359. Telephone Transmitter, Chicago Solid Back Type. The transmitter used on most commercial phones, especially long distance lines....  | 1.77            |
| 2365. Battery Call Telephone. An attractive, high grade instrument, especially designed for inside work; very useful for connecting principal's office with the janitor or for other practical school work. Price for each station, with complete directions..... | 3.35            |
| 2369. Microphone, simple form, for demonstration, on wood support.....  | 2.25            |
| 2370. Microphone or Loud Speaking Telephone. See Catalog K for description .....  | Duty free 27.00 |
| 2371. Wireless Telephone Outfit for acetylene light. See Catalog K for description .....  | Duty free 36.00 |
| 2373. Wireless Telephone Outfit for arc lamp. See Catalog K for description .....   | Duty free 80.00 |
- For Selenium Cells, see Catalog K.



No. 2401.

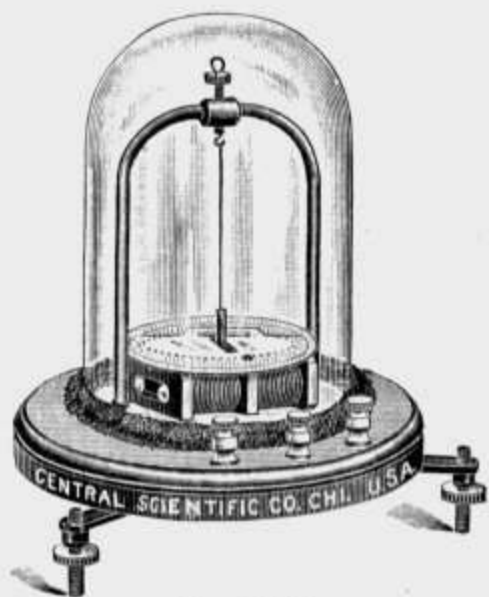


No. 2403.



No. 2405.

2401. **Galvanoscope.** Simple form with three coils of 1, 10 and 50 turns of wire, for use with a compass as illustrated. The coils may be used separately, depending upon the strength of the current, and the sensibility of the instrument can be changed at will by varying the distance between the coils and the compass. Without compass \$ 1.25
1765. **Compass,** delicate and good quality, for use with No. 2401..... 1.45  
For other Compasses as illustrated with No. 2401, see page 140.
2403. **Galvanometer.** A delicately balanced agate cap needle, with removable stop attachment to prevent violent oscillations of the needle and to bring it to rest. Small currents are detected and indicated by this instrument. May be used in elementary Wheatstone Bridge experiments. Mounted on hardwood base with glass shade..... 4.50
2405. **Galvanometer, Elementary Astatic Form,** improved form of Dr. Hall's design. Neatly and substantially constructed, with fiber suspension, aluminum pointer and leveling screws..... 3.55



No. 2407.



No. 2409.



No. 2411.

2407. **Galvanometer, Astatic,** supplied with an astatic pair of needles, fiber suspension and aluminum pointer, with two coils wound for strong and weak currents. Mounted on hardwood base with leveling screws 6.65
2409. **Galvanometer, Tangent, Elementary Form,** after Dr. Hall. Body and base of finished wood. Either 5, 10 or 15 turns of wire may be used. Complete with No. 1761-40 mm. Compass. This instrument is substantially made and is superior to the old forms with coils wound on frail metal frames..... 1.80
2411. **Galvanometer, Tangent.** A brass ring 8 inches in diameter, mounted on mahogany base, with leveling screws. The needle,  $\frac{3}{4}$  inch long, has an agate cap, aluminum indicator and stop, and is mounted in a brass cup with glass cover. Winding is two coils of 5 and 10 turns, No. 20 silk covered magnet wire, brought to three binding posts, so that either 5, 10 or 15 turns may be used..... 5.25
2412. **Universal Tangent Galvanometer.** See Catalog K for description..... 50.00



No. 2413.

2413. **Galvanometer, Tangent.** Solid brass ring nine inches in diameter, mounted on a mahogany base which rotates on a heavy brass tripod provided with leveling screws. The needle is well proportioned to the diameter of the ring and has jeweled bearing with aluminum pointer. The card dial is engine divided with mirror to avoid parallax. The winding consists of 300 turns of magnet wire so connected to the plugs in front that 20, 40, 80 or 160 turns or any combination of these numbers may be used. For heavy currents a band of copper is used by connecting to the extra pair of binding posts in the rear of the instrument. The constant  $K$  of a Tangent Galvanometer cannot be satisfactorily determined on an instrument having less than 300 turns..... \$ 16.65

2413A. **Electro-Dynamometer.** See Catalog K for description.....Net 80.00

## D'ARSONVAL GALVANOMETERS.

Galvanometers of this type are independent of the earth's magnetic field and are not affected by surrounding magnetic bodies, so that they can be used in many places where other galvanometers cannot. For this reason they have become more universally used than any other form, and we have given considerable attention to the development of a model series of these instruments.

Our D'Arsonval Galvanometers have the following salient features:

**Magnets.**—The magnets of all our D'Arsonval instruments are designed with a view to securing such proportions as to concentrate the greatest intensity of the magnetic field between the poles and thus through the coil.

**Suspensions.**—The elasticity of the suspending wire controls the movement of the coil and tends to bring it back to its initial position. For the upper suspensions we use both steel and phosphor bronze ribbons, choosing for each instrument the material and size which will give best results. The suspensions are so attached that they may easily be replaced.

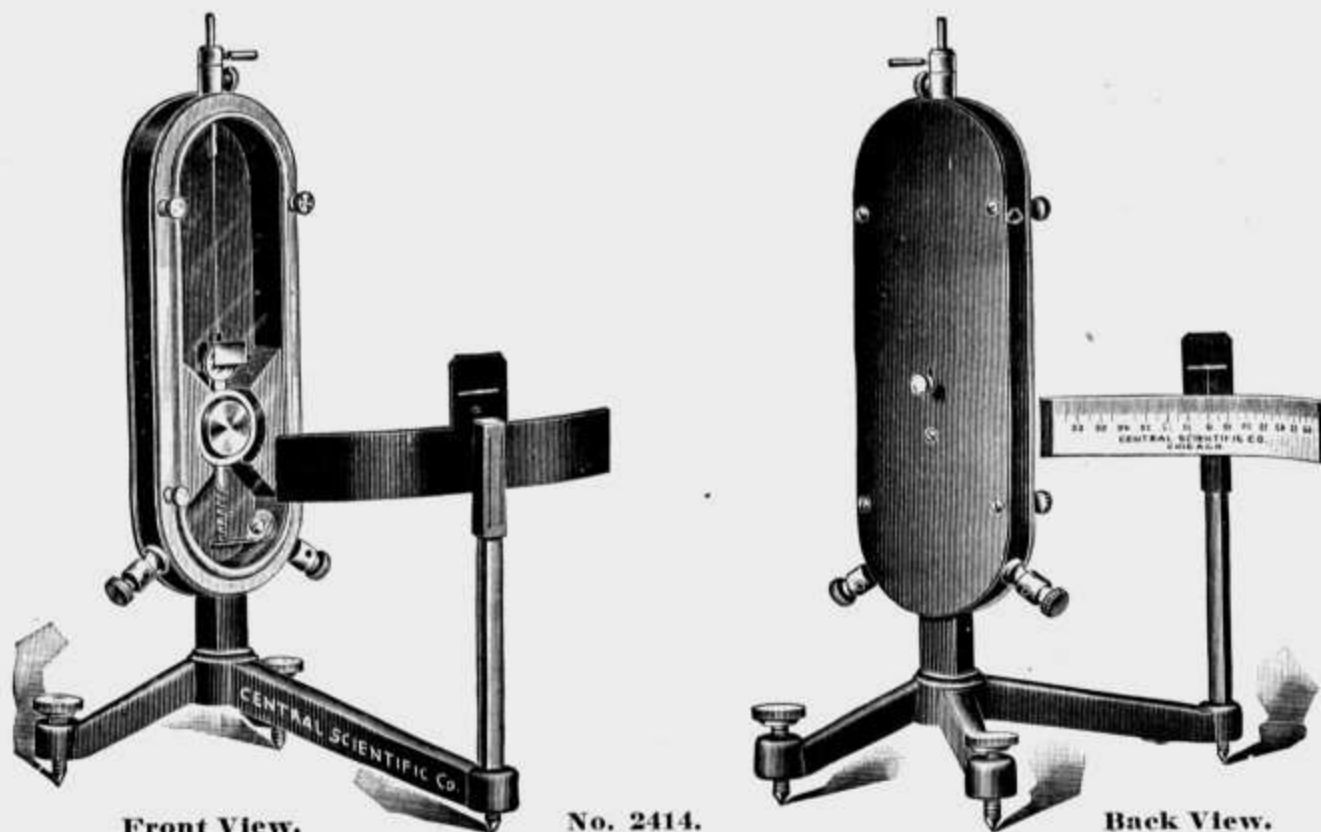
**Coil Systems.**—These will be found described in the explanatory matter for the different galvanometers.

**Reading Device.**—On Nos. 2414 and 2415 we use a sight and scale. With this device, quicker adjustment is possible for inexperienced students. On account of the position of the zero line in reference to the scale all parallax is obviated, regardless of the point from which the reading is taken. No. 2417, which is intended for better grades of work, is supplied with a reading telescope with achromatic lens mounted with an adjustable bichrome scale.

### METHODS OF SPECIFYING SENSIBILITY.

The three methods of specifying sensibility, Micro-Amperes per mm., Micro-Volts per mm., and "Megohms," are equivalent to each other. When the number of amperes per division has been determined, it can by Ohm's Law immediately be changed to volts per division, as soon as the resistance of the galvanometer is known. The sensibility in megohms means the number of megohms through which one volt will produce a deflection of one division, and this can be calculated from the number of amperes per division, if the resistance is known. There is a slight advantage in favor of the use of "megohms" in the fact that the number of megohms is directly proportional to the sensibility, while the other quantities are inversely proportional to the sensibility.

For Repairs for Galvanometers, see page 199.



Front View.

No. 2414.

Back View.

2414. Galvanometer, D'Arsonval. For general laboratory use this galvanometer is recommended to the majority of teachers, as it possesses these commendable features:

The MAGNET is cast and carefully aged. The poles are so proportioned as to give a strong magnetic field through the coil.

The COIL is circular, giving maximum strength and area with minimum weight. The clearance is ample to insure quick adjustment. The suspension is a phosphor bronze ribbon of medium weight to prevent excessive breakage. The coil may be raised or lowered or set to zero by means of the screw adjustment at the top of the instrument. The coil may also be locked to protect the suspension when not in use.

In the SIGHT AND SCALE ATTACHMENT a slot has been substituted for the former minute peephole. The position of the slot and its zero line in reference to the scale is such that all parallax is avoided, regardless of from what point on the slot the reading is taken. The scale is a segment of the circumference of a circle whose center is at the coil mirror, which gives proportional readings. It is mounted directly on the tripod supporting the instrument, preventing vibrations by the stability thus secured.

To RENEW SUSPENSIONS, when broken, it is only necessary to remove the glass window, laying open for easy access all parts of the coil system.

WORKING PERIOD. On short circuit, the coil comes to rest in 4 seconds, and is absolutely dead-beat. On open circuit, the working time is about 12 seconds.

SENSIBILITY. From the mean of a number of readings, in which a known but variable difference in potential was applied to the galvanometer terminals, the sensibility was found to be as follows:

	At Working Distance.	At 1 Meter.
Micro-amperes per mm.....	0.37	0.054
Micro-volts per mm.....	63.0	9.2
Megohms .....	2.7	18.5

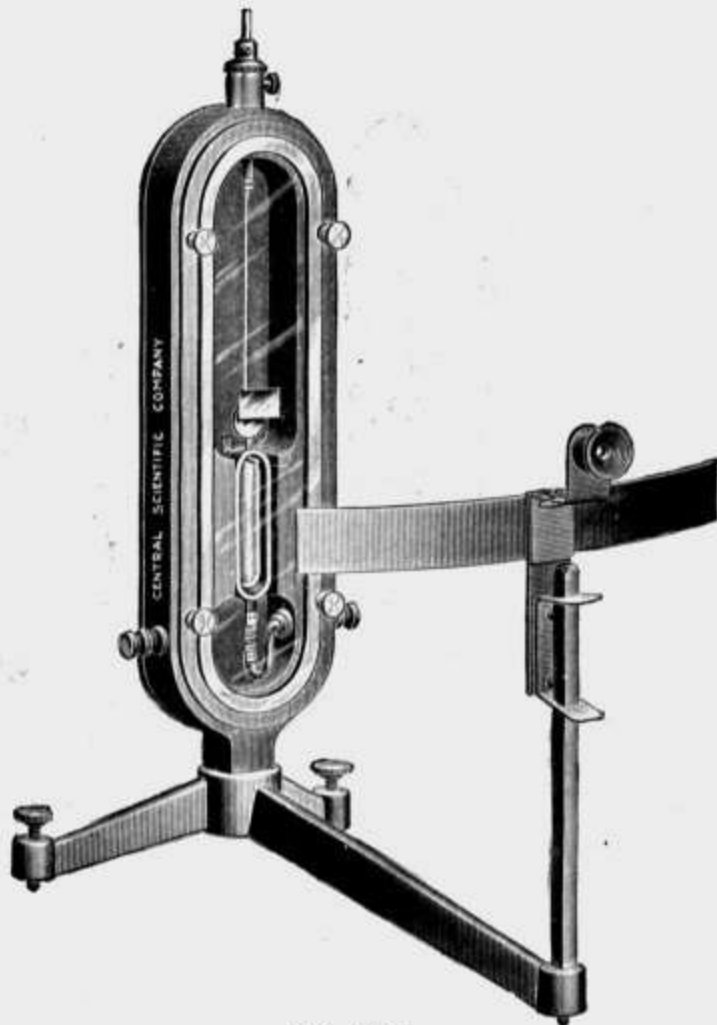
We claim that this is the best D'Arsonval Galvanometer offered to the laboratories of this country for a reasonable price. This assertion is confirmed by the large number sold since its introduction. One large state university placed twenty at one time in its laboratories. The design has been copied by several German instrument manufacturers..... \$ 5.55



No. 2414A.

the entire current flows through the galvanometer. The resistance of the shunt is about 0.2 ohms..... 4.50

2414A. Shunt, for No. 2414 Galvanometer. This is a very convenient device for reducing the sensibility of the galvanometer. Consists of a length of manganin wire wound on a hard rubber disc which can easily be attached to the binding posts of the galvanometer. A sliding contact permits the resistance of this shunt to be varied continuously from nearly zero to the maximum, so that the size of the galvanometer reading can readily be adjusted. With one position of the sliding contact,



No. 2415.



Front View of Scale.

2415. **D'Arsonval Galvanometer.** We are manufacturing this instrument to meet the demand for an instrument better in quality than our No. 2414, and less in cost than our No. 2417. Though similar in appearance to No. 2414, the workmanship is fully equal to that of No. 2417. It stands over all 16 inches (No. 2414, 11 inches), and other parts are proportionately larger than No. 2414.

The **Magnet** is heavy, with pole area made in correct ratio to the yoke, is carefully hardened and aged, thus securing a strong magnetic field in which the coil swings.

The **Coil** is rectangular in shape, and swings freely with a minimum air gap between the pole faces. Coil supplied has a resistance of 250 ohms. Coils of higher or lower resistance can be easily substituted. The upper suspension is a fine steel ribbon which has practically no zero variation. The lower suspension is of copper in form of a coil.

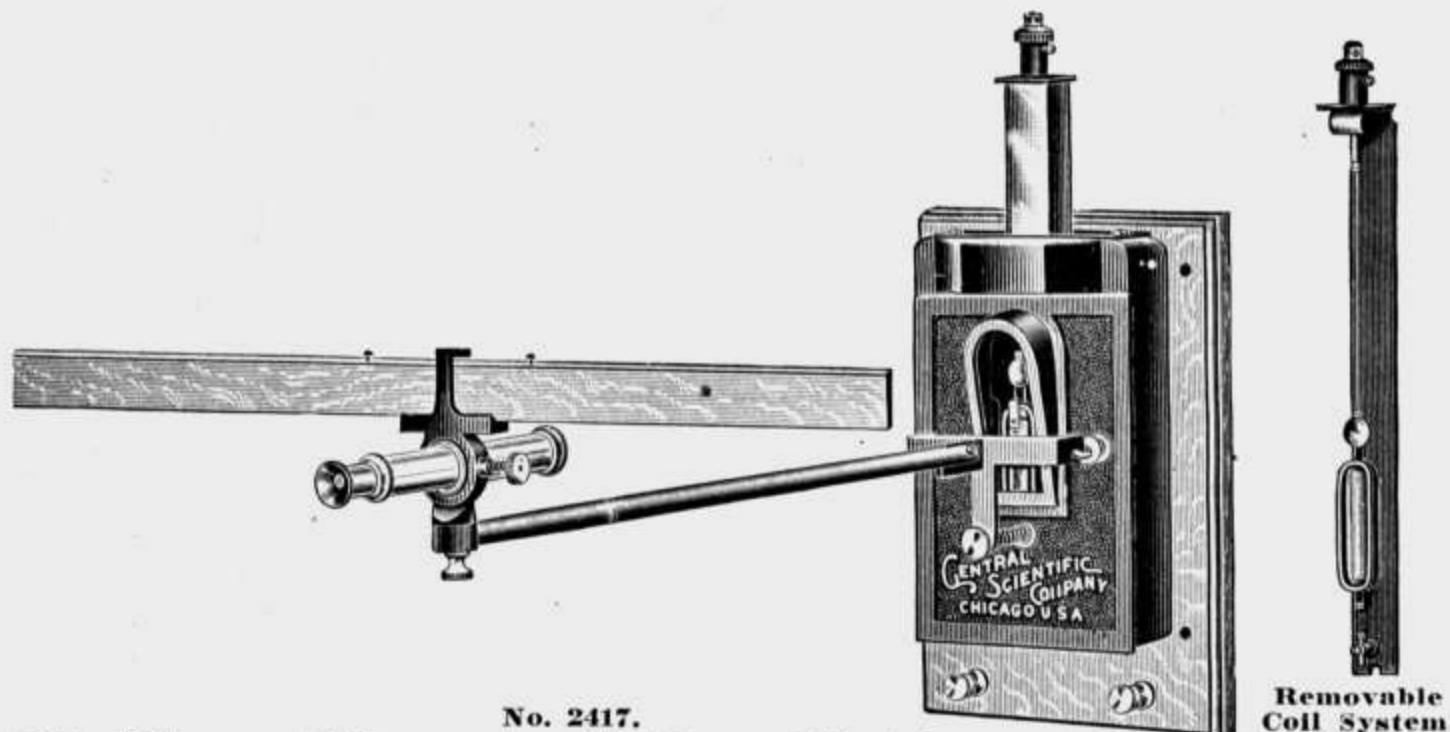
Suspensions when broken are easily renewed by removing the glass front.

The **Reading Device** on this Galvanometer is like that of No. 2414, with the addition of an adjustable zero line, enabling the operator to quickly secure exact coincidence.

**Construction.** All parts of this Galvanometer are made with great care, and the instrument is finished in dead black and lacquer, with the exception of the tripod, which is japanned.

**Sensibility.** From the mean of a number of readings in which a known but variable difference in potential was applied to the galvanometer terminals, the sensibility at working distance (25 centimeters) was found to be 30.3 megohms. Complete with 250 ohm "Dead Beat" coil

2415A. Extra Coil, "Dead Beat," 5 ohms.....	\$ 16.65
2415B. Extra Coil, "Dead Beat," 250 ohms.....	3.00
2415C. Extra Coil, "Dead Beat," 500 ohms.....	3.50
2415D. Extra Coil, Ballistic, 500 ohms .....	4.00



No. 2417.

2417. **D'Arsonval Galvanometer.** Wall form. This Galvanometer is a superior instrument, combining the commendable features and correcting the faults of those equally priced. It is compact in design, and well finished in every detail. THE MAGNET is cast, strongly magnetized, aged and very heavy, weighing approximately 6 kilos. The proportion between the yoke area and area of poles has been determined with a view to giving the greatest intensity of the magnetic field through the coil. This field is further concentrated by a soft iron core.

**COIL SYSTEM.** As noticed from the illustration, one of the principal features of this Galvanometer is its REMOVABLE COIL SYSTEM. The coil is suspended in a frame and forms with it a UNIT which slides into place by means of guides into a good electrical contact. It is therefore possible, by securing any number of coil systems, to have a universal instrument with only the additional cost of the extra systems. Also, if any adjustments or repairs are to be made on the suspension system, the frame can be removed and laid flat on the table.

Each Galvanometer is supplied with a 250 ohm "DEAD BEAT" Coil, with a plane mirror of  $\frac{5}{8}$ -inch diameter. Extra Coils, Dead Beat and Ballistic, are listed below.

**THE SUSPENSION.** The upper suspension, unless otherwise requested, is a steel ribbon which has a high tensile strength and a "zero set" of less than a millimeter. The sensibility can be much increased by the substitution of phosphor-bronze suspension.

**THE READING DEVICE** consists of a telescope with achromatic objective and a bichrome scale mounted upon an adjustable arm, which may be either swung up to a vertical position or entirely removed when not in use.

**THE HOUSING.** The front plate is detachable by loosening two thumb screws, giving easy access to the interior. A large window is provided for viewing the moving system. This window is placed at an angle found to obviate the blur of the scale image due to reflection from the front glass plate.

**FOR MOUNTING AND LEVELING** we furnish two adjustable screws fastened to the back board, so that the instrument may be leveled rapidly and accurately on the wall. A jeweler's screw driver is furnished with each instrument.

**SENSIBILITY.**

From the mean of a number of readings, in which a known but variable difference of potential was applied to the galvanometer terminals, the sensibility was found to be as follows:

At working distance..... 53.4 megohms.

At one meter distance.....101.1 megohms.

The working period is 15 seconds on open circuit.

Complete with 250 ohm "Dead Beat" coil.....	\$ 25.00
2417A. "Dead Beat" Coil System, with 5 ohm coil.....	6.00
2417B. "Dead Beat" Coil System, with 250 ohm coil.....	6.00
2417C. "Dead Beat" Coil System, with 500 ohm coil.....	6.50
2417D. Ballistic Coil System, with 500 ohm coil.....	7.00
2417E. Ballistic Coil System, with 1000 ohm coil.....	7.50
2417F. Ballistic Coil System, with 150 ohm coil.....	7.00

2419. **Galvanometer**, made on D'Arsonval principle, same type as used in commercial testing sets, and built for hard service.

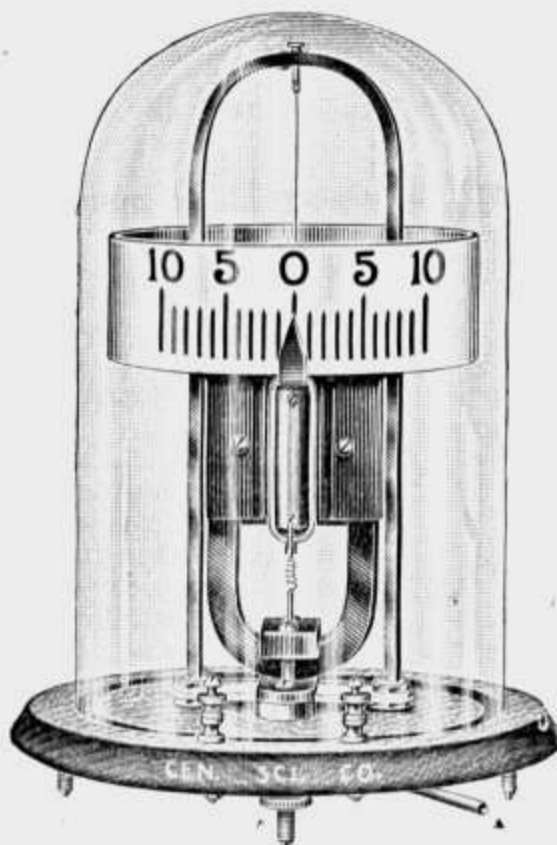
Gives 1 scale division deflection with 1 volt through about 100,000 ohms..... \$ 15.00



No. 2419.

2421. **Lecture Table Galvanometer**,

Prof. Millikan's, improved design. This galvanometer with its open construction, large size scale and large pointer, is especially well adapted for use on the physics lecture table. The size of the scale divisions and figures, and the size and shape of the pointer makes it easy to read the deflections at a distance. The instrument is sufficiently sensitive for use in induction experiments, giving results which may be observed and readily understood by a large class when used with No. 2217 Coil as an Earth Inductor, or with two No. 2219 Coils in connection with No. 1702 Soft Iron Rod and No. 2111 Dry Cell. With No. 1716 Horseshoe Magnet and No. 2219 Coil a study of the action of a dynamo armature can be made.



No. 2421. (Patented July 25, 1911.)

Thermo-electric currents are readily detected, as the maximum deflection produced by heating a single copper-iron junction is about 32 degrees or 7.5 scale divisions.

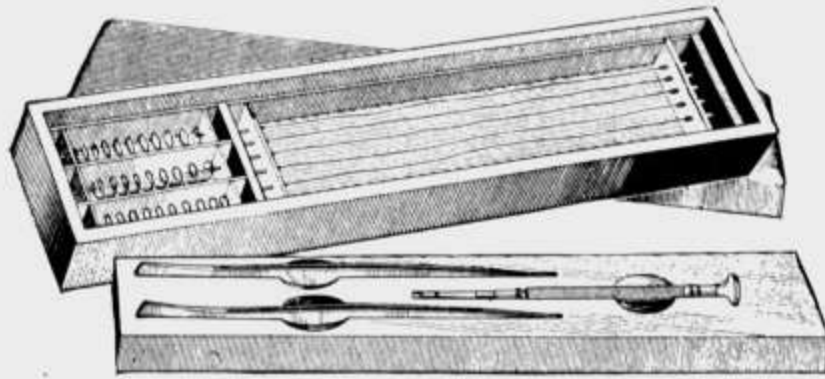
The advantages which this galvanometer possesses over a mirror lecture table galvanometer are:

- (1) It is more convenient and easier to manipulate, and since no lamp or external scale is needed, it is always ready at a moment's notice for any experiment.
- (2) It is easier to understand, since all parts are in plain view.
- (3) All experiments may be performed in daylight without the need of wholly or partially darkening the lecture room.
- (4) A second scale and pointer are provided on the back of the instrument for the teacher's use.

The galvanometer is mounted on a finely finished hardwood base provided with three leveling screws and it is protected from air currents by a glass shade. A new device is provided by which the pointer may readily be brought back to zero without lifting the shade. RESISTANCE of galvanometer, about 20 ohms. SENSIBILITY—A deflection of one scale division (6.1 mm.) on the circular scale 8.2 cm. from the axis of the coil is produced by a current of 0.000232 amperes. In other words, a mirror galvanometer of the same sensibility would have shown a deflection of 1 mm. on a scale at 1 meter distance when in series with a 1 volt cell and 10 megohms resistance .....

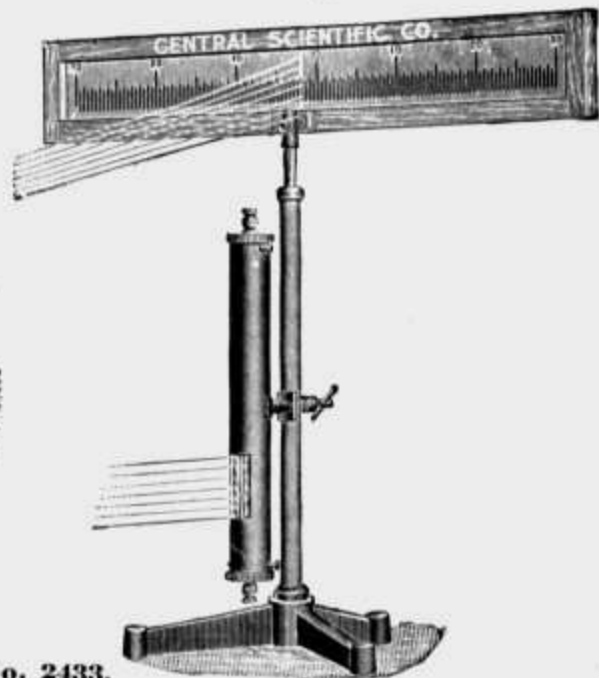
2422. **Universal Shunt**. See Catalog K for description.....Duty free 15.00

10.00

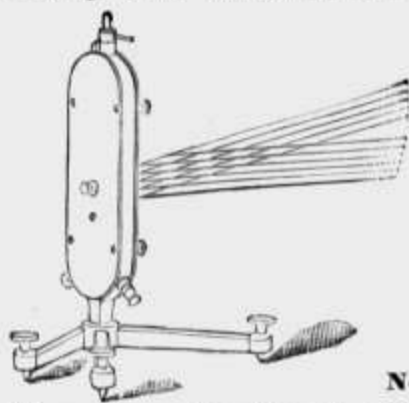


No. 2423.

2423. **D'Arsonval Repair Kit.** Consists of a neat wooden box containing two pairs of forceps for handling suspensions, a watchmaker's screw driver, suitable for small screws on any galvanometer, 6 upper steel suspensions and 3 lower copper suspensions, all conveniently accessible ..... \$ 3.00
- 2423A. **D'Arsonval Repair Kit.** Same as No. 2423, with phosphor bronze instead of steel upper suspensions..... 3.00
- 2423B. **Lower Suspension, only, copper, of No. 2423.**..... .17
455. **Galvanometer Dial or Scale,** printed on bristol board, 2¾, 3¼ and 5 inches in diameter, in 1 degree divisions. Each..... .11
2424. **Galvanometer Mirror,** plane, ½ inch diameter..... .33
- 2424A. **Galvanometer Mirror,** plane, ⅝ inch diameter..... .60
- 2424B. **Galvanometer Mirror,** concave, 1 meter focus, ½ inch diameter..... 1.25
- 2424C. **Galvanometer Mirror,** concave, 2 meter focus, ½ inch diameter..... 1.25
2425. **Galvanometer Shades,** of clear white glass.
- |                      |      |      |      |      |      |
|----------------------|------|------|------|------|------|
| Height, cm. ....     | 9.5  | 14.5 | 18   | 30   | 32   |
| Diameter, cm. ....   | 11.5 | 8.9  | 11.5 | 15.2 | 19   |
| For Galvanometer No. | 2403 | 2405 | 2407 | 2420 | 2421 |
| Each .....           | .45  | .45  | .60  | .80  | 1.10 |
2426. **Galvanometer Suspension Fiber,** of unspun silk, best quality. Five yards wound on card. Per card..... **.11**
2427. **Galvanometer Suspension Ribbon,** of phosphor bronze, 0.001x0.013 inches. Per foot..... .06
- 2427A. **Galvanometer Suspension Ribbon,** of phosphor bronze, 0.005x0.0007 inches. Per foot..... .06
- 2427B. **Galvanometer Suspension Ribbon,** of steel, 0.0013x0.004 inches. Per foot ..... .10
2428. **Agate Cap,** for mounting needles, etc. Agate set in a brass cap..... .20
2433. **Lamp and Scale for individual use.** The scale is etched on a ground glass strip 6 centimeters wide by 60 centimeters long with long centimeter divisions and shorter millimeter divisions the entire length, reading both ways from zero in the center. It is mounted in adjustable wooden frame.
- A straight filament lamp (110 volts) is enclosed in a metal hood japanned black to cut out all reflected light. This form of filament makes a single brilliant line on the scale, enabling closer readings than the "spot of light." The lamp hood can be adjusted to any desired height on the support rod. Complete with lamp, support and scale..... 14.15
- 2433B. **Single Filament Incandescent Lamp,** of No. 2433, with hood and clamp 7.50
- 2433C. **Scale and Support, only,** of No. 2433..... 6.65



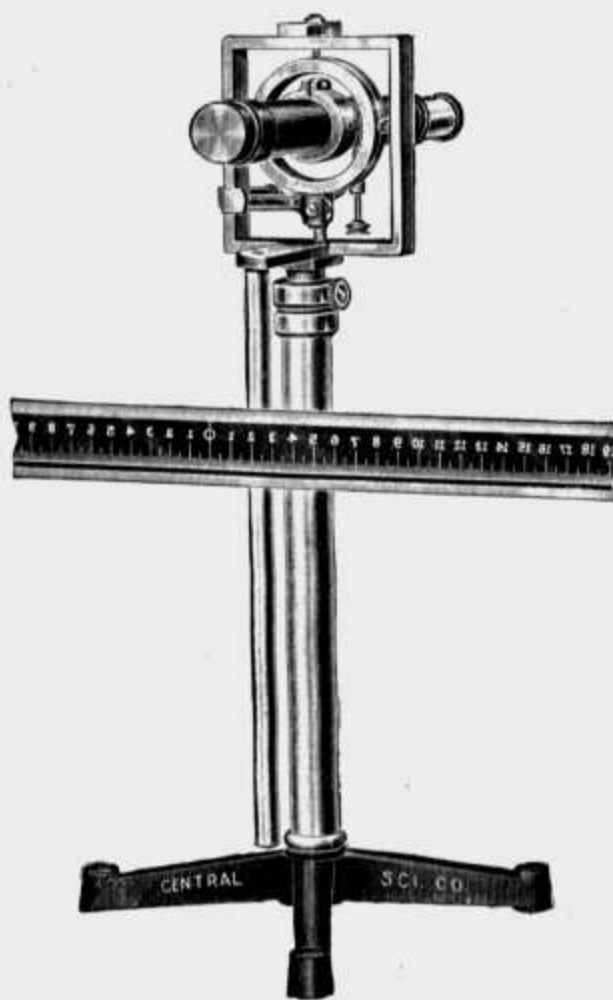
No. 2433.







No. 2435.



No. 2438.

- |       |   |          |
|-------|---|----------|
| 2435. | <b>Reading Telescope and Support.</b> The support is built up from our laboratory support pieces and allows adjustment of telescope and scale in every direction. Height of upright rod, 40 cm. Complete with No. 80 Telescope and No. 85 Scale.....                          | \$ 11.00 |
| 2436. | <b>Reading Telescope and Support.</b> Same as No. 2435, but fitted with No. 82 Telescope in place of No. 80.....  | 20.00    |
| 2437. | <b>Reading Telescope and Support.</b> The support is similar to No. 2435, but made entirely of brass, so as to be non-magnetic, for use with magnetometer. Allows adjustment of the telescope and scale in every direction. Complete with No. 82 Telescope and No. 85 Scale.. | 30.00    |
| 2438. | <b>Reading Telescope.</b> Consists of No. 82 Telescope with an adjustable support of our own improved design. The telescope and support are constructed entirely of non-magnetic materials. (For full description, see page 13.).....   | 33.35    |

### RESISTANCE BOXES.

In the selection of a resistance box a number of points should be taken into consideration, as a poor, unreliable box is expensive at any price, since it will render doubtful any results obtained in electrical measurements.

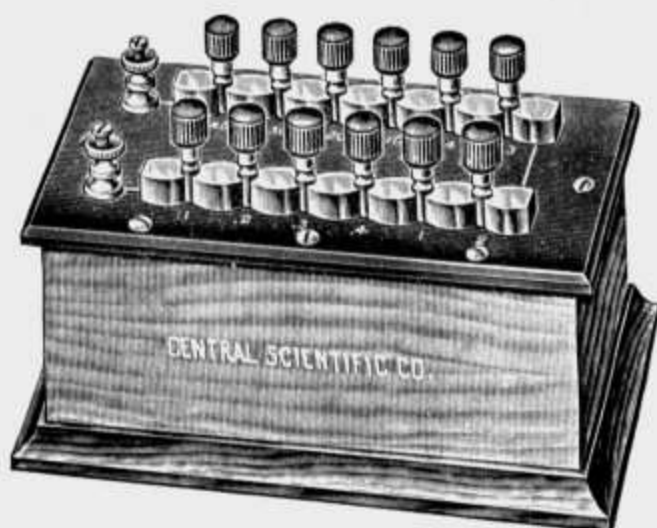
We use high grade rubber plates for the tops, of sufficient thickness to insure a firm anchorage for the brass bars.

We use only imported Manganin Wire, which is the same as advised by the German Physikalisch-Technische Reichsanstalt for all standard resistances. This wire has a negligible temperature coefficient amounting to only .00001 per degree C. Besides, it does not change its qualities after use, the variation in six years being only one part in 30,000.

All coils are wound bifilar in uniform layers and are practically free from inductance and capacity so that any of the boxes may be used in conductivity experiments with alternating currents. The coils are securely fastened to the top, so that there is no danger of the spools breaking loose and destroying the connections.

One important part of the box is the plug. Our plugs are provided with knurled hard rubber tops moulded on, which prevents removal. The plugs are carefully fitted, giving good contacts, and are placed sufficiently far apart to insure easy manipulation. The brass blocks are heavy and separated so that the insulation between may be cleaned.

We guarantee, without reservation, all our boxes to be accurate within the per cent. claimed, and any boxes will be replaced that show faulty construction or do not come up to the guaranteed accuracy when compared with reliable standards.



No. 2441.

2441. **Resistance Box.** The standard design for individual student use. We believe this box will be found to be superior to any sold at an equal price.

The total resistance is 111 ohms, divided as follows: 0.1, 0.2, 0.3, 0.4, 1, 2, 3, 4, 10, 20, 30 and 40 ohms. The coils are guaranteed accurate to  $\frac{1}{2}$  of 1%.

For detailed description of construction, see page 200..... \$ 7.50

2441A. **Resistance Box**, same as No. 2441, guaranteed accuracy,  $\frac{1}{5}$  of 1%..... 9.00

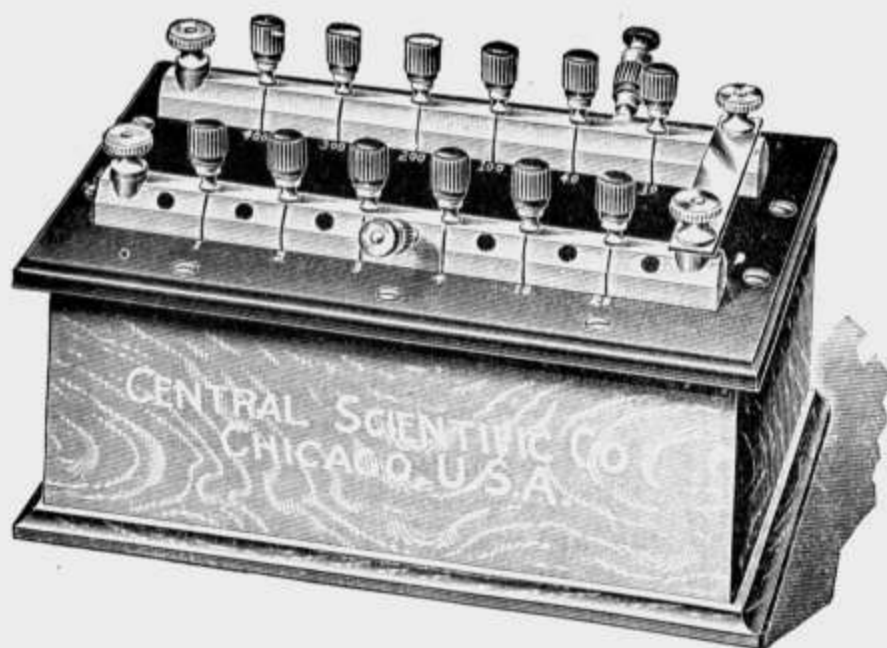
2441B. **Resistance Box**, same as No. 2441, but with following coils: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400 ohms, guaranteed accuracy,  $\frac{1}{5}$  of 1% 11.10



No. 2442.

2442. **Resistance Box**, new design, with Spring Contacts. The greatest objection to the plug form resistance box, when used by inexperienced students, is the unreliability of the contacts, caused either by the loosening of the adjoining plugs when one is withdrawn or by a loose fit, caused either by exchange or failure to properly insert the plugs. As will be noticed in the above illustration, these dangers have been obviated by the use of the spring contact, which, on account of the taper, fits tightly all points of the plug, causing no irregular wear. The external resistance of the box has not been materially increased. The capacity and coils are the same as in No. 2441. Wound non-inductively with Manganin wire. Guaranteed accuracy, 1% .....

6.00

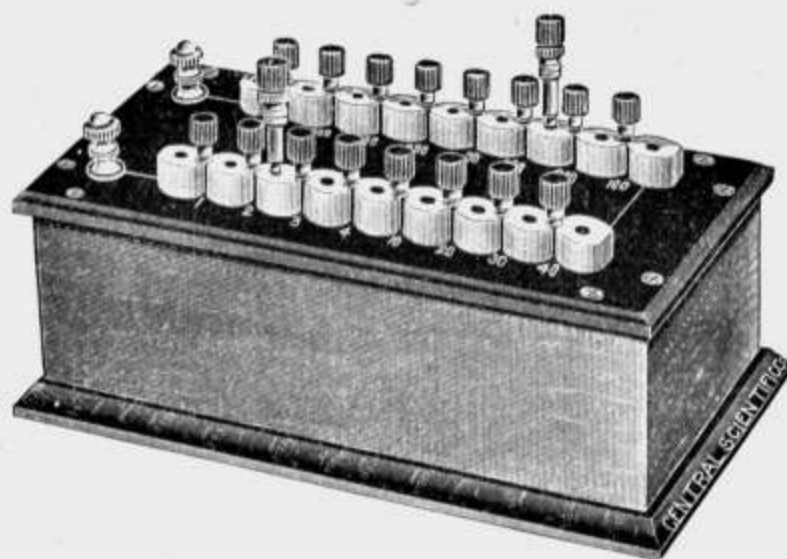


No. 2443.

2443. **Resistance Box**, traveling plug form. Extra heavy brass blocks; rubber top  $\frac{3}{8}$ -inch thick.

The total resistance is 1,110 ohms, divided as follows: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300 and 400 ohms. The box is supplied with two traveling plugs, which add greatly to the usefulness of the instrument, making it available for the comparison of the E. M. F. of batteries and other tests by the potentiometer method. For detailed description of construction, see page 200.

Guaranteed accuracy,  $\frac{1}{5}$  of 1%..... \$ 25.00



No. 2444.

2444. **Resistance Box**. Similar to No. 2443, but with greater capacity and with blocks of new and improved design, which enables the coils to be held more firmly in position, and lessens the danger of imperfect contact between coils and blocks. The total resistance is 11,110 ohms, as follows: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000, 3000 and 4000.

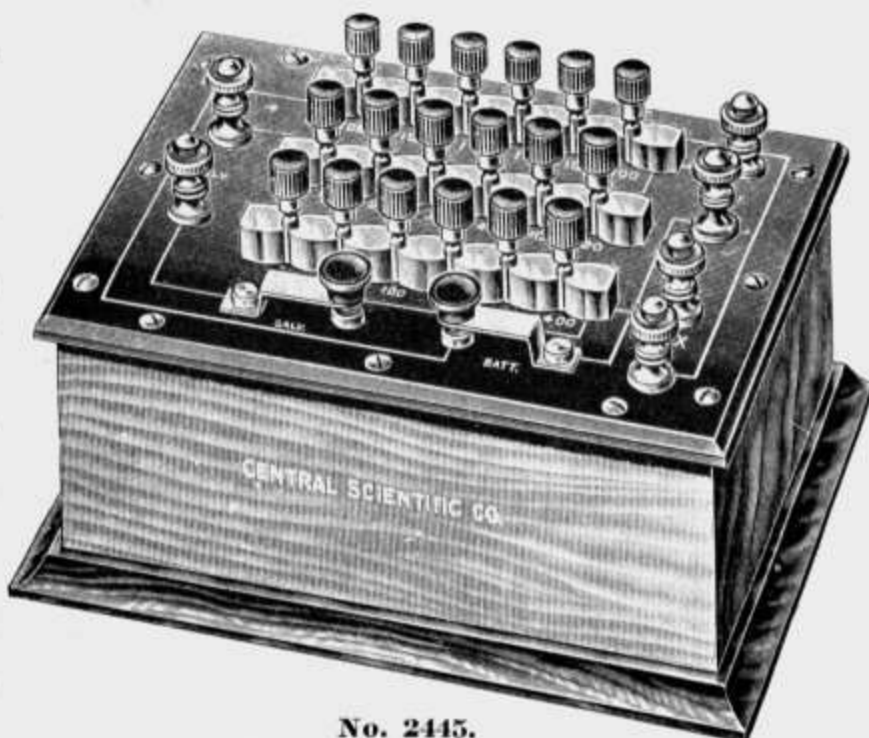
For detailed description of construction see page 200.

Guaranteed accuracy,  $\frac{1}{5}$  of 1%..... 27.75

2444A. **Resistance Box**, same as No. 2444 except that the total resistance is 1111 ohms as follows: 0.1, 0.2, 0.3, 0.4, 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300 and 400.....

27.75

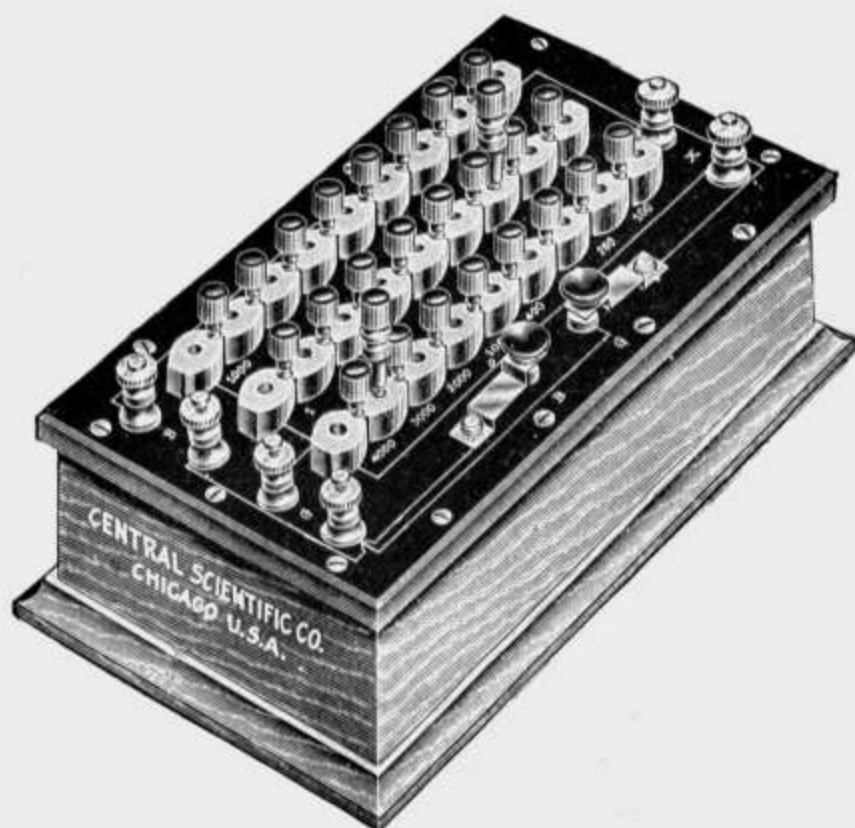
2445. **Resistance Box and Bridge Combined.** Polished hardwood mahogany finished box with hard rubber top  $\frac{3}{8}$  inch thick. Heavy brass blocks of new design (See No. 2444.) are used. For other details of construction, see page 200. The bridge coils are six in number, 1, 10 and 100 ohms on each side. The rheostat coils are twelve in number, viz.: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400 ohms. The total range of measurement is therefore from .01 to 111,000 ohms.



No. 2445.

The binding posts for battery, galvanometer, and unknown, and keys with platinum contacts for battery and galvanometer are conveniently placed, and all hidden connections are clearly indicated by lines on the top of the box.

Guaranteed accuracy,  $\frac{1}{2}$  of 1%..... \$ 25.00



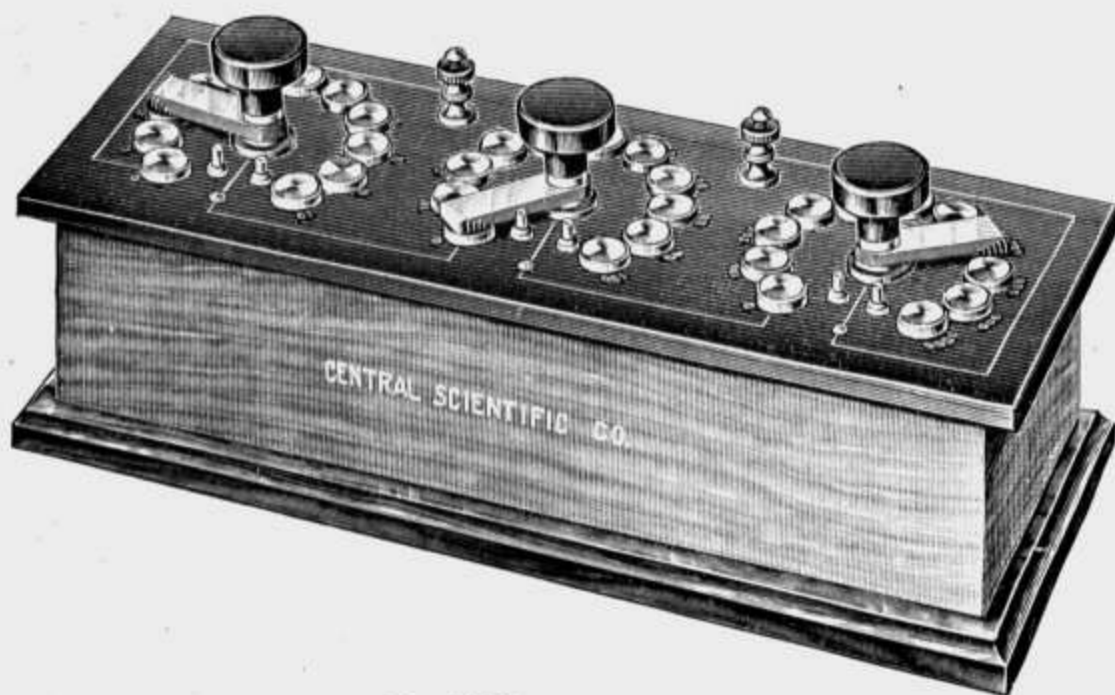
No. 2446.

2446. **Resistance Box and Bridge Combined.** An exceptionally high grade box of the finest materials and first class workmanship. The blocks are of new and improved design (See No. 2444), and the other details of construction are as described on page 200.

The rheostat coils are sixteen in number, viz.: 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000, 3000, 4000 ohms. The bridge coils are eight in number, 1, 10, 100 and 1000 ohms on each side. All coils are guaranteed to  $\frac{1}{15}$  of 1%.

The binding posts for battery, galvanometer, and unknown, and keys with platinum contacts for battery and galvanometer are conveniently placed, and all hidden connections are clearly indicated by lines on the top of the box.

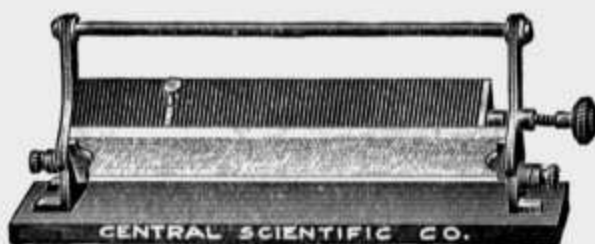
With two traveling plugs..... 40.00



No. 2446B.

No. 2449.

2446B. Brass Plug, with knurled rubber top, as used on Resistance Boxes....	\$	0.17
2447A. Decade Resistance Box. See Catalog K for description.....	Duty free	90.00
2447B. Decade Resistance Box. See Catalog K for description.....	Duty free	120.00
2447C. Decade Resistance Box. See Catalog K for description.....	Duty free	142.50
2447D. Decade Resistance Box. See Catalog K for description.....	Duty free	165.00
2448. Megohm Box. See Catalog K for description.....	Duty free	90.00
2449. Dial Resistance Box. A 3-dial resistance box having a total resistance of 1110 ohms, mounted in a mahogany finished hardwood box, with hard rubber top about 6x16 inches. Contact with the blocks at the end of the swinging arm is made by a multiple brush with ends bent so that they are not tangent to the circle in which they move and therefore do not wear rings in the blocks. The coils are of the same description as those used in our other resistance boxes (see page 200), and are guaranteed to $\frac{1}{5}$ of 1%.....		25.00
2450. Resistance Box. See page 205 for description.....		25.00

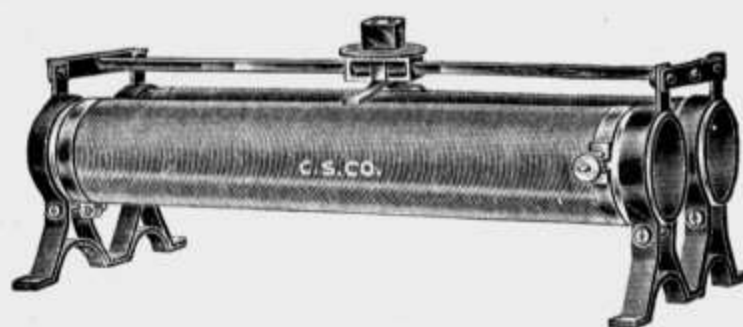


No. 2451.

2451. Carbon Rheostat, for use in battery testing, calibrating electrical instruments, photometry, and any experiments in which a UNIFORM VARIATION of resistance is desired. Consists of 90 carbon plates $1\frac{1}{2}$ inches square and $\frac{1}{8}$ inch thick, mounted between castings on a base of asbestos wood so that pressure can be placed on them by a screw, thus allowing a range of resistance of from about 0.1 ohm to 8 ohms or more, including all intermediate values. Safe load for constant duty, 200 watts. A momentary overload of from 500 to 1000 watts may be applied without danger of injury.....		11.00
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**RUHSTRAT RHEOSTATS OR SLIDE RESISTANCES.****Single Rheostat, Type F.**

These popular resistances have recently been improved so as to obtain very great capacity for the consumption of energy, combined with small weight. Oxidized resistance wire is wound on an enameled metal tube which provides for the more rapid dissipation of heat than the old slate form. The difference of potential between the adjacent turns is so small that the oxide covering of the wire provides sufficient insulation. **The Current Ratings are for Continuous Duty.** We list the capacities that are most commonly used, and which are kept in stock in Germany, thus insuring prompt delivery. Other capacities will be furnished upon request at prices approximately those of the sizes and capacities nearest the one desired. We list three types of the single resistance; Type "S" provided with lugs for the switch-board, type "F" provided with legs for the laboratory table, and type "V" vertical air cooled.

**DOUBLE RHEOSTATS.****Double Rheostat, Type D.**

Any two single rheostats of the same capacity listed above may be mounted on a single support and supplied with a sliding contact connecting the two rheostats. They may be used in either series or parallel.

**UNIVERSAL RHEOSTATS.**

Two single rheostats of the same or different capacities but of the same dimensions may be mounted on the same base, each with independent sliding contact. They may be used separately on different circuits, or connected in series or parallel. For price, add the prices of the two rheostats in type "F."

**PRICE LIST ON NEXT PAGE.**

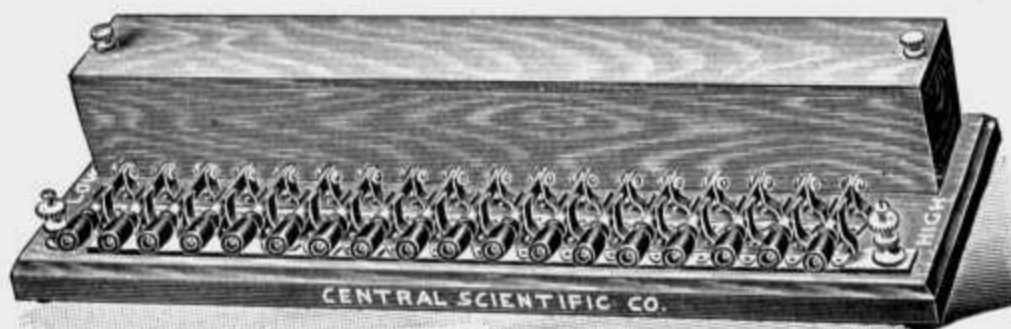
**When ordering, please give Catalog Number and Type desired.**

## PRICE LIST OF RUHSTRAT RHEOSTATS.

(For description see preceding page).

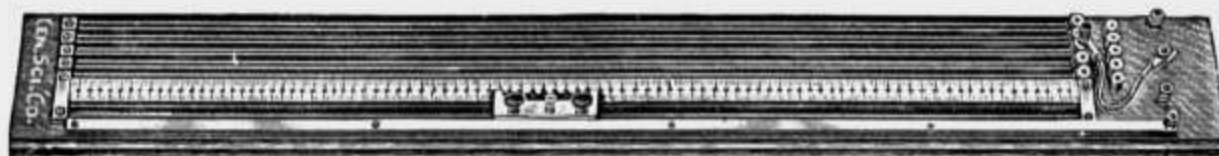
When ordering, please give Catalog Number and Type desired.

Catalog Number.	Size of Tube, mm.	SINGLE.					DOUBLE.		Price, Duty Free.
		Amperes.	Ohms.	Price, Duty Free.			Amperes.	Ohms.	
				Type S.	Type F.	Type V.			Type D.
2439.	150x30	0.3	700	\$2.40	\$2.65	\$2.85	0.3	1400	\$ 4.15
2439A.		1.0	150	2.40	2.65	2.85	1.0	300	4.15
2439B.		2.0	25	2.40	2.65	2.85	2.0	50	4.15
2439C.		3.3	10	2.40	2.65	2.85	3.3	20	4.15
2439D.		5.0	5	2.70	2.95	3.15	5.0	10	4.60
2439E.		12.0	1	2.70	2.95	3.15	12.0	2	4.60
2439F.		20.0	.25	2.70	2.95	3.15	20.0	0.5	4.60
2439G.	200x30	0.3	1000	2.80	3.00	3.25	0.3	2000	4.80
2439H.		1.0	225	2.80	3.00	3.25	1.0	450	4.80
2439J.		2.0	38	2.80	3.00	3.25	2.0	75	4.80
2439K.		3.3	15	2.80	3.00	3.25	3.3	30	4.80
2439L.		5.0	7.5	3.10	3.30	3.55	5.0	15	5.25
2439M.		12.0	1.5	3.10	3.30	3.55	12.0	3	5.25
2439N.		20.0	0.4	3.10	3.30	3.55	20.0	0.8	5.25
2439P.	200x40	0.3	1400	3.25	3.45	3.70	0.3	2800	5.95
2439Q.		1.0	270	3.25	3.45	3.70	1.0	540	5.95
2439R.		2.0	50	3.25	3.45	3.70	2.0	100	5.95
2439S.		3.3	20	3.25	3.45	3.70	3.3	40	5.95
2439T.		5.0	11	3.55	3.75	4.00	5.0	22	6.45
2439U.		12.0	1.8	3.55	3.75	4.00	12.0	3.6	6.45
2439V.		20.0	0.45	3.55	3.75	4.00	20.0	0.9	6.45
2439W.	300x40	0.3	2300	4.00	4.20	4.50	0.3	4600	7.35
2439X.		1.0	450	4.00	4.20	4.50	1.0	900	7.35
2439Y.		2.0	85	4.00	4.20	4.50	2.0	170	7.35
2439Z.		3.3	35	4.00	4.20	4.50	3.3	70	7.35
2440.		5.0	18	4.35	4.65	4.90	5.0	35	7.95
2440A.		12.0	3	4.35	4.65	4.90	12.0	6	7.95
2440B.		20.0	0.75	4.35	4.65	4.90	20.0	1.5	7.95
2440C.	300x50	0.3	2600	4.75	5.05	5.35	0.3	5200	8.70
2440D.		1.0	500	4.75	5.05	5.35	1.0	1000	8.70
2440E.		2.0	100	4.75	5.05	5.35	2.0	200	8.70
2440F.		3.3	42	4.75	5.05	5.35	3.3	84	8.70
2440G.		5.0	20	4.95	5.25	5.55	5.0	40	9.25
2440H.		12.0	3.2	4.95	5.25	5.55	12.0	6.4	9.25
2440J.		20.0	0.8	4.95	5.25	5.55	20.0	1.6	9.25
2440K.	400x50	0.3	3600	5.40	5.70	6.10	0.3	7200	10.15
2440L.		1.0	710	5.40	5.70	6.10	1.0	1420	10.15
2440M.		2.0	140	5.40	5.70	6.10	2.0	280	10.15
2440P.		3.3	60	5.40	5.70	6.10	3.3	120	10.15
2440Q.		5.0	28	5.80	6.10	6.40	5.0	56	10.75
2440R.		12.0	4.4	5.80	6.10	6.40	12.0	8.8	10.75
2440S.		20.0	1.1	5.80	6.10	6.40	20.0	2.2	10.75
2440T.	500x60	0.3	5500	7.20	7.60	8.05	0.3	11000	13.50
2440U.		1.0	1130	7.20	7.60	8.05	1.0	2260	13.50
2440V.		2.0	220	7.20	7.60	8.05	2.0	440	13.50
2440W.		3.3	90	7.20	7.60	8.05	3.3	180	13.50
2440X.		5.0	45	7.75	7.95	8.35	5.0	90	14.35
2440Y.		12.0	7.8	7.75	7.95	8.35	12.0	15.6	14.35
2440Z.		20.0	1.9	7.75	7.95	8.35	20.0	3.8	14.35



No. 2450.

2450. **Resistance Box**, knife switch pattern, as described in Experiment 15 of Millikan & Mills' "Electricity, Sound and Light." With this resistance box the necessary changes in current for obtaining the hysteresis loop and the curve of magnetization for an iron ring (No. 1779A Hysteresis Apparatus) may easily be made. The coils are arranged to be thrown into circuit in parallel and are mounted under a removable cover on a nicely finished wood base..... \$ 25.00



No. 2479.

2479. **Students' Potentiometer**, as designed by Prof. B. B. Brackett of South Dakota State College.

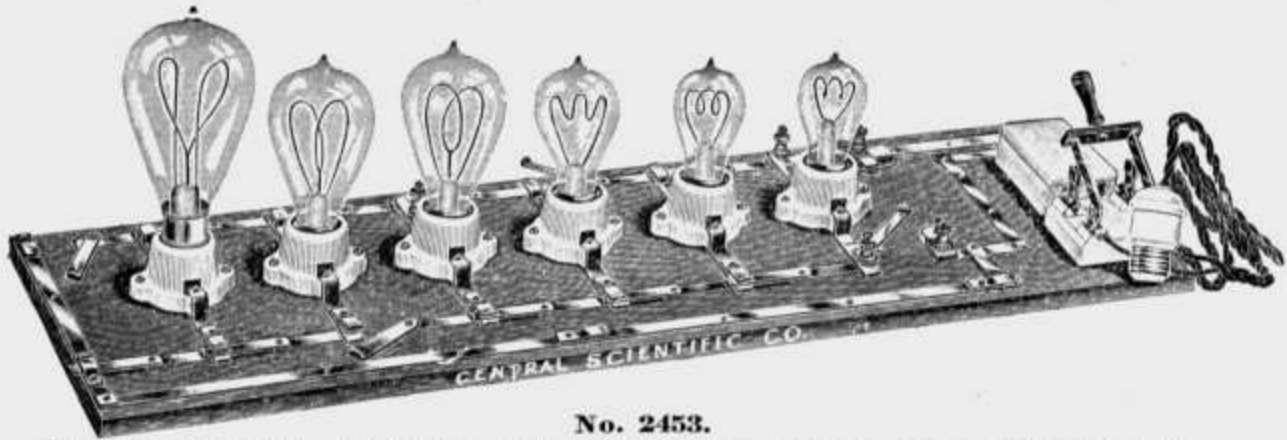
This new potentiometer is of simple design and because of its lack of complexity is especially suited for use in High Schools and with beginners in Colleges. Ten parallel resistance wires, each one meter long, are mounted on a board, the lower wire being provided with a meter scale and sliding contact. Connection may be made with either end of any one of the wires, this connection being made by means of a plug attached to a flexible cord. In use, a battery is connected to the two outside ends of the wire and by means of the plug and the sliding contact any number of ten-thousandths of the potential difference between the two ends of the wire can be tapped off, thus enabling the ordinary simple potentiometer experiments to be performed.

All the connections are simple, easily traced, and easily understood, and at least as accurate readings can be made with this instrument as with a high grade voltmeter.

Every student of electricity should have a working knowledge of the principles involved in the use of a potentiometer and this moderate priced piece puts an opportunity for this acquaintance within the reach of every High School Physics Department.

- Complete as illustrated ..... 10.00





No. 2453.

2453. **Lamp Rheostat.** Parsons' latest improved design, for controlling incandescent lighting circuits, and for demonstrating the laws of series and parallel combinations. All connections are in plain sight and the lamps may be used in series, parallel or combination connections, changes from one arrangement to another being rapidly made by means of small knife switches specially constructed for this purpose. Binding posts are provided to permit the introduction into the circuit of ammeters, voltmeters, tangent galvanometers, magnet coils, permeameters, electrolytic cells and other apparatus. Six lamps with candle power ranging from four to fifty, as shown in the table below, are provided, and by their means the current is controllable from .06 amperes when in series to 5.05 amperes when in multiple. By using six 16-candle power lamps, other resistances may be obtained and the laws of series and parallel connections readily illustrated.

Lamp No. ....	1	2	3	4	5	6	Total
Candle Power .....	4	8	16	32	32	50	142
Current at 110 V.....	.2	.38	.53	1.12	1.12	1.70	5.05
Resistance, hot, ohms.....	550	289.3	207.5	98.2	98.2	64.7	21.7
Resistance, 20° C., ohms...	1125	607	452	221	222	136	48
Resistance in series at 110 volts.....							1308 ohms
Resistance in series at 20° Centigrade.....							2763 ohms
Current when connected in series at 110 volts.....							0.084 amp.

Price .....Net \$ 15.00

2454. **Lamp Rheostat.** Same design as No. 2453, but for 220 volt circuit. The following report shows the capacity of the instrument:

Lamp No. ....	1	2	3	4	5	6	Total
Candle Power .....	8	16	16	32	32	50	154
Watts per Candle.....	5	4	4	3.5	3.5	3.4	3.65
Power, watts .....	40	64	64	112	112	170	562
Current, amperes .....	.18	.29	.29	.51	.51	.77	2.55
Resistance, hot, ohms.....	1222	759	759	431	431	286	86
Resistance, 20° C., ohms...	2556	1659	1659	938	938	619	178
Resistance in series at 220 volts.....							3888 ohms
Resistance in series at 20° Centigrade.....							8369 ohms
Current when connected in series at 220 volts.....							0.057 amp.

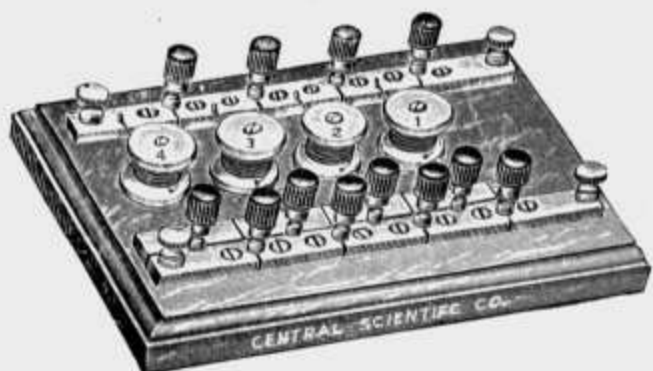
Price .....Net 16.00



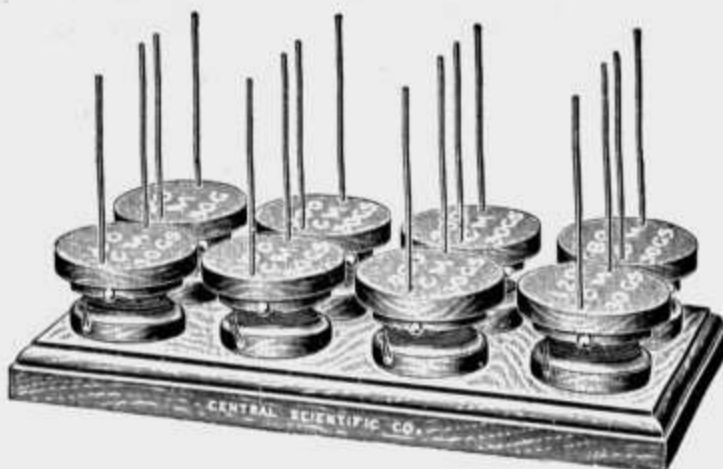
No. 2455.

2455. **Resistance Spools.** Set of five spools of unknown resistance, mounted on polished hardwood base, with binding screws so that the spools may be separately or collectively measured. This form of resistance spools is very durable for rough usage and makes a neat looking piece of apparatus for the laboratory. Consists of the following spools:

- No. 1. 10 Meters No. 22 Copper Wire.
- No. 2. 10 Meters No. 28 Copper Wire.
- No. 3. 20 Meters No. 22 Copper Wire.
- No. 4. 20 Meters No. 28 Copper Wire.
- No. 5. 10 Meters No. 22 German Silver Wire. Complete..... 3.00



No. 2456.



No. 2457.

2456. **Resistance Board**, originally designed in 1904 by C. H. Andrews of the South High School, Worcester, Mass., and made from specifications furnished us. It consists of four coils of wire with the following possible combinations:

1. Two coils of the same length and material, but of different diameters.
2. Two coils of the same length and diameter, but of different materials.
3. Two coils of the same diameter and material, but of different lengths.

Care has been taken to select wires whose diameters and resistances have convenient ratios to each other, and are therefore best suited for use in parallel.

The coils are so connected to the brass blocks that the different combinations may be secured by the plugs, connecting any of the coils either in series or parallel.

Mounted on finished hardwood base with hard rubber top plugs..... \$ 5.00

2457. **Resistance Spools**. Set of eight for use with Wheatstone's Bridge. The wood base is fitted with pegs to hold the spools when not in use. As an improvement, we fasten each lead wire to the spool itself and solder it to the resistance wires wound on the spools. This prevents the wires from breaking and makes the coils, in consequence, more durable. Set consists of the following spools:

- 2 Spools wound with 200 cm. No. 30 D. S. C. German Silver Wire.
- 1 Spool wound with 160 cm. No. 30 D. S. C. German Silver Wire.
- 1 Spool wound with 120 cm. No. 30 D. S. C. German Silver Wire.
- 1 Spool wound with 80 cm. No. 30 D. S. C. German Silver Wire.
- 1 Spool wound with 40 cm. No. 30 D. S. C. German Silver Wire.
- 1 Spool wound with 200 cm. No. 28 D. S. C. German Silver Wire.
- 1 Spool wound with 2,000 cm. No. 30 D. S. C. Copper Wire. Per set.. 3.00



No. 2457A.

2457A. **Resistance Board**, after design by Prof. Jos. F. Merrill of the University of Utah. Six lengths of No. 22 Bare German Silver Wire and four lengths of No. 20 Bare German Silver Wire, each 100 cm. long, mounted on a mahogany finish hardwood board and provided with six double binding posts. With this board used in connection with any Wheatstone's Bridge the laws of variation of resistance with length and with diameter of conductor, and the law of the resistance of wires in parallel, may readily be determined.....

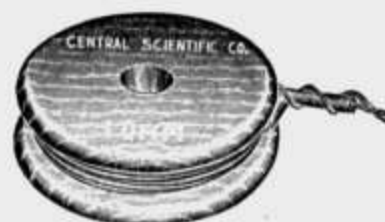
5.55



No. 2458.



No. 2459.



No. 2460.

2458. **Resistances on spools.** These resistances are the same as used in our Resistance Boxes and are guaranteed to be of the best workmanship. The winding is bifilar, of Manganin wire on wooden spools, the ends soldered to heavy copper terminals. Accurate to  $\frac{1}{5}$  of 1%.  
Resistance in ohms. 1 2 5 10 25 50 100 200 500 1000 5000  
Each .....\$0.55 .55 .55 .60 .60 .70 .80 .90 1.00 1.50 2.25
2459. **Resistance Coils**, mounted in brass case, rubber top, with two binding posts and rubber top brass taper plug for short circuiting the coil. Coils wound bifilar of Manganin wire and guaranteed to an accuracy of  $\frac{1}{10}$  of 1%.  
Resistance in ohms. 1 2 5 10 25 50 100 200 500 1000 5000  
Each ..... 5.50 5.50 5.50 5.50 5.75 6.00 6.25 6.50 6.75 7.00 7.50
2460. **Resistance Coil**, 1 ohm, mounted on simple wood spool; convenient for Wheatstone's Bridge experiments..... \$ 0.20
- 2460A. **Resistance Coil**, 1000 ohms. Same as No. 2460..... .30
2461. **Standard Ohm.** See Catalog K for description.....Duty free 11.25
2463. **Graphite Rods**,  $\frac{1}{2}$  inch, for resistance work. In ordering specify what resistance is desired. Length, inches 8 10  
Each .....1.10 1.25
2465. **Electric Toaster and Heater Parts**, page 494.
2466. **Temperature Coil** for use with a Wheatstone Slide Wire Bridge in studying the effects of temperature on resistance. A bifilar coil of 24 double turns of bare copper wire, wound on a fiber tube and provided with heavy connecting wires rigidly attached to the tube.. \$ 0.90



No. 2466.

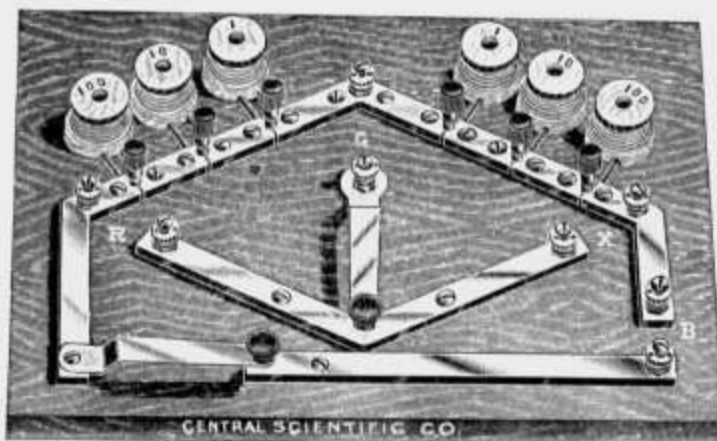


No. 2467.



No. 2467A.

2467. **Temperature Coil**, Cornell University design, for the measurement of the temperature coefficient of resistance of a copper conductor. Fine copper wire (double silk covered) is wound bifilar in spiral grooves on a thin copper cylinder, which is perforated for the free circulation of oil about the coiled wire. This cylinder is also used as a stirrer and is supported by a fiber cap, which fits loosely in the top of the heavy nickel plated copper calorimeter.  
Complete with clamp, but without thermometer and support..... 9.00
- 2467A. **Electric Calorimeter**, after Prof. Millikan. For determining the number of calories of heat developed in a wire, and for use in calibrating voltmeters by means of the absolute determination of the potential difference. Consists of two heavy nickel plated copper vessels, the inner supported and insulated from the outer by a fiber ring and having a capacity of about 300 c. c. A coil of fine platinum wire, wound on a block of heat-resisting material, is fastened at the ends to two brass rods which support the coil from the fiber cover and connect it with binding post terminals. A special stirrer with insulating handle is included. Without thermometer..... 10.00
2468. **Continuous Flow Calorimeter.** See Catalog K for description..... 20.00
2469. **Temperature Coefficient Apparatus.** See Catalog K for description... 11.00



No. 2471.

2471. **Wheatstone's Bridge**, demonstration form, convenient for determining resistance. From a teaching standpoint, our new form is superior to those which have preceded it, as all connections and resistance coils are in plain sight on the upper surface of the board and the Wheatstone's diagram given in every text book is closely followed. Furnished with coils of 1, 10 and 100 ohms in each proportional arm. Accuracy of coils,  $\frac{1}{5}$  of 1%. Complete with directions..... \$ 6.65



No. 2473.

2473. **Wheatstone's Bridge**, standard slide wire form of simple construction. The wire is of German silver, one meter long, mounted on a scale graduated in millimeters, and provided with a sliding knife edge contact. The strips are of brass with no soldered joints and provided with a single gap in each of two arms of the bridge for known and unknown resistance. Complete with necessary binding posts and full directions..... 3.00



No. 2475.

2475. **Wheatstone's Bridge**, standard slide wire form, heavier and better than No. 2473. The brass strips are  $\frac{1}{8} \times \frac{1}{2}$  inch with no soldered joints and provided with two gaps in each of two arms of the bridge for known and unknown resistance. The wire is of platinoid, mounted on a scale graduated in millimeters, and provided with sliding knife edge contact. Complete with necessary binding posts and full directions..... 4.45



No. 2476.

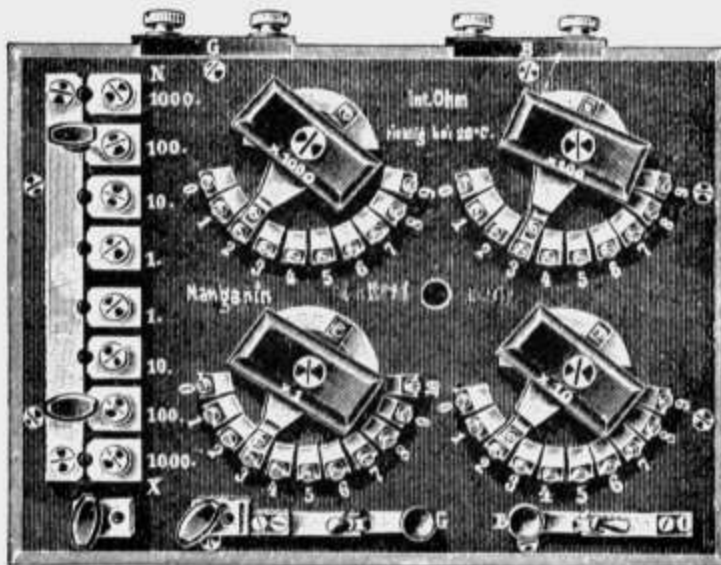
2476. **Half Meter Bridge**. (Simple Carey-Foster Type.) For calibration of a bridge wire or measurement of resistances; by short circuiting the two end gaps, it may be used also as an ordinary Wheatstone Bridge. This bridge is well made and neatly finished, and binding posts for all necessary connections are furnished. We call attention to the improved contact key. It is of the knife edge type and moves easily along a brass tube with which it makes good electrical contact. With this type of key the galvanometer wires do not get tangled or interfere with easy movement of key, knife edge always makes contact at right angles to the wire, contact is sure and adjustments can be made with great exactness. Complete with directions ..... 11.00

See also No. 2477 Wheatstone's Bridge on next page.



No. 2477.

2477. **Wheatstone's Bridge**, standard slide wire form, high grade. The strips are of heavy copper without soldered joints and provided with two gaps in each of two arms of the bridge. The wire is of manganin, which does not appreciably change in resistance with change of temperature. Mounted on a scale graduated in millimeters. With this bridge is provided an improved form of contact key having contacts at each end so that the point of balance of the bridge may more readily be located approximately. This contact key slides along and makes good electrical contact with a metal strip provided with binding posts to either of which one galvanometer wire is attached. This does away with the trouble caused by a loose, dangling wire. Complete with necessary binding posts and full directions ..... \$ 12.00



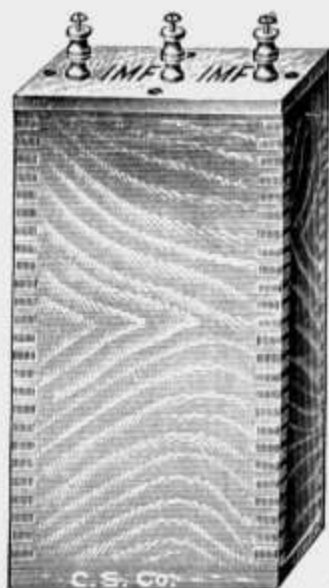
No. 2478.

2478. **Wheatstone's Bridge with Four Decades**, with sliding contacts for rapid manipulation. Four pairs of ratio resistances of 1, 10, 100, 1,000 ohms or 10, 100, 1,000, 10,000 ohms. Four decades of comparison resistances, 9x1000, 9x100, 9x10, 10x1 ohm or 9x100, 9x10, 9x1, 10x0.1 ohm. Provided with battery and galvanometer keys, a pair of terminals for connecting the resistances to be measured, and a wooden lid to keep out light and dust when not in use...Duty free 142.50
- 2478A. **Wheatstone's Bridge**, same as No. 2478, but with five decades. Duty free 172.50
- 2478B. **Wheatstone's Bridge**, same as No. 2478, but with six decades. Duty free 240.00
2479. **Students' Potentiometer**, see page 205.
2480. **Wire Potentiometer**. See Catalog K for description.....Duty free 15.00
- 2480A. **Wire Potentiometer**. See Catalog K for description..... 10.00
2481. **Potentiometer**. See Catalog K for description.....Duty free 180.00
2482. **Potentiometer and Wheatstone's Bridge**. See Catalog K.....Duty free 225.00
2483. **Multiplier**. See Catalog K for description.....Duty free 52.50

For Wheatstone's Bridge, box form, see Nos. 2445-6.

For Conductivity Wheatstone's Bridge, see page 431.

**CONDENSERS.**



No. 2485.

Nos. 2484 to 2485 Condensers will meet the demand for an inexpensive type for experimental purposes, which is reliable in its electrical characteristics. They are thoroughly recommended for use with a potential of 500 volts or less. The following sizes are carried in stock:

- 2484. Paper Condenser, capacity approximately 1 M. F., size  $4\frac{1}{4} \times 2\frac{1}{8} \times \frac{7}{8}$  inches..... \$ 1.00
- 2484A. Paper Condenser, capacity approximately 2 M. F, size  $4\frac{1}{4} \times 5 \times \frac{3}{4}$  inches..... 1.55
- 2485. Paper Condenser, in hardwood case. The box contains two commercial condensers capable of standing 120 volts. Each condenser has a capacity of approximately 1 micro-farad. Three Cenco binding posts are provided so that the condensers may be used or measured singly, in series or parallel..... 4.50
- 2486. Mica Condenser. 0.1 M. F. See Catalog K.....Duty free 10.50
- 2486A. Mica Condenser. 0.2 M. F. See Catalog K.....Duty free 10.50
- 2486B. Mica Condenser. 0.5 M. F. See Catalog K.....Duty free 12.00
- 2486C. Mica Condenser. 1.0 M. F. See Catalog K.....Duty free 15.00
- 2487. Mica Condenser. 0.5 M. F. See Catalog K.....Duty free 46.20
- 2487A. Mica Condenser. 5 subdivisions. See Catalog K.....Duty free 72.00
- 2487B. Mica Condenser. 8 subdivisions. See Catalog K.....Duty free 85.00
- 2488. Mica Condenser, a good condenser mounted in a neat hardwood case, 6x4x3 inches. The terminal binding posts are secured in rubber bushings. A copper strap is furnished to short circuit the terminals. Capacity 1 M. F. adjusted approximately to within 1 per cent..... 10.00
- 2489. Air Condenser. See Catalog K for description..... 12.00
- 2489A. Mica Sheet. See Catalog K for description..... 1.10

**POCKET METERS.**



No. 2491.



No. 2492.



No. 2494.

These meters are of the permanent magnet type and are extensively used for rapidly measuring the polarity, voltage and amperage of batteries. They are exceedingly "dead beat," being made so by the relation of the moving system to the magnetic field and not by friction or air vanes, as in other types. Each instrument is packed in a chamois bag.

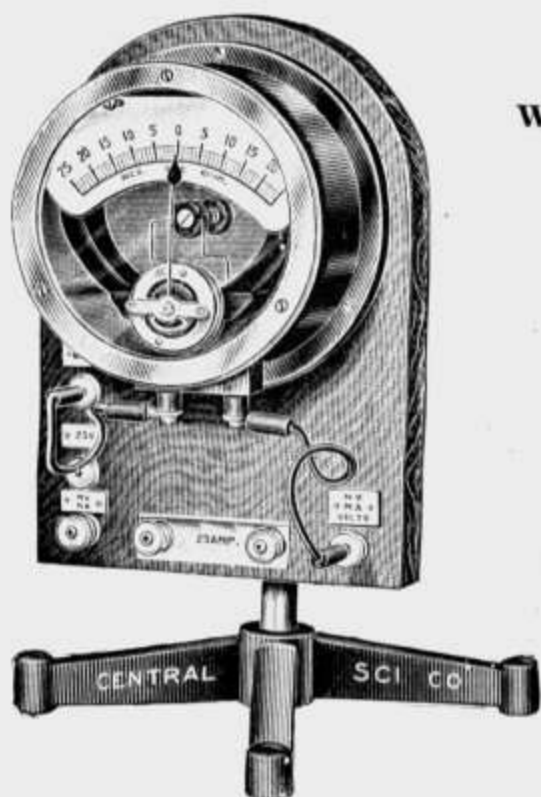
- 2491. Voltmeter. Range 0-10 volts..... 2.00
- 2492. Ammeter. Range 0-30 amperes..... 1.65
- 2494. Volt Ammeter. Range 0-15 volts and 0-30 amperes..... 2.50

## CENCO METERS.



No. 2512.

2512. **Volt-Ammeter.** Instrument illustrated above is of our own design and will meet the demands for a dependable electrical measuring instrument at a reasonable price. It is a direct current instrument made on the D'Arsonval Galvanometer principle with a rectangular coil of wire rotating in a small annular gap between a core and pole pieces. This gap is traversed by a concentrated uniform field produced by a powerful permanent magnet carefully aged. The current is carried into and out of the coil by means of non-magnetic springs. The moving element is perfectly balanced between two highly polished jewels. The throw of the coil is stopped by the coil striking its support. This prevents the bending of the pointer and the destroying of the calibration of the instrument. The large window directly over the moving system shows to the student the moving system. The meter is enclosed in a dust proof aluminum case mounted on a polished mahogany base. Leads are brought to three of our Cenco binding posts, which are recommended for their convenient size and from the fact that their construction will not allow the knurled nuts to be lost. Scale has a range of 10 volts by  $\frac{1}{10}$  volt divisions and 10 amperes by  $\frac{1}{10}$  ampere divisions. Calibration guaranteed to 1% of the full scale..... \$ 10.00
2514. **Volt-Ammeter, Visible Form,** see page 220B..... 12.00
2516. **Ammeter.** Same construction as No. 2512, range 0-1 amperes in 0.01 ampere divisions ..... 10.00
2518. **Ammeter.** Same construction as No. 2512, range 0-10 amperes in 0.1 ampere divisions ..... 10.00
2519. **Ammeter.** Construction similar to No. 2512 but with a double scale giving a range of 0 to 12 amperes in 0.1 ampere divisions and 0 to 1.2 amperes in .01 ampere divisions..... 11.00
2520. **Voltmeter.** Same construction as No. 2512, range 0-5 volts in 0.05 volt divisions . . . . . 10.00
2522. **Voltmeter.** Same construction as No. 2512, range 0-10 volts in 0.1 volt divisions . . . . . 10.00
2524. **Voltmeter.** Same construction as No. 2512, range 0-120 volts in 1 volt divisions . . . . . 10.00
2525. **Voltmeter.** Construction similar to No. 2512, but with a double scale giving a range of 0 to 120 volts in one volt divisions, and 0 to 6 volts in  $\frac{1}{20}$  volt divisions..... 11.00



WESTON MAKE.



No. 2529.

**2529. Galvano-Volt-Ammeter.** Combines six different electrical measuring instruments: (1) Galvanometer; (2) Milli-Voltmeter, range 25-0-25 mv. in 1 mv. divisions; (3) Mil-Ammeter, range 25-0-25 ma. in 1 ma. divisions; (4) Voltmeter, range 5-0-5 volts in 0.2 volt divisions; (5) Voltmeter, range 125-0-125 volts in 5 volt divisions; (6) Ammeter, range 25-0-25 amperes in 1 ampere divisions.

The zero is in the center of the scale so that no time need be wasted in determining the positive terminal of a circuit. It is so mounted that it may be used in either of **THREE POSITIONS**—vertical, horizontal, or inclined at a convenient angle. (Two positions are shown in the illustrations above.) The working parts are fully exposed to view and all connections may readily be traced. It is an extremely sensitive instrument, and having no suspensions, mirrors or adjustments to get out of order, is always ready for use. Among many uses are the following: The **MEASUREMENT OF VOLTAGE, AMPERAGE AND RESISTANCE OF BATTERIES**; the **DETERMINATION OF RESISTANCE, CONDUCTIVITY, etc.**, of the various metals; the **MEASUREMENT OF THE THERMO-ELECTRIC EFFECTS** of different metals; as a **CURRENT INDICATOR IN WHEATSTONE BRIDGE WORK**; and as a **LECTURE TABLE GALVANOMETER** .....Net \$ 30.00



No. 2531.



No. 2531A.



No. 2532A.

**2531. Voltmeter**, with zero at left of scale, mounted vertically in a dust-proof case, for demonstration work. Very sensitive, and always ready for use. Range 0-4 volts in 0.05 volt divisions .....Net 20.00  
**2531A. Extra Coil**, to make No. 2531 read from 0 to 120 volts in 1.5 volt divisions ..... 3.90  
**2532. Ammeter**. Same style and mounting as No. 2531. Range 0-1 ampere in 0.01 ampere divisions. .Net 20.00  
**2532A. Extra Shunt**, to make No. 2532 read 0 to 10 amperes in 0.1 ampere divisions ..... 3.35



## WESTON METERS.



Model 45.



Model 1.

## DIRECT CURRENT.

## Portable Meters, Model 45.

These instruments are of sufficient accuracy for station work and general testing. The movement is completely enclosed in an iron case (which protects it from stray magnetic fields), securely fastened in a wooden carrying box. This box is provided with a hinge cover which protects the scale and binding posts.

Nos. 2541-3 Meters are provided with self-contained shunt.

No. 2544 Meter has an external shunt.

2533.	Milli-Voltmeter, range 0-50 mv. in 0.5 mv. divisions.....	Net \$	25.00
2534.	Mil-Ammeter, range 0-100 ma. in 1.0 ma. divisions.....	Net	25.00
2535.	Voltmeter, range 0-5 volts in 0.05 volt divisions.....	Net	25.00
2536.	Voltmeter, range 0-15 volts in 0.1 volt divisions.....	Net	25.00
2537.	Voltmeter, range 0-150 volts in 1.0 volt divisions.....	Net	29.50
2541.	Ammeter, range 0.5 amperes in 0.05 ampere divisions.....	Net	25.00
2542.	Ammeter, range 0-15 amperes in 0.1 ampere divisions.....	Net	25.00
2543.	Ammeter, range 0-25 amperes in 0.2 ampere divisions.....	Net	25.00
2544.	Ammeter, range 0-50 amperes in 0.5 ampere divisions.....	Net	25.50

NOTE.—Double Scale Voltmeters of the above type will be furnished at a price of \$5.00 in addition to the price of the highest range.

## Standard Portable Meters, Model 1.

These meters are adjusted and calibrated with the greatest care, and when used properly give exceedingly accurate results. They are direct reading, portable, permanent, and "dead beat," and are, in fact, the recognized standard instruments for laboratory and general testing.

2545.	Milli-Voltmeter, range 0-20 mv. in 0.2 mv. divisions, readable to 0.02 mv. ....	Net	50.00
2546.	Milli-Voltmeter, zero center, range 10-0-10 mv. in 0.2 mv. divisions, readable to 0.02 mv.....	Net	50.00
2546A.	Milli-Voltmeter, zero center, double range 10-0-10 and 100-0-100 mv. supplied with key by which either range may be employed.....	Net	55.00
Any of the above instruments may be supplied with <b>Shunts</b> for ampere readings at an additional cost of.....			
2547.	Voltmeter, range 150 volts in 1 volt divisions, readable to 0.1 volt..	Net	55.00
2548.	Voltmeter, double range, 150 volts readable to 0.1 volt and 15 volts readable to 0.01 volt.....	Net	75.00
2548A.	Voltmeter, same as No. 2548, but with Reversing Key.....	Net	77.50
2549.	Ammeter, range 15 amperes, in 0.1 ampere divisions, readable to 0.01 ampere .....	Net	65.00
2549A.	Ammeter, range 25 amperes, in 0.25 ampere divisions, readable to 0.025 ampere .....	Net	65.00
2549B.	Ammeter, range 50 amperes, in 0.5 ampere divisions, readable to 0.05 ampere .....	Net	65.00

**WESTON METERS—Continued.**



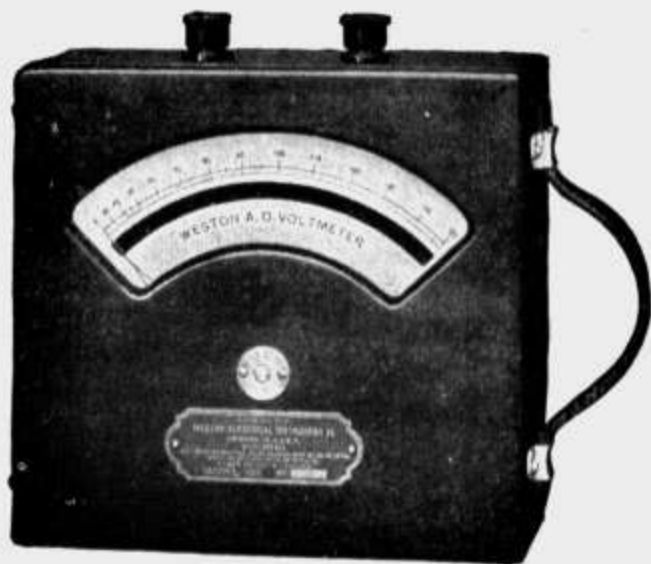
**Model 24.**

**DIRECT CURRENT.**

**Switchboard Meters, Model 24.**

These small round pattern meters are expressly designed to meet the demand for good but low price instruments for use on switchboards. The total diameter of the front is 6 $\frac{5}{8}$  inches and the total depth 4 inches. They are carefully designed to secure the highest degree of durability and reliability; they are absolutely dead beat, and their indications can be relied upon within 1%. The cases are finished in black japan and nickel and are neat in appearance.

2550.	Voltmeter, 0-10 volts in .2 volt divisions.....	Net \$	16.00
2551.	Voltmeter, 0-25 volts in .5 volt divisions.....	Net	16.00
2552.	Voltmeter, 0-50 volts in 1 volt divisions.....	Net	16.00
2553.	Voltmeter, 0-130 volts in 2 volt divisions.....	Net	16.50
2554.	Ammeter, 0-10 amperes in .2 ampere divisions.....	Net	15.00
2555.	Ammeter, 0-25 amperes in .5 ampere divisions.....	Net	15.50
2556.	Ammeter, 0-50 amperes in 1 ampere divisions.....	Net	15.75



**Model 155.**



**Model 156.**

**ALTERNATING CURRENT.**

**Portable Meters, Model 155.**

These instruments are perfectly dead beat, extremely sensitive and quickly and accurately respond to the most minute as well as to the greatest fluctuations in current strength, or in potential difference in the circuit. They may be used on circuits of any frequency, within the limits of engineering practice of today, without sensible error in their indications. Provided with hardened steel pivots, jeweled bearings and mounted in neatly finished dust-proof wood cases.

2560.	Voltmeter, 0-75 volts.....	Net	18.50
2561.	Voltmeter, 0-125 volts.....	Net	18.50
2562.	Ammeter, 0-10 amperes.....	Net	17.00
2563.	Ammeter, 0-25 amperes.....	Net	17.00

**Switchboard Meters, Model 156.**

These instruments are of a high standard of excellence, indicate the same whether left in circuit for a minute or permanently, may be used on circuits of any ordinary frequency, are entirely dead beat, and are provided with a remarkably uniform scale. Diameter of case, 7.25 inches; depth of case, 3.15 inches.

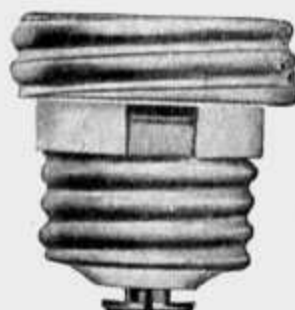
2570.	Voltmeter, 0-75 volts.....	Net	14.50
2571.	Voltmeter, 0-125 volts.....	Net	14.50
2572.	Ammeter, 0-10 amperes.....	Net	13.50
2573.	Ammeter, 0-25 amperes.....	Net	13.50
2574.	Ammeter, 0-50 amperes.....	Net	13.75



No. 2585.



No. 2587—Top View.



No. 2587—Side View.

- |       |   |    |      |
|-------|---|----|------|
| 2585. | Standard Plug Fuse Cut-Out. Double pole, Edison sockets, for 125 and 250 volts, 30 amperes. Without fuse plugs..... | \$ | 0.33 |
| 2587. | Plug, Fuse, will hold fuses of from 3 to 20 amperes capacity. Without fuse wire.....                                |    | .22  |
- For Fuse Wire, see No. 6108.



No. 2589.



No. 2591.

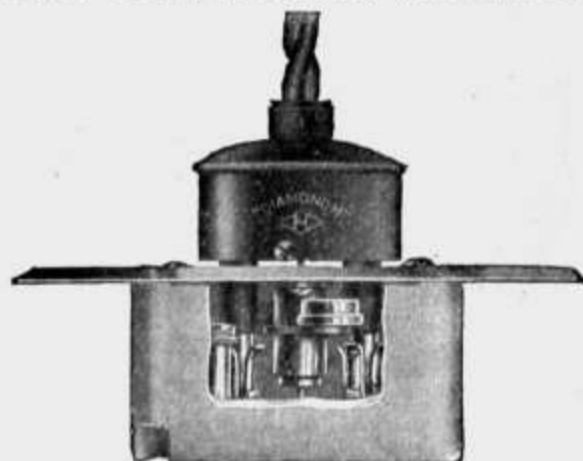


No. 2593.



No. 2594.

- |       |   |     |
|-------|---|-----|
| 2589. | Receptacle, porcelain, Edison, keyless.....                             | .17 |
| 2591. | Receptacle, porcelain base, brass shell, Edison, with key.....          | .50 |
| 2593. | Receptacle, concealed, porcelain, to take No. 2594 Plug.....            | .22 |
| 2594. | Plug, porcelain, with two finger contacts to fit No. 2593 Receptacle... | .11 |



No. 2597.



No. 2599.



No. 2601.



No. 2603.

- |       |   |      |
|-------|---|------|
| 2597. | Flush Plate Receptacle and Plug, Diamond H. The best and safest on the market.....  | 2.50 |
| 2599. | Socket, brass, Edison, 1/8-inch cap, with key.....  | .37  |
| 2601. | Attaching Plug, Edison, porcelain, fuseless, with separable cover....   | .28  |
| 2603. | Attaching Plug for multiple work. One end fits any Edison Receptacle, and the other is provided with socket for incandescent lamp. At the side is a separable plug for attaching a lamp cord which will be in multiple with the lamp in the socket..... | .55  |
| 2604. | Attaching Plug for series work. Same as No. 2603 except that the lamp cord will be connected in series with the lamp in the socket..  | .55  |



No. 2607.



No. 2609.

- |       |   |     |
|-------|---|-----|
| 2607. | Rosette, double pole, fuseless, for 250 volts or less.....  | .15 |
| 2609. | Snap Switch, double pole, slotted base, for 250 volts or less, 10 ampere current. Indicates whether current is on or off..... | .85 |



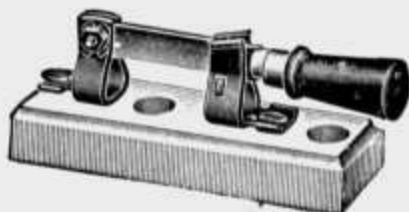
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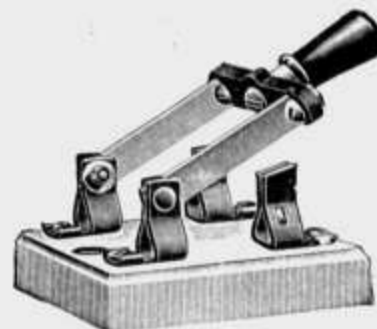
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No. 2632.

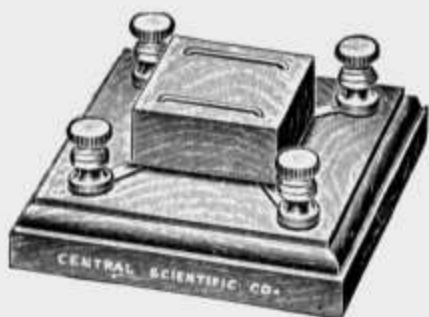


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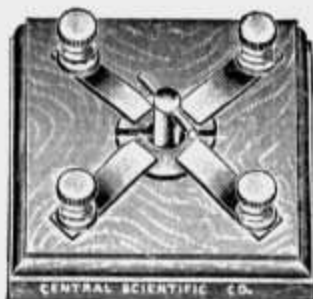


No. 2633.

- |       |   |    |      |
|-------|---|----|------|
| 2615. | Switch, Wood Base, 2½ inches diameter, 1 point.....                     | \$ | 0.10 |
| 2616. | Switch, Wood Base, 2½ inches diameter, 2 point.....                     |    | .11  |
| 2618. | Switch, Wood Base, 2½ inches diameter, 4 point.....                     |    | .17  |
| 2621. | Switch, Rubber Base, with binding posts, 1 point.....                   |    | .65  |
| 2622. | Switch, Rubber Base, with binding posts, 2 point.....                   |    | .75  |
| 2624. | Switch, Rubber Base, with binding posts, 4 point.....                   |    | 1.10 |
| 2631. | Switch, Knife, porcelain base, single pole, single throw, 15 amperes... |    | .40  |
| 2632. | Switch, Knife, porcelain base, single pole, double throw, 15 amperes..  |    | .67  |
| 2633. | Switch, Knife, porcelain base, double pole, single throw, 15 amperes..  |    | .47  |
| 2634. | Switch, Knife, porcelain base, double pole, double throw, 15 amperes.   |    | .82  |



No. 2641.



No. 2643.

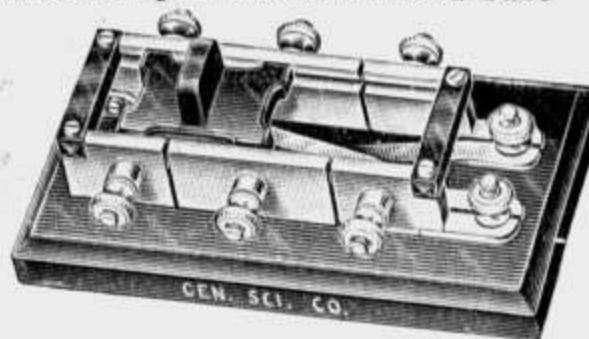


No. 2645.

- |       |   |  |      |
|-------|---|--|------|
| 2641. | Commutator or Pole Changer, simple form, four binding posts and mercury cups. Contact parts are made of steel.....  |  | .66  |
| 2643. | Commutator or Pole Changer, new form, mounted on polished wood base. Heavy phosphor bronze spring clips, giving an excellent contact. Cannot short circuit the battery. This is a convenient and desirable form, since there is no spilled mercury or corroded contacts |  | 2.00 |
| 2645. | Commutator or Pole Changer (Pohl's). This is the familiar, popular form in use for so many years. Mounted on polished hardwood base   |  | 2.25 |



No. 2647.

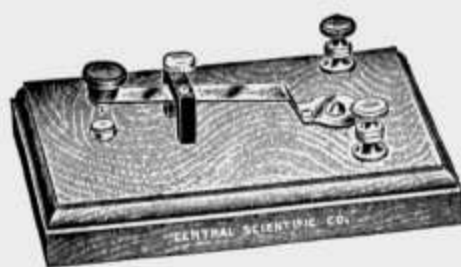


No. 2648.

- |       |  |  |      |
|-------|--|--|------|
| 2647. | Commutator or Pole Changer, knife switch form, mounted upon a substantial slate base; all connections visible, hence easy to understand. No mercury to spill. Will carry 15 amperes.....   |  | 1.25 |
| 2648. | Commutator and Double Throw Switch Combined, after design by Prof. A. P. Andrews of the Central High School, Minneapolis, Minnesota. Possesses the following features: Stability; can be operated by one hand; quickly changeable from double throw switch to commutator; connections quickly and easily made; all connections visible. It cannot get out of order because, (a) it has sliding contacts; (b) all screws and fixed joints are soldered; (c) no loose parts to become detached; and hence it is always ready for use.... |  |      |
| 2649. | Rotary Commutator.   |  |      |

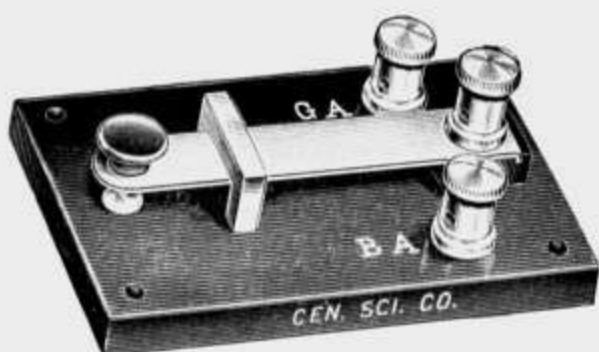


No. 2651.



No. 2653.

- 2651. Single Contact Key, simple form, 4x6 inch wood base..... \$ 0.78
- 2653. Single Contact Key, with platinum points, 4x6 inch wood base..... 1.25

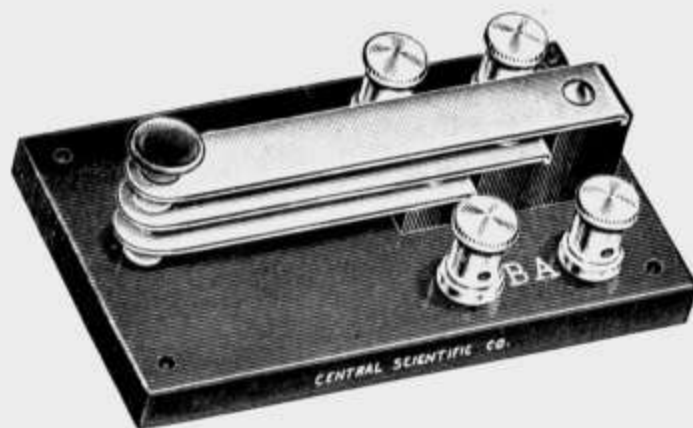


No. 2654.



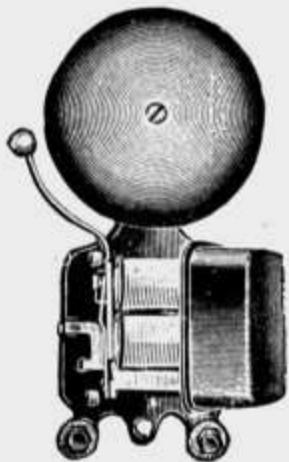
No. 2655.

- 2654. Single Contact and Short Circuiting Key. A high-grade key mounted on a heavy rubber base and of the best workmanship. Provided with heavy platinum contacts and well insulated. The key is so connected in the galvanometer circuit that whenever it is not depressed the galvanometer is short-circuited and its oscillations, therefore, rapidly damped out..... 6.65
- 2655. Double Contact Key, with platinum points, on 4x6 inch wood base.... 3.35

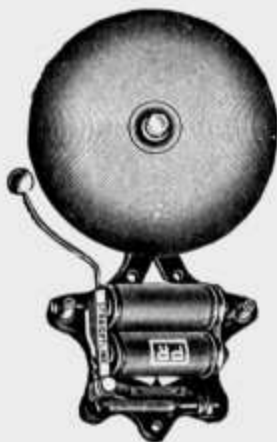


No. 2657.

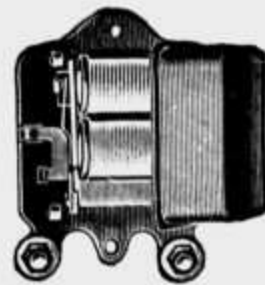
- 2657. Double Contact Key. A high-grade key of the best workmanship, mounted on a heavy rubber base. Provided with heavy platinum contacts. Especially suited to experiments where a high degree of insulation is desired..... 11.00
- 2659. Reversing Key. See Catalog K for description.....Duty free 27.00
- 2663. Zeleny Discharge and Damping Key. See Catalog K for description .....Net 25.00
- 2665. Discharge Key. See Catalog K for description..... 10.00



No. 2672.

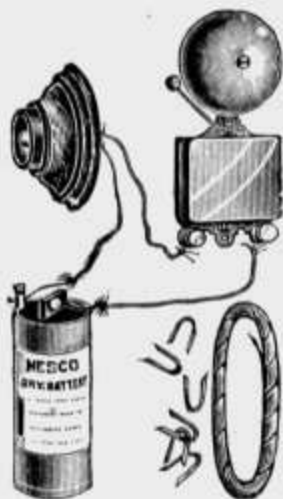


No. 2684.



No. 2695.

- |                      |   |    |      |
|----------------------|---|----|------|
| 2672.                | Bell, Electric, latest improved design, iron box, pivoted armature, 2½-inch nickel plated gong.....                                   | \$ | 0.40 |
| 2673.                | Bell, Electric, same as No. 2672, 3-inch gong.....  |    | .50  |
| 2674.                | Bell, Electric, same as No. 2672, 4-inch gong.....  |    | .60  |
| 2684.                | Bell, Electric, Skeleton Type, pivoted armature, superior workmanship, 4-inch nickel plated gong, giving clear, penetrating tone..... |    | 1.50 |
| 2686.                | Bell, Electric, same as No. 2684, 6-inch gong.....  |    | 2.25 |
| 2688.                | Bell, Electric, same as No. 2684, 8-inch gong.....  |    | 3.75 |
| 2690.                | Bell, Electric, same as No. 2684, 10-inch gong.....   |    | 6.00 |
| 2695.                | Buzzer, iron box.....   |    | .45  |
| 2696, 2696A and 2697 | Electric Bells, page 220A.  |    |      |

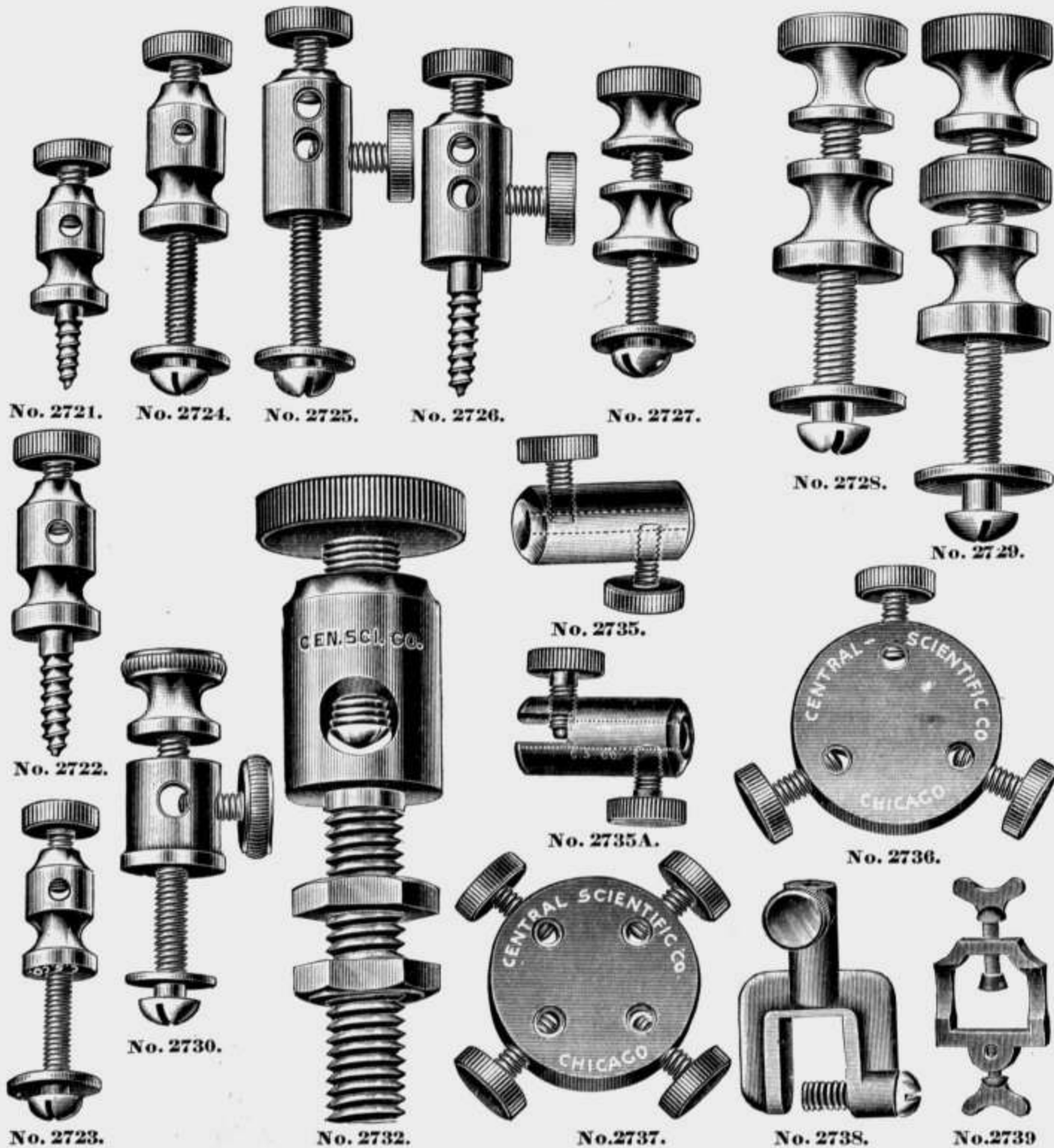


No. 2699.



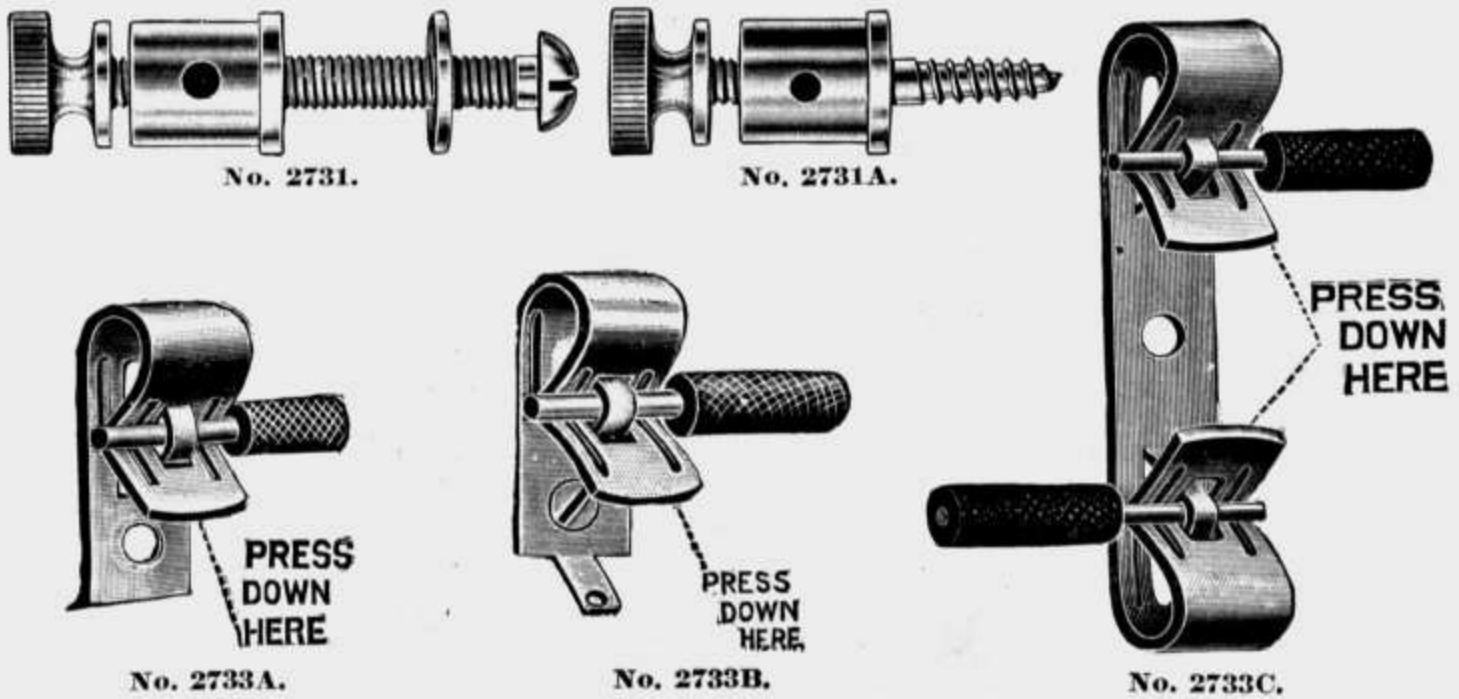
No. 2701A.

- |        |  |  |      |
|--------|--|--|------|
| 2699.  | Electric Bell Outfit, consisting of No. 2672 Bell, No. 2111 Dry Battery, No. 2756 Push Button, 1 lb. (150 feet) annunciator wire, and staples for putting up.....  |  | 1.40 |
| 2701.  | Bell Ringing Transformer. Designed for ringing bells and buzzers and operating annunciators, burglar alarm systems and gas lighting systems. It is intended for connection directly to the 110-volt, 60-cycle A. C. mains, is absolutely fireproof and may be short circuited indefinitely without burning it out or impairing its efficiency. Current at six volts is obtained from the secondary terminals, which is sufficient for all ordinary purposes..... |  | 4.00 |
| 2701A. | Bell Ringing Transformer. Similar to No. 2701, but provided with three secondary terminals, so that current at 6, 14 or 20 volts may be obtained.....  |  | 5.00 |



Illustrations are full size.

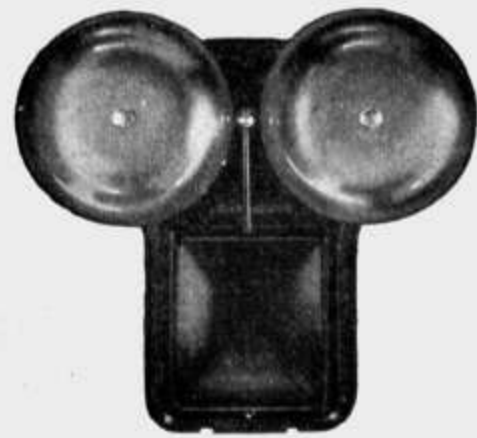
2721.	Binding Post, American form, with wood screw, small.....	\$ 0.07
2722.	Binding Post, American form, with wood screw, large.....	.09
2723.	Binding Post, American form, with machine screw, small.....	.07
2724.	Binding Post, American form, with machine screw, large.....	.09
2725.	Binding Post, American form, with machine screw, double.....	.13
2726.	Binding Post, American form, with wood screw, double.....	.13
2727.	Binding Post, English form, with machine screw, small.....	.07
2728.	Binding Post, English form, with machine screw, large.....	.13
2729.	Binding Post, English form, with machine screw, double.....	.17
2730.	Binding Post, combination English and American form, with machine screw .....	.17
2732.	Binding Post, American form, extra heavy, with two nuts for attaching to board or table top.....	.55
2735.	Connector, double .....	.09
2735A.	Connector, double; one end for wire and other slotted for receiving plates 1/8-inch thick or less.....	.17
2736.	Connector, triple .....	.16
2737.	Connector, quadruple .....	.20
2738.	Connector, for zinc .....	.17
2739.	Connector, for carbon .....	.20



2731. **Binding Post**, new form, combined English and American, with machine screw .....Net \$ 0.12
- 2731A. **Binding Post**, new form, combined English and American, with wood screw .....Net .12
2733. **Binding Post, Spring**, of brass, Fahnstock Patent. Will take any size wire up to No. 10 B. & S. gauge. Styles A and B are identical, except B is provided with a lug to which wire may be soldered.
- |                      |                                |                                |                                |
|----------------------|--------------------------------|--------------------------------|--------------------------------|
| Order Letter .....   | A                              | B                              | C                              |
| Length, inches ..... | 1 <sup>1</sup> / <sub>16</sub> | 1 <sup>1</sup> / <sub>16</sub> | 2 <sup>1</sup> / <sub>16</sub> |
| Width, inches .....  | <sup>3</sup> / <sub>8</sub>    | <sup>3</sup> / <sub>8</sub>    | <sup>3</sup> / <sub>8</sub>    |
| Price each .....     | Net \$0.03                     | 0.04                           | 0.08                           |



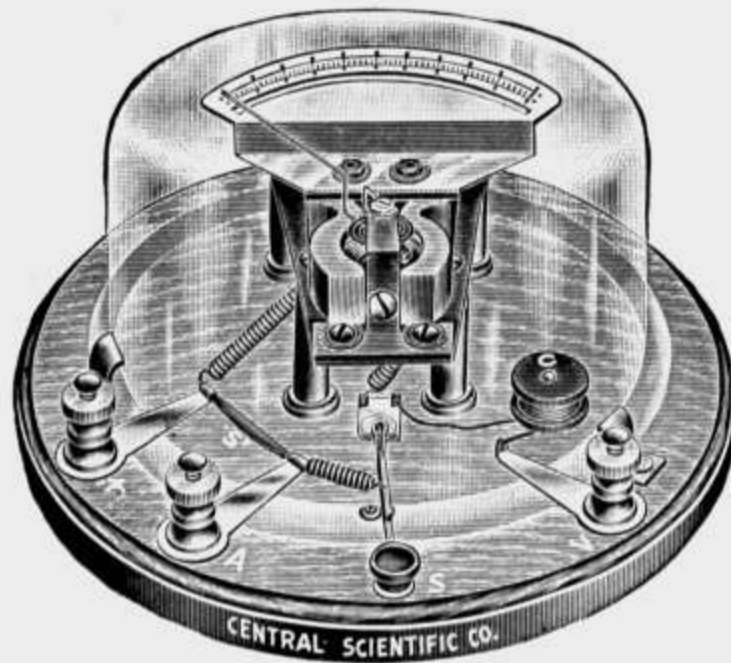
No. 2696.



No. 2697.

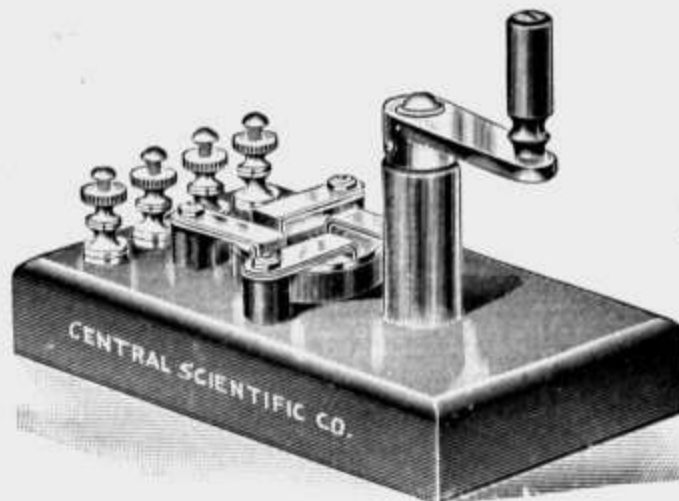
2696. **Bell, Electric**, loud ringing, for outside service; entirely moisture proof; operates on 10 volts (six or seven dry cells). 6 inch gong ..... Net 14.00
- 2696A. **Bell, Electric**. Same as No. 2696, excepting adjusted to operate on commercial circuits up to 220 volts direct current. In ordering, specify voltage.
- |                               |             |       |       |
|-------------------------------|-------------|-------|-------|
| Diameter of gong, inches..... | 6           | 8     | 10    |
| Price .....                   | Net \$14.00 | 20.00 | 22.00 |
2697. **Bell, Electric**. Similar to No. 2696A, but designed to operate on commercial alternating circuits of 110 volts, 60 cycles. 6 inch gong ..... Net 8.25





No. 2514.

2514. **Volt-Ammeter, Visible Form.** This instrument is of the same design as No. 2512, but is so mounted under a heavy glass dome that all parts are in plain view, as shown in the illustration. The student is thus enabled to see the entire construction, which is concealed from view in the ordinary instrument, and to understand clearly the distinction between a voltmeter and an ammeter, as the connections can readily be traced. When the switch S is in its normal position the current passes from post marked + through the moving coil and resistance coil C to the post V. When the switch S is depressed the bundle of wires S' is placed in shunt with the moving system, thus giving the required low resistance, and the current passes from post marked + to post A. The scale has a range of 10 volts by  $\frac{1}{10}$  volt divisions and 10 amperes by  $\frac{1}{10}$  ampere divisions. Calibration guaranteed to 1% of full scale..... \$ 12.00



No. 2649.

2649. **Rotary Commutator.** For use in Experiment 15 of Millikan & Mills' "Electricity, Sound, and Light." With this commutator and No. 2450 Resistance Box, the ring of No. 1779A Hysteresis Apparatus may rapidly be demagnetized preparatory to obtaining its curve of magnetization. In the present new form of this apparatus, the gears are located in the base of the instrument, and the binding posts for connections to the circuit are so placed that the connecting wires rest conveniently on the table. This instrument corresponds to a hand driven secohm-meter..... 25.00



No. 2755.



No. 2756.

- |       |  |    |      |
|-------|--|----|------|
| 2755. | Push Button, bronze, with screw cap.....   | \$ | 0.45 |
| 2756. | Push Button, hardwood, with screw cap..... |    | .09  |



No. 2793.

- |       |   |      |
|-------|---|------|
| 2793. | Push Button, compound. Polished oak block with three numbered buttons ..... | 1.25 |
| 2795. | Push Button. Same as No. 2793, but with five numbered buttons....           | 3.00 |
| 2799. | Push Button. Same as No. 2793, but with ten numbered buttons....            | 5.00 |



No. 2800.



No. 2801.



No. 2802.

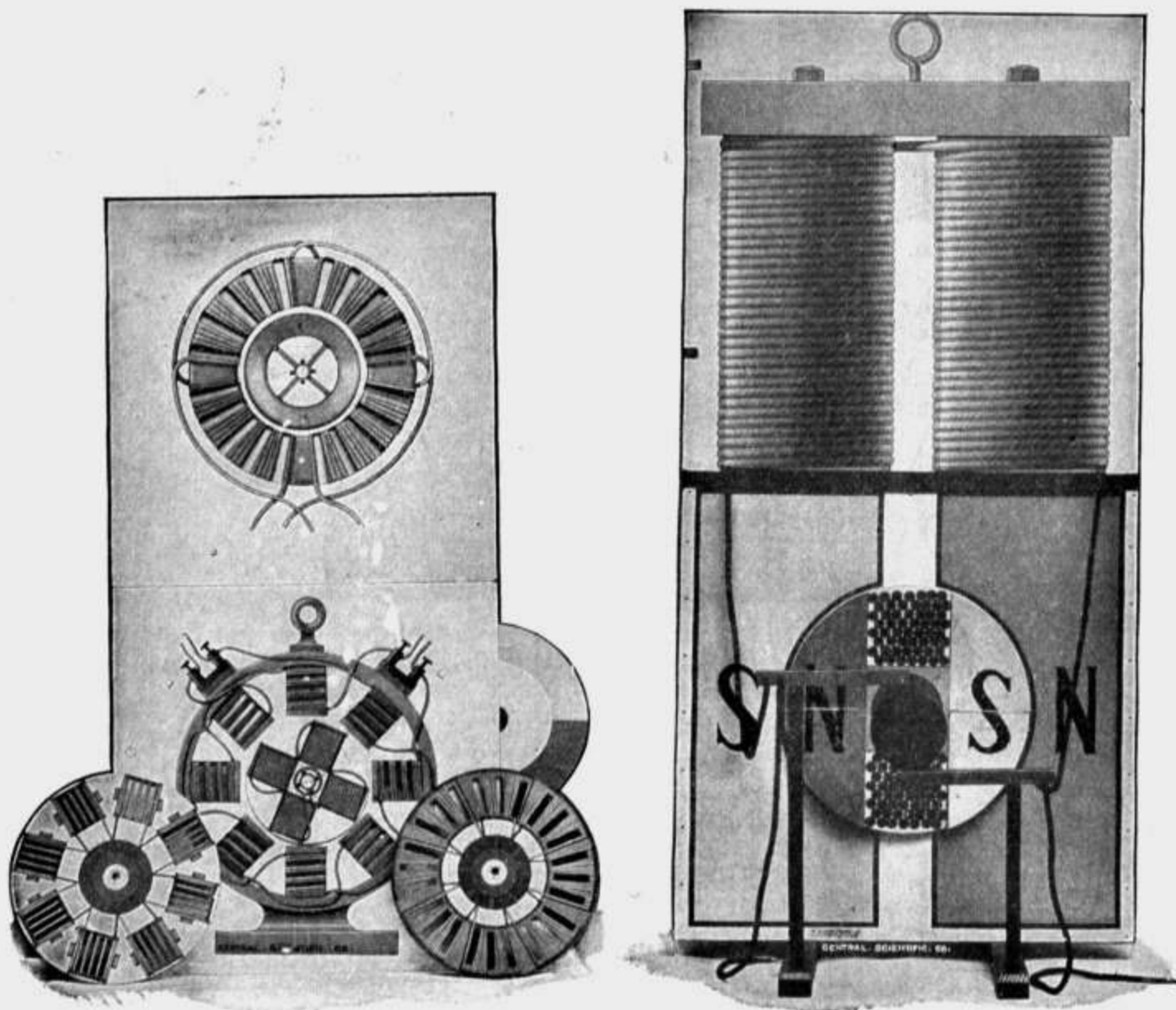


No. 2803.



No. 2804.

- |       |   |     |
|-------|---|-----|
| 2800. | Connector Tip, for use in making connections with American binding posts; may also be used with English binding posts in conjunction with No. 2802..... | .07 |
| 2801. | Connector Tip, Universal, for use in connecting to either English or American binding posts. Very convenient. To be soldered to cord .....              | .05 |
| 2802. | Binding Post Attachment, for use with Nos. 2800 or 2803 connectors in making single or two-way connections. Will fit any English binding posts .....    | .13 |
| 2803. | Connector, consists of two No. 2800 connector tips attached to 3 feet flexible silk cord.....   | .22 |
| 2804. | Connector, consists of two No. 2801 connector tips soldered to ends of 3 feet flexible silk cord.....   | .17 |
| 2805. | Staples, Wire, square top, 3/8-inch, for bell wiring. In 4-oz. packages; per package .....  | .10 |
| 2807. | Insulating Tape, cloth base, 3/4 inch wide, black, best quality; will not dry out. Per quarter pound roll.....  | .28 |
- For Wire of all kinds, see Nos. 6101ff.  
For Batteries, see pages 156 to 163.



No. 2821.

**2821. Electro-Dynamic Charts.** These charts, finely lithographed in eight colors and mounted on heavy cardboard, are used to demonstrate the principles of the electric generator and motor and the 3 phase current machine.

The charts are 28x30 inches, and can easily be seen across the largest lecture room. The complex mechanism of the dynamo, motor and alternating current are more clearly shown by means of these charts than is possible by any other means. The different windings, connections and armatures are all plainly indicated. The charts can be mounted on a frame, as shown in the above illustration, and the armature revolved by means of a crank, operated from the rear. The change of poles in the armature is automatically shown by different colors, red for the north pole and blue for the south pole, which change as the armature is revolved. The set includes 8 charts, as follows:

Magneto-Electric Machine, 2 pole armature, direct current.

Magneto-Electric Machine, 2 pole armature, alternating current.

Dynamo, 2 pole armature.

Dynamo, Gramme ring.

Motor, Gramme ring.

Motor, 2 pole armature, direct current.

Alternating Current Generator (2 phase).

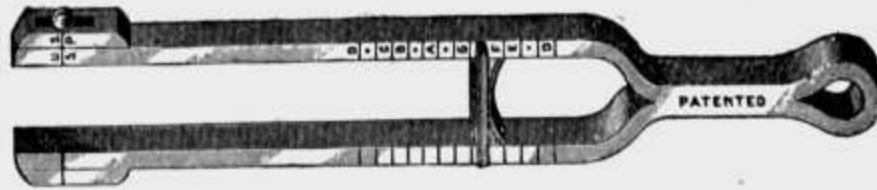
Alternating Current Motor (3 phase).

Commutator, connecting cords, cranks, brushes and frame, complete. . . \$ 12.50

**Alternating Current Apparatus, page 167.**

**A. C. Motors, page 179.**

# SOUND



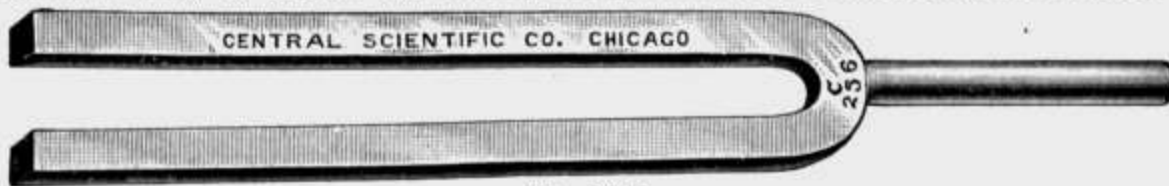
No. 3001.

3001. Tuning Fork, adjustable..... \$ 1.10



No. 3003.

3003. Tuning Fork, A, about 4 $\frac{7}{8}$  inches long..... .13  
 3004. Tuning Fork, C, about 4 $\frac{7}{8}$  inches long..... .13

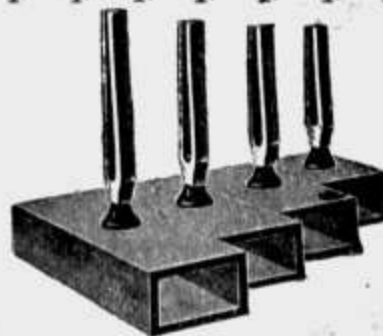


No. 3012.

Tuning Forks, unmounted, physical pitch.

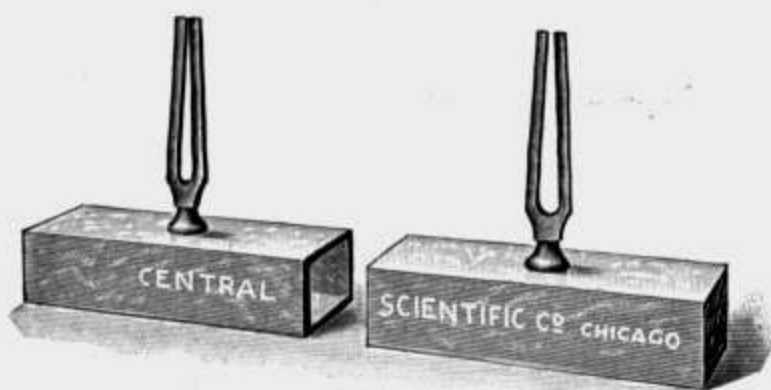
Catalog No. . .	3011	3012	3013	3014	3015	3016	3017	3018	3019
Letter .....	C	C <sub>1</sub>	D <sub>1</sub>	E <sub>1</sub>	F <sub>1</sub>	G <sub>1</sub>	A <sub>1</sub>	B <sub>1</sub>	C <sub>2</sub>
Vibrations P. S.	128	256	288	320	341 $\frac{1}{3}$	384	426 $\frac{2}{3}$	480	512
Length, inches.	10	7 $\frac{1}{4}$	7	6 $\frac{7}{8}$	6 $\frac{3}{4}$	6 $\frac{1}{2}$	6 $\frac{1}{4}$	6	5 $\frac{7}{8}$
Price .....	2.00	1.10	1.00	1.00	.80	.80	.70	.70	.70

3019A. Stylus, bristle, for tracing vibrations, with special wax for attaching to any of the above forks..... .22  
 3020. Tuning Forks, set of 4, C<sub>1</sub>, E<sub>1</sub>, G<sub>1</sub>, C<sub>2</sub>, giving major chord..... 3.60  
 3020A. Tuning Forks, set of 8, C<sub>1</sub>, D<sub>1</sub>, E<sub>1</sub>, F<sub>1</sub>, G<sub>1</sub>, A<sub>1</sub>, B<sub>1</sub>, C<sub>2</sub>, giving full octave 6.80



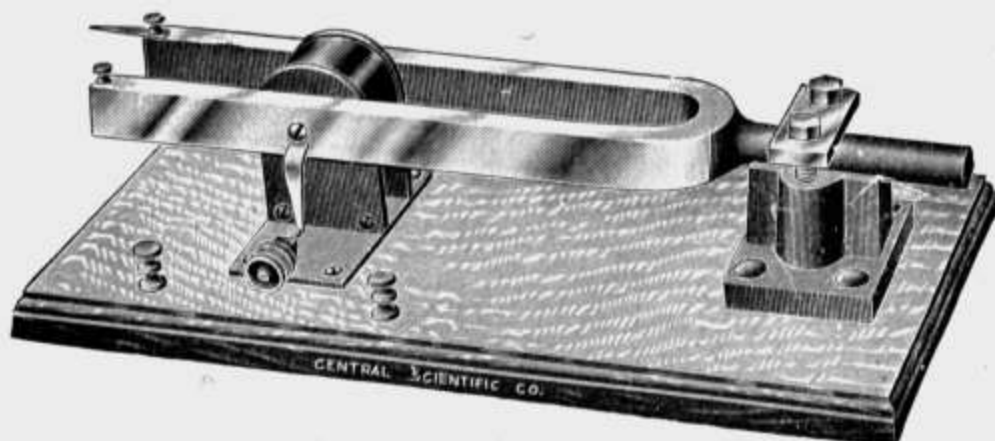
No. 3025.

3021. Tuning Fork, No. 3012 C<sub>1</sub> Fork, mounted on a resonant case; with hammer ..... 3.00  
 3022. Tuning Fork, No. 3014 E<sub>1</sub> Fork, mounted on resonant case; with hammer ..... 3.00  
 3023. Tuning Fork, No. 3016 G<sub>1</sub> Fork, mounted on resonant case; with hammer ..... 2.90  
 3024. Tuning Fork, No. 3019 C<sub>2</sub> Fork, mounted on resonant case; with hammer ..... 2.65  
 3025. Tuning Forks, set of 4, Nos. 3021 to 3024, giving full major chord..... 11.55  
 3027. Tuning Forks, Standard, physical pitch, set of 8, giving the diatonic scale from C=256 to C=512 v. p. s. Mounted on resonance boxes .....Duty free 51.00  
 3028. Tuning Fork, C<sub>-3</sub>= 16 vibrations.....Duty free 4.00  
 3028A. Tuning Fork, C<sub>-2</sub>= 32 vibrations.....Duty free 4.00  
 3029. Tuning Fork, C<sub>-1</sub>= 64 vibrations, extra heavy, 18 in. long. Duty free 4.75  
 3029A. Tuning Fork, C = 128 vibrations, extra heavy, 14 in. long. Duty free 4.00  
 3029B. Tuning Fork, C<sub>1</sub>= 256 vibrations, extra heavy, 11 in. long. Duty free 3.50  
 3029C. Tuning Fork, C<sub>2</sub>= 512 vibrations, extra heavy, 9 in. long. Duty free 3.00  
 3029D. Tuning Fork, C<sub>3</sub>=1024 vibrations, extra heavy, 7 in. long. Duty free 2.25  
 3029E. Tuning Fork, C<sub>4</sub>=2048 vibrations, extra heavy, 6 in. long. Duty free 2.00  
 3029F. Tuning Fork, C<sub>5</sub>=4096 vibrations, extra heavy, 5 in. long. Duty free 1.75



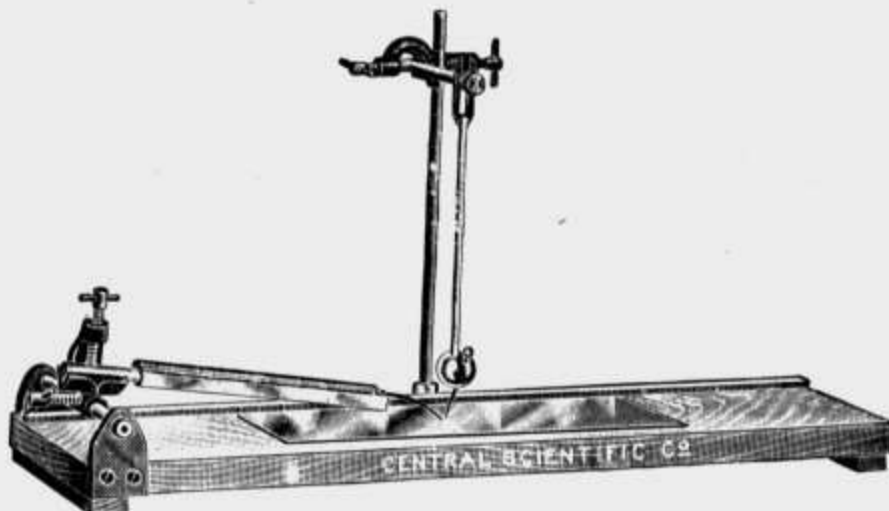
No. 3030.

3030. **Sympathetic Forks.** A pair of extra heavy forks of polished steel, mounted on resonant cases and tuned in unison so that either fork will respond to vibrations set up in the other. Complete, with large rubber hammer..... \$ 11.00
3031. **Sympathetic Forks.** An extra heavy pair of the finest made tuning forks especially forged for sympathetic work, mounted on resonant cases. Either fork will respond to vibrations set up in the other at a distance of 15 meters. Complete with large rubber hammer .....Duty free 11.00
3033. **Rubber Hammer, small, with flexible handle.....** .10
- 3033A. **Rubber Hammer, large, for heavy forks, with flexible handle.....** .17
3034. **Sound Interference Apparatus.** See Catalog K.....Duty free 27.00
3035. **Apparatus for Lissajous' Figures.** See Catalog K.....Duty free 72.00



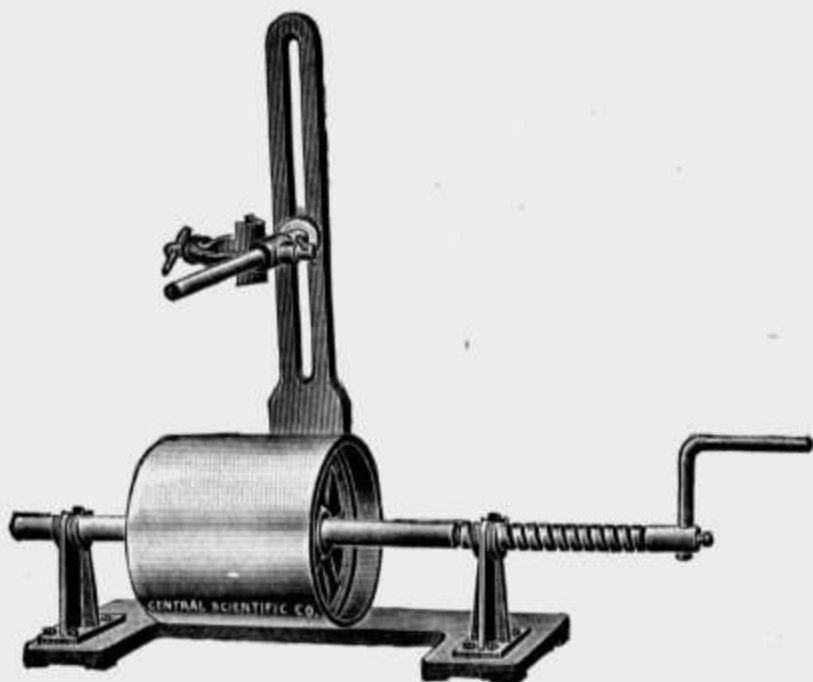
No. 3036.

3036. **Tuning Fork, electrically maintained.** The fork is adjustably mounted on a heavy, polished, hardwood base. Prongs measure  $\frac{1}{2} \times 1$  inch, are 12 inches long and nickel plated. Each prong is provided with binding screws for attaching cords, and a steel stylus is included. The prongs are also tapped on the end to receive mirrors. This apparatus will be found invaluable for many experiments, especially for the projection of Lissajous' curves, Melde's method of studying waves in stretched strings and other phenomena due to sound vibration ..... 13.35
- 3036A. **Mirrors.** A pair of  $\frac{1}{2}$ -inch plane mirrors mounted in a light brass spinning, threaded to fit No. 3036 Fork, for Lissajous' experiments. 2.25
3037. **Tuning Fork, electrically maintained.** See Catalog K.....Duty free 16.50
- 3037A. **Tuning Fork, electrically maintained.** See Catalog K.....Duty free 16.50
3038. **Tuning Fork, electrically maintained.** See Catalog K.....Duty free 29.50
- 3038A. **Tuning Fork, electrically maintained.** See Catalog K.....Duty free 29.50
3039. **Vibrograph, 3039A and B. Coated Paper, page 494.**

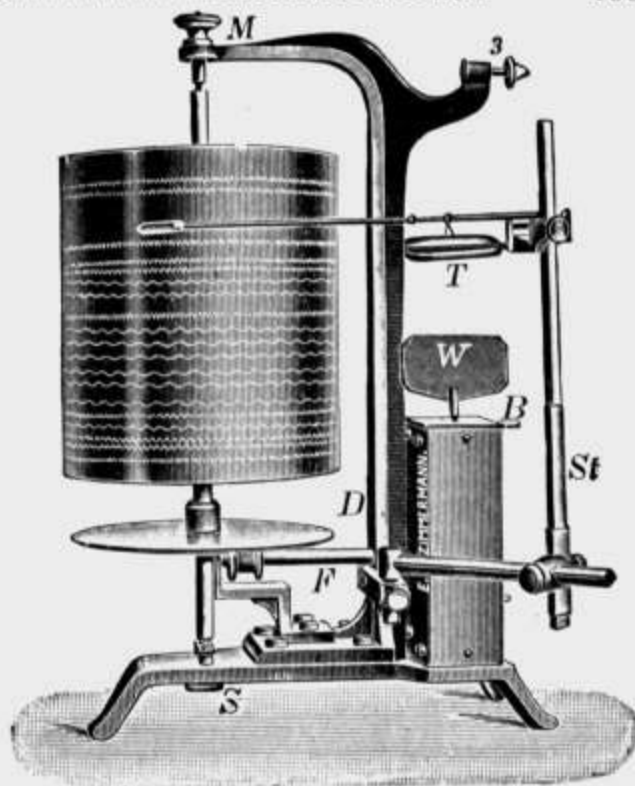


No. 3040.

3040. **Vibrograph.** For determining the number of vibrations per second of a Tuning Fork. Consists of a wood base 6x24 inches with support rod carrying an adjustable pendulum provided with needle stylus. At one end is a clamp for a tuning fork whose position may be varied from one side of the board to the other. A glass plate 4½x12 inches, which slides against a guide on the base, is provided. Without Tuning Fork..... \$ 3.60
3041. **Tuning Fork,** steel, especially designed for the Vibrograph, of low pitch and large amplitude of vibration. With stylus..... 1.35
3042. **Extra Glass Plates** for use with No. 3040.....Each .06

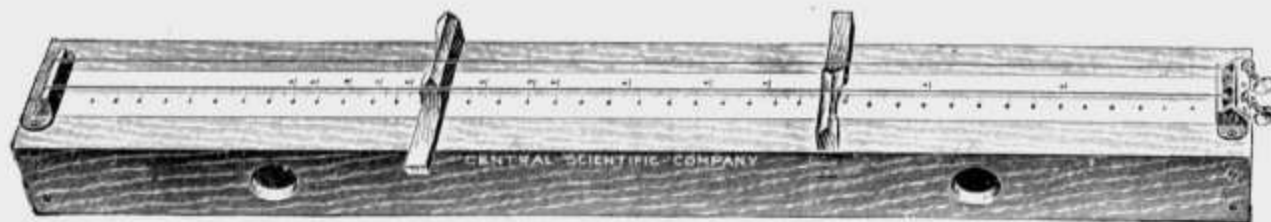


No. 3043.



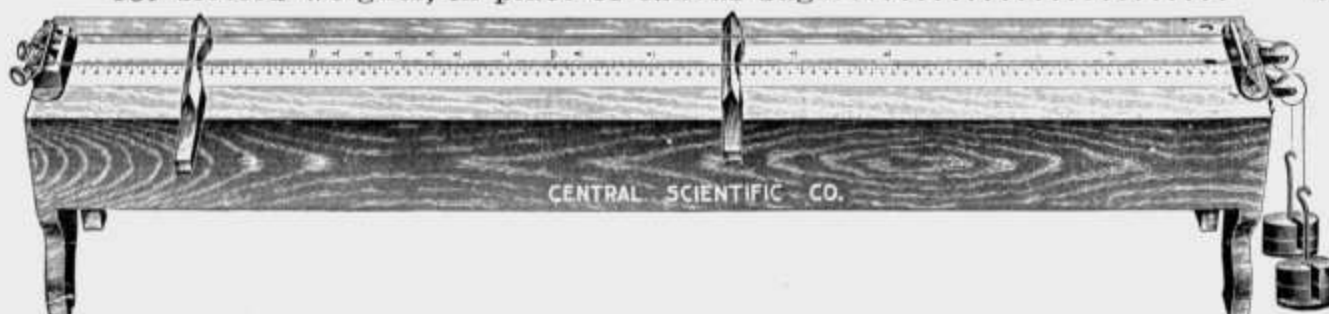
No. 3044.

3043. **Recording Drum,** for recording vibrations of tuning forks. An accurately turned brass cylinder is mounted on a shaft provided with a thread of one centimeter pitch, thus giving a lateral movement of one centimeter for each revolution of the drum. This is mounted on a japanned iron base from which extends a vertical support carrying an adjustable rod for holding tuning fork and time marker. Occupies a minimum of table space..... 22.25
- 3043A. **Paper,** glazed and gummed, for use with No. 3043 Recording Drum. Size, 10 inches by 19 inches.....Per 100 sheets 1.50
- 3043B. **Paper,** glazed and gummed, for use with No. 3044 Kymograph. Size, about 7 inches by 19 inches.....Per 100 sheets 1.25
3044. **Laboratory Kymograph,** clock work driven; drum 18 cm. long. For horizontal or vertical use. Speed, ½ mm. to 40 mm. per sec. (See Catalog K.) Without attachments.....Duty free 30.00
- 3044A. **Laboratory Kymograph.** Like No. 3044, but for motor drive. Duty free 21.00  
For Accessories for No. 3044 and No. 3044A, see Catalog K.  
For Time Marker for use with any of the above, see No. 778.
3045. **Helmholtz' Resonators.** See Catalog K for description.....Duty free 30.00



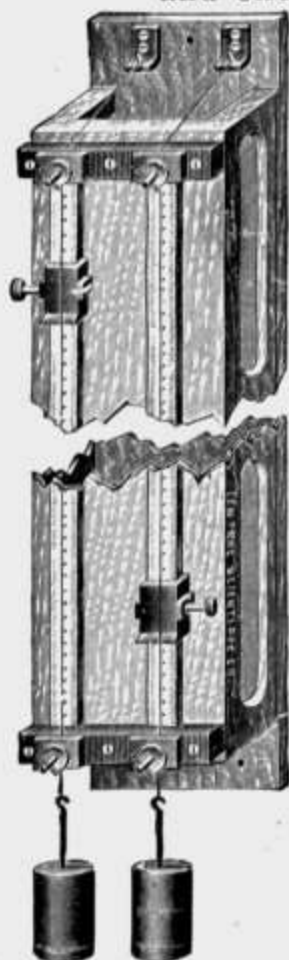
No. 3052.

3052. **Sonometer**, for illustrating laws of vibrating strings. Consists of a resonant case with millimeter scale one meter long, on which is indicated also the lengths of string necessary to give both the Diatonic Scale and the Equally Tempered Scale between  $C=256$  v. p. s. and  $C=1024$  v. p. s. Provided with two tension keys, two bridges and one No. 3061 set of four wires..... \$ 4.45
3053. **Sonometer**. Same as No. 3052, but fitted with pulleys instead of tension keys and provided with stout canvas bags for holding weights 5.00
3054. **Sonometer**. Same as No. 3053, but with two No. 3062 Weight Hangers for slotted weights, in place of canvas bags..... 6.00



No. 3055.

3055. **Sonometer**, with large resonant case made of the best kiln dried birch with a spruce sounding board, and mounted on legs. Has a millimeter scale one meter long on which is indicated also the lengths of string necessary to give both the Diatonic Scale and the Equally Tempered Scale between  $C=256$  v. p. s. and  $C=1024$  v. p. s. Provided with two tension keys at one end and two pulleys at the other, two bridges so shaped that the exact position of the bridge may be noted on the scale, one No. 3061 set of four wires, two No. 3062 Weight Hangers, two No. 3063-2K Weights and one No. 3063-5K Weight..... 13.35



No. 3056.

3056. **Sonometer, Vertical Wall Form**. This sonometer is TWO METERS long and fastened to the wall by means of two brackets. The deadening effect of the wall is prevented by means of rubber pads. The case is made of the best quality of seasoned wood, well finished. The bridges are in the form of clamps which may be fastened at any point of the scale. The tension of the wires is effected by means of weights attached to the lower end. This tension may be held by means of screw clamps.

The advantages of this instrument over the horizontal forms are:

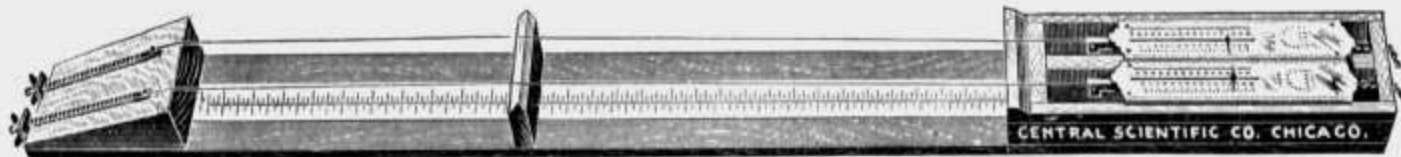
- First: It can be used for demonstration.
- Second: The pull or tension is supplied direct, hence no loss through friction.
- Third: The greater length allows a greater range.

Fourth: It is out of the way at all times.

Complete with two wires, two bridges, but without weight hangers or weights

20.00

For Hangers and Weights, see next page.



No. 3057.

3057. **Sonometer.** Consists of a heavy wooden frame supporting two No. 3873 Spring Balances by which the tension is measured. The balances are firmly clamped at one end, and tension is secured on the wire by a screw device which displaces the old style of tension keys. Provided with same scale as No. 3052, No. 3061 set of four wires, and two bridges of special shape..... \$ 8.35



Nos. 3062-3063.



No. 3065.



No. 3067.

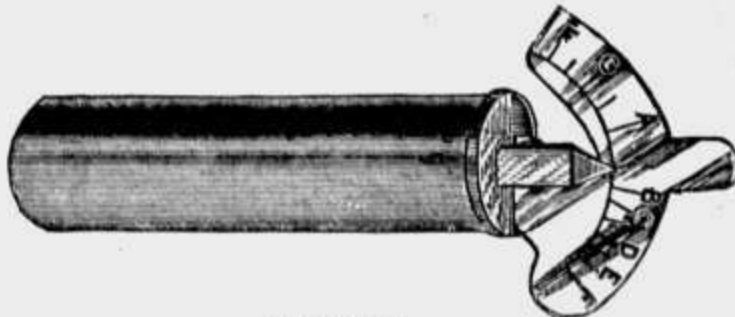
3061. **Sonometer Wires.** Set of four wires, 45 inches long, with loops, including two piano wires 0.014 inches in diameter, one piano wire 0.028 inches in diameter, one brass wire 0.028 inches in diameter.. .20
6125. **Music Wire on Spools.**
- |                             |     |     |     |     |     |     |     |     |     |     |
|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Music gauge No.....         | 00  | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   |
| Approximate feet on spool.. | 15  | 15  | 14  | 12  | 12  | 12  | 10  | 10  | 8   | 8   |
| Per spool .....             | .06 | .06 | .06 | .06 | .06 | .06 | .06 | .06 | .06 | .06 |
- For other Wire, see Nos. 6101ff.
3062. **Weight Hanger,** to be used with Sonometers for carrying slotted weights. Made of iron with hook. Weighs one kilogram, and will hold 20 kg. of No. 3063 Weights..... .55
3063. **Weights,** of iron, with slot for No. 3062 Weight Hangers.
- |                         |     |     |     |      |
|-------------------------|-----|-----|-----|------|
| Weight, kilograms ..... | 1/2 | 1   | 2   | 5    |
| Each .....              | .45 | .55 | .75 | 1.65 |
3065. **Violin Bow,** for light work..... .66
3066. **Violoncello Bow,** for general work except the heaviest..... .77
3067. **Double Bass Bow,** for heaviest work..... 1.35



No. 3070.



No. 3068.

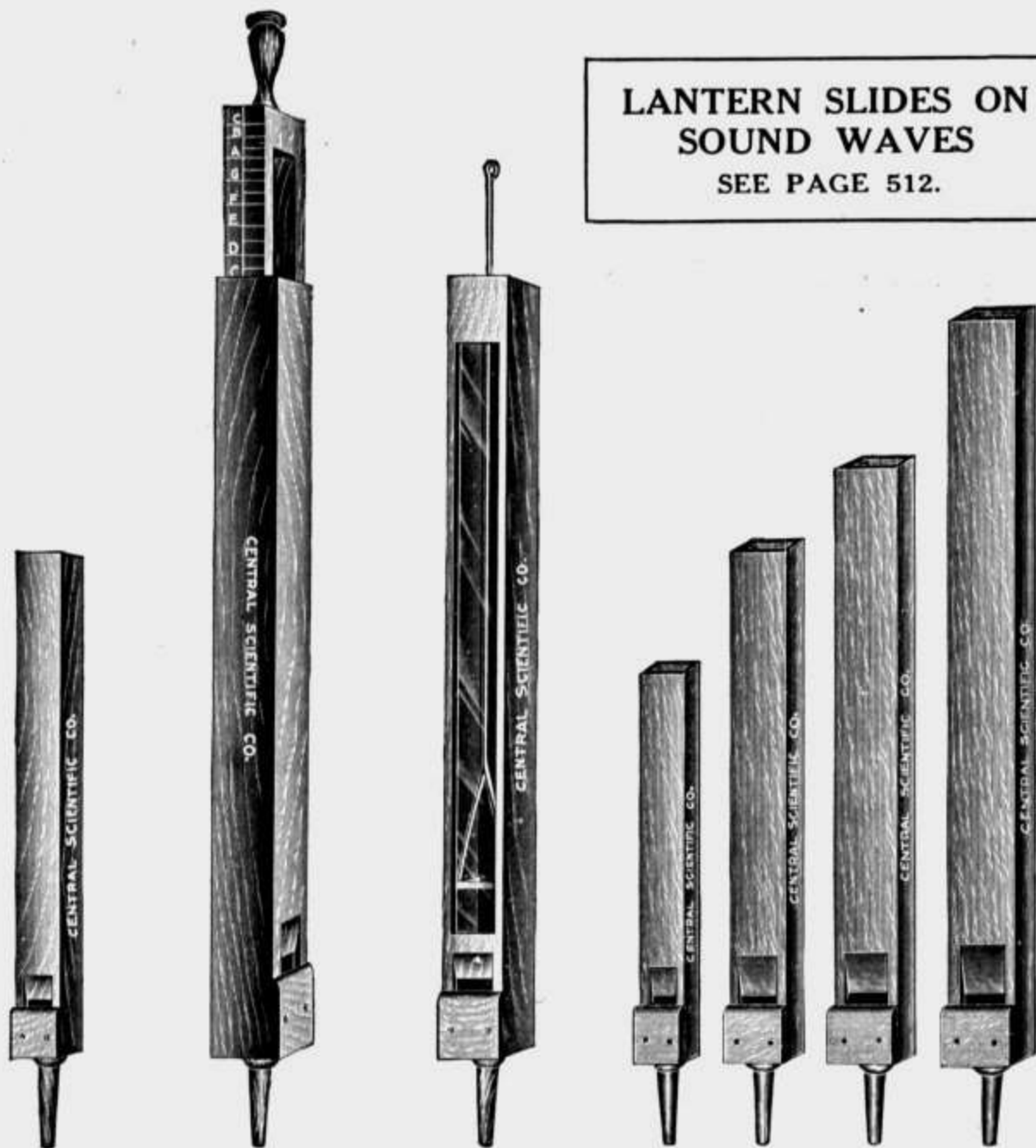


No. 3072.

3068. **Rosin, French,** best quality, for use on bows and rods..... .06
3070. **Pitch Pipe,** keys of A & C combined, in metal box..... .11
3071. **Pitch Pipe,** keys of C & G combined, in metal box..... .11
3072. **Pitch Pipe, Chromatic,** with sliding rod, giving octave..... .89



**LANTERN SLIDES ON  
SOUND WAVES**  
 SEE PAGE 512.



- |   |  |   |
|---|--|---|
| <p>No. 3081.</p> <p>3081. Organ Pipe, plain, of wood.....</p> <p>3082. Organ Pipe, with sliding piston, sounding two octaves, with tones and semi-tones marked on the piston.....</p> <p>3083. Organ Pipe, one side of glass, with membrane on sliding frame.....</p> <p>3084. Organ Pipes, set of four open pipes, sounding chord C<sub>1</sub>, E<sub>1</sub>, G<sub>1</sub>, and C<sub>2</sub>...</p> <p>3085. Organ Pipes, set of eight open pipes, sounding the octave C<sub>1</sub> to C<sub>2</sub>...</p> | <p>No. 3082.</p> <p>No. 3083.</p> <p>No. 3084.</p> | <p>\$ 1.00</p> <p>4.45</p> <p>3.35</p> <p>8.00</p> <p>15.00</p> |
|---|--|---|



- |  |  |                        |
|--|--|------------------------|
| <p>No. 3089.</p> <p>3089. Tube, with cone, for illustrating wave motion in air, 10 feet long, in 6 sections, without support.....</p> <p>3089A. Pair of Supports for No. 3089.....</p> <p>3092. Sensitive Flame. Burner 6 inches high with opening of very small diameter, provided with an adjustable wire gauze. When gas is lighted above this gauze and the flow of gas and height of gauze adjusted to the gas pressure, a very sensitive flame is obtained.....</p> <p>3093. Singing Flame or Hydrogen Tones (Philosopher's Lamp). Set of 3 glass tubes of varying lengths and diameters, complete with hydrogen jet of glass.....</p> | <p>1.30</p> <p>1.10</p> <p>No. 3092.</p> | <p>1.50</p> <p>.80</p> |
|--|--|------------------------|

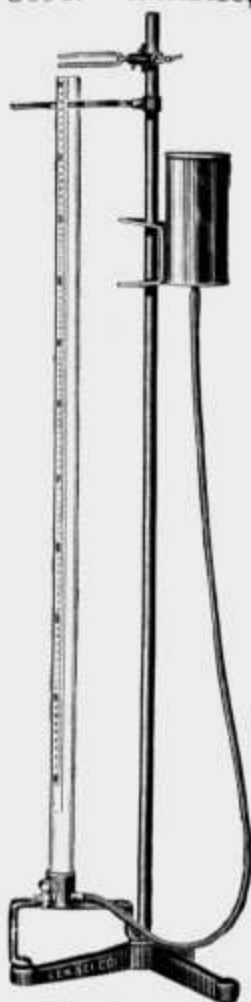


No. 3095.



No. 3096.

3095. **Acoustic Tubes, Quincke's.** Set of seven, illustrating the effects of different diameters and lengths of tube upon pitch. With two of the tubes interference may be shown. . . . . \$ 1.25
3096. **Whistle, of glass, 10 in. long, with sliding piston and glass mouthpiece** . . . . . .90



No. 3097.



No. 3099.



No. 3100.

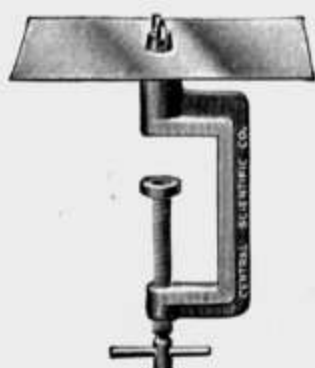
3097. **Resonance Tube, improved design.** A glass tube more than one meter long, provided with a millimeter scale, is sealed into a brass cup at the bottom, and mounted on a substantial support. To the rod of this support is attached, by a clamp which permits of rapid adjustment, a brass supply tank, which is connected with the bottom of the glass tube by a rubber hose. A tuning fork clamp is provided and the glass tube is adjustable so that tuning forks of lengths up to 10 inches may be used. The water may rapidly be emptied from tube and tank by means of a stop cock. Without tuning fork. . . . . 10.00
3099. **Resonance Tube, simple form with support and piston.** Tube 4 feet long . . . . . 2.00
- 3099A. **Glass Tubes, with annealed ends, for use in resonance experiments.**
- |                |           |          |           |
|----------------|-----------|----------|-----------|
| Size . . . . . | 3x120 cm. | 4x45 cm. | 4x110 cm. |
| Each . . . . . | .75       | .45      | 1.00      |
- For other sizes, see No. 4982A.
3100. **Resonance Tube.** This design combines the features of existing forms with the addition of durability. It consists of an upright metal tube 56 inches high, supported on a heavy tripod; at the lower end of this tube is a tube which serves as both inlet and outlet tube. A glass tube connected to this tube serves as an indicator of the height of water in the Resonance Tube. The inlet tube is provided with stop cock for regulating the height of the water. . . . . 6.50
- For **Resonance Tube**, simple form, see No. 1022.  
 For **Resonance Jars**, use No. 1127 Hydrometer Jars.  
 For **Pendulums** to illustrate resonance, see No. 790.  
 For **Wilberforce Spring** to illustrate resonance, see No. 794A, Catalog K.

3101. **Rods**, for longitudinal vibrations. Consists of set of three—steel, pine and hardwood—each 100 cm. long, 10 mm. in diameter. Per set.... \$ 0.50

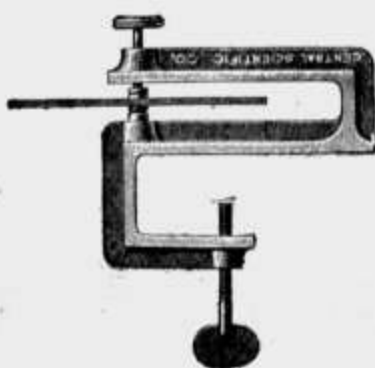


No. 3103.

3103. **Kundt's Apparatus**, for determining velocity of longitudinal vibrations in brass. Consists of a resonant tube on support, with piston to vary length of vibrating column of air, brass rod and vise for clamping the rod..... 3.65
3104. **Kundt's Apparatus**. See Catalog K for description.....Duty free 12.00



No. 3105.



No. 3107.



No. 3114.

3105. **Chladni's Plate Apparatus**, for showing position of nodes and anti-nodes in a vibrating body. Fine white sand or lycopodium powder sprinkled over plate will arrange itself in peculiar figures, sand or powder massing itself at nodes when the plate is bowed. Apparatus consists of one each round and square plate of brass 6 inches in diameter, with table clamp..... 1.45
3106. **Clamp**. Clamp only of No. 3105, for use with metal Chladni's plates, which are provided with a center hole from  $\frac{1}{8}$  to  $\frac{5}{8}$  inch in diameter. Clamp attaches to table top  $2\frac{7}{8}$  in. thick or less..... .78
3107. **Clamp**, a substantial plate holder for glass or metal plates up to 12 inches in diameter. Can be securely clamped to table top  $2\frac{1}{8}$  in. thick or less..... 2.00
3109. **Chladni's Plates**, set of five glass plates of different diameters and shapes, without center holes, to be used with No. 3107 Clamp..... .80
3112. **Chladni's Plate**, of brass, 10 inches in diameter, for use with No. 3106 or No. 3107 Clamp..... 1.35
3114. **Chladni's Plate**, of brass, 10 inches square, for use with No. 3106 or No. 3107 Clamp ..... 1.35
3115. **Vibration Plates**. See Catalog K for description....Duty free 34.00 to 55.00
- 3115A. **Vibration Plates**. See Catalog K for description.....Duty free 75.00
- 3115B. **"Harmonic Vibrations."** A complete treatise on the various phenomena of acoustic vibrations and the experiments for demonstrating the same.....Net 2.25
3116. **Lycopodium Powder**. For use with Kundt's tubes and Chladni's plates. This powder usually must be dried before using to give best results. Per 4-ounce carton..... .45
3117. **Sand**. Best quality fine sand carefully sifted. For use on Chladni's plates. Per 8-ounce carton..... .22



No. 3120.

3120. **Trevelyan's Rocker**, consisting of a lead ring of special shape and grooved brass rocker, with rod and counterbalance. When the rocker is heated and placed upon the lead ring, as shown above, it will vibrate rapidly and produce a musical tone..... 2.00



No. 3126.

3126. **Xylophone**, twelve bars of steel, sounding one and one-half octaves, mounted and labeled. Complete with wooden hammers..... \$ 2.50
3127. **Xylophone**, eight pieces of wood, sounding the octave. Wooden pieces rest on cords. Complete with wooden hammer..... 1.10



No. 3128.

3128. **Gamut Bells**. These bells are twenty-five in number. Made of the finest tool steel and tuned true, giving two chromatic octaves, from and including A below middle C, to the first A above treble staff. The tones are pure, clear and mellow. Especially intended for teachers in demonstrating the exact sound belonging to each letter or note in the chromatic scale. A large number are in use in the Chicago schools. Complete with two rubber hammers..... 11.00



No. 3129.

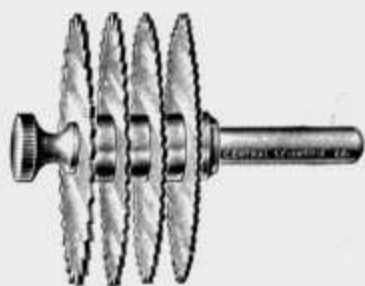
3129. **Galton's Whistle**, for measurement of the highest audible note. The graduations indicate the length of the column of air vibrating in the whistle for the different positions of the piston in  $\frac{1}{10}$  mm..... 8.90
3130. **Galton's Whistle**. See Catalog K for description .....Duty free 16.65
3131. **Attachment** for No. 3130. See Catalog K for description .....Duty free 3.35
3139. **Siren, Cagniard-Latour's**. Simple form, without indicators, for the determination of the number of vibrations per second for any pitch. Consists of a wheel on a vertical spindle, which revolves over the head of the cylinder, both pierced with diagonal holes. The current of air causes the wheel to revolve, thus opening and closing the air exits, and producing a musical tone (vibration in the air) which rises in pitch as the rate of revolution increases. Made of brass and nicely finished.....Duty free 8.00
3140. **Siren, Cagniard-Latour's**, same as No. 3139, but furnished with dials, by which the number of vibrations is determined.....Duty free 13.00



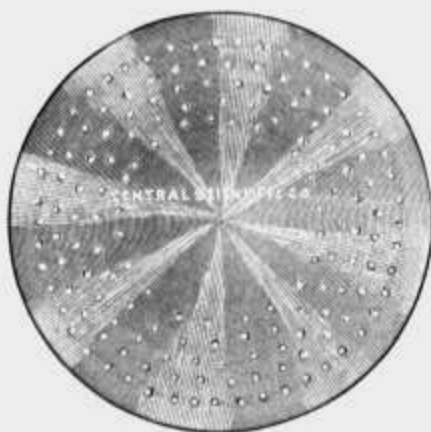
No. 3140.

## ROTATOR ACCESSORIES.

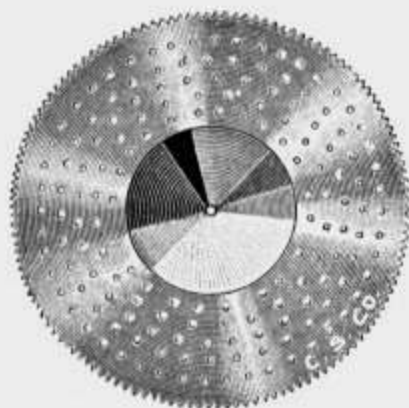
For Rotators, see Nos. 829 to 841.



No. 869.



No. 879.



No. 881.

869. **Savart's Toothed Wheels.** Four brass wheels on same axle, so that the speed is uniform for each wheel. When they are rotated rapidly, a card held to the teeth will sound the octave..... \$ 2.65
871. **Savart's Toothed Wheel,** a single wheel, 3 inches in diameter. Will sound single note if used as above..... .55
877. **Siren Disc,** of metal, diameter 8 inches, one row of holes..... .55
879. **Siren Disc,** of metal, diameter 10 inches, with five rows of holes, the first four giving the chord do, me, sol, do. To operate, hold the corner of a card on a row of holes in succession or blow strongly on the holes through a tube with bore slightly smaller than the holes. (See No. 883 Attachment.) The fifth row of holes is unevenly spaced and does not emit a musical tone, but a "noise"..... 1.10
881. **Combined Acoustic and Color Disc,** 10 inches in diameter, combining a Siren, Savart's Wheel and a Newton's Color Disc. The disc is made of heavy metal, which prevents its vibration when being rotated ..... 1.50
883. **Attachment,** for use with the Siren Disc for sounding any one note or four notes at the same time. Metal air tips, flexible hose and mouthpieces. Clamps to No. 837 or No. 839 Rotator..... 2.75

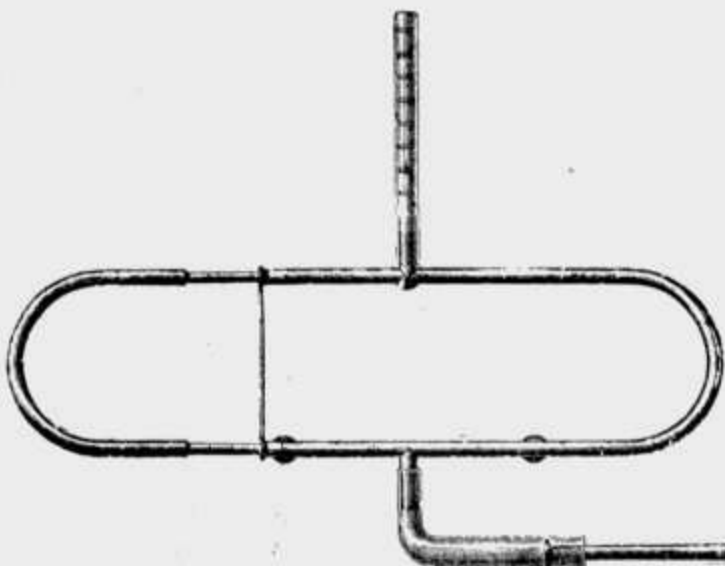


No. 3145.

3145. **Doppler's Principle Apparatus.** A reed is mounted on the end of a rod which is arranged to attach to a rotator. This reed seems to give forth notes of different pitch when coming towards and moving from the observer..... 3.00
5149. **Acoustical Chart.** A reproduction of the piano keyboard, showing the relation between the Orchestra, Philharmonic, International and Physical Pitch..... .22



No. 3153.



No. 3154.

3153. **Interference Tube**, after Prof. Quincke. Of glass, with rubber connections for varying the length of the arms. If the lengths of the two arms are the same there will be no interference. If not, there will be discord. By manipulation a number of interesting phenomena may be shown..... \$ 0.90
3154. **Interference Tube**, after Kundt. This instrument consists of two telescoping brass tubes with one glass tube for formation of Kundt's Dust Figures and a second glass tube for receiving one end of the vibrating rod of Kundt's Dust Figure Apparatus. The lengths of the two paths by which the sound reaches the Dust Figure Tube may be varied by pulling out the inner of the two telescoping tubes and it will be found that at certain positions, when one path is an odd number of wave lengths longer than the other, interference will result and no evidence of sound will be visible in the Dust Figure Tube. Complete as described, with vibrating rod and clamp .....Duty free 15.00



No. 3155.



No. 3160.



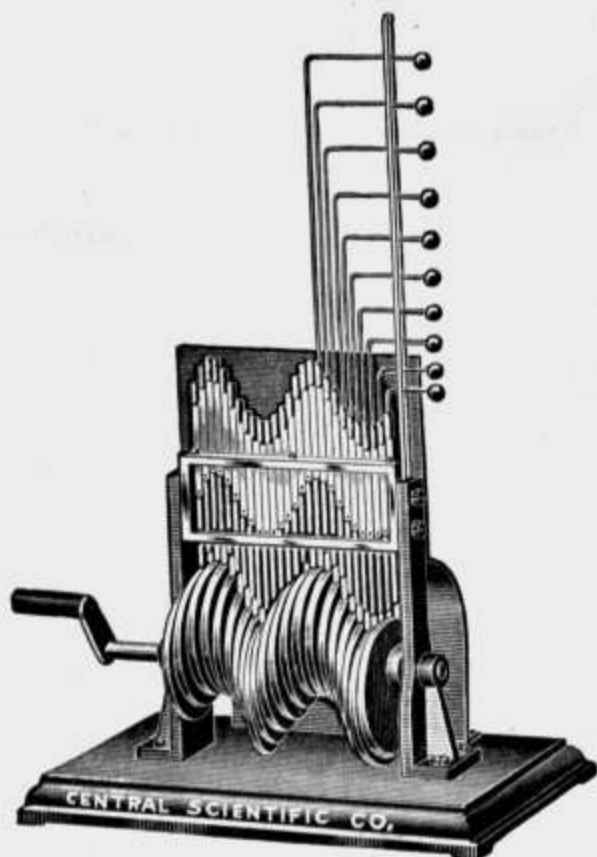
No. 3165.

3155. **Oscillograph**. Will produce Lissajous' figures, the only accessory being a beam of direct sunlight. A mirror mounted on a sensitive diaphragm is made to vibrate by talking or singing. Any word, letter or note produces a definite figure..... .45
3160. **Sound Lens**, a rubber lens 15 inches in diameter. When inflated and filled with carbon dioxide gas, shows refraction of sound. Neatly mounted on iron stand..... 10.00
3162. **Sound Reflectors**. See Catalog K for description..... 13.90
3165. **Manometric Flame Apparatus**, for the analysis of sound waves. Consists of No. 897 Cubical Mirror and No. 899 Vibrator. May be used with any Rotator..... 6.10

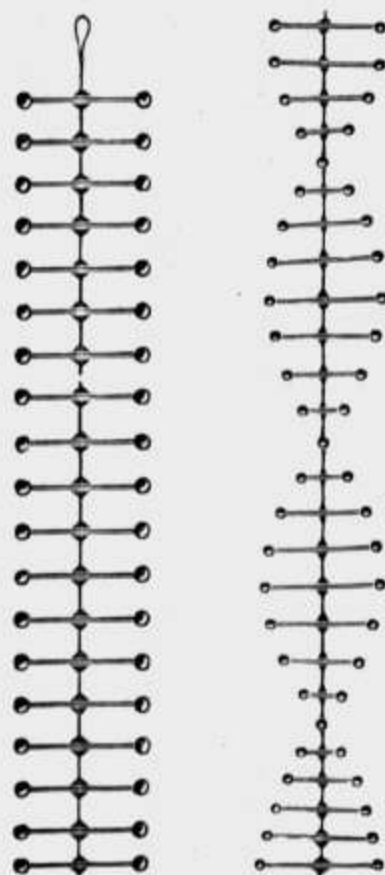


No. 3170.

- 3170. **Spiral of Brass Wire.** A helix of spring brass wire, 175 centimeters long, unstretched, for illustrating progressive wave motion..... \$ 1.10
- 3171. **Rubber Cord,** three meters long, for showing wave motion..... .66

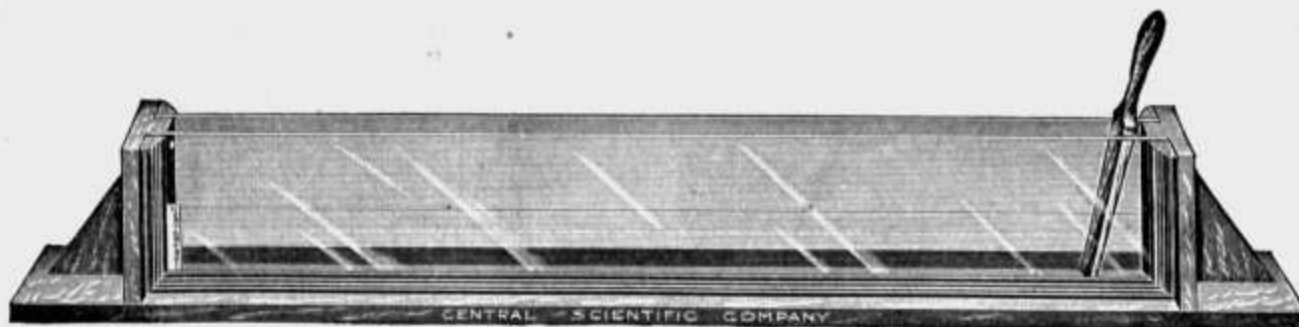


No. 3175.



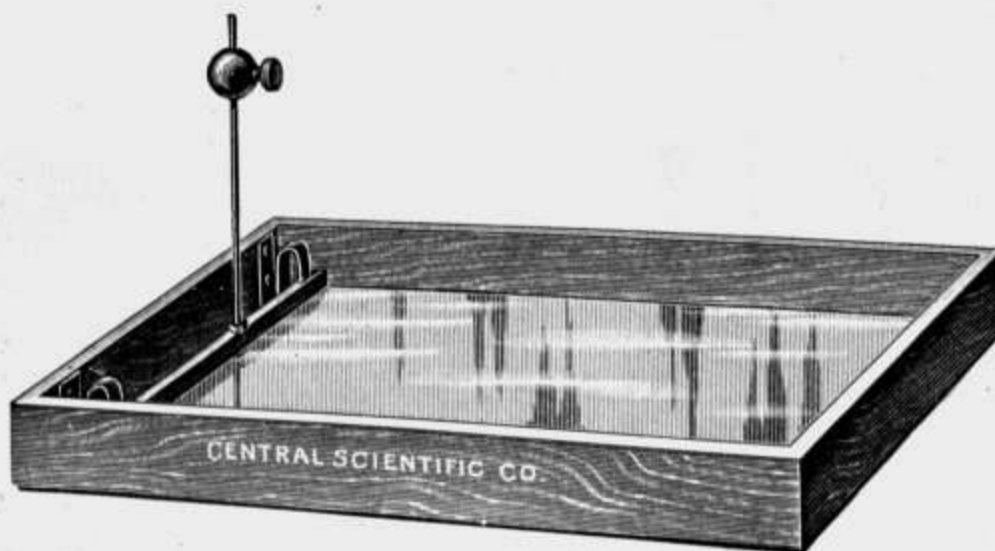
No. 3176.

- 3175. **Wave Apparatus,** for the study of transverse and longitudinal waves. A model made entirely of metal. A set of metal rods rests on a series of metal discs so arranged eccentrically on a shaft that the top of the rods gives a sine curve, and as the shaft is revolved, the progress of the wave is easily seen. As shown in the illustration, some of the metal rods are provided with an extension with knob on the end so that longitudinal as well as transverse wave forms can be studied. The two forms of waves may readily be compared, for both are in view at the same time. In the center of each of the metal rods a hole is drilled so that the wave forms may conveniently be shown on a screen by means of a projection lantern ..... 20.00
- 3176. **Wave Apparatus,** after Ames and Bliss. This model illustrates the propagation of both transverse and longitudinal waves. It consists of a spring steel strip fourteen feet long, to which are attached at regular intervals metal rods carrying balls at each end. Provided with rings for suspension. When one end of the strip is attached to a hook in the ceiling and the lower cross-bar twisted out of place, this displacement travels from bar to bar throughout the entire length of the apparatus and illustrates very clearly the propagation of a transverse wave. At the top the wave is reflected and on reaching the bottom it is again reflected so that the difference between the reflection at the boundary of a more dense medium and that at the boundary of a less dense medium may be studied. A longitudinal wave may be started by depressing in a vertical direction one end of the lowest cross-bar..... 9.50
- 875. **Crova's Disc,** consists of a thick cardboard 12 inches in diameter, with a series of eccentric circles. When fitted to the rotator and a card with slit (the length of the radius of the disc) is held in front of the rapidly rotated disc, it will show a wave effect..... .28



No. 3177.

3177. **Wave Trough**, 2½ inches by 10 inches by 5 feet long, as described in Smith, Tower and Turton's "Experimental Physics." Consists of a heavy square oak case, open at the top, and with plate glass sides. Has millimeter scale at one end and black line on the glass 10 cm. from the bottom. Very useful in the study of water waves. (See also No. 3179 Ripple Trough.) Complete with paddle.....Net \$ 15.00
3179. **Ripple Trough**, as described in Smith, Tower and Turton's "Experimental Physics." Consists of a square oak box, 17x25x1¾ inches, with a glass bottom, and open at the top. This trough, together with No. 3177 Wave Trough, furnishes a complete outfit for the study of the formation and propagation of wave forms and a thorough study of waves..... 5.00



No. 3183.

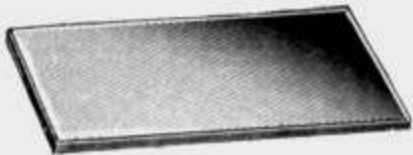
3183. **Wave Projection Apparatus**, as described by W. C. Baker of Queen's University, Kingston, Ont., in "School Science and Mathematics," February, 1909. Consists of a shallow watertight box, 12x20 inches, with wooden sides and a plane glass bottom, together with necessary accessories for performing many experiments on the propagation, reflection, refraction and diffraction of water waves. The box is to be supported so that light may be thrown on it from below, water poured in to a depth of 6 or 7 mm., and the light which passes through the box received on an inclined screen or on the ceiling of the lecture room. When a wave is set up in the water, shadows will be seen on the screen corresponding to the wave front. Complete with spring device for starting a train of plane waves, 2 metal bars to act as plane reflectors, 2 curved metal reflectors, 1 rectangular refraction plate, 1 triangular refraction plate, 3 lens shaped plates, and 3 metal stops..... 16.65



# LIGHT REFLECTION.



No. 3201.



No. 3203.

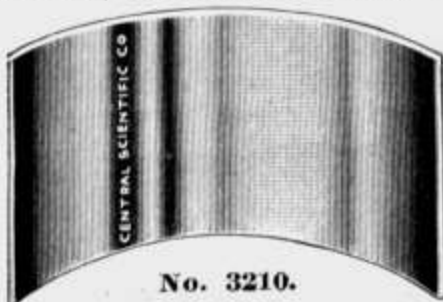


No. 3206.

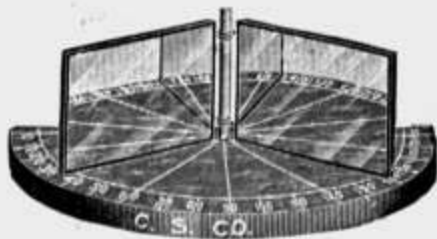


No. 3207.

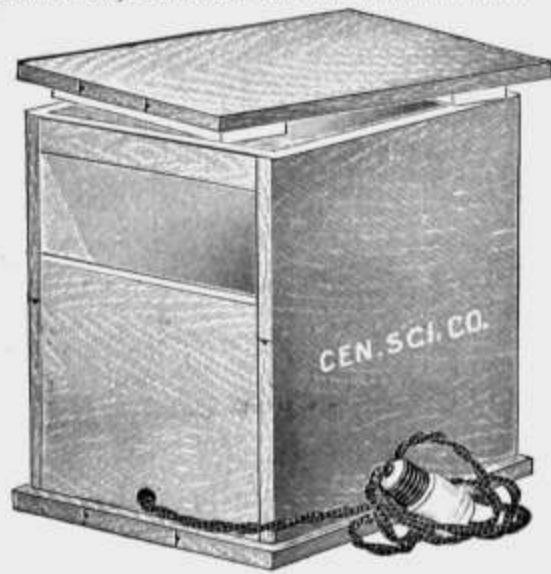
- |        |   |           |       |
|--------|---|-----------|-------|
| 3201.  | Mirror, Plane, best German glass, 4x15 cm.....  | \$        | 0.08  |
| 3202.  | Mirror, Plane, of glass, lacquered black on one side; useful in studying the laws of reflection, since error due to refraction is avoided..   |           | .06   |
| 3203.  | Mirror, Plane, of thick plate glass 10x15 cm., for double images.....   |           | .22   |
| 3204.  | Fresnel's Mirrors. See Catalog K for description.....   | Duty free | 12.00 |
| 3204A. | Fresnel's Mirrors. See Catalog K for description.....   | Duty free | 4.50  |
| 3205.  | Mirror, Concave and Convex, of heavily nicked brass, 7.5 cm. in diameter. Focus about 7 cm.....   |           | .22   |
| 3206.  | Mirror, Concave and Convex, of glass, 12 cm. in diameter, mounted in one frame, with handle. Focus 25 to 30 cm.....   |           | 1.55  |
| 3207.  | Mirror, Concave and Convex. Of glass 12 cm. in diameter, mounted on an adjustable stand of new and improved design. The mirror is adjustable in height, and being attached to the upright by a swivel clamp can be set at any angle. Focus 60 cm..... | Duty free | 13.35 |
| 3208.  | Mirror, Convex, of glass, 4 cm. in diameter, 25 cm. focus.....  |           | .45   |
| 3209.  | Mirror, Concave, of glass, 4 cm. in diameter, 25 cm. focus.....   |           | .45   |



No. 3210.

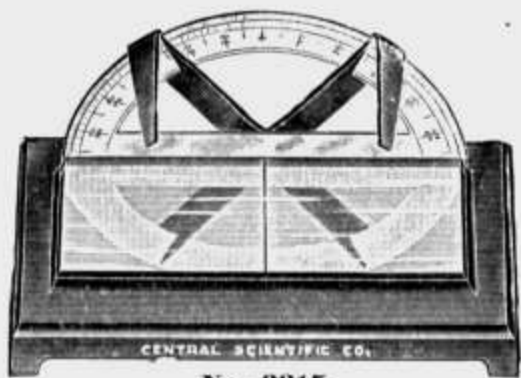


No. 3211.

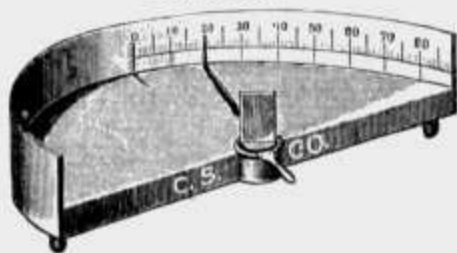


No. 3214.

- |       |  |  |      |
|-------|--|--|------|
| 3210. | Mirror, Cylindrical, of heavily nicked brass, 2x4 inches.....  |  | .33  |
|       | See also Mirrors on page 249. For Models of Mirrors, see page 267.   |  |      |
| 3211. | Multiple Image Apparatus. Two hinged mirrors on semi-circular base of 7 inch radius, graduated for illustrating multiple reflections....   |  | 4.50 |
| 3212. | Multiple Image Apparatus, according to Hall and Bergen. A board 14x14 in. on which is a circle with holes set at equal distances in the circumference, two hinged mirrors and pegs to fit the holes....  |  | 1.65 |
| 3213. | Kaleidoscope, for illustrating multiple reflections.....   |  | .45  |
| 3214. | Image Box, for illuminating the object whose image is to be formed in space. A nicely finished wood box about 10.5x10.5x8.5 inches, painted white inside, and provided with two mounted incandescent electric lamps. When a bouquet is hung from the inside of the cover, its image, formed by means of a concave mirror, will appear to be located in a vase placed upon the cover. This is a very striking experiment. Complete with five feet of lamp cord and plug.... |  | 5.00 |



No. 3215.



No. 3217.

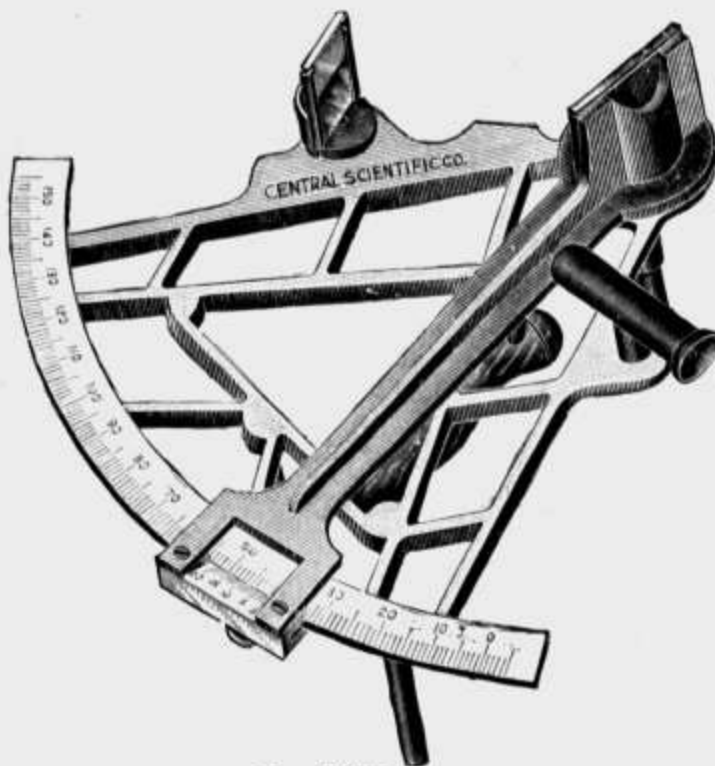


No. 3221.

- |       |  |    |        |
|-------|--|----|--------|
| 3215. | <b>Incidence and Reflection Apparatus</b> , new design. Graduated semicircle about 13.5 cm. in diameter, mounted on a heavy metal base, with mirror. Simple method of proving law of reflection. Angle of incidence very easily read from graduated scale and proved equal to angle of reflection.....   | \$ | 2.25   |
| 3217. | <b>Incidence and Reflection Apparatus</b> , a semi-cylindrical metal case with graduations on one quadrant and holes on the other quadrant to correspond; with movable mirror and indicator.....   |    | 5.55   |
| 3221. | <b>Heliostat</b> , simple form, consisting of a clock movement mounted on a heavy base with mirror. A separate mirror mounted on adjustable stand is also included with each instrument. In ordering, state latitude of laboratory, so that the instrument may be adjusted before shipment.....Duty free |    | 30.00  |
| 3223. | <b>Heliostat</b> . See Catalog K for description.....Duty free   |    | 130.00 |



No. 3226.

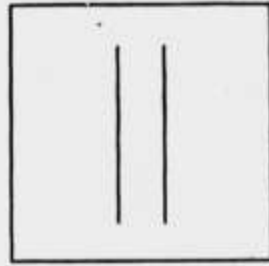


No. 3227.

- |       |   |  |       |
|-------|---|--|-------|
| 3225. | <b>Sextant</b> , full sized copy of the standard Engineer's and Mariner's sextant, on an 11x14 inch cardboard, printed from an engine divided plate. The adjustments of the correct position of the mirrors and sight are easily made. Full directions for making parts, assembling and using the sextant are furnished. Per dozen..... |  | 2.25  |
| 3226. | <b>Sextant</b> , same as above, with addition of hardwood block for handle, mirrors, mirror holders and sight, complete, ready for assembling, as shown in the illustration, with directions.....   |  | 1.65  |
| 3227. | <b>Sextant</b> , good quality, brass base with handle, mirror mountings and vernier arm; with telescope, assembled ready for use. The main scale is divided to read to 20 minutes, and the vernier on the index arm to read to 30 seconds. Accurately made.....   |  | 16.65 |
| 3228. | <b>Test Types</b> , page 495.   |  |       |



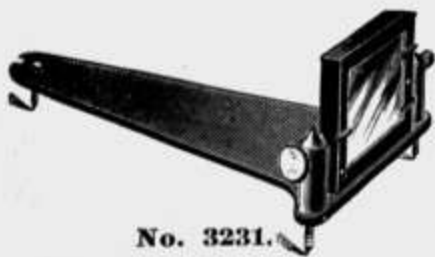
No. 3229.



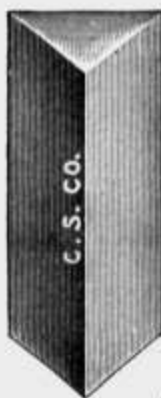
No. 3233.

3229. **Ophthalmoscope, Loring**, with 19 lenses, quadrant tilting round mirror and condensing lens, in leather case.....Net \$ 5.00
3231. **Optical Lever**, useful in determining thickness of thin plates, and in measuring small elongations, as for the determination of Young's Modulus, etc., by means of the deviation of a beam of light. A plane mirror 2.5 cm. square set in a metal frame which is mounted on a tripod base as shown. Effective length of base 7.5 cm..... 4.15
3233. **Optical Illusion Plates**, showing Zoellner's figures. For use with the projection lantern. Set of three plates, 12 cm. square, with instructions ..... 2.25

**REFRACTION.**



No. 3231.



No. 3236.



No. 3237.



No. 3238.

3236. **Prisms, Crystal Glass** (commonly called flint), equilateral.
- |                            |       |       |       |       |       |
|----------------------------|-------|-------|-------|-------|-------|
| Width of face, inches..... | 1     | 1 1/8 | 1 1/4 | 1 1/2 | 2     |
| Length, inches.....        | 1 1/2 | 3     | 4     | 6     | 4 1/2 |
| Each.....                  | .25   | .20   | .28   | .40   | 1.65  |
3237. **Prisms, Crystal Glass** (commonly called flint), right angled, for total reflection, angles of 45 and 90 degrees, widest face 1 1/4 inches.
- |                     |     |     |
|---------------------|-----|-----|
| Length, inches..... | 1   | 2   |
| Each.....           | .33 | .45 |
3238. **Prism, Crystal Glass** (commonly called flint), thin edge, with refracting angle of 20 degrees. Dimensions, 25x50 mm..... .33
3240. **Prism, Flint Glass**, extra quality, 60 degree, optically true surfaces 1 1/2x2 inches..... 9.50
3306. **Equilateral Prism** (Millikan and Gale, Exp. 43), 75 millimeter face, 9 millimeters thick, for determining the Index of Refraction of glass ..... .45



No. 3306.



No. 3241.



No. 3243.

- |       |  |           |       |
|-------|--|-----------|-------|
| 3241. | Prism, No. 3236, 4 inch, mounted. Prism may be placed with its axis either vertical or horizontal and rotated about its axis in either position. The prism is adjustable vertically.....                 | \$        | 2.00  |
| 3242. | Prism, No. 3236, 6 inch, mounted same as No. 3241.....   |           | 2.25  |
| 3243. | Prism, Achromatic, of crown and flint glass, accurately ground, with faces about 4 cm. square. Mounted on adjustable elevating stand, arranged so that the two prisms may be used separately or together |           | 12.00 |
| 3244. | Fresnel's Bi-Prism. See Catalog K for description.....   | Duty free | 8.00  |



No. 3245.

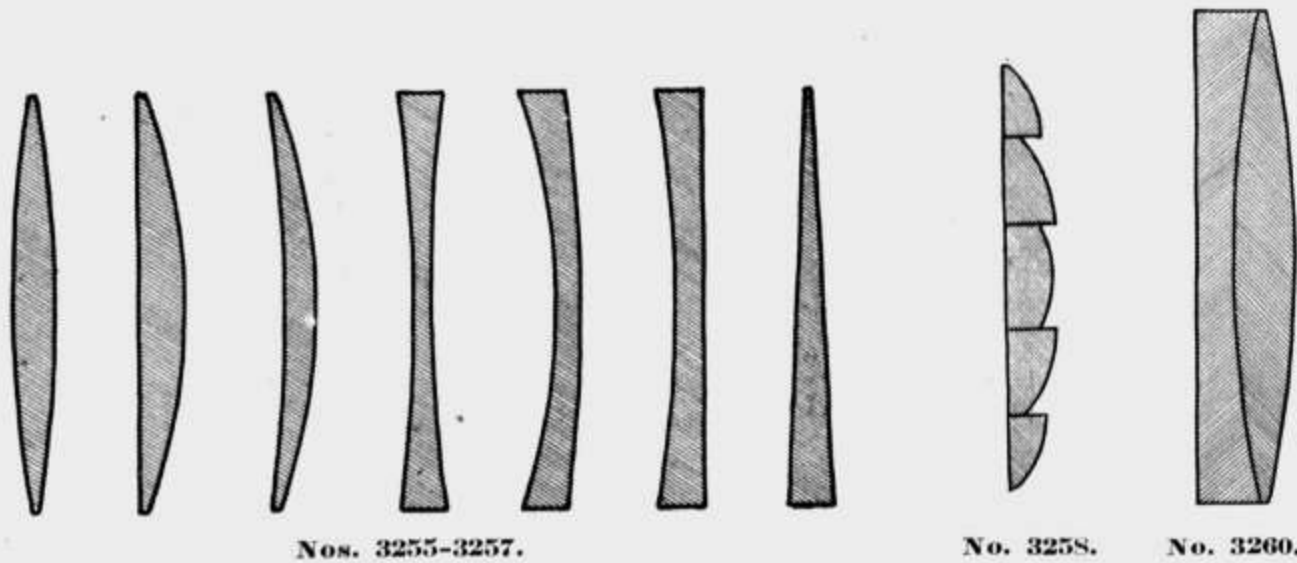


No. 3247.



No. 3730.

- |       |  |           |       |
|-------|--|-----------|-------|
| 3245. | Prism. Hollow, for carbon bisulphide, made of one piece of glass, with ground glass stopper.....   |           | 1.10  |
| 3247. | Prism, Hollow, for carbon bisulphide, triangular, all glass, with two plane polished glass faces. Faces 6 cm. wide by 9 cm. high. Best quality .....   |           | 6.65  |
| 3730. | Eaton's Direct Vision Prism, for the projection of spectra on a screen. It consists of a combination of dense glass and carbon bisulphide prisms of accurately calculated angles and indices of refraction, so as to give a "direct vision" spectrum of large dispersion. At a distance of 20 feet from screen a clear spectrum band 6 feet long by 2 feet wide is secured. This is the only moderate priced prism, to our knowledge, capable of such results. Mounted on a rod 10 mm. in diameter, and may be used on the bed of a lantern, or, as illustrated, on a stand. The spectrum of any intense illuminant may readily be obtained. For the spectra of metals we recommend the use of No. 3731 Mann's Metal Spectra Apparatus. Complete, with support ..... |           | 25.00 |
| 3248. | Hollow Prisms. See Catalog K for description.....  | Duty free | 3.60  |
| 3249. | Polyprism, or Multiplying Glass, mounted in copper tube.....   |           | .40   |
- For Spectroscope Prisms, see page 259.  
For Nicol's Prisms, see page 261.



- Nos. 3255-3257.                      No. 3258.                      No. 3260.
- |       |  |         |
|-------|--|---------|
| 3255. | <b>Lenses, Demonstration Set</b> , consists of six lenses, with ground edges, double convex, double concave, plano-convex, plano-concave, concavo-convex, convexo-concave, each 1½ inches in diameter, in box..                          | \$ 1.00 |
| 3256. | <b>Lenses, Demonstration Set</b> , set of six lenses as above listed, but two inches in diameter and of superior quality and construction, in wooden case .....  | 2.50    |
| 3257. | <b>Lenses, Demonstration Set</b> . Ten lenses 1½ inches in diameter, consisting of cylindrical convex, cylindrical concave, sphero-cylindrical and sphero-prismatic, in addition to the six lenses of set No. 3255, complete in box..... | 3.35    |
| 3258. | <b>Fresnel's Lens</b> , a highly polished glass casting, 3 inches in diameter. Shows construction of lenses used in lighthouses, semaphores, etc., and the advantages of the use of same.....  | .33     |
| 3259. | <b>Lenses, Concave and Convex</b> . A pair 1½ inches in diameter, ground to fit each other.....  | .33     |
| 3260. | <b>Achromatic Lens</b> . A high grade lens, consisting of a plano-concave flint glass lens and a double convex crown glass lens, perfectly fitted and accurately ground. Diameter 2 inches, focus 8 inches....                           | 3.35    |



Nos. 3261-3263.



Nos. 3265-3267.

- |       |   |      |
|-------|---|------|
| 3261. | <b>Condensing Lens</b> , plano-convex, 4 inch diameter, 6½ inch focus... \$   | 1.10 |
| 3760. | <b>Condensing Lens</b> , plano-convex, 4½ inch diameter, 6½ inch focus...   | 1.10 |
| 3761. | <b>Condensing Lens</b> , plano-convex, 4½ inch diameter, 7½ inch focus...   | 1.10 |
| 3762. | <b>Condensing Lens</b> , plano-convex, 4½ inch diameter, 10 inch focus...   | 1.10 |
| 3263. | <b>Condensing Lens</b> , plano-convex, 5 inch diameter, 8 inch focus...   | 1.80 |
| 3265. | <b>Mounted Lens</b> . No. 3263 Plano-convex Lens mounted on adjustable stand of new and improved design. The lens is adjustable in height, and being attached to the upright by a swivel clamp can be set at any angle..... | 5.55 |
| 3267. | <b>Mounted Lens</b> . No. 3274 Double Convex Lens mounted on adjustable stand of same design as No. 3265.....   | 5.25 |



No. 3268-3274.



No. 3275-3278A.

**LENSES, DOUBLE CONVEX, ground edges, first quality.**

Catalog No. ....	3268	3269	3269A	3270	3270A	3272	3273	3273A	3274
Diameter, in. ....	1½	1½	1½	2	2	3	4	4	5
Focus, in. ....	4	6	8	5	20	7	10	20	14
Price .....	\$0.28	.28	.28	.30	.30	.50	.90	.90	1.40

**LENSES, DOUBLE CONCAVE, ground edges, first quality.**

Catalog No. ....	3275	3276	3277	3278	3278A
Diameter, inches .....	1½	1½	1½	2	3
Focus, inches .....	4	6	8	8	8
Price .....	.22	.22	.22	.50	.90

**LENSES, DOUBLE CONVEX, rough edges, for student use.**

Catalog No. ....	3280	3281	3282
Diameter, inches .....	1½	1½	1½
Focus, inches .....	4	6	8
Price .....	.11	.11	.11

**LENSES, DOUBLE CONCAVE, rough edges, for student use.**

Catalog No. ....	3285	3286	3287
Diameter, inches .....	1½	1½	1½
Focus, inches .....	4	6	8
Price .....	.11	.11	.11

For Reading Glasses and Magnifiers, see Catalog N.

For Optical Disc to demonstrate all laws of lenses, see No. 3320.



No. 3294.

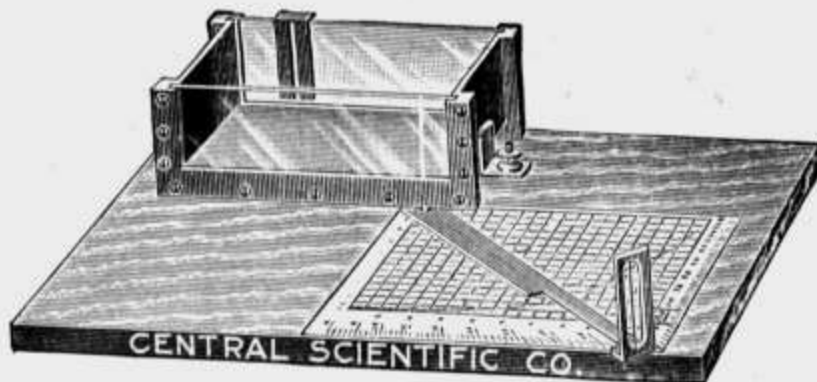


No. 3298.

- 3294. **Hollow Lens** for determination of the index of refraction of liquids. Consists of two pieces of thin glass with parallel sides, so shaped that when placed together, with a liquid between them, they form a perfect lens of the liquid. By comparing the refraction of light by this lens with that by a glass lens of the same dimensions whose index of refraction is known, the index of refraction of the liquid may be determined. Complete, with brass holder and glass lens... \$ 3.35
- 3296. **Refraction Tank.** Of glass, 4 in. by 4 in. by ¾ in., with plane sides.. 1.65
- 3298. **Refraction Tank.** A glass jar about 65x105x175 mm., with flat faces, one side being provided with a protractor. A metal cover provided with a narrow slit for admission of a beam of light to the jar is furnished ..... 1.65



No. 3299.



No. 3300.

3299. **Refraction Tank.** Semi-circular glass tank, made of one piece of glass, convex surface graduated in degrees; plane surface blackened, with slit for admission of a narrow beam of light..... \$ 8.00

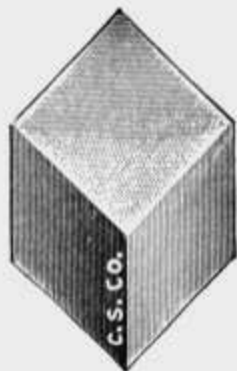
3300. **Refraction Apparatus.** A metal tank with parallel glass sides is mounted on a base provided with engine divided protractor (No. 428) and swinging index arm. A metal slit slides along the rear glass plate, and by swinging the index arm is brought into line with a scratch on the front plate and a cross-wire on the swinging arm. When the tank is partly filled with the liquid whose index of refraction is desired, the angle of incidence in the liquid is read by sighting ABOVE the surface of the liquid, and the angle of refraction by sighting THROUGH the liquid. In this way a great number of independent values may be obtained, at angles of incidence varying from zero degrees almost up to the critical angle, without the necessity of removing the liquid each time.

The values of the sines of the angles may be read directly on the scale, or the angles themselves may be read and their sines obtained from a table of trigonometric functions. With a special sliding slit the index of refraction of glass may be obtained by use of a plate with plane parallel sides. (See No. 3301.)

Complete with two slits and directions for use..... 5.55



No. 3301.



No. 3302-3303.



No. 3306.

3301. **Index of Refraction Plate, after Dr. Hall.** Glass plate 7 cm. x 7 cm. x 6mm. Edges ground, two opposite edges also polished. Simple yet effective plate for Index of Refraction of glass. Can be used for this purpose with No. 3300 Refraction Apparatus..... .20

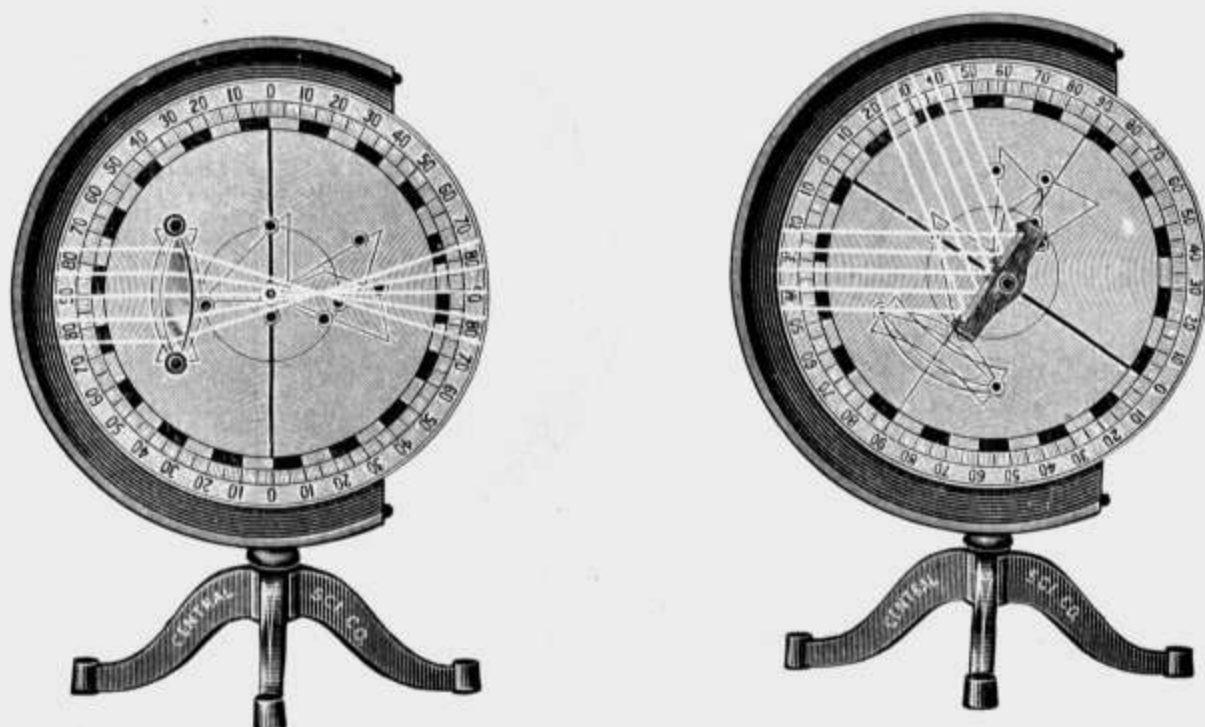
3302. **Glass Cube, for Index of Refraction Experiments, 3 cm. edge.....** .33

3303. **Glass Cube, for Index of Refraction Experiments, 5 cm. edge.....** .67

3306. **Equilateral Prism (Millikan & Gale, Exp. 43), 75 millimeter face, 9 millimeters thick, for determining the Index of Refraction of glass** .45

3310. **Index of Refraction of Water Board, new design of the Gilley Board.** .55

For Iceland Spar for double refraction, see page 261.



No. 3320.

## HARTL OPTICAL DISC.

AS DESIGNED BY PROF. HANS HARTL, REICHENBERG, AUSTRIA.

Manufactured and sold exclusively by us. The several accessories as designed by Prof. Hartl can be used only with the "Hartl Optical Disc."

This apparatus is designed to illustrate in a simple and perfect way the fundamental laws of optics. The sunlight is utilized either directly as it falls into the room through a partly shaded window or reflected by means of a simple mirror. It is not necessary or desirable to use a darkened room. The paths of the light rays upon the graduated disc, the lenses and mirrors, can be seen by the entire class. THE HARTL DESIGN PERMITS THE USE OF THE OPTICAL DISC IN EITHER VERTICAL OR HORIZONTAL POSITION. A great variety of optical experiments may be performed with this apparatus, two of which are illustrated above. These experiments with a single ray or several parallel rays include the following:

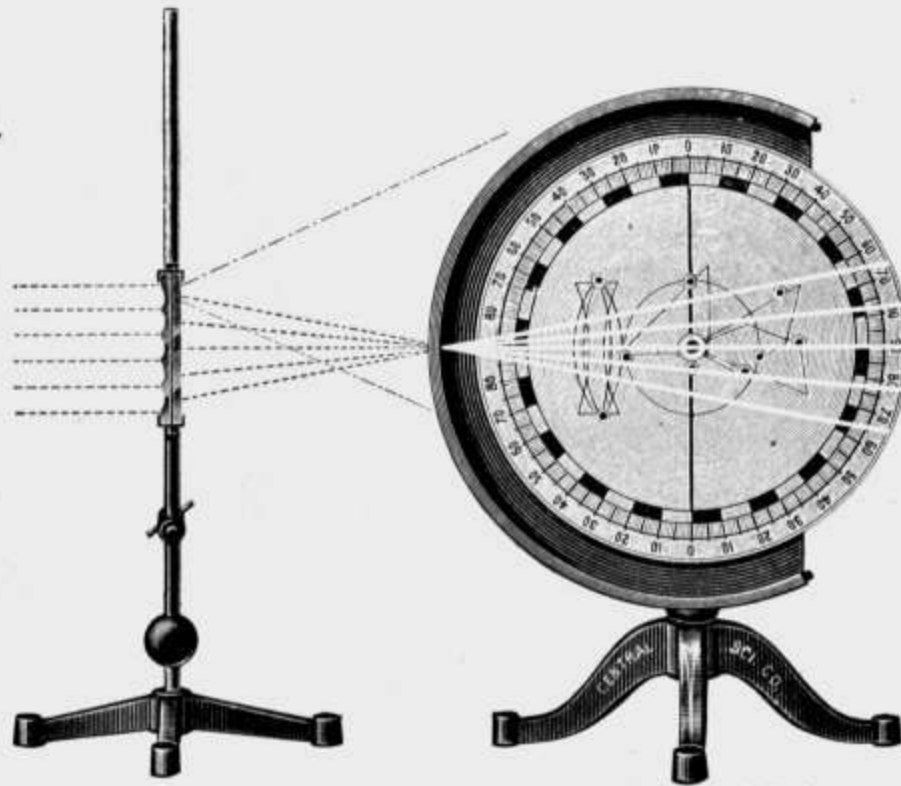
- |                               |  |
|-------------------------------|--|
| 1. Angle of reflection.       | 10. Stereo binocular.  |
| 2. Angle of refraction.       | 11. Refraction through a parallel plate.                           |
| 3. Index of refraction.       | 12. Refraction through a prism.                                    |
| 4. Total reflection.          | 13. Perre's prism system.  |
| 5. Critical angle.            | 14. Measurement of the angle of a prism.                           |
| 6. Refraction through lenses. | 15. Dispersion showing spectrum.                                   |
| 7. Caustic of lenses.         | 16. Theory of the rainbow, formation of primary and secondary bow. |
| 8. Principal rays.            |  |
| 9. Principal focus of lenses. |  |

A complete pamphlet is furnished with each set, describing and illustrating these and other experiments.

3320. Hartl Optical Disc complete, with—

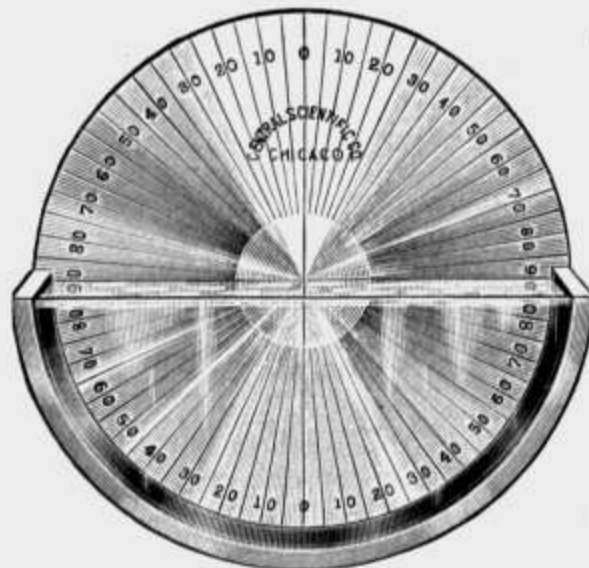
- 1 set of four concave and convex lenses.
- 2 prisms, 3 mirrors (plane, concave and convex).
- 2 slotted plates with 2 opaque sliders for using a single ray or several rays.
- 1 set of 2 colored screens..... \$ 16.65





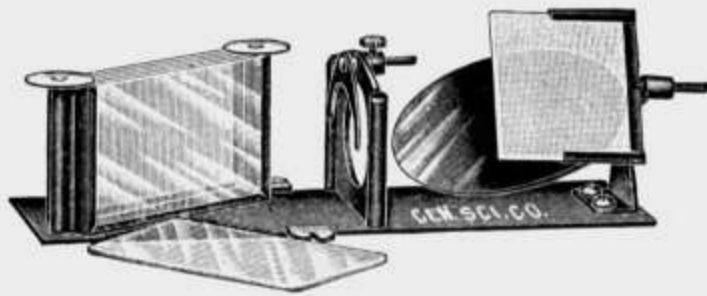
No. 3322 (In connection with Hartl Optical Disc).

3322. **Diverging Ray Attachment**, for the Hartl Optical Disc. It consists of a glass plate forming a system of parallel concave cylindrical lenses adjustably mounted with a counterpoise upon a separate base. This is placed between the screen and the source of light ordinarily used with the Optical Disc so that the center of its shadow coincides with the opening in the screen. Each cylindrical lens sends out a bundle of diverging rays; one ray from each lens will pass through the slit in the screen, thus forming a system of rays which appear to come from the slit as a source and cross the disc. The divergence of this bundle may be varied by varying the distance of the glass plate from the screen. By the use of two or more slits, two or more bundles of rays may be seen just as in the case of an extended light source. With these bundles all the experiments which were performed with parallel rays may be performed with diverging rays, and the action of optical instruments fully explained. When a thick convex lens is used in combination with one of the thin lenses, the fact that an extra lens makes the image either recede from or approach the first lens, is shown. This illustrates the action of eye-glasses, the thick lens acting as the eye lens and the thin lens as the eye-glass. Complete with short focus lens and metal screen ..... \$ 5.50

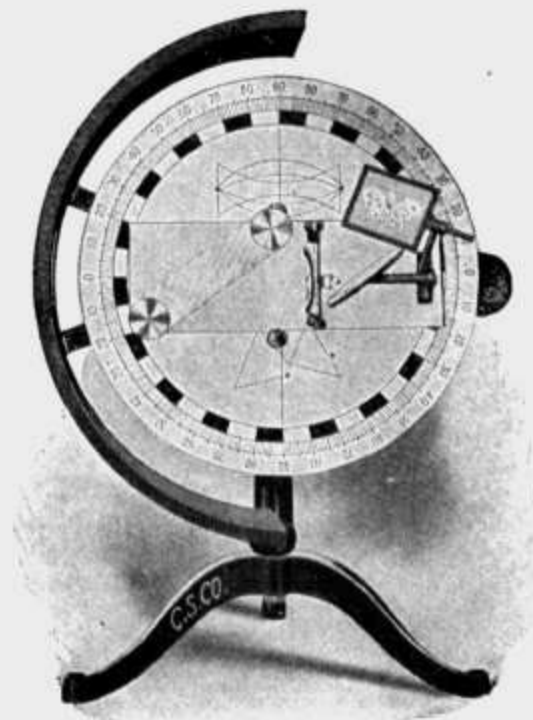


No. 3324.

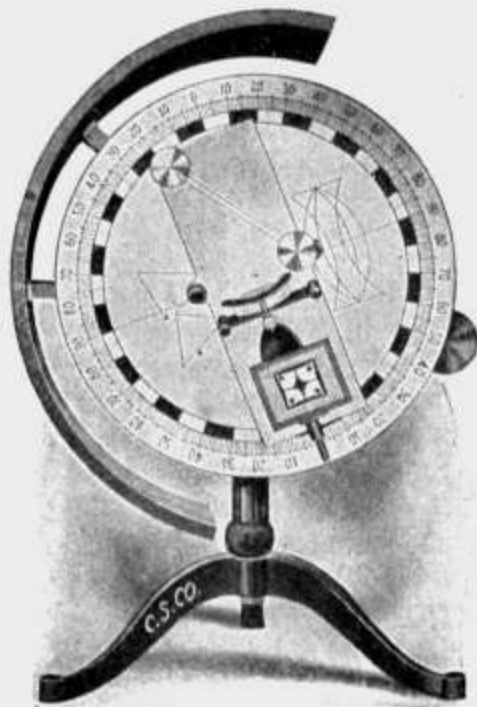
3324. **Refraction Tank**, for determining the Index of Refraction of any transparent liquid. To be attached to the face of the Optical Disc. Clamp for holding plane mirror to edge of disc for reflecting ray of light into the tank is included..... 3.35
3326. **Diffraction Attachment**. Consists of a Wallace Replica of Rowland Grating (Grade D), suitably mounted for attaching to the face of the Optical Disc..... 3.35



No. 3328.



No. 3328 (Attached to No. 3320 Optical Disc).



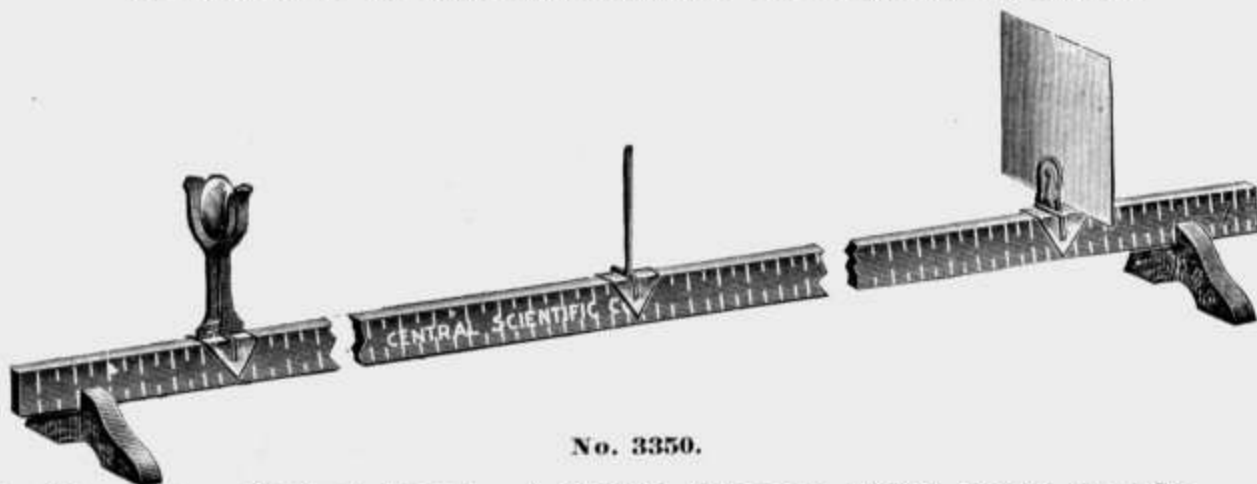
No. 3328 (Attached to No. 3320 Optical Disc), Showing No. 3330 on Stage.

3328. **Polarized Light Attachment.** Prof. Hartl has arranged this attachment for the Optical Disc to show to a class the phenomena of polarized light with as great ease and simplicity as the ordinary phenomena of optics. Easily attached. (See also No. 3330.) ..... \$ 8.35
3330. **Condensing Lens and Slide Carrier,** with one specimen of Potassium Nitrate (optically biaxial) and one specimen of Sodium Nitrate (optically uniaxial). To be used with No. 3328 ..... 4.45

**Polariscope Preparations for Use With No. 3328.**

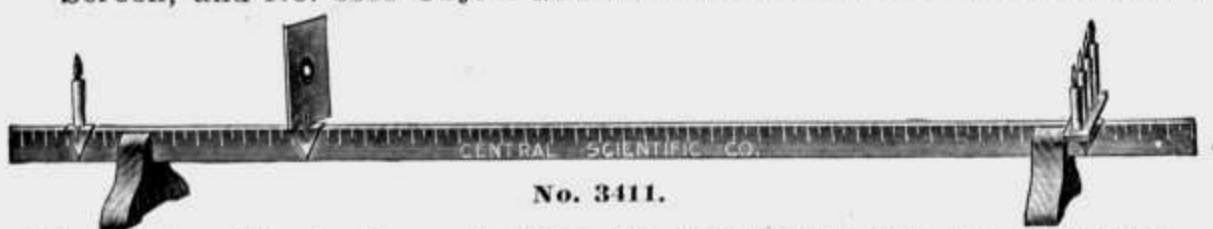
- |  |      |
|--|------|
| 3331. Gypsum Figure, plain. 4 strips, 4 colors.....  | 2.20 |
| 3331A. Gypsum Figure, cube in 3 colors.....  | 2.75 |
| 3331B. Gypsum Figure, octahedron in 4 colors.....  | 3.35 |
| 3331C. Gypsum Figure, star in 6 colors.....  | 5.00 |
| 3332. Holder, for compressing No. 3333 annealed glass blocks to show same effect as unannealed plates..... | 2.25 |
| 3333. Annealed Glass, rectangular block, 1x1x $\frac{3}{8}$ in., to fit No. 3332 Holder..                  | 1.10 |
| 3335. Selenite Films (Gypsum), after Mueller. Set of eight different colors                                | 8.00 |
| 3336. Unannealed Glass Plate, square.....  | 1.10 |
| 3337. Unannealed Glass Plate, rectangular.....   | 1.10 |
| 3338. Unannealed Glass Plate, round.....   | 1.10 |
| 3339. Unannealed Glass Plate, triangular.....  | 1.10 |
| 3341. Mica Plate, square, large, quarter wave.....   | 2.50 |
| 3342. Mica Plate, round, medium, quarter wave.....   | 1.65 |
| 3343. Mica Plate, round, small, quarter wave.....  | 1.10 |
| 3344. Mica Plate, round, small, half wave.....   | 1.10 |
| 3345. Mica Plate, round, small, whole wave.....  | 1.33 |

**OPTICAL BENCHES AND PHOTOMETERS.**



No. 3350.

3350. **Elementary Optical Bench.** A simple but very useful bench for elementary work. Includes No. 319 Meter Stick, No. 3351 Support Blocks, No. 3352 Lens Support, No. 3353 Screen Support, No. 3354 Screen, and No. 3355 Object and Marker..... \$ 0.75



No. 3411.

3411. **Photometer, Simple Form,** includes No. 319 Meter Stick, No. 3351 Support Blocks, No. 3353 Screen Support, No. 3354A Screen, No. 3355A Candle Holder, and No. 3355B Candle Holder..... 1.00  
 3351. **Support Blocks,** for meter stick, per pair..... .13



No. 3351A.



No. 3357.



Nos. 3385-6.

- 3351A. **Metal Supports,** for elementary optical bench. Designed for those who desire a more substantial support than the ordinary wooden blocks. These supports clamp to the meter stick, holding it rigidly in position so that the location of screens, lens supports, etc., may be changed without danger of overturning the bench. Per pair... .40  
 3352. **Lens Support,** of brass; will hold 4 cm. lenses..... .11  
 3353. **Screen Support,** of brass, for meter stick..... .08  
 3354. **Screen,** of best bristol board, 8 cm. square, with millimeter scale along one edge ..... .05  
 3354A. **Screen, Bunsen's,** simple form, according to Dibdin. Light passes through a star of thin paper instead of through a grease spot..... .13  
 3354B. **Screen,** of wire gauze, 10 cm. square, for use in front of a source of light as an object..... .10  
 3355. **Object and Marker,** of brass, for use on meter stick..... .08  
 3355A. **Candle Holder,** for four candles, of brass..... .25  
 3355B. **Candle Holder,** for one candle, of brass..... .08  
 3356. **Lens or Mirror Support,** similar to No. 3352, for objects 75 mm. in diameter; will hold No. 3205 Mirror or No. 3272 Lens..... .15  
 319. **Meter Stick,** of maple, one side graduated in millimeters, other in inches and eighths..... .30  
 3357. **Gas Burner,** low form, with aluminum gas tip..... .44  
 3380. **Candles,** paraffine, twelve to the pound..... Per dozen .18  
 3381. **Candles,** paraffine, six to the pound..... Per dozen .33  
 3382. **Candle, Standard,** sperm, six to the pound, will burn 120 grains (7.776 grams) of wax per hour. Imported. Each..... .25  
 3383. **Candles,** Christmas wax, twenty-four in box..... Per box .17  
 3385. **Kerosene Lamp,** small, of brass, with wick and chimney..... .25  
 3386. **Asbestos Shade,** with pin hole, for use with No. 3385 Lamp..... .10

**THE SPOKANE OPTICAL LIGHT BOX.**

This piece of apparatus has been tried out with great success in the laboratories of the Spokane High Schools. It consists essentially of a metal box containing an electric, gas, or oil illuminant by means of which objects blocked out on small squares of ground glass are highly illuminated. There are two object plates, one placed on the side opposite the other so that two students can use the same box at the same time, each for his own individual experiment. Images of the "object" can be obtained in the usual way by means of lenses and mirrors.

The device has the following advantages over any other piece of apparatus for the study of mirrors, lenses, prisms, etc.:

(1) The object is so intensely illuminated that brilliant images are produced without the laboratory having to be wholly dark.

(2) The optical bench and its accessories are dispensed with. The lenses, mirrors, screens, etc., are held by the ordinary test tube holders and tripods or stands with which all laboratories are supplied.

(3) The "object" is rigid, stationary, and plane. This reduces errors of observation to a minimum. A shoulder is provided on the clip holding the object plates on which the end of the meter stick can be rested while the student is measuring. There are no flickering candle flames or other sources of light whose location must be guessed at and cannot be determined accurately.

(4) All the measurements are direct, from lens to object or to image by meter stick, and are not read on some support or bench.

(5) Each Optical Light Box is supplied with two object plates on opposite sides of the box so two students can use the box at the same time, thus reducing the cost of equipment one-half. Twelve boxes will supply a class of twenty-four students, all doing individual work.

(6) The glass plates can easily be changed so that objects of different sizes and designs can be used. These plates can easily be made by cutting the design out of black opaque paper and then pasting it on a sheet of ground glass of the correct size. The letter L furnished shows both the inversion and reversion of the image.

(7) The box is adapted to any school as it is equipped with either electric light, Welsbach gas burner, or kerosene lamp.

(8) This single piece of apparatus is suitable for use in the following experiments:

- (a) Determination of the Focal Length of Concave and Convex Lenses and Concave Mirrors.
- (b) Determination of the Character of Images in Lenses and Mirrors.
- (c) Study of the Prism and Refraction.
- (d) Formation of Images through Small Apertures.
- (e) Formation of Shadows.
- (f) Demonstration of the Relation between Size of Object and Image and Distance from Lens or Mirror.
- (g) Illustration of the Principle of the Stereopticon.

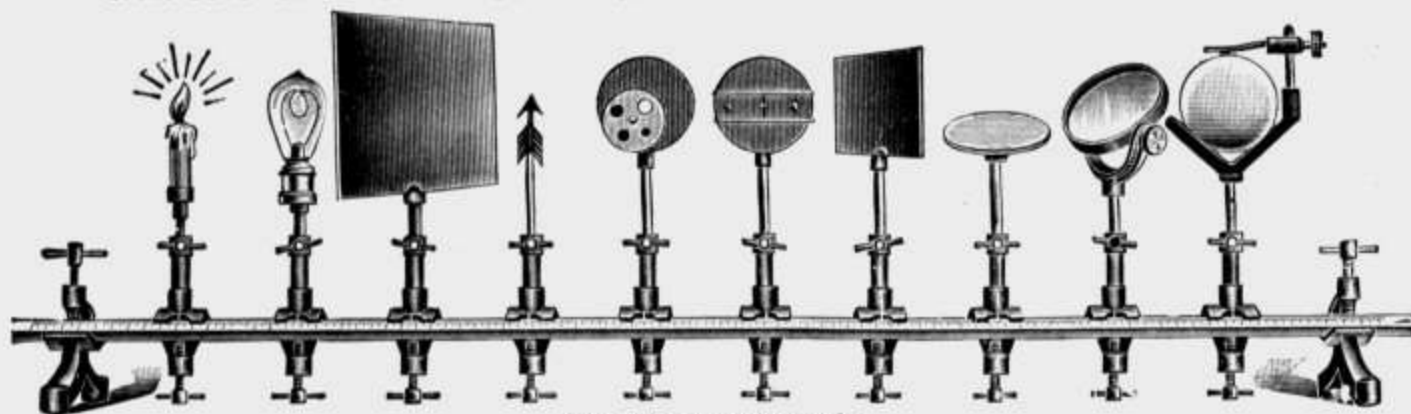
3358. Optical Light Box, complete with 110-volt incandescent lamp, 6 feet of lamp cord and attachment plug, with two "L" object plates, and two object plates with slit.....	3.50
3358A. Optical Light Box, complete with Welsbach gas burner, two "L" object plates, and two object plates with slit.....	3.25
3358B. Optical Light Box, complete with kerosene lamp, two "L" object plates, and two object plates with slit.....	3.00
3358C. Optical Light Box, without illuminant, but with two "L" object plates, and two object plates with slit.....	2.50



No. 3358. (Patent applied for.)

ACCESSORIES FOR BUILDING PHOTOMETER AND OPTICAL BENCHES.

Nos. 3360 3362 3368 3364 3370 3369 3367 66C 48 50



Single Rod Bench.

It has been our intention in cataloging the following accessories to give the teacher as much latitude in selection as possible. Very excellent Laboratory Optical Benches or Photometers may be made up from these accessories. As a suggestive Photometer we list one that has been in actual use in many schools and has given perfect satisfaction. (See No. 3406, page 138).

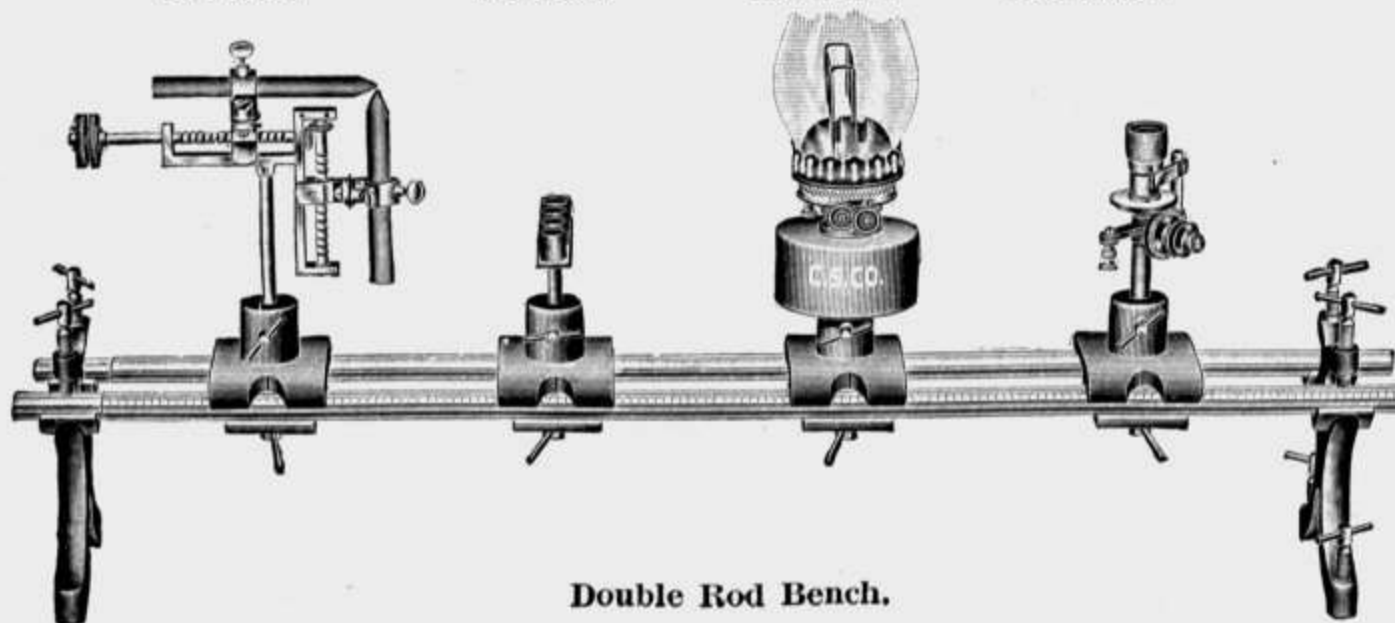
- 25. Rod, not graduated, 19 mm. square; 1 meter, \$2.35; 2 meters..... \$ 4.50
- 25A. Graduated Rod, 19 mm. square and graduated in millimeters; 1 meter, \$6.65; 2 meters..... 10.00
- 26. End Supports, with extra long "V," accurately milled, for holding graduated rods, forming a solid bed, each..... .55
- 26A. End Support, similar to above, but to hold two 19 mm. square rods 7.5 cm. apart and 15 cm. above the table. One support is provided with a leveling screw. Per pair..... 2.30
- 31. Clamp, double, for use on double rod bed, provided with index line for use with graduated rods. Will hold same accessories as No. 44 Clamp. Hole is 10 mm. diameter..... 3.00
- 36A. Clamp, with zero line, designed to hold No. 3363 Universal Holder, "V" opening 19 mm. hole 13 mm..... 1.00
- 36B. Clamp, designed to hold No. 3366 Eye Shades, "V" opening 19 mm., hole 6 mm..... .55
- 44. Clamp, with index line, designed to hold all accessories, except as specified under Nos. 36A, 36B and 44B Clamps. "V" opening 19 mm., hole 10 mm..... .55
- 44B. Clamp, with index line, same as No. 44, with addition of spring, which permits adjustment along the rod without loosening the set screw. Designed to carry the comparison screens, Nos. 3401-3404.. 1.35
- 50. Lens Holder, for lenses 25 to 50 mm. diameter, mounted on rod to fit No. 44 Clamp..... 1.00
- 51. Lens Holder, for lenses 50 to 100 mm. diameter, mounted on rod to fit No. 44 Clamp..... 1.35
- 66C. Stand Top, of three ply wood, 15 cm. diameter, mounted on rod to fit No. 44 Clamp..... 1.16

No. 3393.

No. 3361.

No. 3387.

No. 3559A.



Double Rod Bench.

3359.	<b>Rotator</b> , for rotating unknown (incandescent lamp) to obtain mean horizontal candle power; for use with single rod.....	\$ 6.65
3359A.	<b>Rotator</b> , same as No. 3359, but for use with No. 31 Bridge Clamp.....	6.65
3360.	<b>Candle Holder</b> , for one candle, mounted on rod to fit No. 44 Clamp....	.55
3361.	<b>Candle Holder</b> , for four candles, mounted on rod to fit No. 44 Clamp..	1.10
3362.	<b>Lamp Socket</b> , for holding incandescent lamps, mounted on rod to fit No. 44 Clamp.....	1.10
3363.	<b>Universal Holder</b> , for holding the "unknown" lamp, with graduated disc, adjustable arm and lamp socket, to fit No. 36A Clamp.....	8.35
3364.	<b>Image</b> , arrow shaped, mounted on rod to fit No. 44 Clamp.....	.90
3365.	<b>Scale</b> , cardboard, 5 cm. long, in mm. divisions, mounted on rod to fit No. 44 Clamp.....	.90
3366.	<b>Eye Shades</b> , pair of black cloth shades, mounted to fit No. 36B Clamp, per pair .....	1.33
3367.	<b>Screen</b> , 10 cm. square, finished dead black, mounted on rod to fit No. 44 Clamp.....	.65
3368.	<b>Screen</b> , opalescent, 20 cm. square, ground glass plate in frame, mounted on rod to fit No. 44 Clamp.....	1.65
3369.	<b>Screen</b> , with adjustable, vertical slit, mounted on rod to fit No. 44 Clamp .....	3.35
3370.	<b>Screen</b> , with apertures of different size, mounted on rod to fit No. 44 Clamp .....	3.35
3371.	<b>Screen Holder</b> , for holding cardboard, sheet gauze, etc., mounted on rod to fit No. 44 Clamp.....	.67
48.	<b>Mirror</b> , plane, 30 mm. diameter, adjustable about a horizontal axis, mounted on rod 15 cm. long by 10 mm. diameter, to fit No. 44 Clamp	2.00
3372.	<b>Mirror</b> , plane, same as No. 48, but not mounted, to be used with No. 50 Lens Holder.....	.28
3373.	<b>Mirror</b> , convex, 4 cm. in diameter, 25 cm. focus, mounted same as No. 48, on rod to fit No. 44 Clamp.....	2.66
3208.	<b>Mirror</b> , convex, same as No. 3373, but not mounted, to be used with No. 50 Lens Holder.....	.45
3374.	<b>Mirror</b> , concave, 4 cm. in diameter, 25 cm. focus, mounted same as No. 48, on rod to fit No. 44 Clamp.....	2.66
3209.	<b>Mirror</b> , concave, same as No. 3374, but not mounted, to be used with No. 50 Lens Holder.....	.45
3375.	<b>Mirror</b> , concave and convex, in one frame, diameter 120 mm., focus 25 to 30 cm., mounted on rod to fit No. 44 Clamp.....	2.66
3377.	<b>Prism</b> , flint glass, 4 inches long, mounted on rod to fit No. 44 Clamp..	1.50
	<b>Prisms</b> , carbon bisulphide; may be supported on No. 66C Stand Top. See Nos. 3245-7.	
	<b>Prism</b> , achromatic, see No. 3243.	
	<b>Bi-Prism</b> , Fresnel's, see No. 3244.	
3380.	<b>Candles</b> , paraffine, twelve to the pound.....Per dozen	.18
3381.	<b>Candles</b> , paraffine, six to the pound.....Per dozen	.33
3382.	<b>Candles</b> , Standard, sperm, six to the pound, will burn 120 grains (7.776 grams) of wax per hour. Imported. Each.....	.25
3383.	<b>Candles</b> , Christmas wax, twenty-four in box.....Per box	.17
3385.	<b>Kerosene Lamp</b> , small, of brass, with wick and chimney; may be supported on No. 66C Stand Top.....	.25
3386.	<b>Asbestos Shade</b> , with pin hole, for use with No. 3385 Lamp.....	.10
3387.	<b>Kerosene Lamp</b> , with adjustable screen in front of flame, as used for secondary standard. Mounted on rod to fit No. 44 Clamp.....	5.00
3389.	<b>Gas Burner</b> , with 4, 6 or 9-foot tips, mounted on rod to fit No. 44 Clamp	.55
3390.	<b>Welsbach Gas Burner</b> , complete, mounted on rod to fit No. 44 Clamp.	1.35



No. 3392.

- 3391. **Pentane Lamp**, Harcourt's 10 candle power, generally accepted as a standard for illuminating gas .....Duty free \$ 65.00
- 3392. **Hefner Lamp**, German standard, recommended by the Imperial Institute as a photometric standard. To be carried on No. 66C Stand Top .....Duty free 13.50
- 3392A. **Hefner Lamp**, same as No. 3392, with Reichsanalt certificate of accuracy. To be carried on No. 66C Stand Top.....Duty free 15.75
- Amyl Acetate**, pure, for use with Hefner Lamp. Lb. ....Net 1.25
- 3393. **Electric Arc Lamp**, right angle, hand feed, same as Nos. 3636 and 3638; mounted on a 10 mm. rod to fit No. 44 Clamp..... 10.00
- 3395. **Standard Incandescent Lamp**, for stationary use; 16 candle power, 110 volts; guaranteed accuracy of voltage and current consumption at rated candle power, 1/4%. Standardized by the Electrical Testing Laboratories .....Net 2.70

3396. **Standard Incandescent Lamps.** On special order we can supply the following lamps, which we do not carry in stock. These lamps are standardized by the Electrical Testing Laboratories, and the stated percentage of accuracy refers to the voltage and current consumption at their rated candle power:

**Net Price List.**

Candle Power.	Voltage.	Rotating Accuracy.		Station'y Accuracy.	
		1/4%	1/10%	1/4%	1/10%
2 to 20	100 to 125	\$2.25	4.00	2.70	4.40
24 to 32	100 to 125	3.00	4.80	3.60	5.20
50	100 to 125	5.00	6.40	5.40	6.80

3401. **Dibdin's Modification of Bunsen Photometer Box.** In the Bunsen Box the grease spot and its surrounding media do not transmit light equally, and in consequence the grease spot is never entirely lost, even when equal illumination is on either side. We have therefore modified the Bunsen form, according to Dibdin, and use a star of paper through which light may pass. Mounted to fit No. 44B Clamp .....



No. 3401.



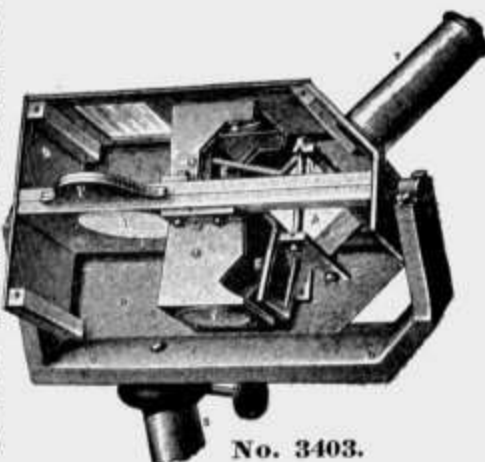
No. 3402.

3402. **Flicker Photometer**, after Simmance-Abady. The principle of the Flicker Photometer is a departure from that of the grease spot and optical effect familiar to the majority of experimentalists. The field of comparison is a revolving screen, which is observed through an eyepiece. When the lights are unequal, a flickering or throbbing effect is apparent. When they are equal the flickering vanishes, and all the observer sees is an apparently motionless disc of light. Thus personal error is avoided. For horizontal testing only. Mounted on rod to fit No. 44B Clamp.....Duty free 50.00

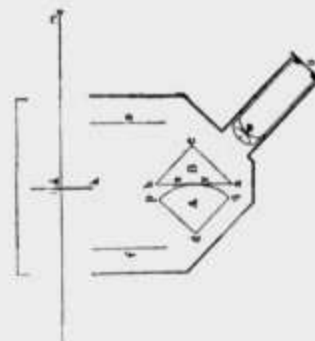
3402A. **Flicker Photometer**, same as No. 3402, for both angle and horizontal testing. Mounted on rod to fit No. 44B Clamp. Duty free 70.00

3403. **Lummer-Brodhun Photometer Box**, mounted on rod to fit No. 44B Clamp. Duty free 36.00

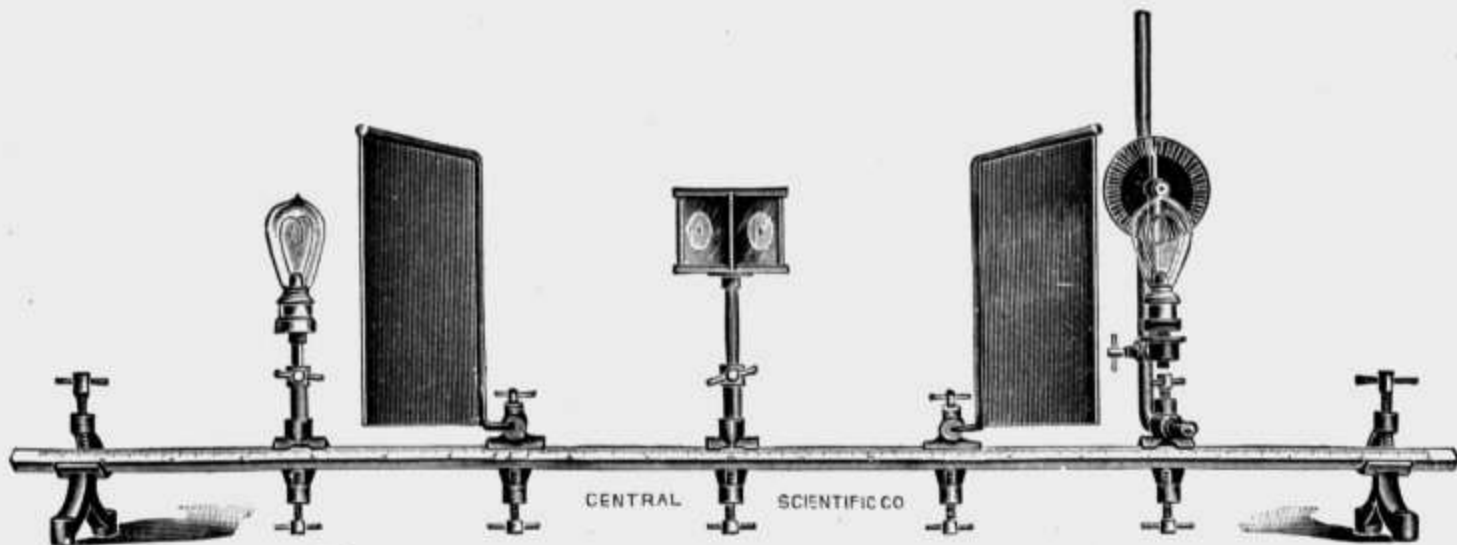
3404. **Joly's Diffusion Paraffine Photometer Box**, mounted on rod to fit No. 44B Clamp. Duty free ..... 15.00



No. 3403.



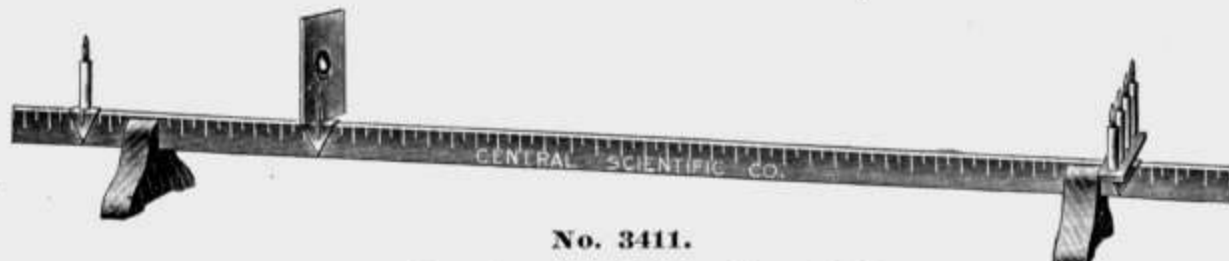
No. 3403 (Cross Section).



3406. **Laboratory Photometer**, built up from the accessories listed on the preceding pages. This outfit embodies the essential features of the high-priced and elaborate photometers used in commercial work. It has been tested by actual use in a prominent technical school, where accurate work was done with oil, gas and electrical illuminants. The outfit is complete with light standard for the determination of maximum candle power (vertical or horizontal distribution) and mean spherical candle power of incandescent lamps... \$ 30.00

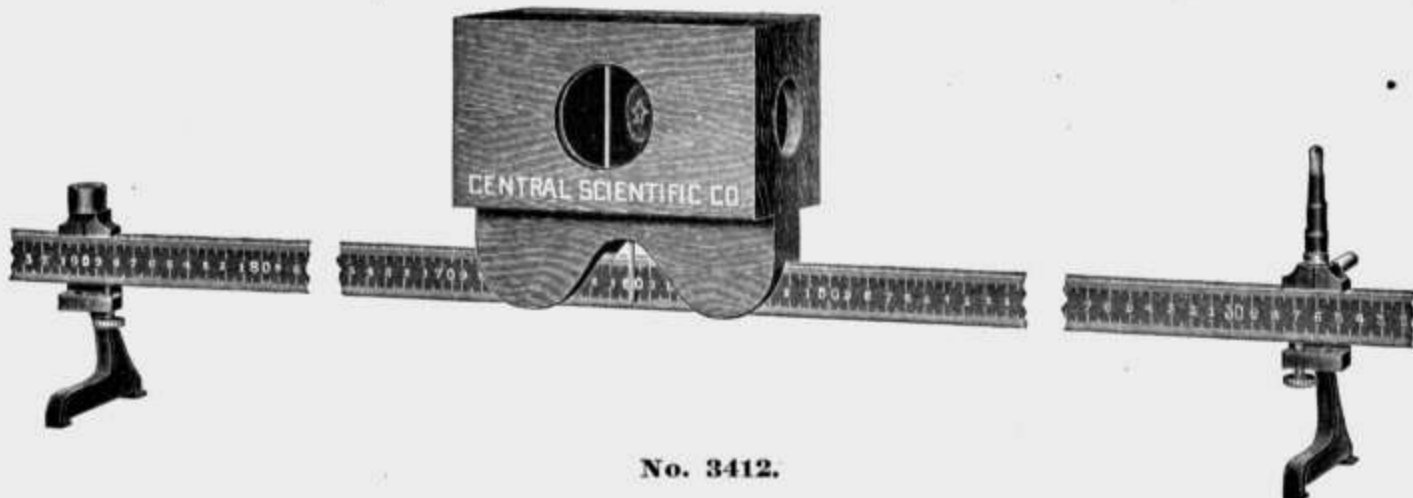
Complete Set as Follows:

- |                                     |   |
|-------------------------------------|---|
| 25A. 1 Steel Rod, 2 meters long.    | 3366. 2 Eye Shades.                         |
| 26. 2 End Supports.                 | 36B. 2 Clamps for No. 3366 Eye Shades.      |
| 3395. 1 Standard Incandescent Lamp. | 44. 1 Clamp for No. 3362 Socket.            |
| 3362. 1 Lamp Socket.                | 36A. 1 Clamp for No. 3363 Universal Holder. |
| 3363. 1 Universal Holder.           | 44B. 1 Clamp for No. 3401 Box.              |
| 3401. 1 Bunsen Photometer Box.      |   |



No. 3411.

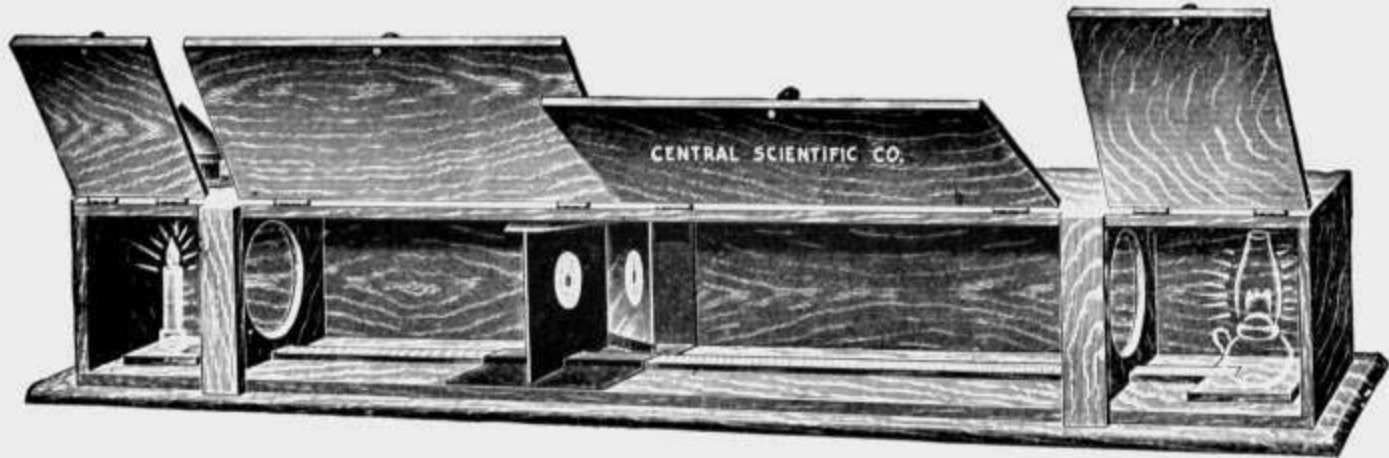
- |  |           |
|--|-----------|
| 3408. <b>Precision Photometer.</b> See Catalog K for description.  |           |
| 3409. <b>Collar.</b> See Catalog K for description.....  | Net 1.00  |
| 3410. <b>Universal Compound Rotator.</b> See Catalog K for description....   | Net 75.00 |
| 3411. <b>Photometer, Simple Form</b> , includes No. 319 Meter Stick, No. 3351 Support Blocks, No. 3353 Screen Support, No. 3354A Screen, No. 3355A Candle Holder, and No. 3355B Candle Holder..... | 1.00      |



No. 3412.

- |   |      |
|---|------|
| 3412. <b>Photometer, Student's, Bunsen Form.</b> A simple and convenient form for individual work. Consists of a meter stick mounted on two supports bearing a gas jet at one end and a candle holder at the other. A box painted dead black, so as to avoid any reflection, slides upon this meter stick, and contains a Bunsen screen with two mirrors at right angles for viewing both sides of screen at the same time. Box is provided with indicator..... | 2.50 |
| 3413. <b>Photometer</b> , same as above, with paraffine blocks, after Joly.....   | 3.00 |





No. 3414.

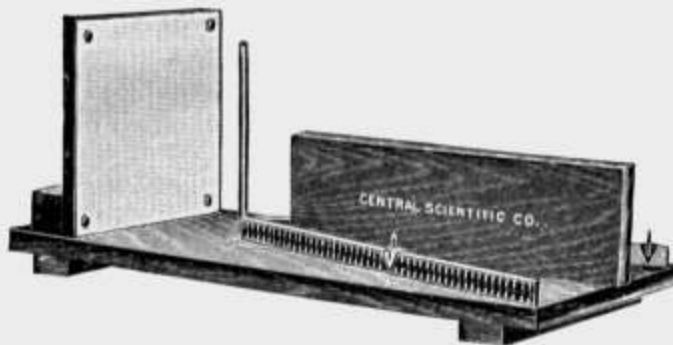
3414. **Photometer, Bunsen's**, with separate doors for lamp and candle, and a door opening on each side of the screen. Complete, with screen, mirrors, scale and hoods..... \$ 9.00



No. 3415.

3415. **Photometer, Bunsen's, New Design**. This photometer is designed for rapid work in a light room. The Bunsen screen is viewed through a shaded slot mounted upon a strip of light proof canvas fitted into grooves upon the top of the box. This canvas passes over rollers and is attached to the screen directly under the viewing slot. By turning the rollers, the screen may be moved to any point of the scale between the lamps. The distance between the screen and the illuminants is indicated upon a scale mounted on the top of the box. The lights may be reached through a light-proof door, which remains closed through the experiment. This is the only form which may be used in an ordinary laboratory..... 14.00

3416. **Electric Light Attachment for No. 3415 Photometer**. By means of this device an electric light may be used at each end of the photometer, and easily adjusted so that its center is at the correct height. Complete, with two sockets, two plugs and two five-foot lengths of lamp cord, but without lamps..... 3.35



No. 3418.

3418. **Photometer, Rumford's**. A wooden base, 12x28 inches, on which are mounted two meter sticks meeting at an angle, and an upright rod; and two movable screens, one for receiving the shadow and the other for separating the two lights. Complete, with two No. 3355B Candle Holders ..... 3.50



#### WALLACE REPLICAS OF ROWLAND'S PLANE DIFFRACTION GRATINGS.

Made by R. James Wallace, formerly Photo-Physicist of the Yerkes Observatory.

We take pleasure in announcing that we have become exclusive agents for Dr. Wallace's famed diffraction grating replicas and accessory instruments. These replicas during the eight years they have been on the market have become so well and favorably known that further words seem almost unnecessary; but, since the publication by Dr. Wallace of his method of manufacture, important modifications in the process have been effected, which result in the production of a replica grating of the very highest point of practical perfection.

All Wallace gratings bear the signature of Dr. Wallace, together with the grade and date when tested, engraved in the glass, and this constitutes an absolute guarantee of quality.

**Grade A.** These gratings are guaranteed to possess the finest resolving power and definition, showing clean, sharp black lines in sunlight "condensed" upon the slit, and in an instrument of aperture as indicated. With a sufficiently high power eye-piece to render the separation visible, they will show the clear resolution of the

triple  $\left\{ \begin{array}{l} \lambda 5226.707 \\ 5227.043 \\ 5227.362 \end{array} \right\}$  in the second order, a resolving power equal to 19 times that

necessary to separate the D lines,—  $\left\{ \begin{array}{l} D1-5886.155 \\ D2-5890.186 \end{array} \right\}$

**Grade B.** Gratings of this grade are guaranteed to resolve the double at  $\lambda$   $\left\{ \begin{array}{l} 5262.419 \\ 5261.876 \end{array} \right\}$  a power of eleven times that necessary to resolve the D lines, in the second order spectrum, and, while not giving quite as perfect definition as those of Grade A, are yet for all but the most critical work a very perfect article, and one which is recommended for general class instruction.

**Grade C.** These are grating replicas, which through error in the mounting do not define as well as Grade B, and are not entirely free from "ghosts" caused by distortion of the lines. They are guaranteed to show the Ni line between the D's very clearly; the D lines themselves being widely separated.

**Grade D.** For projection purposes, and use in the chemical laboratory, dark room, etc. Gratings of this grade are bound between thin glass plates, lantern-slide fashion, and when simply held in the hand close before the eye are extremely useful in the flame test for the detection of K in the presence of Na—the study of dichroism—general absorption, estimation of transmission of dark room light, etc., etc. In projecting the spectrum with the optical lantern, they are simply held in front of and against the lens nozzle, while an opaque slide with a slit cut in it is placed in the stage. These gratings are not intended for use in the spectroscope, as the definition of the Fraunhofer lines is not sufficiently good.

All Grade A and Grade B gratings are enclosed in leather covered velvet lined case. Price list on next page.

## NET PRICE LIST OF WALLACE GRATINGS.

No.	Size of ruled Surface	Grade				No. of Lines to 1 inch.
		A	B	C	D	
3420	28x20 m. m.	\$5.00	\$4.00	\$3.00	\$2.00	14,438
3421	25x21 m. m.	5.00	4.00	3.00	2.00	15,000
3422	28x20 m. m.	5.00	4.00	3.00	2.00	20,000
3423	47x35 m. m.	8.00	7.00	5.00	3.00	15,000
3424	46x32 m. m.	8.00	7.00	5.00	3.00	20,000

## CROSSED GRATINGS FOR DIRECT OBSERVATION AND LANTERN PROJECTION.

When a point of light is observed with the grating held close to the eye, eight radiating brilliant spectra of the first order and sixteen second order spectra are seen at once in the field of view, or when held in front of the optical lantern nozzle are projected upon the screen. A very effective piece of class room apparatus.

3425.	Ruled space $\frac{3}{4}$ in. square.....	Net, \$	2 50
3426.	Ruled space $1\frac{3}{8}$ in. square.....	Net,	3 50
3427.	Diffraction Grating, 14,438 lines to 1 inch, mounted upon a single glass, 2 x 2 in., for elementary work.....	Net,	1 00

## NEW REPLICA OF A MICHELSON GRATING, page 495.



No. 3428.

3428. Spectroscope, Wallace's Direct Vision Diffraction, pocket form. This instrument is modeled somewhat on the lines of that of Thorp of England, but has been much improved and rendered more adaptable for general use. The dispersion piece consists of a 15,000 line replica which is mounted upon a  $30^\circ$  prism of light crown. The only object served by the prism is to deviate the direct image of the slit, which is thus thrown to one side out of the field of view, while the brilliant spectrum of the first order is seen in direct line of sight. By directing the vision at a small angle and when using a sufficiently bright light the spectrum of the second order is readily available, which with its greatly increased dispersion is more suited for some observations.

The collimating lens is of high quality and strictly achromatic, thus enabling the Fraunhofer lines to be defined sharply throughout a greater area in the spectrum than would be possible with a simple uncorrected lens, which would bring the lines in each color to a focus at a different plane.

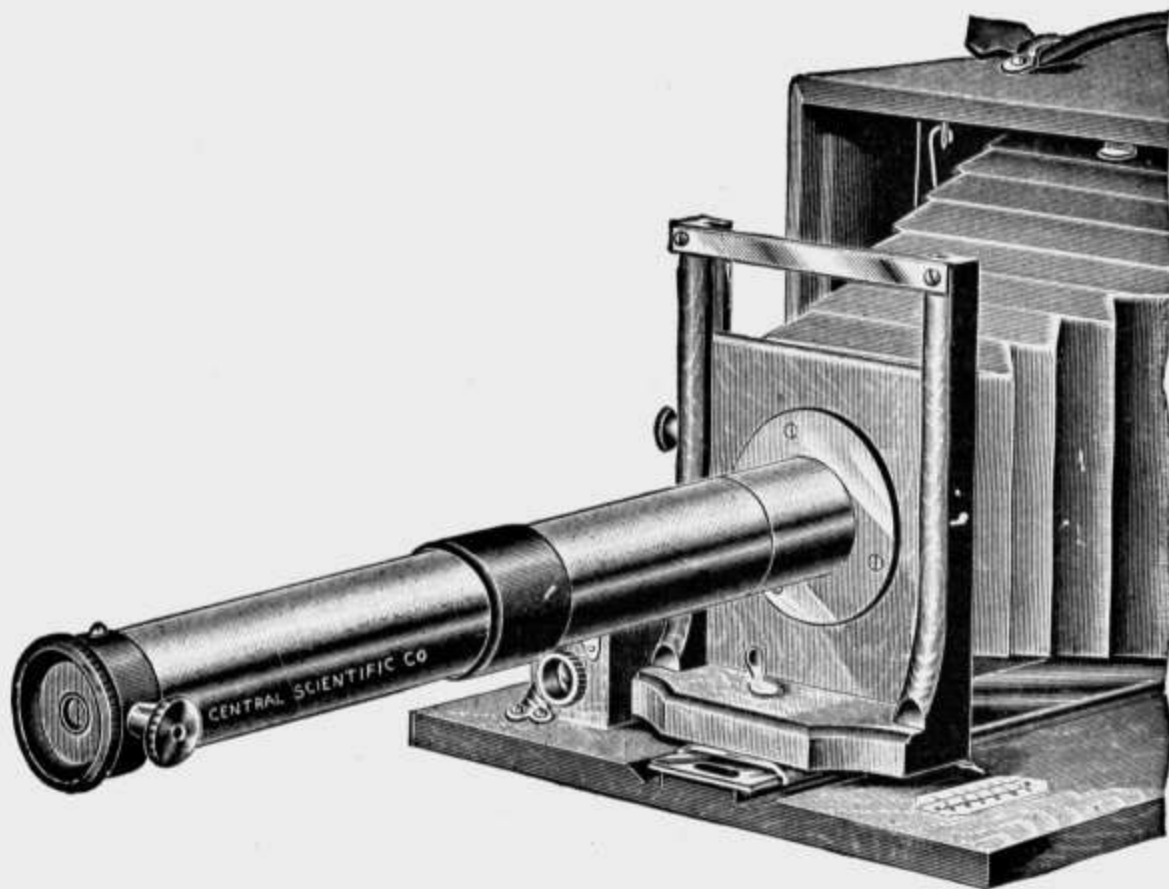
The slit mechanism is of the form usually supplied on much higher grade of European instruments and is exceedingly ingenious in pattern. It is adjustable by means of a screw with milled head, which gives a smooth and even motion to the movable jaw. With direct sunlight (or electric arc) the D lines are shown well and clearly resolved in the spectrum of the second order, and with critical focusing, even in the first order..... \$ 11 00



No. 3429.

3429. **Micro-Spectroscope, Wallace's.** The instrument fits over the ordinary eye-piece of the microscope and is instantly attached or removed without trouble. High dispersion, with direct vision, is secured by means of a Wallace grating prism of 15,000 lines to the inch, which gives a practically "normal" spectrum of much brilliancy. By an exceedingly simple and ingenious arrangement varying widths of slit diaphragms may be made use of—three of which are provided with each instrument.

Merely held in the hand close before the eye, this spectroscope eye-piece will be found an exceedingly "handy" piece of apparatus for the observation of colored flames in the chemical laboratory, etc. The instrument is manufactured of brass, handsomely finished..... \$ 8 35

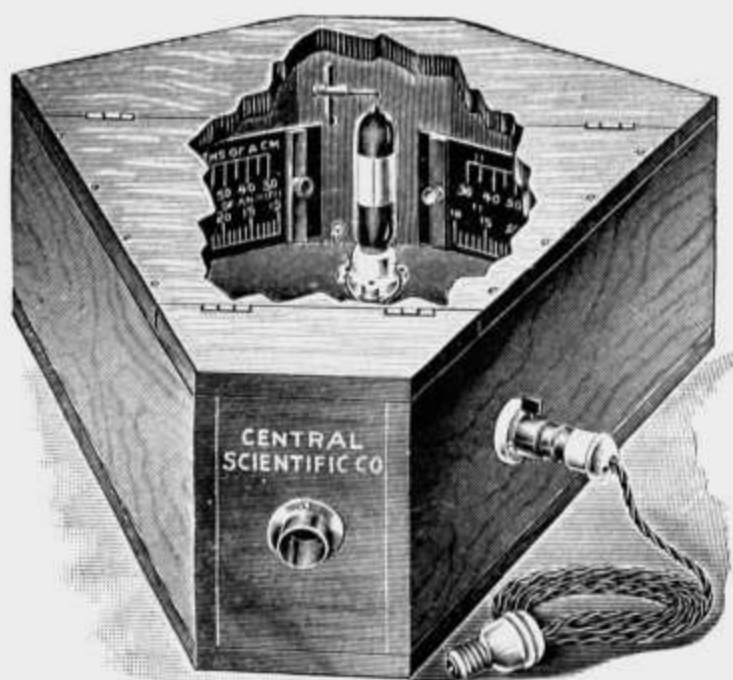


No. 3430.

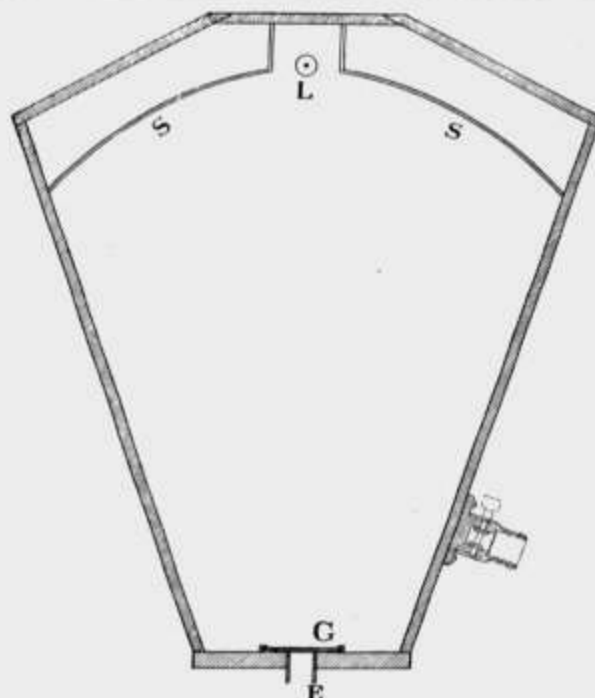
**Spectroscope Assembled and in Use as a Spectrograph.**

3430. **Spectrograph, Wallace's.** By a clearly devised arrangement of supplementary tubes and a flange, which fit the instrument, Spectroscope No. 3428 is instantly adjusted for spectrum photography with **any ordinary camera**, the flange screwing on the front board in place of the ordinary lens. The instrument has been designed of sufficient length of adjustment to accommodate any of the various makes or forms of cameras—from "short" to "long focus".....

13 50

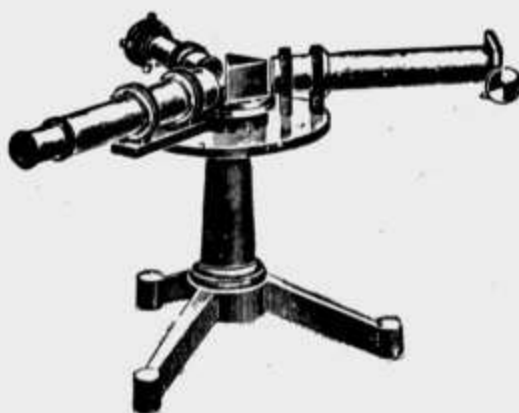


No. 3431.



No. 3431 (Diagram).

3431. **Color Wave Length Meter.** Designed for educational purposes in secondary physics, by Reinhard A. Wetzel, Department of Physics, College of the City of New York. (Not patented.) This ingenious device for directly reading wave lengths of light consists of a light-proof box in which is mounted at one end a straight filament incandescent lamp (L) and at the other a Wallace Replica Diffraction Grating (G). A scale (S) graduated in both English and metric systems is provided on both sides of the lamp. The special shape of this scale makes it possible to read directly, without parallax, the wave lengths of the spectra of the first order which are seen by viewing the lamp through the grating at an aperture (E) provided for this purpose. A holder for Pluecker spectrum tubes is provided, and when these are used instead of the straight filament lamp the wave lengths of the prominent spectrum lines may be read off to within less than 1%. Complete with 110-volt straight filament lamp, 5 feet of lamp cord, and attachment plug, but without Pluecker tubes. \$ 25.00

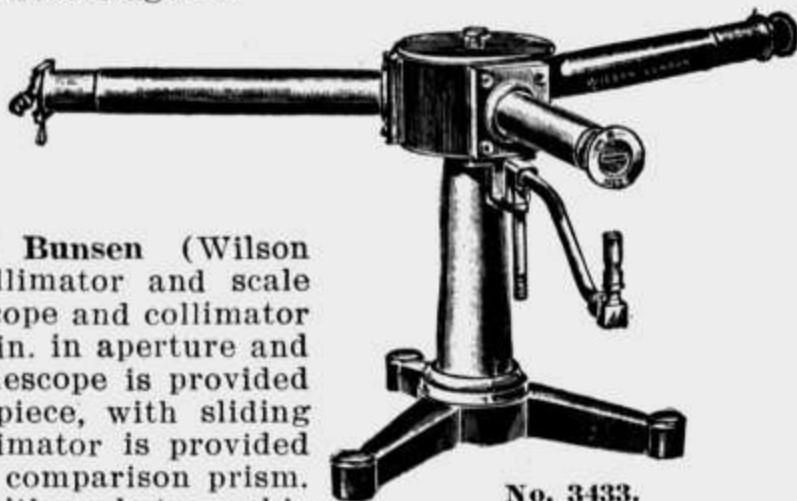


No. 3432.

3432. **Spectroscope, High School pattern.** Furnished with 60° flint glass prism of medium density, and a dispersion of 4°. Telescope is adjustable, has an aperture of 20 millimeters and a focal length of 140 millimeters. The collimator has the same dimensions and is provided with a comparison prism and a micrometer adjustable slit. A separate tube contains the scale. Mounted on neat tripod base, with provision for adjusting to any position.....Duty free 30.00

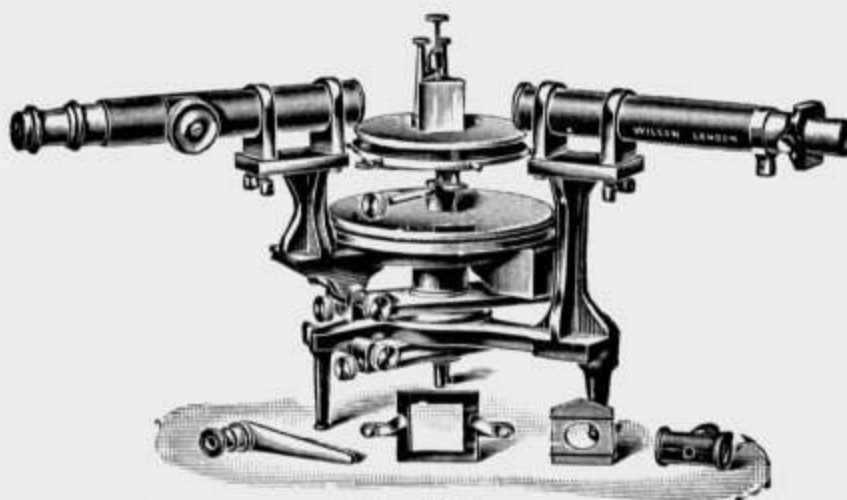
**WILSON SPECTROSCOPES AND SPECTROMETERS.**

The instruments listed on this page are manufactured by W. Wilson of London, England, of whom we are the United States agents.



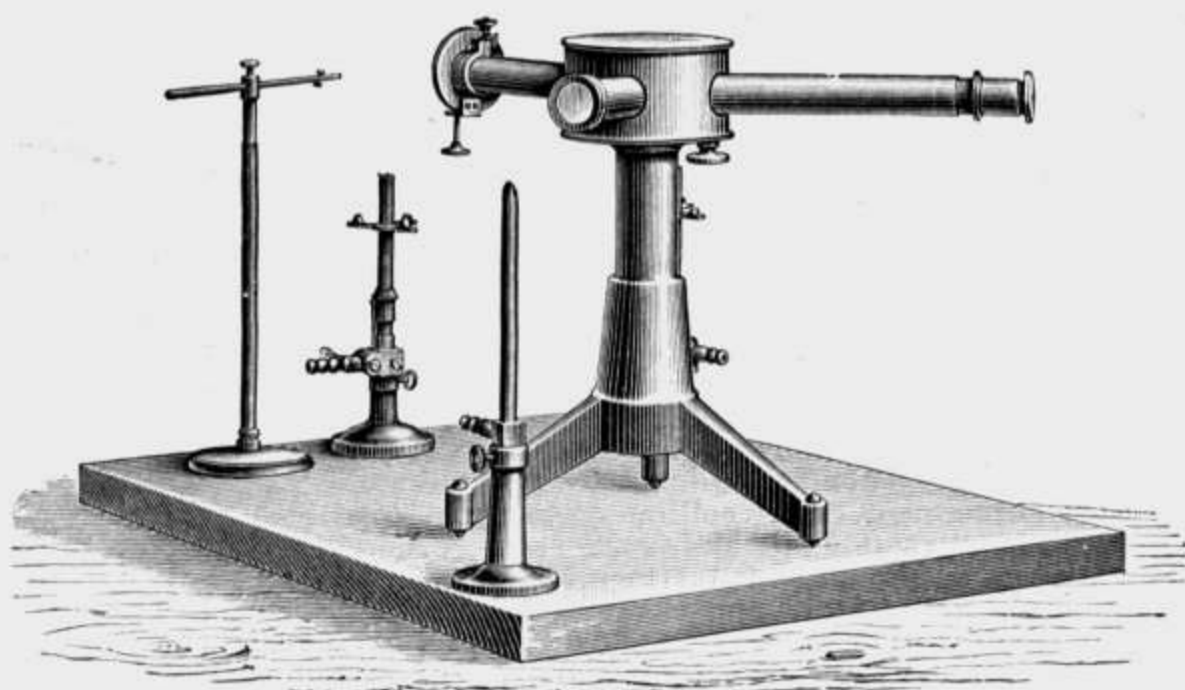
No. 3433.

3433. **Spectroscope, Kirchhoff and Bunsen** (Wilson make). The telescope, collimator and scale tube are all fixed. The telescope and collimator have object glasses about 1 in. in aperture and 10 in. focal length. The telescope is provided with one Huyghenian Eye-piece, with sliding tube adjustment. The collimator is provided with an adjustable slit and comparison prism. The scale tube is provided with a photographic fine scale, gas burner and achromatic lens. The prism is of dense flint glass  $1\frac{1}{8}$  in. high. In a good case.....Duty free \$ 30.00
- 3433A. **K. & B. Spectroscope**, same as No. 3433, but with adjustable telescope .....Duty free 33.00
- 3433B. **Rack Motion** to either telescope or collimator of Nos. 3433 and 3433A. Each .....Duty free 3.00



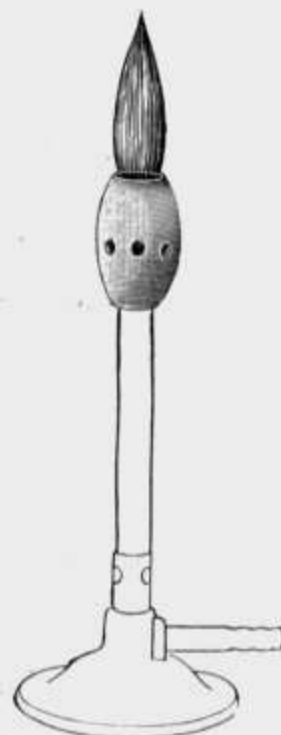
No. 3435.

3435. **Students' Spectrometer** (Wilson No. 2). This instrument was designed to meet the requirements of schools, for an inexpensive yet reliable Spectrometer. It has a protected 127 mm. circle, read by two opposite verniers to 1 minute. The circle and telescope are attached to the outer center and move together. The telescope is counterpoised and provided with cross wires, rack-motion focusing arrangement, clamp and fine adjustment. The collimator has a protected adjustable slit and clamping ring, so that it can be set for verticality and focal distance once for all. The prism table is adjustable by means of three leveling screws, and can be raised or lowered to any convenient height; it can be clamped to the inner center, which carries the vernier, and can be raised or lowered as desired. Both object glasses are about 178 mm. in focal length, with apertures of 22 mm. Adjustments are provided for setting the optical axes of telescope and collimator at right angles to the vertical axis of the instrument. Complete in case, with one eye-piece, grating holder, prism clamp for 2.5x2.9 prism or hollow prism with 1.6 cm. hole (see page 259), and magnifier for reading the verniers, but without prism .....Duty free 39.00
- 3435A. **Students' Spectrometer**, same as No. 3435, but with 228 mm. telescope and collimator .....Duty free 41.00
- 3435B. **Rack Motion** to collimator.....Duty free 3.00
- 3435C. **Comparison Prism** attached to slit.....Duty free 2.40
3436. **Spectrometer**. See Catalog K for description.....Duty free 60.00
3437. **Spectrometer**. See Catalog K for description.....Duty free 42.00
3439. **Spectrometer**. See Catalog K for description.....Duty free 36.00
3441. **Illuminating Attachment** to eye-piece.....Duty free 2.40



No. 3440.

3440. **Spectroscope for Chemists (Société Genevoise).** The metal parts are well made. The prism box is dust-proof with a screw top. The telescope has an object glass, is 23 mm. in diameter, and a double horizontal movement. The instrument has a scale tube with gas lamp for illumination. The collimator is fitted with an accurate slit adjusted by a micrometer screw and provided with a comparison prism. The analyzing prism is of flint glass, 40 mm. high, with a large dispersion insuring a good spectrum. A Bunsen burner, a support for holding the specimen to be tested, and a lamp for illuminating the scale are furnished, mounted upon a wooden base in their proper positions.....Duty free \$ 62.50
- 3440A. **Spectroscope**, same as above, without accessories.....Duty free 55.00
- 3440B. **Spectroscope**, smaller model, prism 30 mm. high.....Duty free 37.50
3441. **Illuminating Eye Piece Attachment.** See Catalog K for description ..... Duty free 2.40
3442. **Photo-Spectroscope.** See Catalog K for description ..... 100.00
3443. **Monochromatic Flame Burner**, after Mr. H. G. Dorsey of Cornell University. Will be found of great service where a continuous monochromatic flame is desired. The burner tip is composed of a porous refractory substance impregnated with a compound of salts of sodium. It is placed upon the tube of an ordinary Bunsen burner and, after warming gently, is soon heated to redness and then produces without any attention a steady sodium flame. It obviates the disagreeable features of the usual method, which ruins the burner, and has the further advantage of being cleanly. Tip only to fit standard Bunsen burner (tube diameter  $\frac{7}{16}$  inch). Each ..... .83



No. 3443.

**PRISMS FOR SPECTROSCOPES.**

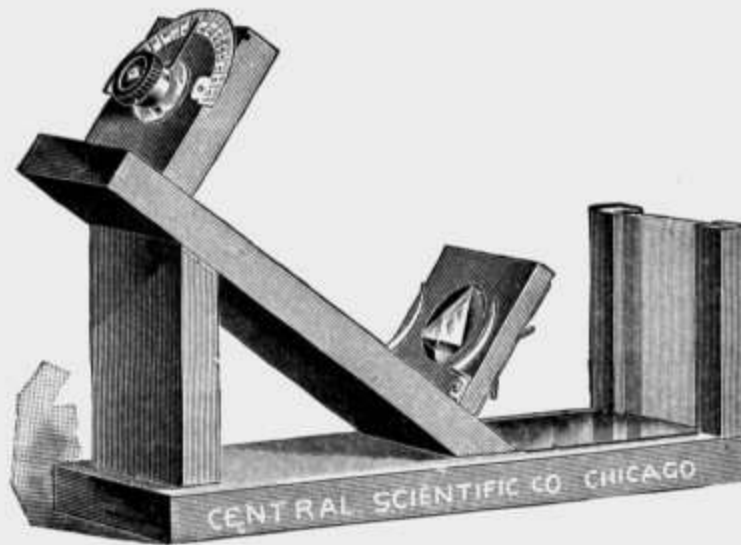
3444. Prism, Flint Glass, 60°. 25 mm. face. Refractive index about 1.62...					\$ 4.50
3445. Prisms, Crown Glass, 60°. Refractive index about 1.52.					
Size face, cm.....	2.5x2.9	2.9x3.5	3.2x3.5	3.5x4.2	
Price, Duty free.....	2.70	4.80	5.40	7.50	
3446. Prisms, Flint Glass, light, 60°. Refractive index about 1.57.					
Size face, cm.....	2.5x2.9	2.9x3.5	3.2x3.5	3.5x4.2	
Price, Duty free.....	2.70	4.80	5.40	7.50	
3446A. Prisms, Flint Glass, dense, 60°. Refractive index about 1.62.					
Size face, cm.....	2.5x2.9	2.9x3.5	3.2x3.5	3.5x4.2	
Price, Duty free.....	2.70	4.80	5.40	7.50	
3446B. Prisms, Flint Glass, extra dense, 60°. Refractive index about 1.68.					
Size face, cm.....	2.5x2.9	2.9x3.5	3.2x3.8	3.8x4.5	
Price, Duty free.....	3.00	5.40	7.50	10.50	
3446C. Prisms, Hollow, 60°.					
Size hole, cm.....		1.6	1.9	2.5	
Price, Duty free.....		3.00	7.50	10.50	
3447. Prism, Rutherford's, consisting of a flint glass prism cemented between two crown glass prisms, 25 mm. high.....					Duty free 12.00
3447A. Prism, same as No. 3447, but 30 mm. high.....					Duty free 15.00
3447B. Prism, same as No. 3447, but 40 mm. high.....					Duty free 22.50

**SPECTRUM CHARTS.**

3448. Spectrum Chart. Prang's Standard Prismatic.....	1.40
3448A. Spectrum Chart, same as No. 3448, with black wood frame close to color band .....	3.35
3449. Spectrum Chart, mounted on linen back with common rollers and containing the following spectra (size of each spectrum 5.5 cm. wide, 52 cm. long): K, Rb, Cs, Tl, Na, Li, Ca, Sr, Ba.....	4.45
3449A. Spectrum Chart, same as No. 3449, with the following spectra: In, C, Bo, Mn, Pb, Cu, Co, Ni, Fe.....	4.45

For Spectrum Tubes, see No. 2025.

**POLARISCOPES.**



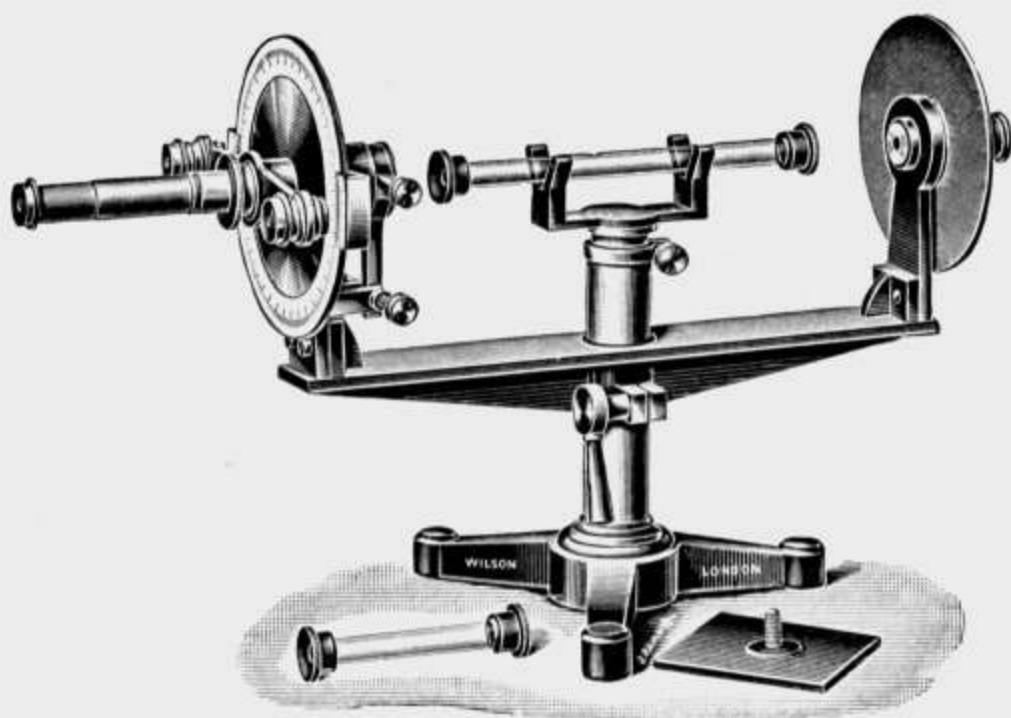
**No. 3450.**

3450. <b>Polariscope</b> , improved simple form with black glass polarizing mirror. Opening for specimens 1½ inches in diameter. A light-proof hood is supplied which permits of satisfactory demonstrations and beautiful color effects with the specimens listed on the next page in ordinary day light or with lamp light. Complete with 6 mm. Nicol prism mounted in brass tube with pointer and graduated arc.....	8.35
3450A. <b>Polariscope</b> , same as No. 3450, with 7 mm. prism.....	9.50
3450B. <b>Polariscope</b> , same as No. 3450, with 8 mm. prism.....	10.00
3451. <b>Magnifier</b> , for either of the above.....	1.00

For **Polariscope Preparations**, see page 261.

3452. **Polarized Light Demonstration Apparatus**, page 496.





No. 3453.

3453. **Polarimeter (Wilson No. 1).** This instrument is designed primarily for teaching purposes, and is so constructed that the various methods of measuring the rotation of the plane of polarisation can be carried out in the same instrument. It is thus possible to compare the different methods and to show the student any advantage one method may have over another for any specific purpose. The transformation of the instrument from one type to another is rapidly and easily made. Starting with the plain instrument, the accessories listed below can be added, so as to obtain any type of polarimeter or saccharimeter in current use, and this without sacrifice of accuracy. The Polariser and Analyser are mounted at the ends of a strong iron bar, which slides up or down, and can be clamped to a stout vertical pillar supported by a heavy iron tripod. A stout draw tube slides within the vertical pillar, and can be clamped thereto. It carries the supports for solution tubes, troughs, etc. At one end of the iron bar are fixed the Nicol-prism Polariser and collimating lens; at the other end are fixed the Nicol-prism Analyser and observing telescope. The Analyser is mounted in a vertical circle read by two opposite verniers to .01 degree; provided with clamp and fine adjustment and two small reading microscopes. Price, in case, with two solution tubes.....Duty free \$ 72.00
- 3453A. **Biquartz**, fitted to No. 3453.....Duty free 4.50
- 3453B. **Laurent Half-Shadow Quartz Plate**, with index and graduated arc, fitted to No. 3453.....Duty free 7.50
- 3453C. **Poynting's Quartz Plate**, fitted to No. 3453.....Duty free 6.00
- 3453D. **Lippich Two-Prism Polariser**, fitted to No. 3453.....Duty free 21.00
- 3453E. **Soleil Quartz Wedges and Compensation Plate**, with scale and vernier and rack motion adjustment, fitted to No. 3453.....Duty free 30.00
- 3453F. **Solution Tubes**, 100, 150, 200, 250, 300 millimeters, each.....Duty free 2.40
- 3453G. **Apparatus to convert No. 3453 into a Wild's Polaristrobometer**..... Duty free 18.00
- 3453H. **Light Filter**, to fit over collimating lens of No. 3453.....Duty free 2.40
3455. **Noerrenberg's Polariscope**. See Catalog K for description..Duty free 30.00

For other **Polariscopes**, see No. 5172 in this catalog and No. 3437 in Catalog K.

**POLARISCOPE PREPARATIONS AND ACCESSORIES.**

3331.	Gypsum Figure, plain, 4 strips, 4 colors.....	\$	2.20	
3331A.	Gypsum Figure, cube, in 3 colors.....		2.75	
3331B.	Gypsum Figure, octahedron, in 4 colors.....		3.35	
3331C.	Gypsum Figure, star, in 6 colors.....		5.00	
3332.	Holder, for compressing No. 3333 Glass Blocks to show same effect as unannealed plates .....		2.25	
3333.	Annealed Glass, rectangular block 1x1x $\frac{3}{8}$ in., to fit No. 3332 Holder..		1.10	
3335.	Selenite Films (Gypsum), after Mueller. Set of eight different colors		8.00	
3336.	Unannealed Glass Plate, square.....		1.10	
3337.	Unannealed Glass Plate, rectangular.....		1.10	
3338.	Unannealed Glass Plate, round.....		1.10	
3339.	Unannealed Glass Plate, triangular.....		1.10	
3341.	Mica Plate, square, large, quarter wave.....		2.50	
3342.	Mica Plate, round, medium, quarter wave.....		1.65	
3343.	Mica Plate, round, small, quarter wave.....		1.10	
3344.	Mica Plate, round, small, half wave.....		1.10	
3345.	Mica Plate, round, small, whole wave.....		1.33	
3460.	Black Mirrors, in mahogany frame.			
	Size, cm. ....	10x20	15x30	20x40
	Each .....	Duty free 3.50	6.30	10.50



Nos. 3465-3467.

3462.	Iceland Spar Rhombohedron. See Catalog K for description. Duty free	4.50
3463.	Iceland Spar Rhombohedron. See Catalog K for description. Duty free	5.40
3464.	Iceland Spar Rhombohedron. See Catalog K for description. Duty free	8.50
3465.	Iceland Spar, showing double refraction, ordinary quality.....	.28
3466.	Iceland Spar, medium quality .....	.40
3467.	Iceland Spar, best quality .....	.90
3468.	Iceland Spar Prism. See Catalog K for description.....Duty free	6.00



No. 3469.



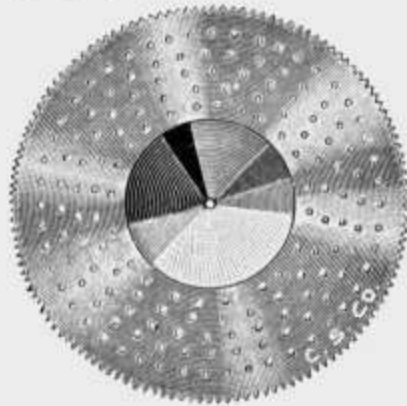
Nos. 3473-3474.

3469.	Tourmaline Tongs .....	2.25		
3470.	Tourmaline Tongs, superior quality, large size tourmaline plates of the same degree of density.....Duty free	11.00		
3473.	Nicol's Prisms, for polarization, diagonal face, rhomboidal section.			
	Size of face, millimeters.....	6	7	8
	Each .....	3.35	5.00	5.55
3474.	Nicol's Prisms, same as No. 3473.			
	Size of face, millimeters.....	15	20	25
	Each .....	Duty free 9.00	22.25	45.00

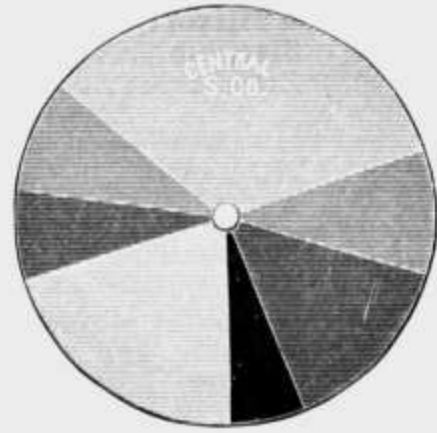
3476.	Glass Plate, of best "pot glass" color, 10 cm. square, Violet.....	\$ 0.10
3477.	Glass Plate, same as No. 3476, Indigo.....	.10
3478.	Glass Plate, same as No. 3476, Blue.....	.10
3479.	Glass Plate, same as No. 3476, Green.....	.10
3480.	Glass Plate, same as No. 3476, Yellow.....	.10
3481.	Glass Plate, same as No. 3476, Orange.....	.10
3482.	Glass Plate, same as No. 3476, Red.....	.10
3485.	Gelatin Film, imported, 8x10 inches, Violet .....	Per sheet .15
3485A.	Gelatin Film, imported, 8x10 inches, Indigo .....	Per sheet .15
3485B.	Gelatin Film, imported, 8x10 inches, Blue .....	Per sheet .15
3485C.	Gelatin Film, imported, 8x10 inches, Green .....	Per sheet .15
3485D.	Gelatin Film, imported, 8x10 inches, Yellow .....	Per sheet .15
3485E.	Gelatin Film, imported, 8x10 inches, Orange .....	Per sheet .15
3485F.	Gelatin Film, imported, 8x10 inches, Red .....	Per sheet .15
3485G.	Gelatin Film, imported, 8x10 inches, White .....	Per sheet .15
3486.	Electric Color Top, page 497.	



No. 3487.



No. 881.



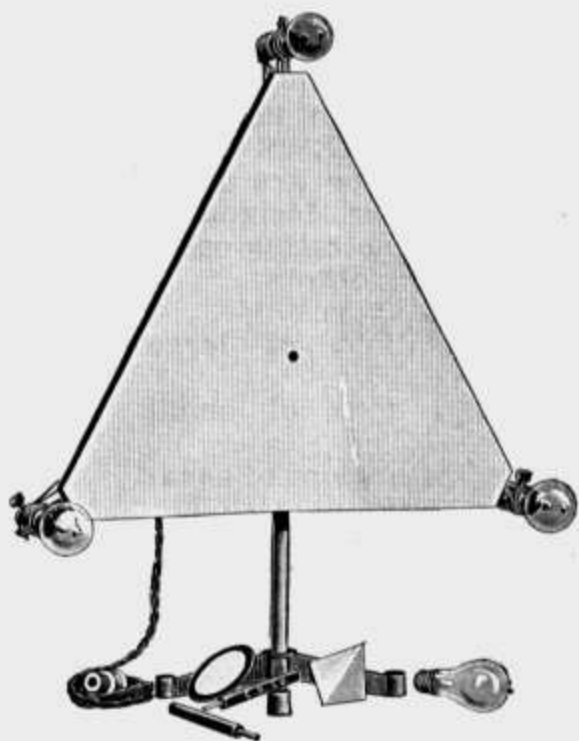
Nos. 885-887.

3487.	Color Tops, for student use in the study of colors and their complements, etc. Complete, with 8 discs 1½ inch, 8 discs ¾ inch, and graduated disc. Per dozen.....	.90
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**ROTATOR ACCESSORIES.**

881.	Combined Acoustic and Color Disc, 10 inches in diameter, combining a Siren, Savart's Wheel, and a Newton's Color Disc. The disc is made of heavy metal, which prevents its vibration when being rotated .....	1.50
885.	Newton's Color Disc, 8 inches in diameter, made of heavy zinc so as not to warp. The seven primary colors are obtained by using the imported Hering papers (for description see No. 890).....	.90
887.	Newton's Color Disc, of heavy cardboard, covered with same imported papers as on No. 885.....	.55
888.	Color Discs, two sets of eight discs each. Each set has graduated disc for quantitative work in color mixing. Illustrates shading, blending, changing of colors, complementary colors, Maxwell's cut color discs, etc. ....	1.00
890.	Hering's Colored Paper Discs. The colored papers of Prof. Hering are justly celebrated for their purity of color, uniformity and absence of gloss. They were originally produced for experimental work in psychological laboratories, but are especially adapted for all color work in physics. Furnished in discs 20 cm. in diameter in the following colors: Violet, indigo, blue, green, yellow, orange, red, black and white. Per sheet.....	.11
891.	Hering's Colored Paper Discs. Complete set of 9 discs as described under No. 890.....	.80

For Rotators, see pages 81 to 83.



No. 3488.

3488. **Color Mixer**, as described in Donath's "Principles of Color Photography." An equilateral wood triangle with sides about 70 cm. long, painted white on the front surface, is provided with incandescent lamps at the 3 corners, each of which can be turned on and off independently of the others. These lamps approximate closely in color to the primary colors of the Young-Helmholtz Color Theory. A lamp with frosted bulb, two cylindrical rods, one small wood pyramid, and one white disc with black border are also provided. With this apparatus the following experiments may be performed:

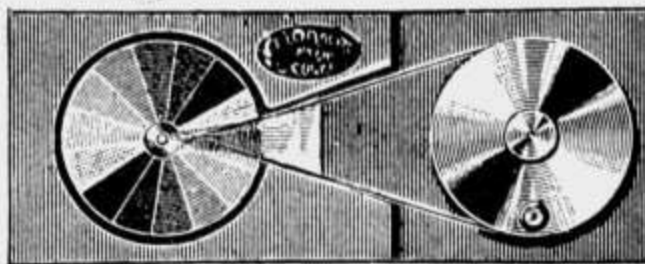
- (1) With all three lamps turned on there will be found at different points on the triangle colors due to the addition of the three colors in different proportions.
- (2) With a shadow-throwing body, such as a rod, in the center of the triangle, the shadows will be complementary to the primary colors.
- (3) When the shadow-throwing body is moved, the shadows will change through all color shades.
- (4) With two rods set up so that their shadows cross, the third primary color will show at the point of intersection.
- (5) When a triangular pyramid is attached to the center of the triangle so that one surface is towards each of the three lamps, the surfaces will show the primary colors and the three shadows will show the corresponding complementary colors.
- (6) With two lamps turned on and a rod placed at the center of the triangle, there will be two shadows with the colors of the lamps. When one of the three lamps is replaced by a white one and this, together with the red is turned on, the shadow thrown by the red lamp will appear green; by the green lamp, carmine; and by the blue lamp, yellow. These are subjective colors which correspond to the complementary colors, for the shadow is not colored, but black, as may be seen by turning out the white lamp.

Complete with set of three colored 110-volt lamps, one frosted white 110-volt lamp, two cylindrical rods, one wood pyramid, and one white disc with a black border for use in observing the colors..... \$ 20.00

3488A. Set of Three Colored Lamps for No. 3488..... Net 5.00



No. 3489.



No. 3495.

3489. **Newton's Rings**. A pair of lenses  $1\frac{1}{2}$  inches in diameter, one plane, the other plano-convex, mounted in brass frames, with three compression screws which also act as legs, showing interference of light 1.50

3495. **Mechanical Slide**, for color mixing, after Newton, for projection. The wooden frame with the painted glass discs and the rotating apparatus are placed in the front of the condenser of a projecting lantern in place of the usual slide carrier.....Duty free 6.00

3496. **Holmgren Test Wools**, page 497.

3491. Rainbow Cup, page 497.



**3498. Stroboscopic Cylinder and new views by Prof. Quincke.**

This instrument is made by ourselves and is much superior to the cheap German toy usually sold. It is 28 cm. in diameter, with 22 slits. The VIEWS which accompany this stroboscope are 18 in number and are the latest designs by PROF. QUINCKE for illustrating oscillation and vibration, as follows:

1. Vibration of a pendulum.
2. Longitudinal vibrations of large amplitude.
3. Longitudinal vibrations of small amplitude.
4. Two longitudinal vibrations of equal amplitude and different period.
5. Transverse vibrations (plane polarized light, vibrations vertical).
6. Vibrations (plane polarized light 30° from vertical).
7. Vibrations (elliptically polarized light).
8. Vibrations (circularly polarized light).
9. Reflection of rope waves at free end of rope.
10. Reflection of rope waves at fixed end of rope.
11. Vibrations of a string sounding a simple tone.
12. Vibrations of a string plucked at one-third its length.
13. Motion of the air layers in a closed pipe.
14. Pressure of the air for the vibrations in a closed pipe.
15. Production of combination tones by rapid rotation of the stroboscope.
16. Vibration of liquid particles at different depths in a wave trough.
17. Vibration of liquid particles at different depths in running water.
18. Progressive transverse waves with rectilinear track of the particles.

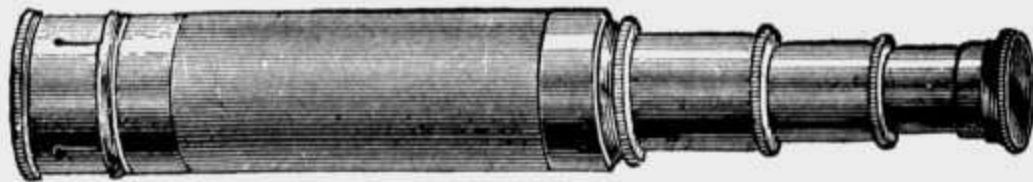
**No. 3498.**

- Complete, on stand for rotating by hand, with views as above..... \$ 7.50  
 3498A. Stroboscope, same as No. 3498, complete with views as described above, except without tripod; for use with Nos. 829 to 841 Rotators 6.65



**No. 3499.**

3499. Camera Obscura, students' form of wood, according to Hall and Bergen. Consists of two telescoping boxes, one with pin hole, the other with ground glass plate. Excellent for showing principle of photographic camera and formation of images ..... .70  
 3500. Stereoscope, hardwood, neatly finished, with handle..... .75  
 3500A. Stereoscope Slides, Martius-Matzdorff, to show luster of crystals. Set includes 12 slides. Per set..... 1.55



**No. 3501.**

**TERRESTRIAL TELESCOPES.**

Metal body, covered with morocco, polished brass draw tubes, achromatic objective with cap, and sliding eye piece cover.

Cat. No.	Number of sections.	Full length, inches.	Closed length, inches.	Diam. of objective glass.	Power, times.	Range, miles.	Price.
3501	4	14¾	5¼	¾	10	5	\$ 2.50
3502	4	16½	6	1	15	6	3.00
3503	4	23	8	1½	25	9	5.00
3504	4	29	10	1¾	30	10	6.65
3505	5	36	11	1¾	35	14	10.50
3506	5	42	11½	2¼	40	18	16.75



No. 3515.

3515. **Prism Binocular**, for Nature Study. This superior prism binocular meets a general demand for a "Stereo" instrument—an instrument increasing the sense of perspective—at a price considerably less than that of the more expensive makes, yet so well equipped mechanically and optically as instantly to command confidence.

**Specifications.**

Magnification .....	8 diams.
Object glass .....	$\frac{3}{4}$ inch.
Field of view at 1000 yds.....	95 yds.
Height .....	4 $\frac{1}{2}$ inches.
Weight .....	18 oz.

Bodies aluminum, japanned, and covered with black morocco leather. Eye-piece adjustable for different strength of eyes; adjustment for pupillary distance. Universal focussing attachment.

Furnished in a sole leather case, hand sewed and velvet lined, provided with an improved spring catch enabling case to be opened or closed with one hand. In addition to the outside carrying strap there is also an adjustable shoulder strap attached to the glass itself \$ 25.00

**ASTRONOMICAL TELESCOPES.**



No. 3521.

3521. **Telescope, Astronomical**, brass body, 40 inches long, achromatic objective 3 inches in diameter, in which the spherical and chromatic aberrations are well corrected. One terrestrial eye-piece, power 50 times, and one celestial eye-piece, power 125 times, with sunshade. Rack and pinion for focussing. Mounted on iron tripod with adjustment for both vertical and horizontal movements. Complete, in strong hardwood case .....Duty free

46.20

- 3522. **Telescope, Astronomical**, same as No. 3521, with addition of a fine achromatic finder with cross wires.....Duty free \$ 52.50
- 3523. **Telescope, Astronomical**, same as No. 3521, but mounted on a strong tripod of hardwood instead of iron.....Duty free 48.40
- 3524. **Telescope, Astronomical**, same as No. 3523, with the addition of a fine achromatic finder with cross wires.....Duty free 57.50

3525. **Telescope, Astronomical**, finely finished brass body with rack and pinion movement for adjustment of focus, very smooth and steady altitude and azimuth movements. Mounted upon a heavy mahogany tripod, giving the instrument great steadiness. A crank movement with rack and pinion raises the body to any desired height, so that observations may be taken either sitting or standing. Achromatic objective 3 in. in diameter; 2 terrestrial eye pieces, 50 and 75 powers; 2 celestial eye pieces, 75 and 125 powers; achromatic finder with cross wires. Complete, in hardwood case with carrying handles and lock and key. ....Duty free 127.50

3527. **Telescope, Astronomical**, same as No. 3525, with achromatic objective 4 in. in diameter; 2 terrestrial eye pieces, 65 and 85 powers; 3 celestial eye pieces, 85, 150 and 250 powers, with finder, case, etc..... Duty free 250.00

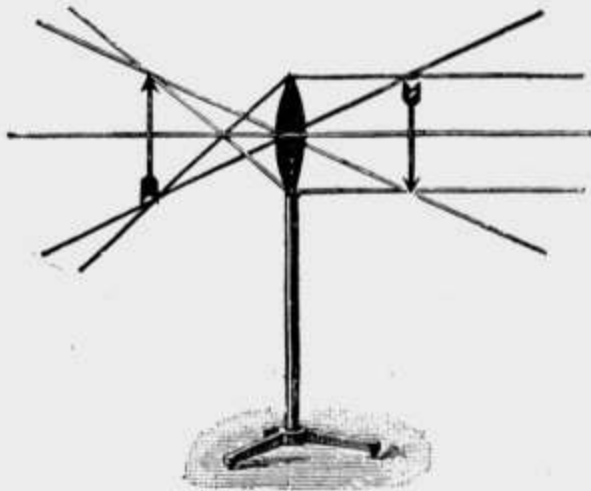


No. 3525-3527.

No. 3548.

**LILLIPUTIAN PROJECTION LAMP.**

Illustrated and described on page 497.



No. 3538.

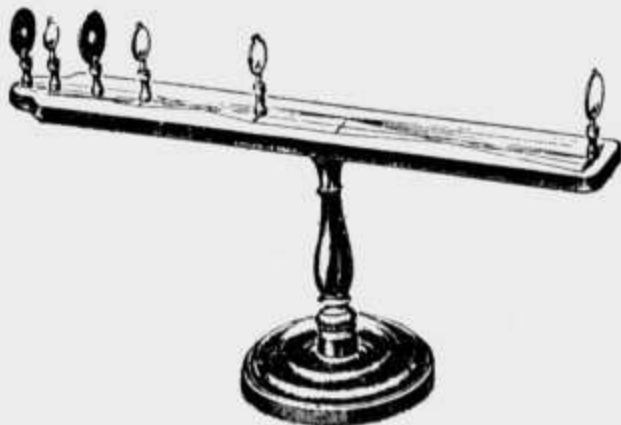


No. 3543.



No. 3544.

- |       |   |         |
|-------|---|---------|
| 3535. | Model of a Concave Mirror, after Muehlenbein, with fixed and movable colored rods for demonstrating the path of the rays and the relations between the object and image, 40 cm. high by 35 cm. long.<br>.....Duty free                  | \$ 6.60 |
| 3536. | Model of a Convex Mirror, after Muehlenbein, similar in construction and dimensions to No. 3535.....Duty free   | 6.60    |
| 3538. | Model of a Convex Lens, after Muehlenbein, similar in construction to No. 3535, 40 cm. high by 60 cm. long.....Duty free  | 7.20    |
| 3539. | Model of a Concave Lens, after Muehlenbein, similar in construction to No. 3535.....Duty free   | 7.20    |
| 3542. | Model of a Compound Microscope, with lenses, diaphragms and stage mounted in plain view on a base, upon which the paths of the rays are indicated by lines; excellent for demonstration. Model 18 cm. high by 20 cm. long.....Duty free | 4.50    |
| 3543. | Model of a Galilean Telescope, similar to No. 3542 in construction and design; 18 cm. high by 14 cm. long.....Duty free   | 2.50    |
| 3544. | Model of an Astronomical Telescope, similar to No. 3543 in construction and design; 18 cm. high by 18 cm. long.....Duty free  | 3.00    |



No. 3545.

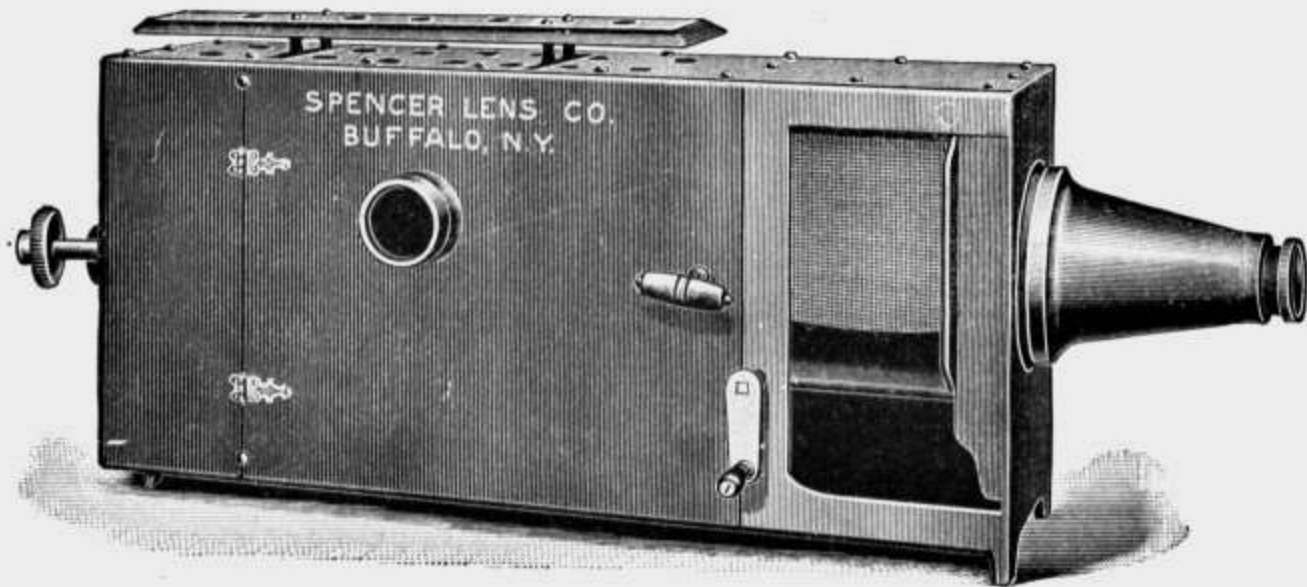


No. 3547.

- |       |  |      |
|-------|--|------|
| 3545. | Model of a Terrestrial Telescope, similar to No. 3543 in construction and design; 18 cm. high by 38 cm. long.....Duty free       | 4.80 |
| 3546. | Model of Newton's Reflecting Telescope, similar to No. 3543 in construction and design; 21 cm. high by 30 cm. long.....Duty free | 5.40 |
| 3547. | Model of a Brachio-Telescope, similar to No. 3543 in construction and design; 20 cm. high by 14 cm. long.....Duty free           | 6.00 |



## DELINEASCOPIES.



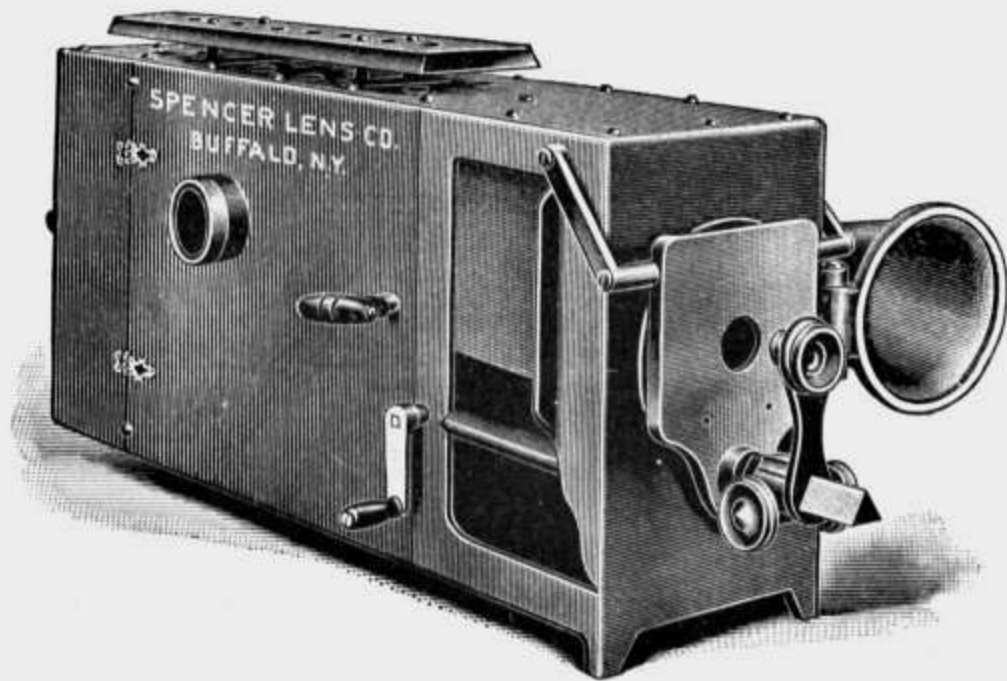
No. 3550 (Fig. 1).

3550. **Spencer Delineascope (Model 2).** The rectangular metal case is 21" long, 10½" high and 6" wide. It is made up of an angle iron frame work covered with enameled sheet iron. A partition partly separates the lamp house proper from the lantern slide chamber. Two parallel rods run between this partition and the back of the case. The hand feed lamp (for either direct or alternating current) is supported on these rods, as are also the condensing lenses and water cell, W.C. Fig. 3. The lenses and water cell may easily be removed for cleaning.

The lamp itself is simply constructed. The working parts are placed as far as possible away from the arc, and are otherwise protected to avoid injury from the heat of the arc. The carbons are manipulated by two concentric buttons at the back of the case. The crater is centered by two buttons, located near to the concentric buttons just mentioned, and is focused to and from the condensers by sliding the lamp on the parallel rods.

This DELINEASCOPE is equipped with the new SPENCER TRANSPOSER for handling the lantern slides. This transposer is entirely new and excels by far any method yet produced for safety, convenience and accessibility. Not only are the slides interchanged in this simple and suitable way but the pictures on the screen are transposed in a way as pleasing to the eye as the old dissolving views, and but one lamp is necessary. The effect is more like that produced by the moving picture machine. The new picture is on the screen before the retina takes cognizance of the change. The slide, S, is placed on the platform, P, Fig. 3, and pushed in until it stops. The slide is raised to a perpendicular position in the focal plane of the objective by turning the lever, L, through 90°. When the slide has passed through about 60°, the slide S<sup>2</sup>, which has been pictured on the screen, recedes from the objective, and is finally released to slide down the inclined plane to a position immediately beneath the platform on which it was placed, from whence it should be removed by simply picking it up. There is no more danger of injury to the slides than in handling them in the old-fashioned way.

The projection objective is mounted in a conical bearing which is hinged to the front of the metal case. A stud is screwed through this bearing into a spiral groove cut into the mounting of the objective. By this means the objective is very comfortably focused by simply turning it, giving at the same time a smoother movement than may be obtained by a rack and pinion.



No. 3550 Delineascope (Fig. 2), with No. 3580 Micro-Attachment.

Shows projection objective and mounting folded back out of the way, and Micro-Attachment in position ready for use.

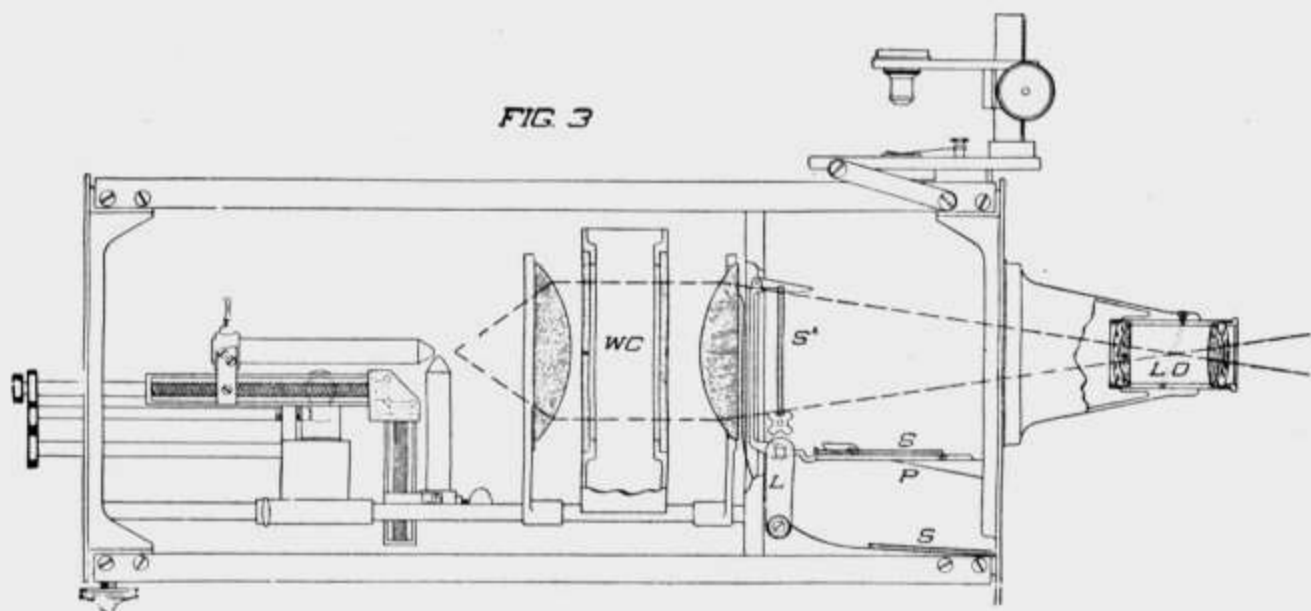


FIG. 3

No. 3550 Delineascope, Longitudinal Section.

Shows Micro-Attachment out of commission on top of the apparatus, and entirely out of the way. It is easily thrown to the working position as illustrated below.

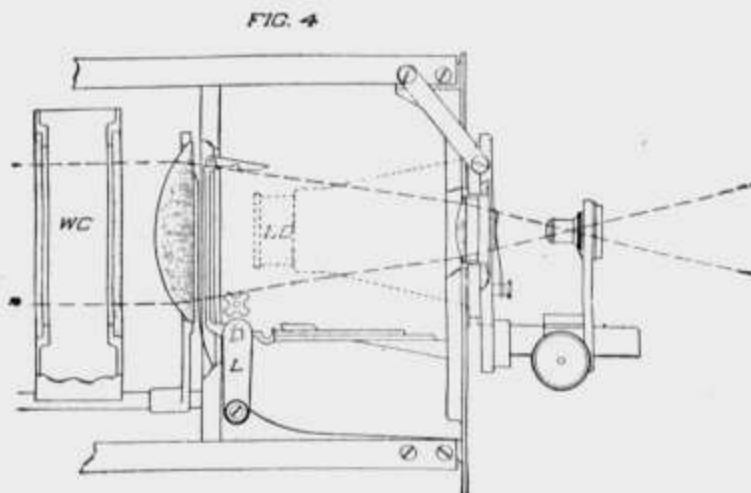
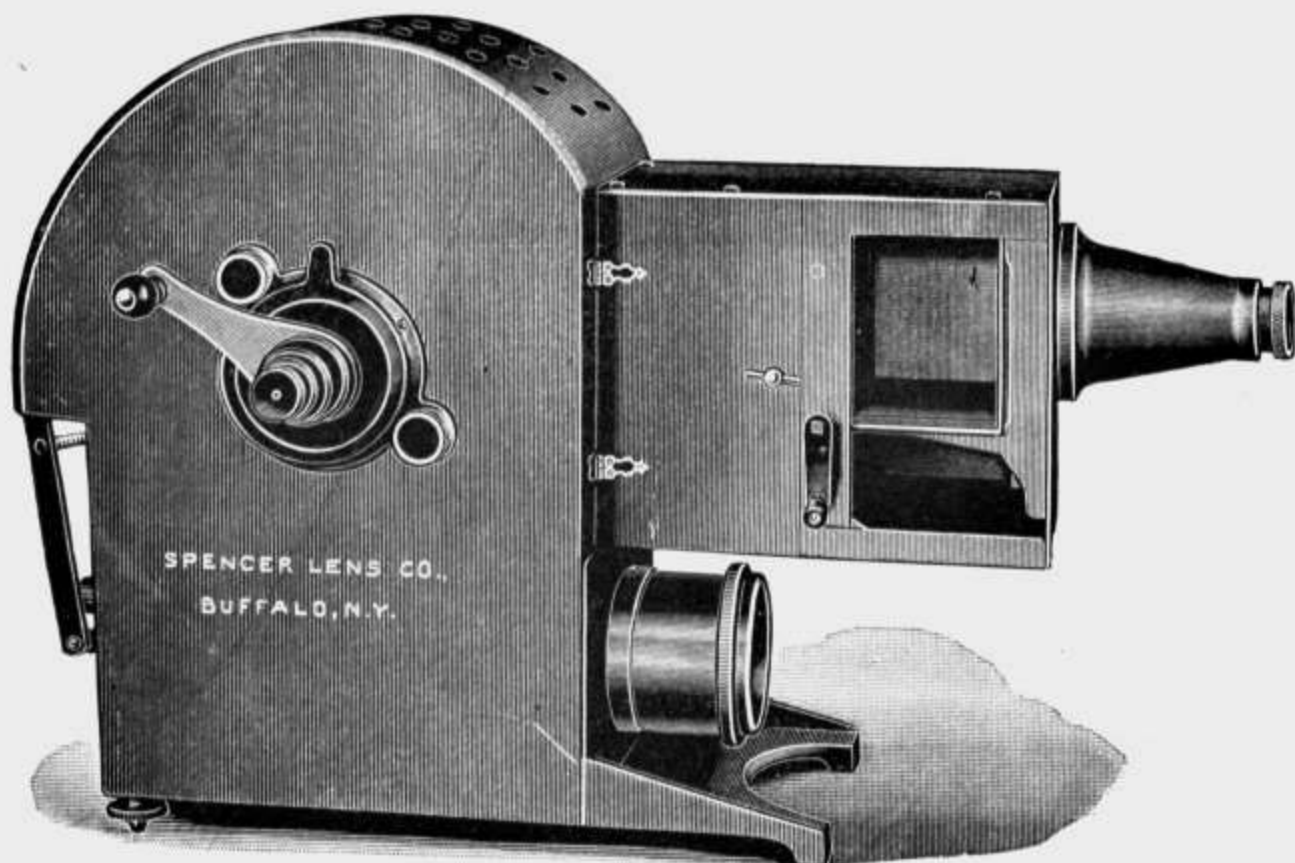


FIG. 4

For prices, see page 274.



Nos. 3560-3563 (Fig. 1).

3560-3563. **Spencer Delineascopes (Model 4).** For efficiency, compactness and convenience this apparatus is not equalled by anything in the line of medium priced projection apparatus. By placing the lamp and the line of light used for transparent projection above the optical axis of the lens used for opaque projection, the space necessary for the opaque projection is also utilized to make a large, well ventilated, light-tight lamp house which will not heat as does a smaller lamp house.

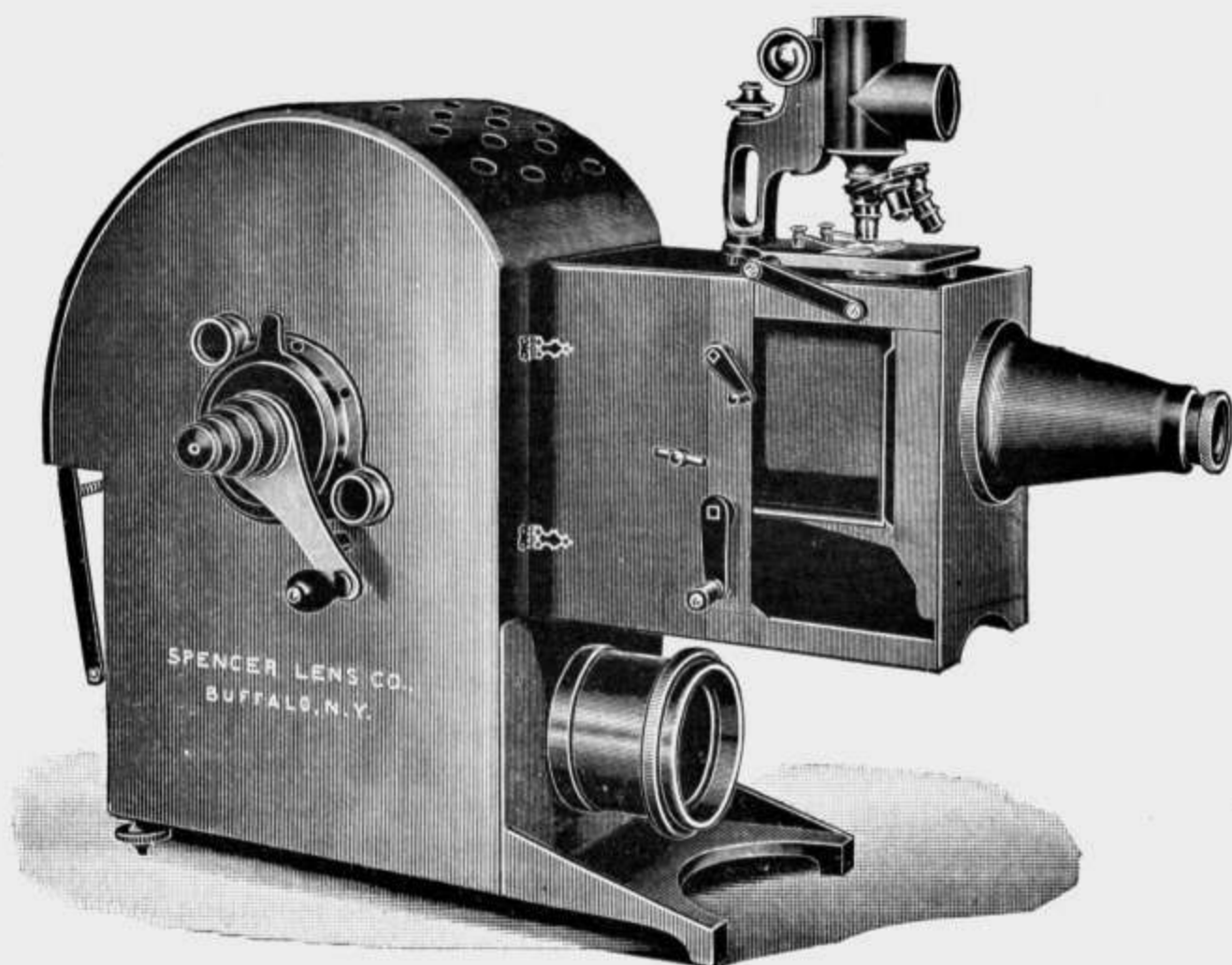
The main portion of the DELINEASCOPE is  $21\frac{1}{2}$ " tall, 9" wide, and 13" from back to front. The smaller projecting part is  $9\frac{1}{2}$ " tall, 6" wide, and 10" from the main part to the front.

The locating of the lamp as described above can be accomplished to advantage only where the lamp and its condensing lenses revolve on a horizontal axis (X, Figs. 3 and 4). When the handle, by which the lamp is revolved, is located as shown above in Fig. 1, the lamp is in position for opaque work. (See Fig. 3, Page 272). When the handle is in the position indicated in Fig. 2 (next page) the lamp is in position for lantern slides and micro projection (see Fig. 4, Page 272). The lamp is the new SPENCER hand feed lamp in which all of the adjustments are concentric with one another and with the axis on which the lamp and condensers revolve. There are, therefore, no slots or other openings in the lamp house for the escape of light. Moreover, the adjustments are in the most accessible position, being but a few inches from the opaque, lantern slide, or micro attachments.

In front of the arc is placed a lens system composed of a Meniscus lens  $5\frac{1}{2}$ " in diameter and a plano convex lens 6" in diameter. When used for opaque projection this illuminates an elliptical area practically 6" in its shortest diameter.

The photograph, post card, or page of book which is to be projected is held in position on the rectangular object holder (OH, Figs. 3 and 4, page 272) at the back of the apparatus. This holder revolves on a horizontal axis and may be pulled out and tipped to any desired angle by the large handle, H. The object can therefore be comfortably put in from the top or the side, as the operator may desire. Heavy springs automatically hold the object holder firmly in place and the object in the focal plane of the objective.

## Nos. 3560-3563 DELINEASCOPES (Continued).



Nos. 3560-3563 (Fig. 2).

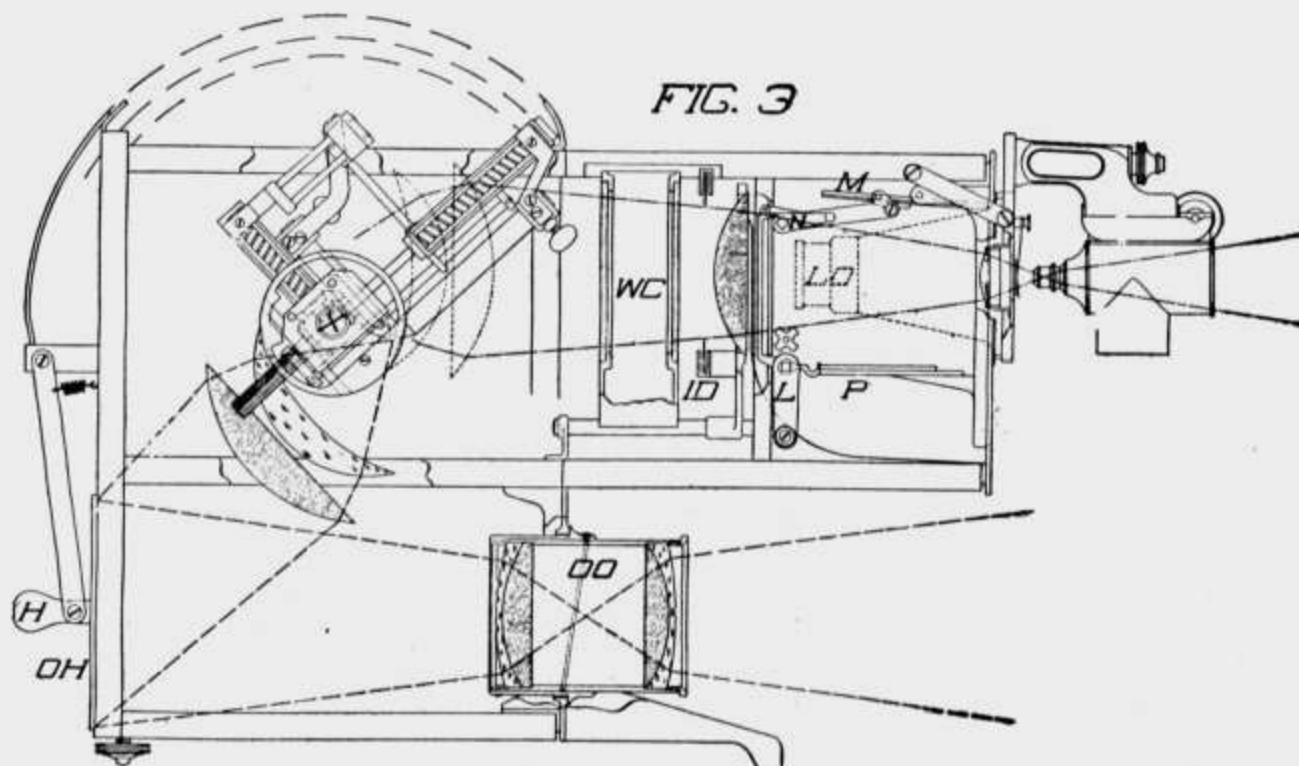
Showing No. 3584 Micro-Attachment in Horizontal Position.

The lenses of the objective, OO, page 272, for opaque projection are 4" in diameter and are mounted in a heavy brass tube with a spiral groove cut in its outer surface. The objective is fitted into a metal sleeve, and a stud from this sleeve works into the spiral groove in the objective. The objective, therefore, is very comfortably focused by simply turning it, doing away with the binding and sticking which accompanies the rack and pinion movement on such objectives.

To change from opaque projection to lantern slides or micro work it is only necessary to swing the lever on the outside of the case from the position occupied in Fig. 1 to that shown in Fig. 2. The light rays then follow the course indicated in Fig. 4, passing through the water cell and condenser just back of the slide, S2.

The lantern slides are operated by the new SPENCER TRANSPOSER, the equal of which has never been offered (See description on page 268). Any of the micro attachments may be added to this apparatus (See Figs. 2, 3 and 4). No. 3584 Micro-Attachment is the one shown in above illustration, and is the one regularly sent out with this Delineascope. When this microscope is in position as indicated in Figs. 2 and 4, the mirror, M, is dropped by the little lever, N, on the outside of the case to the position indicated by the dotted lines in Fig. 4. By this mirror the axis of the beam of light is reflected to a perpendicular position, passes through the stage of the microscope and the microscope objective to a prism just above the objective where it is reflected to a horizontal position. The microscope with the stage in a horizontal position permits the use of fluid mounts and other specimens which could not be used on a perpendicular stage (See Fig. 3). The microscope may be easily thrown from one position to the other. Before bringing it to the position indicated in Fig. 3 it is necessary to swing the cone shaped support of the projection objective on its hinge to a position on the far side of the apparatus as indicated by the dotted lines. (Continued on next page.)

## Nos. 3560-3563 DELINEASCOPIES (Continued).

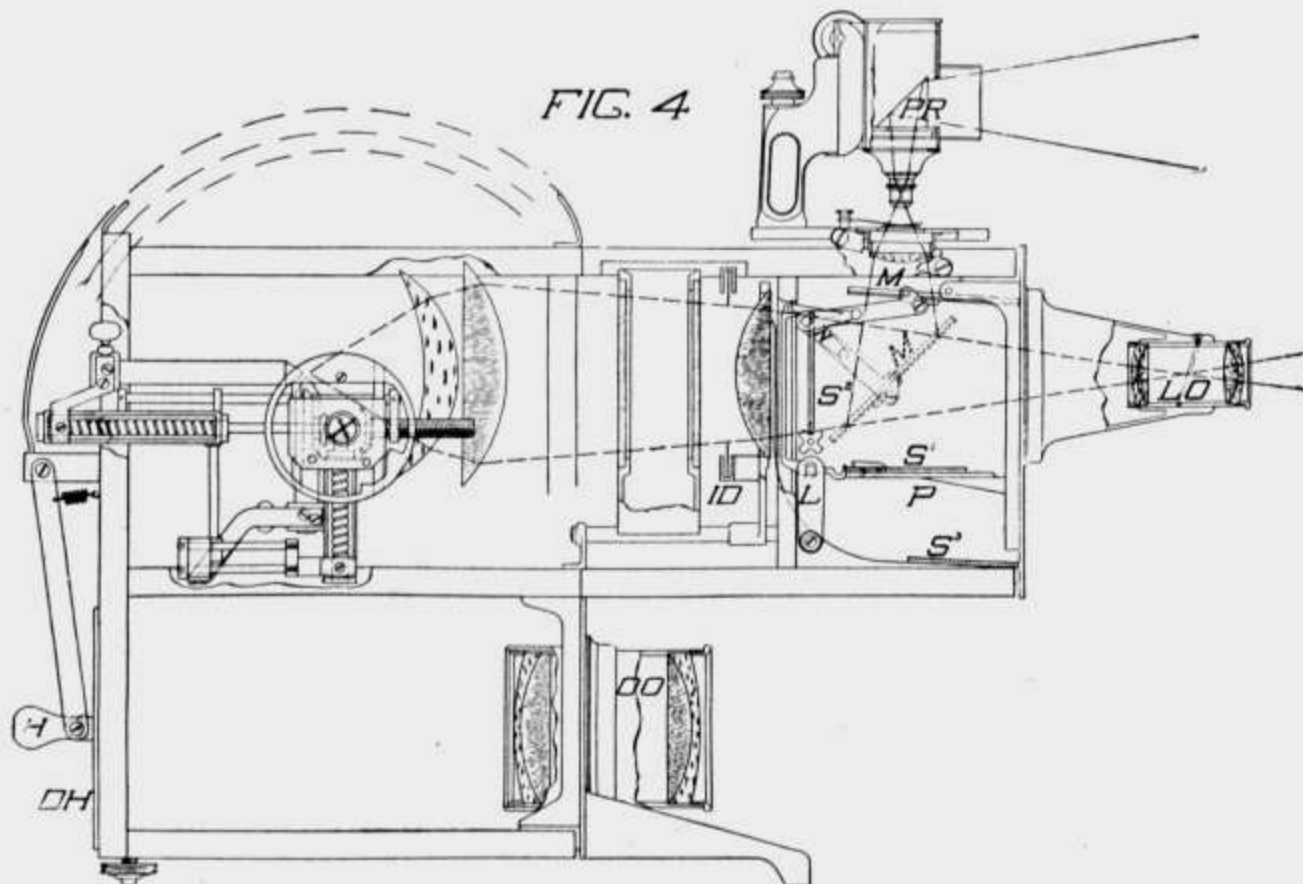


Nos. 3560-3563 (Fig. 3) Longitudinal Section.

Shows lamp system in position for opaque projection and micro-attachment in vertical position.

When the microscope is in this last named position, the mirror, M, is raised so that it does not obstruct the light and the prism is removed from the body tube of the microscope by drawing out from the top of the barrel the mounting to which the prism is attached. When the prism is left in the tube the image may be thrown down on a sheet of paper beneath the MICROSCOPE AND THE APPARATUS USED FOR DRAWING PURPOSES.

Micro-Attachment Nos. 3581 and 3582 may also be used with this Delineascope, but they cannot be used for vertical work as described above.



Nos. 3560-3563 (Fig. 4) Longitudinal Section.

Shows arrangement for ordinary slide projection and micro-attachment in horizontal position.

**Nos. 3560-3563 DELINEASCOPIES (Concluded).**

Micro-Attachment No. 3584 may be very easily converted into a vertical attachment when it is in position on top of the DELINEASCOPE. To do this, unscrew from the lower end of the body tube the adapter which holds the nose piece or objectives and substitute one lens system of a short focus projection objective, and at the same time place the other lens system in the tube in front of the prism. The prism between the lenses makes the best possible arrangement for such projection.

**ADVANTAGES IN GENERAL.**

The large, well ventilated, light-tight lamp house will not heat up like a smaller one.

All the operations are performed on one side of the apparatus, and all parts are conveniently located.

The manipulation of the lamp parts is accomplished by means of the most conveniently located devices on any lamp in existence.

The working lamp parts are at least 4" away from the arc. They are also otherwise protected from the heat of the arc.

The windows for examining the arc are accessibly located.

The simplest and handiest provisions are made for changing from one kind of projection to another.

**For Opaque Projection.**

A large illuminated elliptical area with the long axis of the ellipse in the axis in which it is most apt to be needed.

Provision for large book or page and convenient means for handling same.

The opaque projection objective is easily focused to and from the object.

Large lenses in the projection objective.

**For Lantern Slide Projection.**

The lantern slide compartment is most conveniently located relative to the lamp adjustments.

The NEW SPENCER TRANSPOSER provides the neatest, most accessible and convenient means yet produced for handling the lantern slides.

THIS NEW SPENCER TRANSPOSER not only interchanges the slides but **transposes** the pictures on the screen in a way as agreeable as the old "dissolving" effect—and does it **with one lamp only**.

The projection objective is easily focused.

**For Micro Projection.**

The micro-attachment is entirely out of the way when not in use.

It can be used on top of the DELINEASCOPE with the stage of the microscope horizontal, or in front with the stage perpendicular.

The changing from one position to the other is easily accomplished.

The mirror which is necessary when the attachment is on top of the DELINEASCOPE is easily changed from one position to the other.

When the attachment, No. 3584, is used on top of the DELINEASCOPE the light rays are rendered horizontal by means of a prism in the tube.

This micro-attachment may be easily and inexpensively modified to become a vertical attachment.

When this micro-attachment is located in front of the DELINEASCOPE it may be used as a drawing attachment when the prism is in place in the tube.

The microscope tube is large, providing means for using any micro projection objective from the lowest to the highest powers.

All of the micro parts, even to the objectives, are finished in a dull "mat" black to avoid all reflections.

The microscope stage may be provided with a water cell which comes into direct contact with the slide which helps to cool the specimen by convection as well as absorption of heat.

For prices, see page 274.

### PRICE LIST OF DELINEASCOPIES.

#### MODEL 2.

3550. **Delineascope**, with objective  $1\frac{5}{8}$  inches in diameter and 10 inch equivalent focus ..... Net \$ 31.50
3551. **Delineascope**, with objective  $2\frac{1}{2}$  inches in diameter and 10 inch equivalent focus ..... Net 38.70

#### MODEL 4.

3560. **Delineascope**, with objective for opaque projection 4 inches in diameter, 12 inch equivalent focus, and with lantern slide objective  $1\frac{5}{8}$  inches in diameter and 10 inch equivalent focus.....Net 112.50
3561. **Delineascope**, with objective for opaque projection 4 inches in diameter, 16 inch equivalent focus, and with lantern slide objective  $1\frac{5}{8}$  inches in diameter and 10 inch equivalent focus.....Net 112.50
3562. **Delineascope**, with objective for opaque projection 4 inches in diameter, 12 inch equivalent focus, and with lantern slide objective  $2\frac{1}{2}$  inches in diameter and 10 inch equivalent focus.....Net 119.70
3563. **Delineascope**, with objective for opaque projection 4 inches in diameter, 16 inch equivalent focus, and lantern slide objective  $2\frac{1}{2}$  inches in diameter and 10 inch equivalent focus.....Net 119.70

Other objectives of different diameters and foci may be substituted for the above at corresponding prices. (See page 276.)

**Micro-attachments** may be added to this apparatus at prices indicated on pages 274, 275.

**Rheostats** are extra, see page 284.

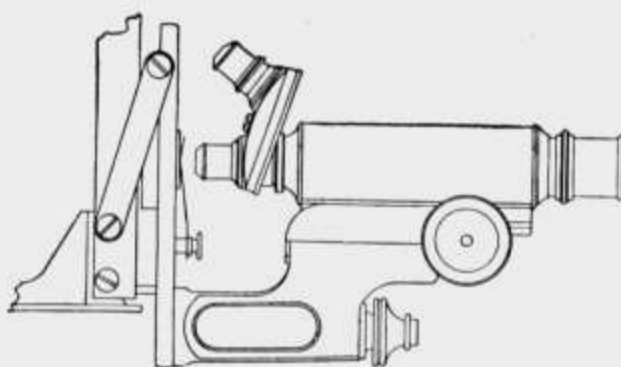
#### MODEL 6.

3570. **Delineascope**. See Catalog K for description.....Net 360.00

### SPENCER MICRO-ATTACHMENTS.

The Spencer Lens Company manufacture three different styles of micro-attachments, all of which are fastened to the main apparatus in the same way, and all of which are finished in a dull "mat" black to avoid reflections.

3580. **Simple Micro-Attachment** (illustrated in Figs. 2, 3 and 4, Page 269), consisting of a stage  $4\frac{1}{2}$ " (112 mm.) square, with a face distance of  $2\frac{1}{2}$ " (62 mm.) from the center of the stage opening to the triangular supports on which the arm holding the objective is focused by means of a rack and pinion. Owing to the fact that this attachment is not provided with a fine adjustment the low power objectives only are recommended. Substage condenser suitable for such magnifications is furnished with the attachment.....Net 13.50
3581. **Simple Micro-Attachment**, same as No. 3580, but with a regular microscope tube for eyepiece.....Net 18.00



No. 3582.

3582. **Intermediate Micro-Attachment.** This micro-attachment is provided with a stage  $4\frac{1}{2}$ " (112 mm.) square with a free distance of  $2\frac{1}{2}$ " (62 mm.) from the optical axis to the arm. The coarse and fine adjustments are exactly like those used on the HIGH GRADE Spencer microscopes, which means that they are the best made. The tube of this attachment is the standard Spencer body tube, which is  $1\frac{9}{16}$ " in diameter. When the draw tube is removed from the upper end of the tube this large body tube does not cut off the angle of the wider angle objective as does the smaller body tube of other makers. Complete with double nosepiece, eyepiece and substage condenser suitable to low power oculars.....Net \$ 41.50
3583. **Intermediate Micro-Attachment,** same as No. 3582, but fitted with a substage water cell.....Net 40.50
3584. **Complete Micro-Attachment,** designed especially for No. 3560 Delineascope, but it can also be used on No. 3550, where it will work exactly as it does on No. 3560.

The stage is  $4\frac{1}{2}$ " (112 mm.) square with a free distance of  $2\frac{3}{4}$ " (70 mm.) from the center of the stage opening to the base of the arm. The fine and coarse adjustments are identical with those used on the high grade Spencer microscopes. It can be used equally well with the stage horizontal or perpendicular. Each position has its advantages. A horizontal stage is often very desirable when fluid mounts are to be used. When in this position the perpendicular beam of light is made horizontal by a prism located just above the objective. This prism may readily be removed when the tube is used in the horizontal position for projecting purposes—or may be left in to throw the image on a paper beneath the microscope for drawing purposes.

Provision is made on the under side of the stage for a water cell, the upper glass wall of which comes flush with the top of the stage. In this position the micro slide is allowed to come into direct contact with the cell and convection of the water as well as the absorption of the heat from the light rays helps to keep the specimen cool.

When this attachment is ordered at the same time as the Delineascope an iris diaphragm (ID, Fig. 3, page 272) is placed between the converging lens of the condensing system and the light. This not only controls the angle of the cone of light, but cuts out all the heat possible as well.

Substage condensers suitable to the different powers of projection objectives are furnished with this attachment.

Complete as described with substage water cell, three condensers, large iris diaphragm attached to converging lens of condensing system, triple nosepiece, prism on separate mounting in body tube, adapter and draw tube for projection ocular, projection ocular..Net 90.00



## PROJECTION OBJECTIVES.

### For Use With Delineascopes.

In computing and constructing these objectives the Spencer Lens Company has paid no heed to the fact that the market has been more or less supplied for years with cheap objectives of more or less inferior grade. As in all their products, they have aimed at the very best obtainable.

The lenses are made from selected glass and after formulae which insure a bright, evenly illuminated field with a crisp definition to the extreme edge of an extremely flat field. The mounting is simple and substantial. The barrel of the objective is made of heavy walled brass tubing with a spiral groove on the outside into which fits a stud from the cylindrical bearing of the objective. The objective is focused by revolving it in its bearings.

Objectives of 10" equivalent focus, which with the lantern slide, having a free opening of  $2\frac{3}{4} \times 3$ ", produce a picture 9 ft. long at a distance of 30 ft., are most generally used, but lenses of different foci to give the desired picture at a given distance may be selected according to the following table which is based on the opening of the mat on the slide as indicated above.

Equivalent focus of objective	Distance of the Delineascope from the screen.								
	20 ft.	30 ft.	40 ft.	50 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.
7 inches	$8\frac{1}{2}$	$12\frac{3}{4}$	17	21	..	..	..	..	..
8 inches	$7\frac{1}{2}$	11	15	$18\frac{1}{2}$	22	..	..	..	..
10 inches	6	9	12	15	18	21	24	..	..
12 inches	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20	$22\frac{1}{2}$	..
14 inches	$4\frac{1}{2}$	$6\frac{3}{4}$	9	$10\frac{1}{2}$	$13\frac{1}{2}$	15	17	19	21
16 inches	$3\frac{3}{4}$	$5\frac{1}{2}$	$7\frac{1}{2}$	$9\frac{1}{2}$	11	13	15	17	19
18 inches	..	5	$6\frac{1}{2}$	8	10	$11\frac{1}{2}$	13	15	$16\frac{1}{2}$

As stated above, the dimensions indicated in this table are based on a three inch opening in the matting of the lantern slide. Any other object, therefore, three inches in length would give the same size picture whether it be opaque, shown through the large objective, or a regular lantern slide shown through the smaller. An opaque object 6" in length would, therefore, with the same objective give pictures twice the size of those indicated on the table. The light circle of 6" diameter as given in No. 3560 would become a light circle on the screen with a diameter twice the dimensions given in the table. But any opaque object in either light circle, which might be but 3" long, would appear on the screen of a size as indicated in the table.

Catalog Number.	Equivalent focus		Net price
	in inches.	Diameter in inches.	
3588	7	$1\frac{5}{8}$	\$ 6.30
3589	8	$1\frac{5}{8}$	6.30
3590	10	$1\frac{5}{8}$	6.30
3591	10	$2\frac{1}{2}$	13.50
3592	12	$2\frac{1}{2}$	13.50
3593	14	$2\frac{1}{2}$	13.50
3594	16	$2\frac{1}{2}$	13.50
3595	18	$2\frac{1}{2}$	16.20
3596	12	4	67.50
3597	14	4	67.50
3598	16	4	67.50
3599	18	4	67.50

3600. **Hand Feed Arc Lamp**, as used on Model 2 Delineascope, one of the most convenient lamps of its kind yet produced. The buttons regulating the carbons are on concentric axes and can be worked either independently or simultaneously. The buttons for centering the crater are close to the buttons just mentioned and are permanently located. The screws and bearings are so cut and arranged and protected that they will not bind and stick when heated. The lamp is made for direct or alternating current.....Net \$ 13.50  
For Rheostats, see page 284.
3602. **Acetylene Lamp**. Whereas the acetylene light is not sufficient in all cases, it does do acceptable work with lantern slides when used with the projection objective of 2½ inches diameter and when used at no great distance. We recommend that nothing of shorter focus than a 10 inch objective be used.
- The jet itself is a very powerful, economical and simple one, which is not as apt to become clogged as those of the older style and which consumes 1¼ cubic feet of gas per hour. Back of it is a concave silvered glass mirror which greatly increases the brilliancy of the jet .....Net 7.20
3606. **Acetylene Gas Generator**, 12 cubic feet capacity.....Net 9.00
3608. **Prest-O-Lite Tank**, 8 hours' capacity with the 1¼ ft. burner.....Net 9.00

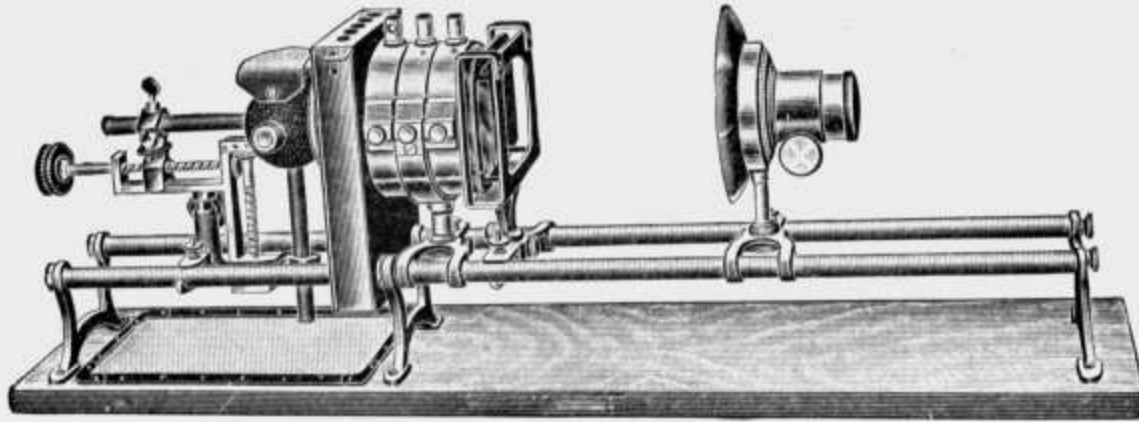
#### CONDENSING LENSES.

.(For Delineascopes Only.)

The condensing lenses put out by the Spencer Lens Company are made of the best glass obtainable and are as free from striae and other imperfections as is possible to secure.

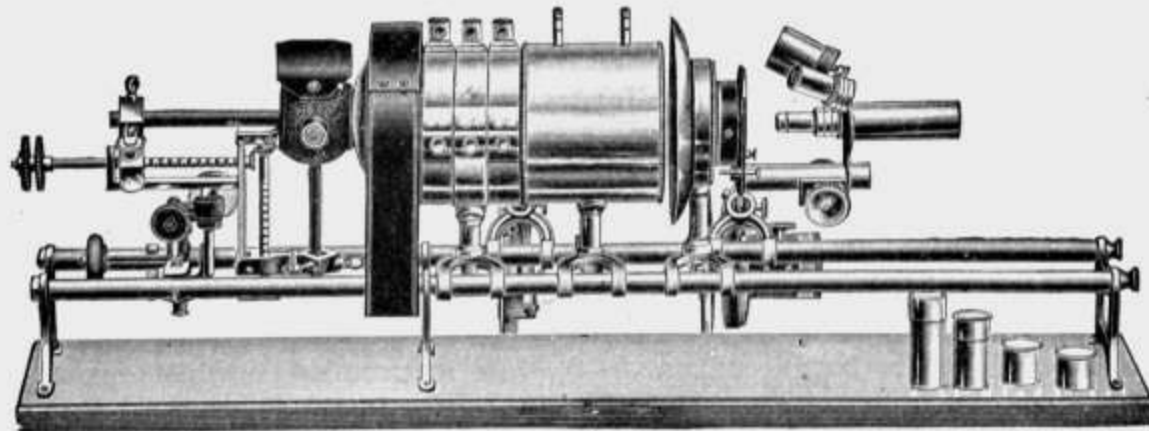
They are mounted in special mountings allowing a free circulation of air around them, which minimizes the likelihood of breakage because of heat.

3610. **Plano Convex Lens**, 4½ inches diameter, any focus. This is the lens used immediately back of the lantern slide, and in ordering it is absolutely necessary to state the focus of the projection lens used .....Net 1.35
3612. **Plano Convex Lens**, 4½ inches diameter; the lens used immediately in front of the arc in Model 2 Delineascope.....Net 1.35
3614. **Plano Convex Lens**, 6 inches diameter; the lens immediately back of the water cell in Model 4 Delineascope.....Net 2.70
- 3614A. **Meniscus Convex Lens**, 5½ inches diameter; the lens immediately in front of the arc in Model 4 Delineascope.....Net 5.40
3616. **Double Convex Lens**, 8 inches diameter; the front lens of the parallelizing system in Model 6 Delineascope.....Net 9.00
- 3616A. **Meniscus Convex Lens**, 6 inches diameter; the lens immediately in front of the arc in Model 6 Delineascope.....Net 6.30
- 3616B. **Plano Convex Lens**, 6 inches diameter; the lens immediately in front of the water cell for micro work in Model 6 Delineascope.....Net 2.70
- 3616C. **Plano Convex Lens**, 4½ inches diameter; the lens between the 6 inch lens and the microscope stage in micro attachment of No. 6 Delineascope .....Net 1.35



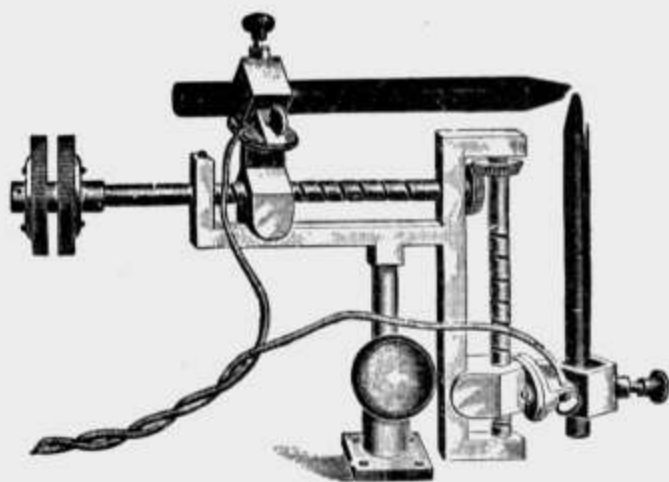
No. 3622.

- 3621. **College Bench Lantern**, without illuminant, consisting of baseboard with bench, Y support for illuminant, steel light shield, one pair regular focus condensing lenses separately mounted, one mounting without lens (used as a light shield), special supporting frame for condensing lenses, steel slide stage, slide carrier, 1/4 size objective with double adapting ring support, three Y bridge pieces for the above parts, and wooden case.....Net \$ 31.50
- 3622. **College Bench Lantern**, complete for lantern slide projection, same as No. 3621, with the addition of No. 3636 Hand Feed Arc Lamp, No. 3638 Ball Hood, No. 3735 Rheostat and No. 3648 Switch, Fuse Block, etc.....Net 45.00
- 3624. **College Bench Lantern**, complete for lantern slide projection, same as No. 3621, with the addition of No. 3656 Alcolite Burner.....Net 40.50

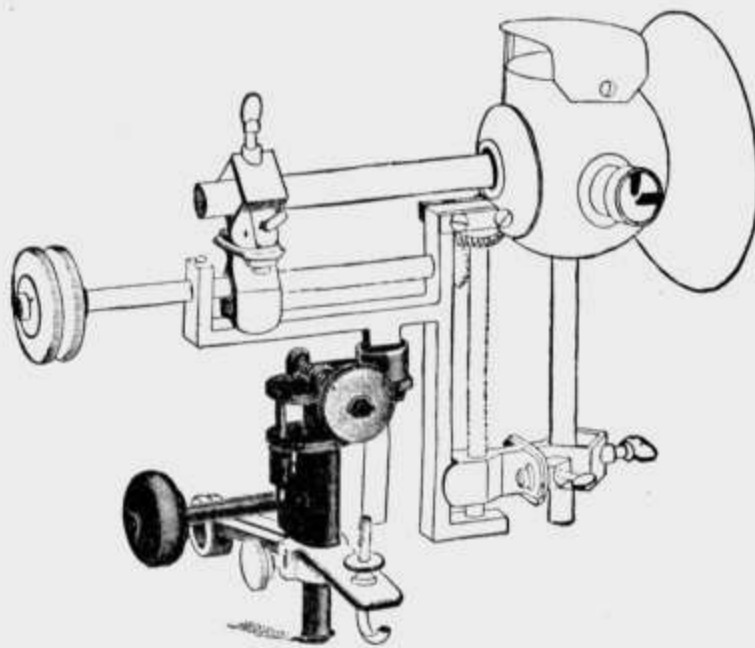


No. 3626.

- 3626. **College Bench Lantern**, for projecting both lantern and microscopical slides, and quickly interchangeable. Consists of No. 3622, with the addition of No. 3642 Fine Adjustment Support, No. 3686 Projection Microscope (without objective or nosepiece), No. 3706 Double Adapting Ring and No. 3708 Y Bridge Piece for holding microscope, thereby providing an immediate change from lantern slide projection to microscopic projection, and vice versa; No. 3710 Cooling Tank and No. 3712 Y Bridge Piece for supporting the same, and No. 3627 Set of Extra Condensing Lenses.....Net 83.00  
 N. B.—The illustration represents the lantern as described above, with the addition of triple nosepiece, three microscope objectives and two amplifying lenses.
- 3627. **Two Condensing Lenses** (long and short focus), with special mounting, for No. 3621.....Net 4.50  
 Note.—No. 3627 is necessary for changing the equivalent focus of the condensing lens by substituting one lens for another.
- 3629. **Pin Support**, for holding condensing lenses in their mounting.....Net .25
- 3630. **Gap Attachment**, for the College Bench Lantern. This consists of a sliding base with the bench rods cut so as to give a gap for the use of apparatus too large to attach to base or by insertion of extra rods to lengthen the base. The rod on the right hand side is graduated to facilitate the location of any point desired.  
 Gap Attachment, including sliding base and graduated rods, add extra to lantern.....Net 10.80

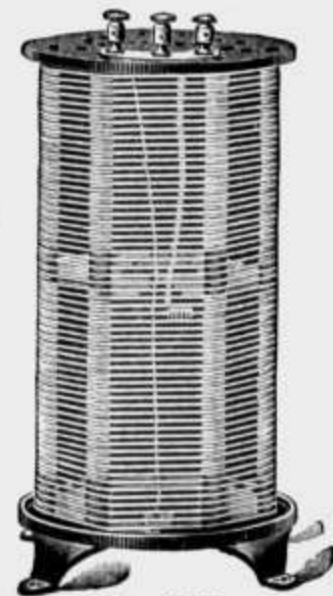


No. 3636.

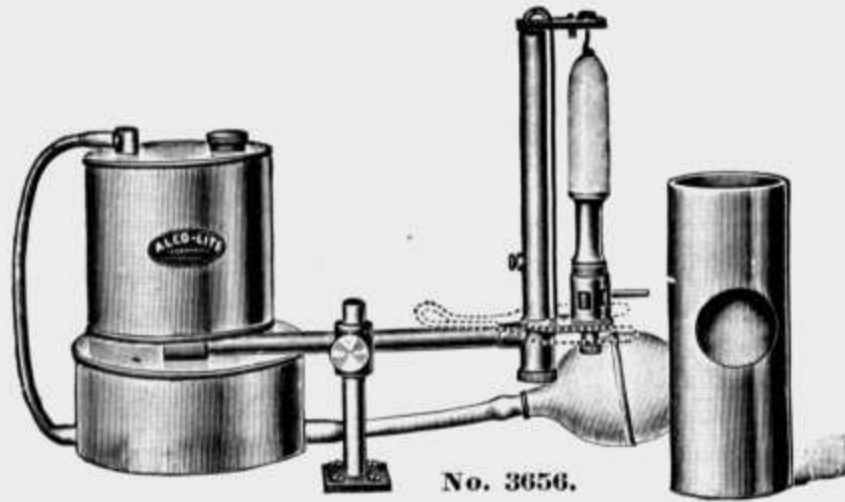


No. 3642.

3636. **Arc Lamp, 90° Hand Feed.** The 90° or Right Angle Arc Lamp has one advantage over the regular upright form, since the arc can be kept nearer in line with the center of the lenses for a greater length of time without readjusting the carbons in the holders than with the upright form, since the horizontal carbon is placed in line with the optical axis and is fed directly towards the center of the condensing lens, the point of the carbon being the source of light. The carbons can each be fed separately or together, depending on how one grasps the feeding wheels. Operated on direct current, a  $\frac{3}{8}$  inch solid vertical and a  $\frac{1}{2}$  inch cored horizontal carbon are necessary; if upon alternating current, both carbons should be  $\frac{1}{2}$  inch cored.....Net \$ 7.20
3638. **Ball Hood and Shield**, with ground mica disc, giving a perfect reduced, inverted image of the carbon points, indicating to the operator their exact position and how to feed the carbons to produce the best results on the screen (see illustration of No. 3642).....Net .90
3640. **Drop Y Bridge Piece**, for No. 3636 (included when arc lamp is ordered with lantern) .....Net .90
3642. **Fine Adjustment Support.** The cut shows the support (shaded portion) in position, clamped to a Y bridge piece and holding No. 3636 Arc Lamp with No. 3638 Ball Hood. By the use of this support the arc is kept in perfect alignment with the center of the lenses by means of two screws, one (at the back) moving the entire lamp up and down, the other (at the side) giving a lateral swinging motion. This support is particularly recommended where a projecting microscope is to be used.....Net 4.50
3735. **Rheostat**, for either direct or alternating current, capacity 15 amperes. For use with lanterns on currents from 110 to 115 volts pressure. Height  $10\frac{1}{2}$  inches. Diameter 6 inches .....Net 4.50
- For other Rheostats for Lantern work, see page 284.
3648. **Switch, Fuse Block and Plugs**, and 15 feet flexible wire cable for No. 3735.....Net 1.90
3650. **Carbons**, direct current, upper,  $\frac{1}{2}$ x6 inches, cored, per dozen.....Net .55
3652. **Carbons**, direct current, lower,  $\frac{3}{8}$ x6 inches, solid, per dozen.....Net .40
3654. **Carbons**, alternating current, upper or lower,  $\frac{1}{2}$ x6 inches, cored, per dozen.....Net .55



No. 3735.



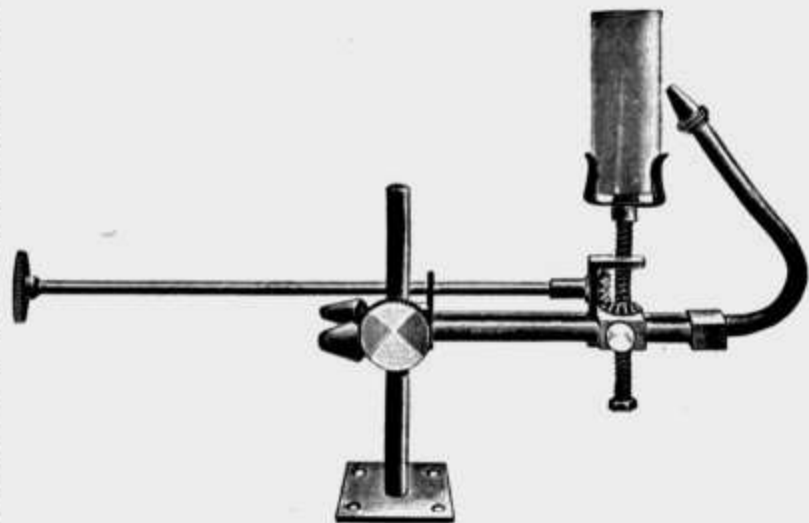
No. 3656.

3656. **Alcolite Burner**, the new projection lamp using a mantle and burning denatured alcohol. Grain alcohol can also be used with equally good results. The lamp consumes but five ounces per hour. The tank holds ten ounces, or enough for a two-hour run. The light produced is next in brilliancy to calcium light and will make a good, clear, satisfactory picture up to ten feet square. It has many points of excellence to recommend it to our customers who, from force of circumstances, cannot use electric or calcium light. It is compact, light in weight, inexpensive to operate, clean, smokeless, simple and safe. (Illustration shows plain chimney and plate base furnished when alcolite burner is sold separately.)

- Complete with rubber bulb, pressure regulator, mantle, funnel shield for use with No. 3621, and instructions for operating.....Net \$ 9.00
3658. **Mantles**, for alcolite burner, any quantity less than 1 dozen, each..Net .15
3659. **Mantles**, for alcolite burner, per dozen.....Net 1.50

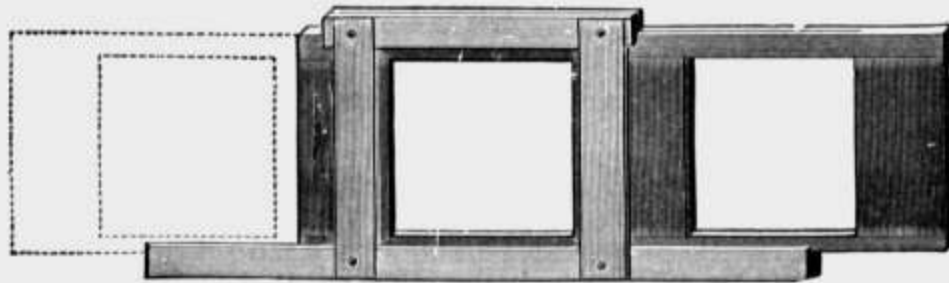
3666. **Oxy-Hydrogen Jet**. This jet is small and light in weight and will produce a powerful light without noise or waste of gas. It has a large mixing chamber and gives a thorough mixture of the gas before it issues from the tip .....Net 9.00

3668. **Lantern Body**, of sheet steel, to fit No. 3621, when Oxy-Hydrogen Jet or an Acetylene Burner is used. This body may also be used with the Arc Lamp or Alcolite Burner, in which case the ball hood on the Arc Lamp and the funnel shield on the Alcolite may be omitted.....Net 4.50



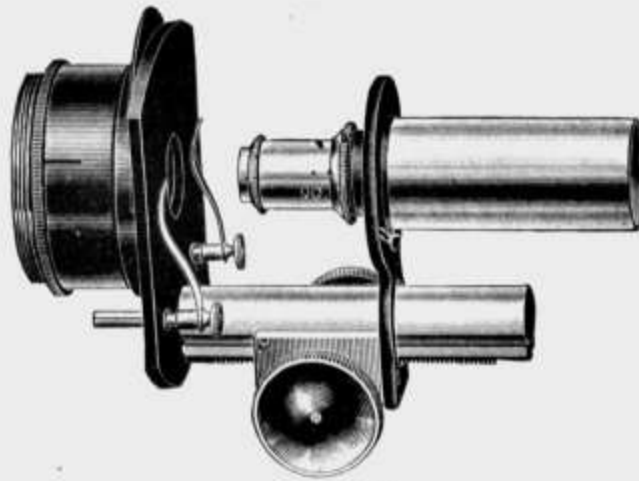
No. 3666.

3670. **Limes**, superior quality, packed one dozen in a screw-top tin can..Net .90
3672. **Limes**, same as No. 3670, sealed in glass tubes. Each.....Net .15
- Per dozen .....Net 1.35



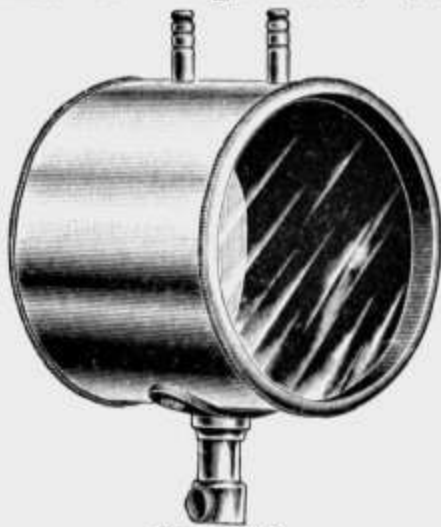
No. 3675.

3675. **Slide Carrier**, "Rapid," of wood.....Net .50
3677. **Adjustable Slit**, for use with prisms in the analysis of light.....Net 3.15
3679. **Pencil Ray Attachment**, with diaphragm and lens for rendering rays parallel .....Net 3.15
3681. **Pencil Ray Attachment**, with diaphragm only.....Net 1.80



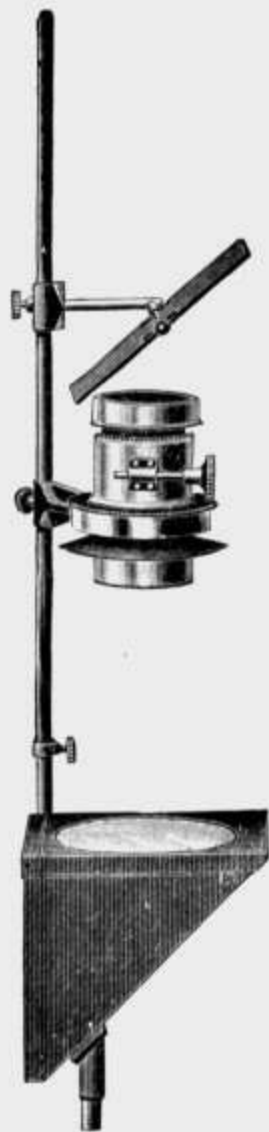
No. 3686.

- 3686. **Projection Microscope**, a superior instrument, embodying all the latest improvements. Has diagonal rack and pinion movement, and is supplied with revolving diaphragm, and sleeve support for sub-stage condensing lens, which is necessary for high power work. The rack bar can be turned around to any desired position after the instrument is screwed fast to the lantern front. Without objective..... \$ 20.00
- 3688. **Micrometer Stage**, fine adjustment, for No. 3686..... 2.25
- 3690. **Sub-stage Condensing Lens**, for No. 3686, necessary with  $\frac{3}{4}$  inch or higher objectives .....Net 3.50
- 7603. **Double Nosepiece**, for No. 3686, or any microscope attachment.....Net 3.60
- 7605. **Triple Nosepiece**, for No. 3686, or any microscope attachment.....Net 4.95
- 3696. **Amplifying Lens**, for No. 3686, to be used in place of eyepiece for giving higher magnification with low power objectives.....Net 1.80
- 3706. **Double Adapting Ring Support**. This piece, together with No. 3708 Y Bridge Piece, is necessary with microscope if quick change from lantern to microscope slide is desired.....Net 1.80
- 3708. **Y Bridge Piece**. (See No. 3706.).....Net .90



No. 3710.

- 3710. **Cooling Tank**, of the latest design; holds about a quart, is of nickel plated brass, polished, and guaranteed water tight; the glass plates are easily removable. A cooling tank is a necessity when a projection microscope is used, the distilled water (alum solution not necessary) with which it is intended to be filled, absorbing much of the heat of the focused beam of light, and so lessening the danger of injury to the specimen under examination.....Net 5.40
- 3712. **Y Bridge Piece**, for tank; necessary when quick change is desired.....Net .90
- 7580. **Projection Objective**, 40 millimeters focus, for No. 3686 or any microscope attachment .....Net 4.05
- 7582. **Projection Objective**, 32 millimeters focus, for No. 3686 or any microscope attachment .....Net 4.05
- 7584. **Projection Objective**, 16 millimeters focus, for No. 3686 or any microscope attachment .....Net 4.50
- 7586. **Projection Objective**, 12 millimeters focus, for No. 3686 or any microscope attachment .....Net 7.20



No. 3713.



No. 3715.

3713. **Vertical Attachment.** This attachment can be used on the College Bench Lantern. This apparatus is designed expressly for the illustration and exhibition of the various phenomena attending the scientific experiments relating to heat, light, sound, electricity, magnetism, cohesion figures and crystallization, and is useful in many experiments where the object projected must be kept in a horizontal position. No prisms are used, but the finest thin German mirror glass, which materially lessens the cost of the apparatus and avoids double reflection to a large extent. Without condensers or objective .....Net \$ 9.00

3713A. **Vertical Attachment,** same as No. 3713, with condensing lenses in mirror box .....Net 12.60

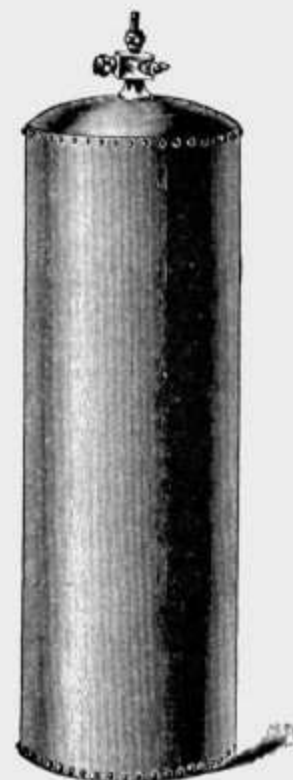
3715. **Lantern Table.** This table is made of polished hardwood, and provided with drawer, lock and key, and compartments for holding lantern slides of the standard size. A cupboard is furnished, with a spring hinged drop door with lock and key, to hold lantern and lantern accessories. Lantern board has slow movement screw for angle adjustment. Legs are provided with casters to facilitate movement of table from one room to another. Shelf for holding rheostat is also provided.

Dimensions over all—height, 4 feet 2 inches; width, 15¼ inches; length, 3 feet 6 inches. Inside measurement of cupboard, 13½ inches x 12 inches x 34 inches. Capacity of drawer, 500 slides. Without lantern or rheostat..... 27.75

**STEEL GAS CYLINDERS.**

These cylinders are made from the best open hearth steel, selected for this particular use. Each cylinder is tested to 600 pounds hydrostatic test and is unqualifiedly guaranteed. The capacity is figured at the standard pressure of 225 pounds to the square inch. Price includes brass nameplate engraved with name and address of school. The MacLachlan Patent Double Needle Valve is also included with each cylinder.

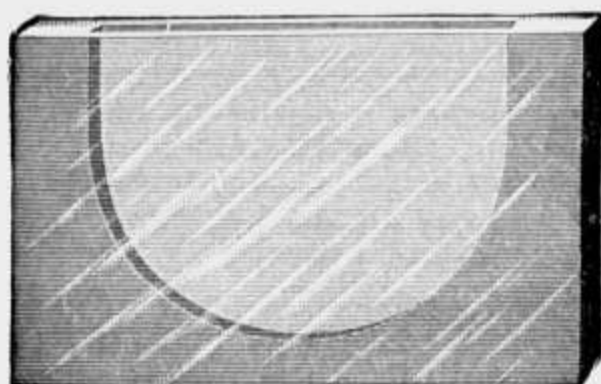
Catalog No.	Capacity, cu. ft.	Size, inches.	Weight, each.	Price, per pair, Net.
3717	25	10x34	62	37.50
3717A	35	12x36	75	40.00
3717B	40	12x42	85	42.50
3717C	50	12x48	95	45.00



No. 3717.

Cylinders filled, either oxygen or hydrogen, per cubic foot .....Net \$ 0.13

3719. **Pressure Gauge.** Indispensable to users of oxy-hydrogen, for measuring the amount of gas in a tank. Indicates both cubic feet and pounds pressure .....Net 4.00

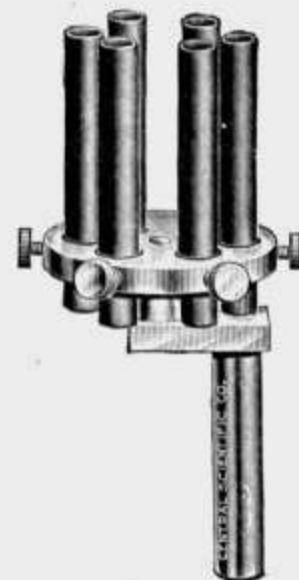


No. 3722.

3722. **Cell,** of glass, 4 inches high and 4 inches long. Will fit into the slide stage of any lantern using standard size slides. It can be used dry to hold insects, or filled with water, showing live specimens from river and pond, such as small fish, leeches, water worms, amoebas, etc. Also useful for illustrating capillary action, specific gravity of liquids, chemical action, etc. Not affected by acid, alkali or alcohol..... 2.25



No. 3730.



No. 3731.

3722A. **Electrodes** for use with No. 3722, for the demonstration of electrolysis; of platinum, with binding posts..... 1.65

3723. **Cell,** consisting of No. 3722 Cell with No. 3722A Electrodes. (See illustration on page 188.)..... 3.90

3728. **Animalculae Cage,** on a glass slip 1x3 inches..... 1.10

3730. **Eaton's Direct Vision Prism,** for the projection of spectra on a screen. Gives a "direct vision" spectrum of large dispersion. The spectrum of any intense illuminant may readily be obtained. For the spectra of metals we recommend the use of No. 3731 Mann's Metal Spectra Apparatus. For complete description, see page 239. Complete with support ..... 25.00

3731. **Mann's Metal Spectra Apparatus,** for the projection of six different metals consecutively on the screen. The attachment in use displaces the negative (or lower) carbon in an ordinary arc lamp. In conjunction with our No. 3730 Eaton's Direct Vision Prism, very clear spectrum bands may easily be produced. For use with 90 degree arc lamp ..... 5.00

3732. **Elevating Stand, Adjustable,** for holding prisms and other apparatus in front of the objective..... .75

Bottle Prisms, page 239.



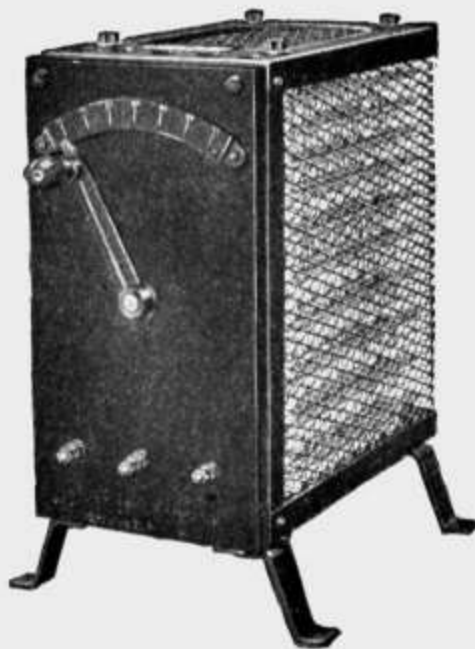
## LANTERN RHEOSTATS.



No. 3735.



No. 3737.



No. 3740.

3735.	Rheostat, for either direct or alternating currents, capacity 15 amperes, for use with lanterns on currents from 110 to 115 volts pressure. Height 10½ inches, diameter 6 inches.....	Net \$ 4.50
3737.	Rheostat, adjustable form, similar to No. 3735, but covered with gauze to prevent contact with the hot wire and furnished with a sliding contact for varying amounts of resistance.....	11.00
3740.	Rheostat, adjustable in steps of five amperes, constructed to meet the requirements of the fire underwriters. Capacity 10 to 25 amperes on 110 volt current.....	18.00
3742.	Rheostat, same as No. 3740, but for 220 volt current.....	25.00
3744.	Rheostat, same as No. 3740. Capacity 10 to 40 amperes on 110 volt current .....	35.00
3746.	Rheostat, same as No. 3744, but for 220 volt current.....	50.00

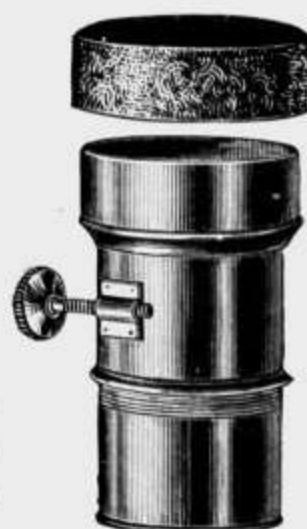


No. 3747.

3747.	Grid Rheostat, specially designed for moving picture machines, consisting of the resistance unit and a number of heavy cast grids hooked up in series on a five point adjustment, encased in a sheet-metal frame with perforated top plate to allow for ventilation. Adjustable from 20 to 55 amperes on 110 volt current.....	Net 30.00
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**ACHROMATIC PROJECTION OBJECTIVES.**

Catalog No.	Size of Lens.	Focus, in.	Back Focus, in.	Price
3750	1/4	6	4 1/2	\$ 5.50
3751	1/4	10	7	5.50
3752	1/4	12	8 1/2	5.50
3754	1/2	10	7	13.35
3755	3/8	12	8 1/2	21.00
3756	1/4	15	10 1/2	26.00



Approximate sizes of pictures made by achromatic objectives at different distances from the screen:

Size of Lenses	10 feet.	20 feet.	30 feet.	40 feet.	50 feet.	60 feet.	70 feet.	80 feet.	90 feet.	100 feet.	110 feet.	120 feet.
1/4 size	5	10	15	20	..	..	..	..	..	..	..	..
1/2 size	..	6	9	12	15	18	21	24	..	..	..	..
3/8 size	..	..	7	10	13	16	19	22	23 1/2	25	..	..
1/4 size	..	..	6	8	10	12	14	16	18	20	21	24

**CONDENSING LENSES.**

3760.	Condensing Lens, 4 1/2 inch diameter, 6 1/2 inch focus.....	\$ 1.10
3761.	Condensing Lens, 4 1/2 inch diameter, 7 1/2 inch focus.....	1.10
3762.	Condensing Lens, 4 1/2 inch diameter, 10 inch focus.....	1.10

**SCREENS.**

Made of the best quality bleached muslin, double corners, edges bound with non-elastic webbing, double tapes or rings at the corners, and tapes or rings for stretching ropes every two feet around the edge.

3765.	Muslin Screen, 6 feet square.....	Net 2.70
3766.	Muslin Screen, 8 feet square.....	Net 3.60
3767.	Muslin Screen, 10 feet square.....	Net 4.00
3768.	Muslin Screen, 12 feet square.....	Net 6.00
3769.	Muslin Screen, 15 feet square.....	Net 9.00

**OPAQUE SCREENS ON SPRING ROLLERS**

Perfectly opaque and of dead white finish.

3771.	Enameled Muslin Screen, on spring roller, 6 feet square.....	Net 4.00
3772.	Enameled Muslin Screen, on spring roller, 8 feet square.....	Net 7.50
3773.	Enameled Muslin Screen, on spring roller, 10 feet square.....	Net 15.00
3774.	Enameled Muslin Screen, on spring roller, 12 feet square.....	Net 20.00

**BOOKS ON PROJECTION.**

"Optical Projection," by Lewis Wright.....Net 2.25

"Manual of Biological Projection and Anesthesia of Animals." A practical guide in the selection and operation of projection apparatus, the methods of preparing live animals and plants for projection, the anesthesia of animals, and the little knacks of manipulation which insure success in projecting vivographs. By Aaron Hodgman Cole, A. M., instructor in biology and projection in the Chicago Normal School. Two hundred pages, 29 illustrations, over 1,200 time saving references in "Index," "Ready Reference Table" and text. Bound in substantial cloth boards. Price, \$1.50 net; by mail, post-paid .....Net 1.60

## LANTERN SLIDES.

Our lists of lantern slides are so extensive that we will only mention them in this place and refer to CATALOG Q, CATALOG X, and other special pamphlets listed below.

The different series are selected, and most of the series prepared, by specialists in the particular subjects. All are of the finest quality, the negatives having been taken only from such illustrations that would give good results. In the majority of slides listed the negatives used were made from the object itself.

The REGULAR SERIES contained in CATALOG Q embraces the following subjects: Anatomy, Architecture, Astronomy, Bacteriology, Botany, Engineering, Forestry, Geography, Geology, Histology, History, Mining, Natural History, Ornithology, Pathology, Physiography, Physiology, Portraits, Psychology, Radium, Radiographs, Zoology.

The SPECIAL SERIES comprise the following:

"ATWOOD AND COOK SERIES." 550 slides selected by Prof. W. M. Atwood of The University of Chicago and Mrs. Jane Perry Cook of the Chicago Normal School, with special reference to an intelligent study of Physical Geography. A description of each slide, edited by Prof. Ridgely of the Normal University at Normal, Illinois, is furnished.

"METEOROLOGICAL SERIES." 268 slides selected by "THE GEOGRAPHICAL SOCIETY OF CHICAGO," with special reference to covering the most important features in meteorological study.

"DERR SERIES," for physics. 735 slides selected and prepared by Prof. Louis Derr of the Massachusetts Institute of Technology. The diagrams and illustrations of instruments and their arrangement in certain experiments will be valuable as an aid to physics teachers in tracing for their pupils the development of scientific work along the physical line.

"DUBOIS SERIES." 325 slides selected and prepared by Dr. Norman A. Dubois of Case School of Applied Science, showing in detail the principal chemical processes and the various forms of manufacturing equipments for making commercial chemical compounds. A brief description is furnished with each slide.

AGRICULTURAL SLIDES. In CATALOG X is listed, in addition to a full line of apparatus and supplies for Agriculture and Physiography, a series of 391 slides selected for illustrating Agricultural Botany, Fruit Tree Cultivation, the Rothamsted Experiments, Veterinary Science, etc.

CATALOG Q, CATALOG X, and SPECIAL LISTS will be mailed to those interested upon receipt of request.

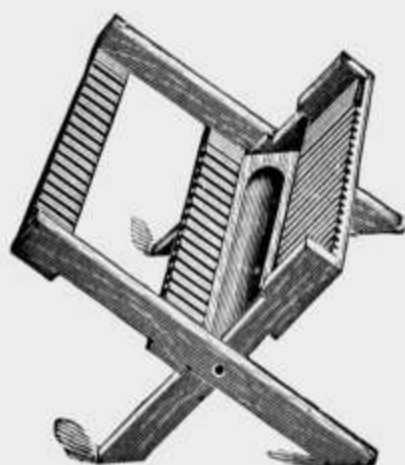
**FOLEY'S LANTERN SLIDES OF SOUND WAVES, page 512.**

LANTERN SLIDE ACCESSORIES.

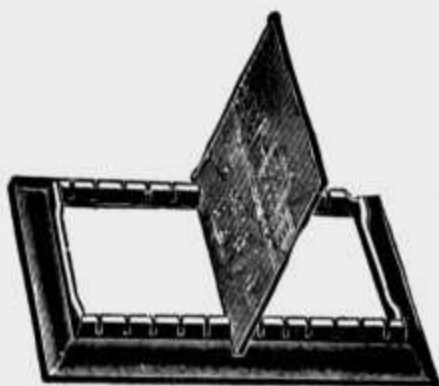


No. 3780.

- |       |  |     |      |
|-------|--|-----|------|
| 3780. | Slide Cabinet, strongly made of hardwood, neatly finished and highly polished. Nickel plated clasps, lock and key, leather handle. Apartments for 50 slides. Will hold 75.....     | \$  | 2.25 |
| 3781. | Slide Cabinet, for 120 slides. Inside of cover padded and plush lined. Leather covered. Better and more expensive construction than above .....                                    |     | 5 55 |
| 3782. | Slide Binding, dense black, heavily gummed, strong rope paper. Per roll of 24 yards 7-16 inch wide.....  |     | 20   |
| 3783. | Slide Binding, strips cut exact size of standard lantern slides. Binders' black cloth heavily gummed on one side with a special gum. Per 50 strips, packed in long carton box..... | Net | 15   |
| 3784. | Slide Cover Glass, uniform in thickness and warranted entirely free from rust. Per dozen.....  |     | 20   |
| 3785. | Slide Mats, Olmsted's special. Cross section ruled and circled for cut out purposes. Per package of 25.....  |     | 40   |
| 3786. | Slide Numbers, gummed on back. 1—10,000 Range, 200 numbers on a sheet. Per sheet.....  |     | 20   |
|       | Slide Plates, in sealed packages of 12 plates, 3¼x4 inches.  |     |      |
| 3787. | Carbutt's. Per package .....   |     | 55   |
| 3788. | Seed's. Per package . . . . .  |     | 55   |
| 3789. | Cramer's. Per package . . . . .  |     | 55   |



No. 3791.



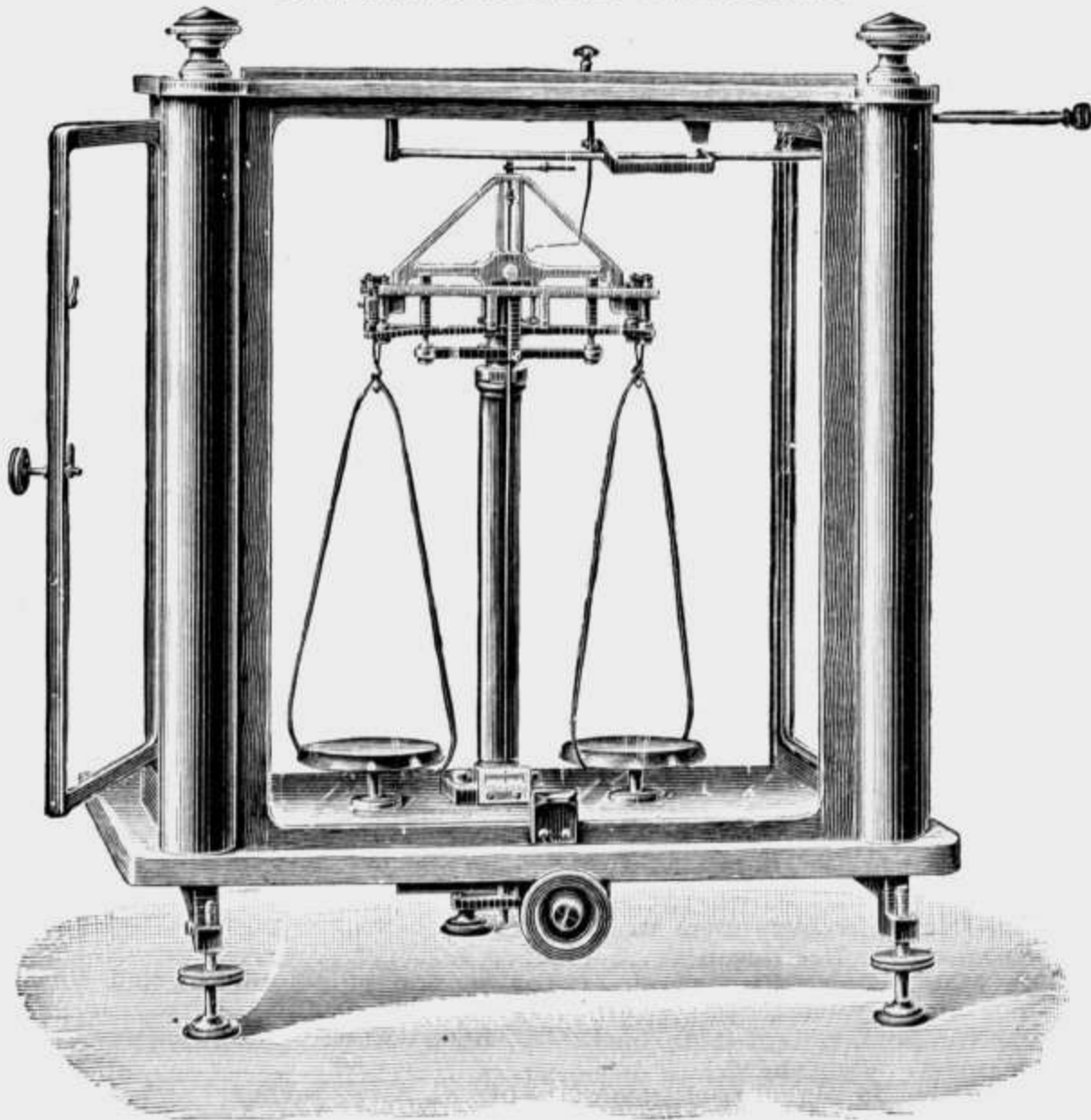
No. 3793.



No. 3794.

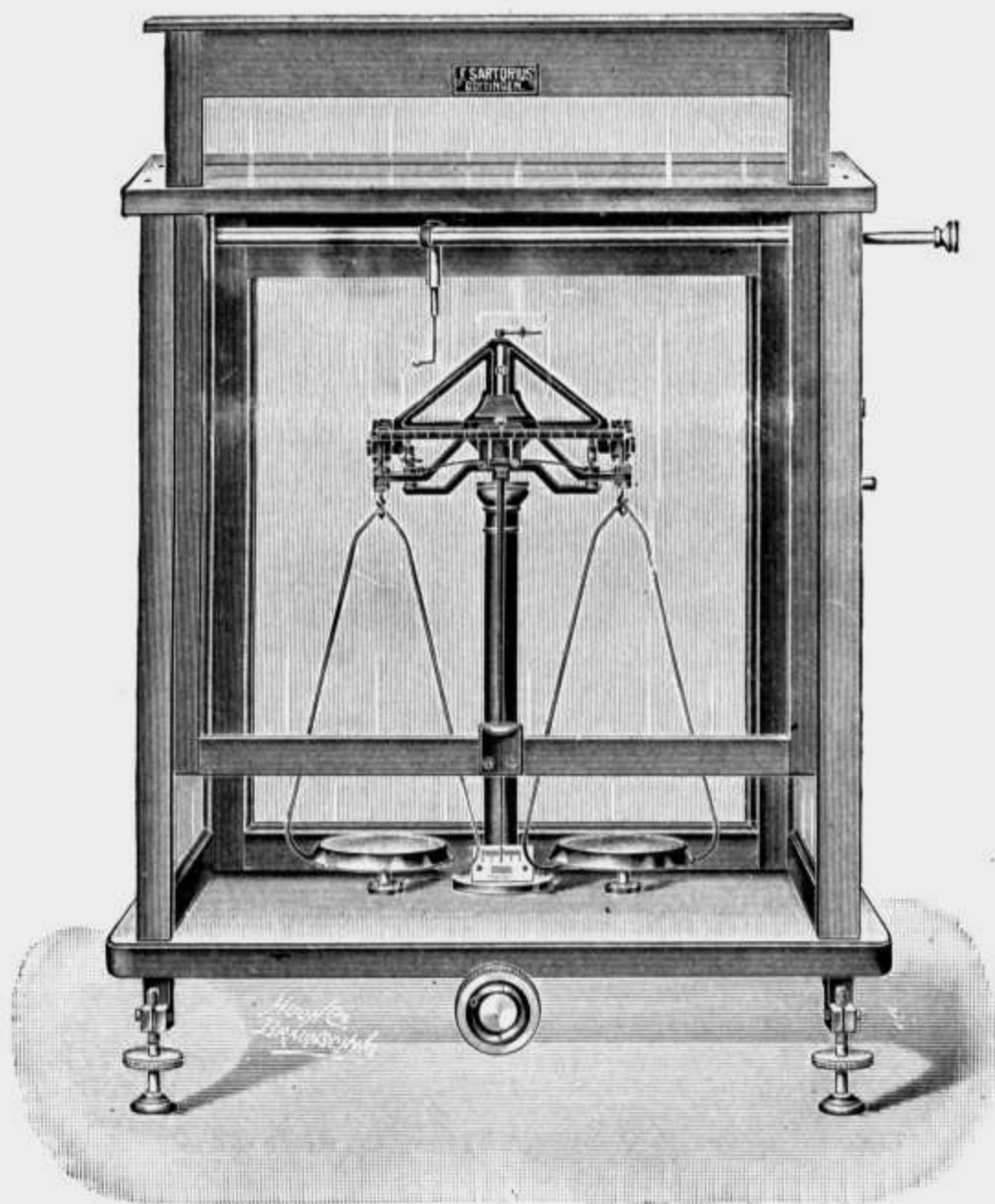
- |       |  |    |
|-------|--|----|
| 3791. | Negative Rack. Folding rack of wood, 24 slides.....  | 40 |
| 3792. | Negative Rack. Same as No. 3791, for 12 slides....   | 20 |
| 3793. | Negative Rack. Black enameled iron, suitable for plates from 3 ½ x 3 ½ up to 8x10 inches.....  | 28 |
| 3794. | Slide Vise. By this device the mat is held in close contact with the lantern slide and cover glass, thus leaving both hands free to manipulate the binding strips. When slide is clamped between the rubber discs it may then be easily revolved to facilitate binding. Each . . . . . | 65 |

## BALANCES AND WEIGHTS.



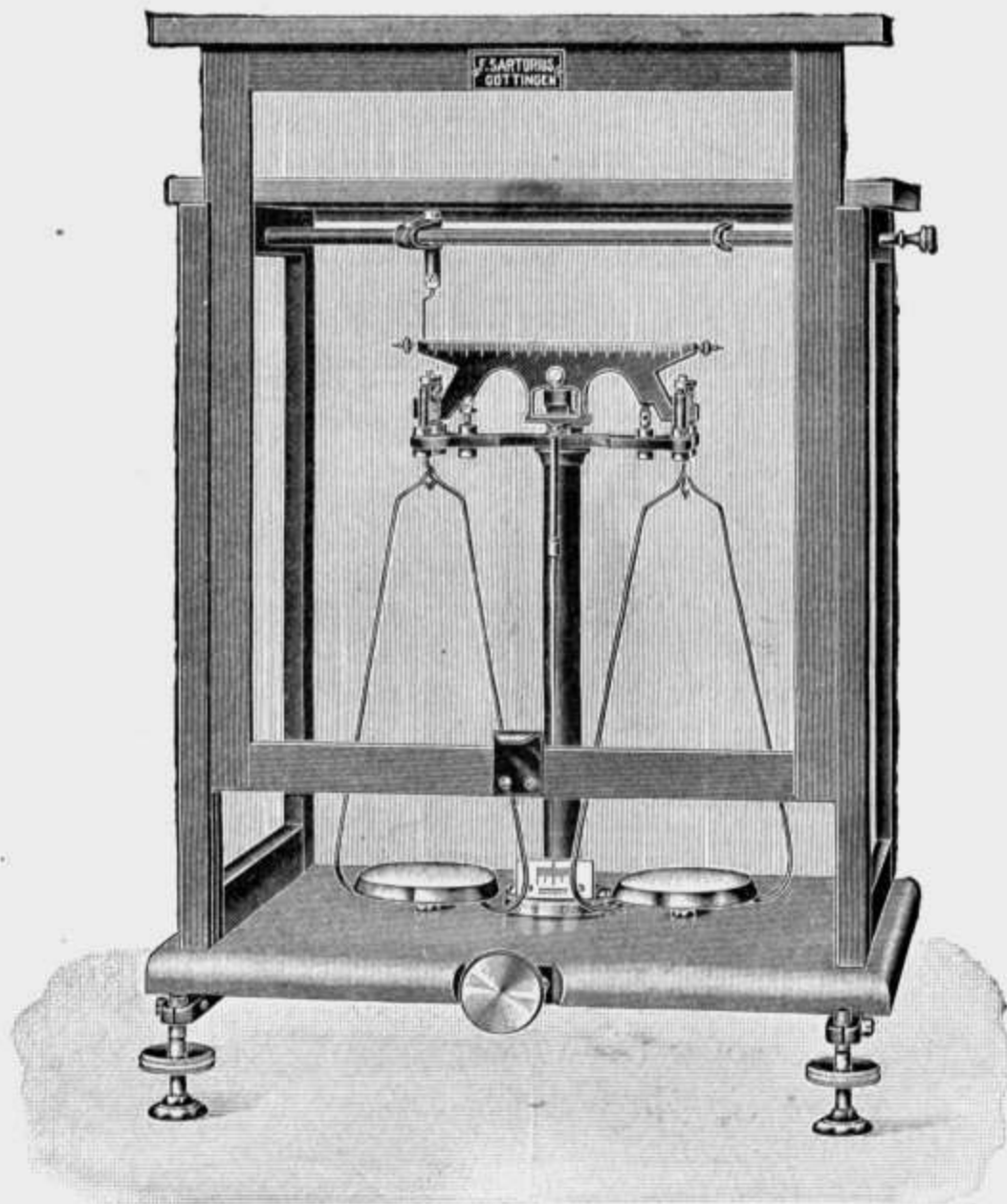
No. 3800.

- |        |  |                     |
|--------|--|---------------------|
| 3800.  | <b>Balance, Sartorius' Short Beam Analytical, No. 2, with aluminum beam, adjustable end knife edges and compensating hangers, agate knife edges and planes and platinum plated pans. Provided with a finely finished aluminum case, fitted with counterpoised front sliding door and mounted on a black glass plate with leveling screws. Length of beam, 14 centimeters; capacity, 200 grams; sensibility with full load, 0.1 milligram.....</b>  | Duty free \$ 120.00 |
| 3800A. | <b>Balance, Sartorius' Short Beam Analytical, No. 2, same as No. 3800, but with capacity of 100 grams; length of beam, 12 centimeters; sensibility with full load, 0.05 milligram.....</b>   | Duty free 120.00    |
| 3801.  | <b>Balance, Sartorius' Short Beam Analytical, No. 6, with straight beam of phospher bronze, which likewise serves as a rider slide. Simple design with green bronze pillar, simple rider movement and improved arrest. Pans are platinum plated. The knife edges and planes are agate. The base is of black plate glass, provided with leveling screws. This balance is very rapid and largely used in universities. Length of beam, 14 centimeters; capacity, 200 grams; sensibility with full load, 0.1 milligram.....</b> | Duty free 48.00     |
| 3801A. | <b>Balance, Sartorius' Short Beam Analytical, No. 6, same as No. 3801, but with length of beam 18 centimeters; capacity, 500 grams; sensibility with full load, 0.15 milligram .....</b>   | Duty free 63.00     |
| 3801B. | <b>Balance, Sartorius' Short Beam Analytical, No. 6, same as No. 3801, but with length of beam 22 centimeters; capacity, 1,000 grams; sensibility with full load, 0.2 milligram .....</b>  | Duty free 97.50     |
| 3801C. | <b>Balance, Sartorius' Short Beam Analytical, No. 5, similar to No. 3801. Length of beam, 27 centimeters; capacity, 2000 grams; sensibility 1 milligram .....</b>  | Duty free 135.00    |



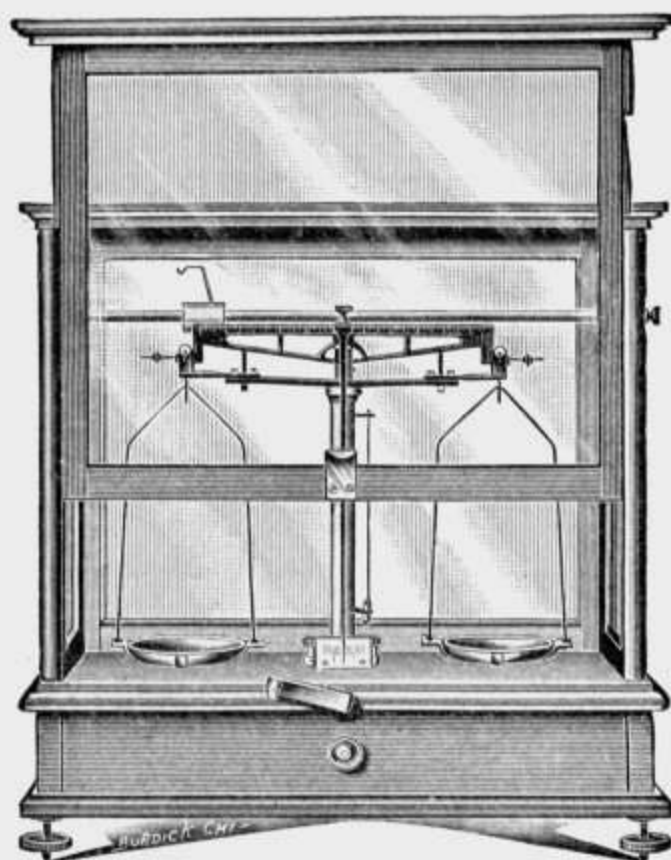
No. 3802.

3802. Balance, Sartorius' Analytical, New Model, "America," especially signed for American educational institutions. The compensating hangers are made in one piece, which prevents their falling apart, and being suspended on three points, they allow for uneven balancing. Short beam of magnalium metal, rider arrangement, agate knife edges and planes, nickel plated pans, mounted on black glass plate, provided with leveling screws. Length of beam, 14 centimeters; capacity, 200 grams; sensibility with full load, .1 milligram .....Duty free \$ 38.50
- 3802A. Balance, Sartorius' "America," furnished from stock..... 54.00
- SEE THE NEW "AMERICAN UNIVERSITY" BALANCE, PAGE 498.**



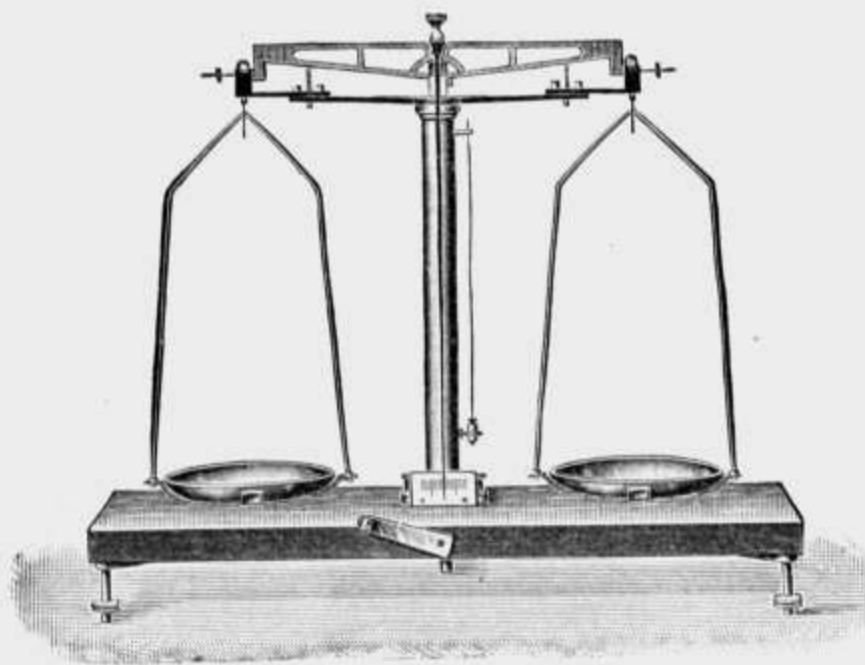
No. 3803.

3803. **Balance, Sartorius' Analytical**, quick weighing. An ideal balance for rapid analytical work and food analysis tests. The beam is of aluminum, and the knife edges and planes are of the best agate. The beam is provided with graduations for use with a rider. Has a simple but effective device for the arrest of the hangers and beam. This balance has the accuracy, construction and quick action necessary for the severe requirements needed in the above mentioned work, which cannot be done with a sensibility of 1 milligram; capacity, 200 grams; sensibility, 0.2 milligram; with rider attachment. Mounted in polished walnut case with a heavy board base and leveling screws.....Duty free 27.00
- 3803A. **Balance, Sartorius'**, same as No. 3803, but with base of heavy black plate glass .....Duty free 30.00
- 3803B. **Balance, Sartorius'**, same as No. 3803A, furnished from stock....Net 43.50



No. 3804.

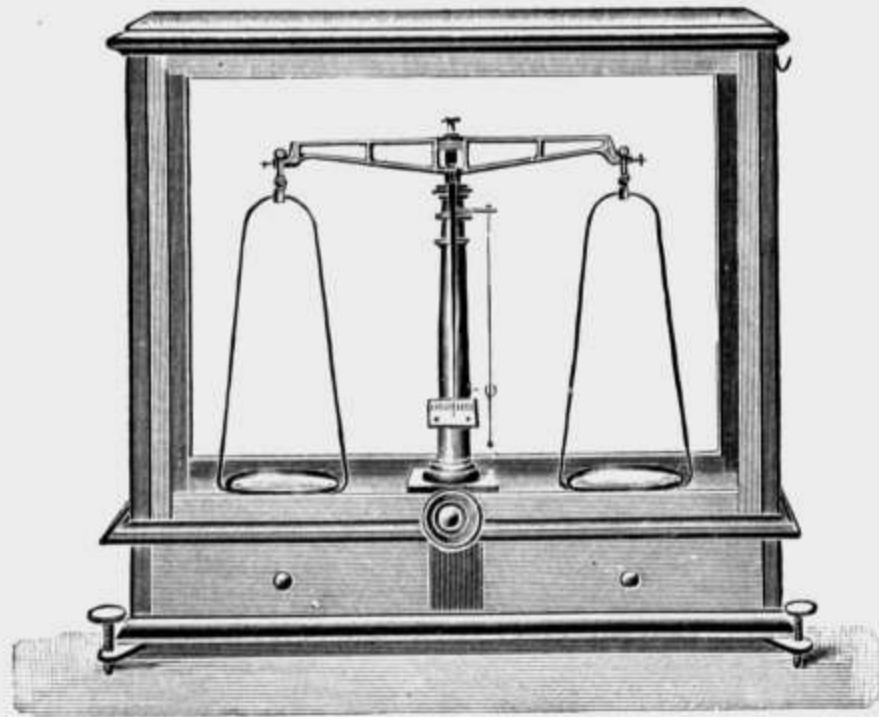
3804. **Balance**, open beam, agate knife edges and planes, arrests for the hangers, beam support, plumb bob and leveling screws, hangers fitted with double hooks for specific gravity experiments. Mounted in mahogany case with glass sides and top and fitted with sliding front and drawer. Length of beam, 21 centimeters; diameter of pans, 8 centimeters; capacity, 100 grams; sensibility, 2 milligrams .....Duty free \$ 22.50
- 3804A. **Balance**, same as No. 3804, furnished from stock..... 33.35



No. 3806.

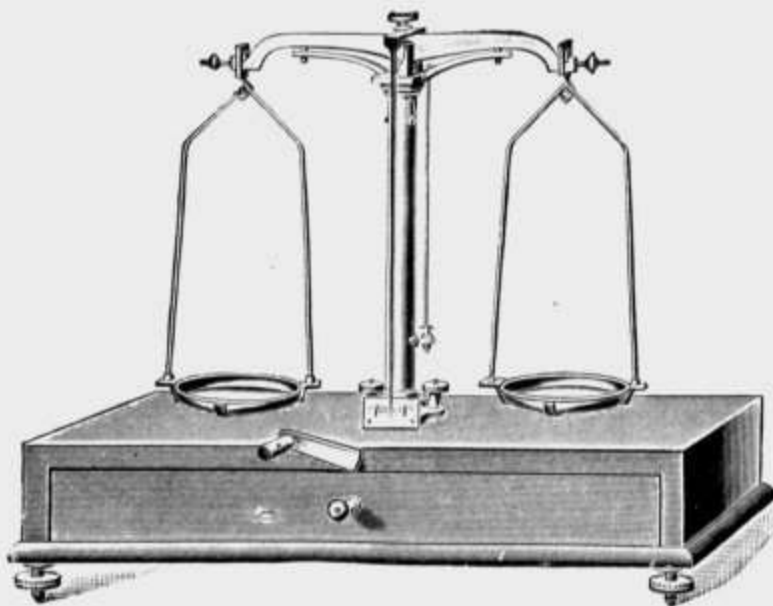
3806. **Balance**, same as No. 3804, mounted on polished mahogany board, fitted with leveling screws.....Duty free 11.00
- 3806A. **Balance**, same as No. 3806, furnished from stock..... 16.00
- 3808, 3809, **MAGNALIUM BALANCES**, pages 499 and 500



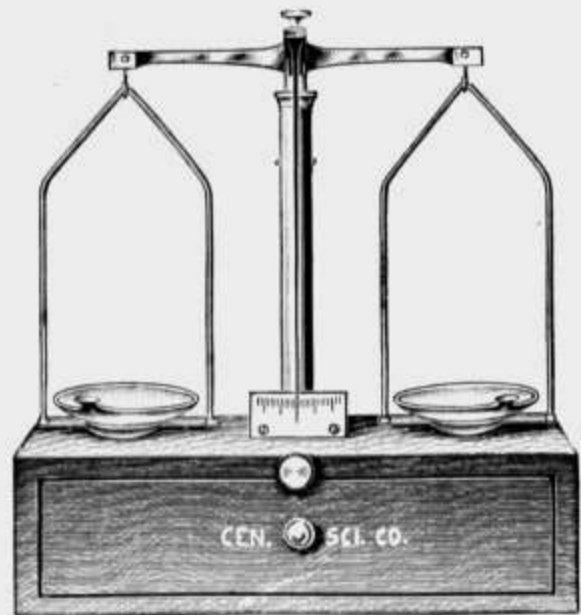


No. 3813.

3813. **Balance**, with steel bearings, beam arrest, eccentric for raising or lowering, plumb bob and leveling screws. Mounted in walnut case with glass sides and top, and fitted with sliding front and one drawer. Length of beam, 21 centimeters; diameter of pans, 7 centimeters; capacity, 50 grams; sensibility, 2 milligrams. From stock..... \$ 20.50
- 3813A. **Balance**, same as above.....Duty free 14.00

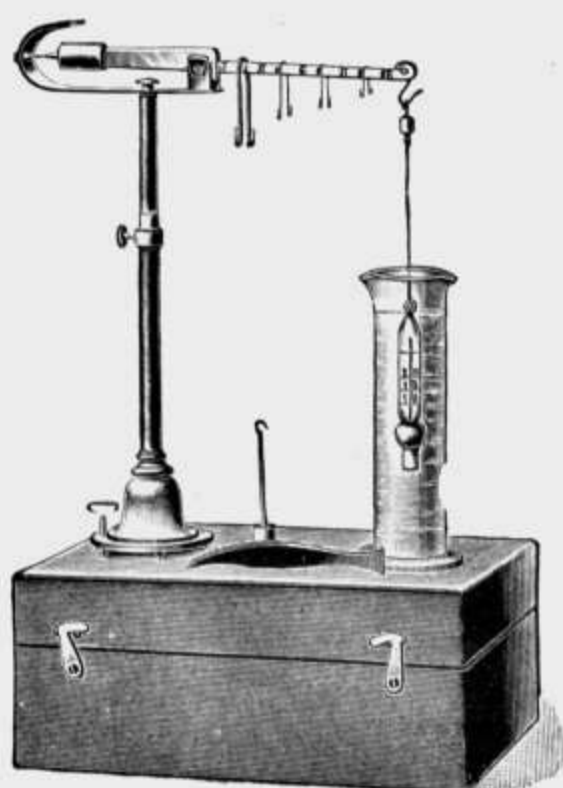


No. 3814.



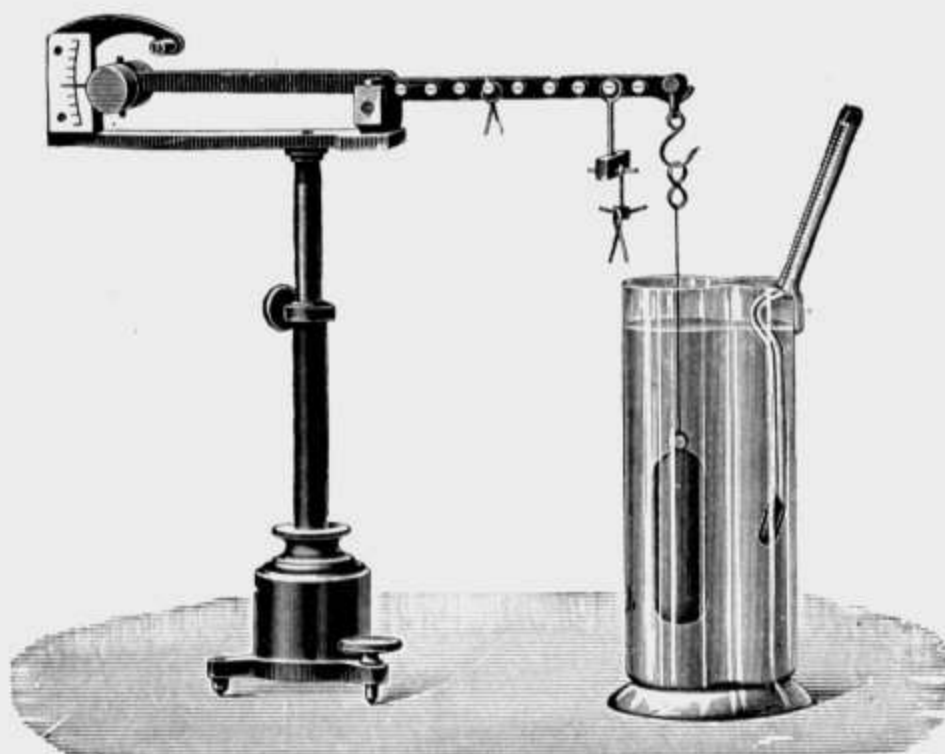
No. 3814A.

3814. **Balance**, with steel bearings, beam arrest, eccentric for raising or lowering, removable pans nickel plated, and plumb bob. Mounted on mahogany box provided with leveling screws and drawer. Length of beam, 19 centimeters; diameter of pans, 7 centimeters; capacity, 50 grams; sensibility, 3 milligrams..... 13.35
- 3814A. **Balance, Chemical**, with eccentric lift. Beam 150 mm. long, pans 65 mm. diameter. Mounted on base with drawer. Sensibility, 1 centigram ..... 6.00



No. 3815.

3815. **Specific Gravity Balance, Westphal.** This is a handy and improved form for exact and quick determination of the density of liquids. In polished hardwood box, with Reimann's patent thermometer sinker. This balance overcomes all trouble with incorrect hydrometers and forms an easy means for standardizing hydrometers..... \$ 13.35
- 3815A. **Extra Weights** for No. 3815 Balance. Per set..... 1.10
- 3815B. **Extra Thermometer, 15°**, for No. 3815 Balance..... 2.65



No. 3815E.

- 3815E. **Specific Gravity Balance, Westphal, improved.** This balance has hard steel bearings and weights provided with steel hangers, which insures a high grade of accuracy and solidity. The outfit includes a Reimann's plummet of 10 c. c. displacement, jar, thermometer and set of rider weights, weighing accurately 10, 1.0, 0.1 and 0.01 g. ....Duty free 22.50

**3816. Laboratory Balance.** Designed for schools desiring a more sensitive and convenient form of balance than the Harvard Trip Scale, at a slight additional cost.

**Capacity, 2 kilos.**

**Sensibility.** Loads up to 2 kilos can be readily weighed within 0.05 gram. Sensibility on light loads is much greater.

**Beam, open construction.** No small weights to handle. A rider upon beam indicates all amounts up to 10 grams by 1-10 gram divisions, each division being 2.54 mm. long.

**Damping Device, positive in action,** brings balance quickly to rest.

**Bearings, high grade steel prisms, carefully polished and adjusted.**

**Hangers of new design, eliminating friction and wear.**

**Pan Arrest.** The base serves as an arrest, enabling operator to move balance safely while loaded.

**Leveling Screws** are supplied, insuring greater sensitiveness.

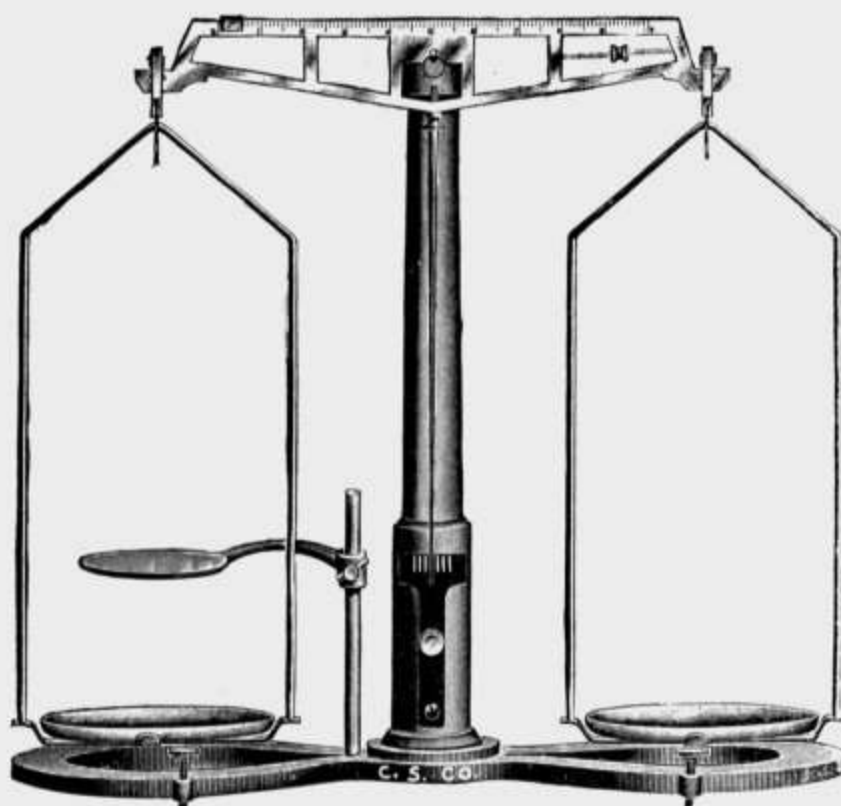
**Plumb Bob, not shown in illustration,** makes accurate leveling a simple matter.

**Adjusting Screw** protected within open work of beam.

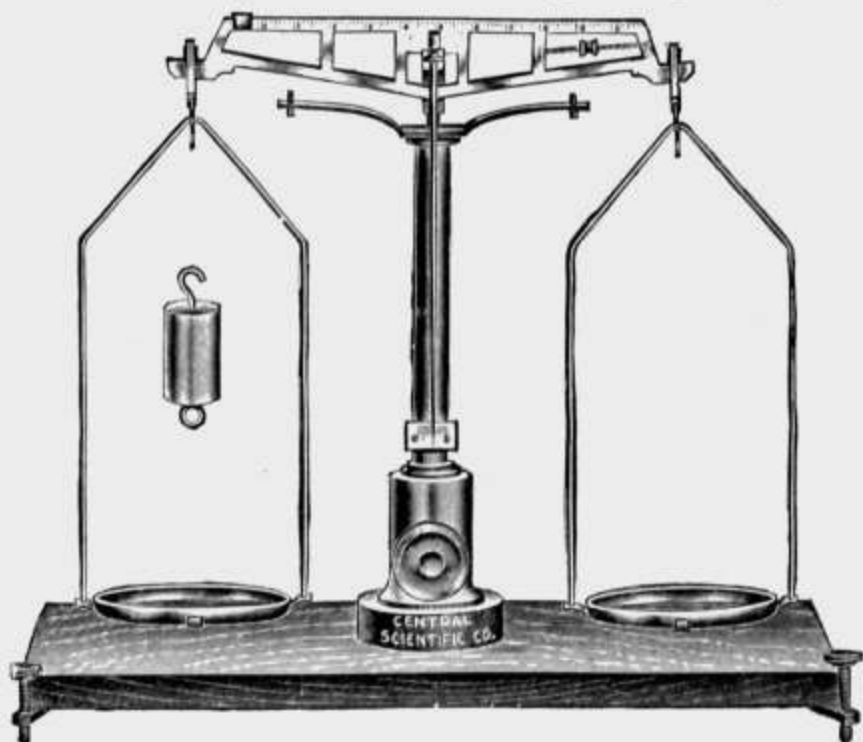
**Dimensions.** Length of beam between knife edges, 32 cm. Length of graduated part, 25.4 cm.

**Pans, 14 cm. in diameter.** Height of balance, 45 cm.

**An Adjustable Shelf** for specific gravity work included..... \$ 12.75



No. 3816.



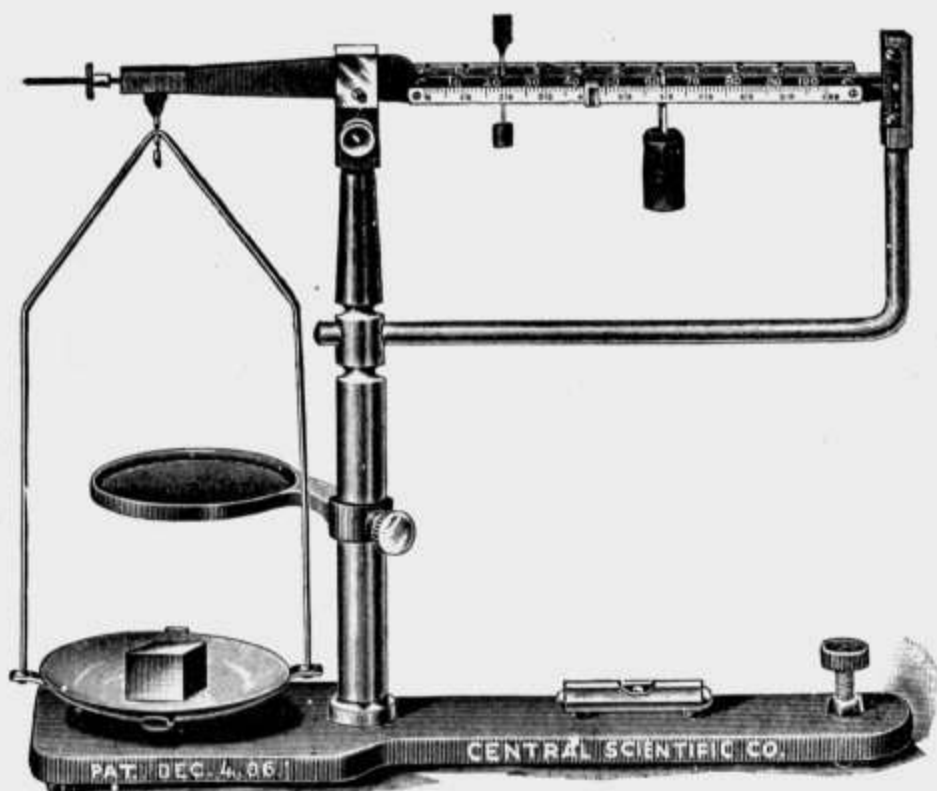
No. 3818.

Height of balance, 48 cm.; diameter of pans, 14 cm.; length of beam (between knife edges), 32 cm.

Capacity 2,000 grams. Sensibility with full load 30 milligrams or less, which is increased with smaller loads.....

22.00

**3818. Laboratory Balance,** similar to No. 3816, but more sensitive and of better finish and construction. Mounted on polished mahogany finish base provided with leveling screws. Sliding rider on graduated beam indicates weight up to 10 grams in 1-10 gram divisions. Prismatic steel bearings and supports. An eccentric movement operated by knurled head raises beam from beam arrest. Provided with counterpoise for specific gravity work. Made of brass finely finished; pans nickel plated. Plumb bob and protected adjusting screw as in No. 3816.



No. 3822.

3822. **Balance, "Cenco" Triple Beam**, for physical and chemical laboratories. The three beams are placed in the same horizontal plane, thus conforming to scientific principles involved, which is not true of other styles of triple beam balances. Weighings are obtained by movement of the riders along the beams. These riders are easily handled and quickly placed in the notches, but cannot be removed from the beams. An adjustable support is provided for a jar or other receptacle for experiments in specific gravity. Provided with stable base neatly japanned, and with sensitive spirit level and leveling screw. Balance neatly finished in nickel plate and japan. Capacity of middle beam, 100 grams by 10 gram divisions; back beam, 10 grams by 1 gram divisions; front beam, 100 centigrams by 1 centigram divisions. Total capacity, 111 grams; sensibility, with or without full load, guaranteed to 1 centigram. Actual tests, however, give a sensibility of from 4 to 8 milligrams. Features easily recognized are: Rapid weighing, constant sensibility, accuracy, freedom from loss of weights, no interference or breaking of weights..... \$ 14.00

3822A. **Extra Weight**, for use with No. 3822, for weighing over 111 grams, but not to exceed 201 grams. Weight is placed on the 100 gram notch of the middle beam. Sold only at the same time with No. 3822 .....

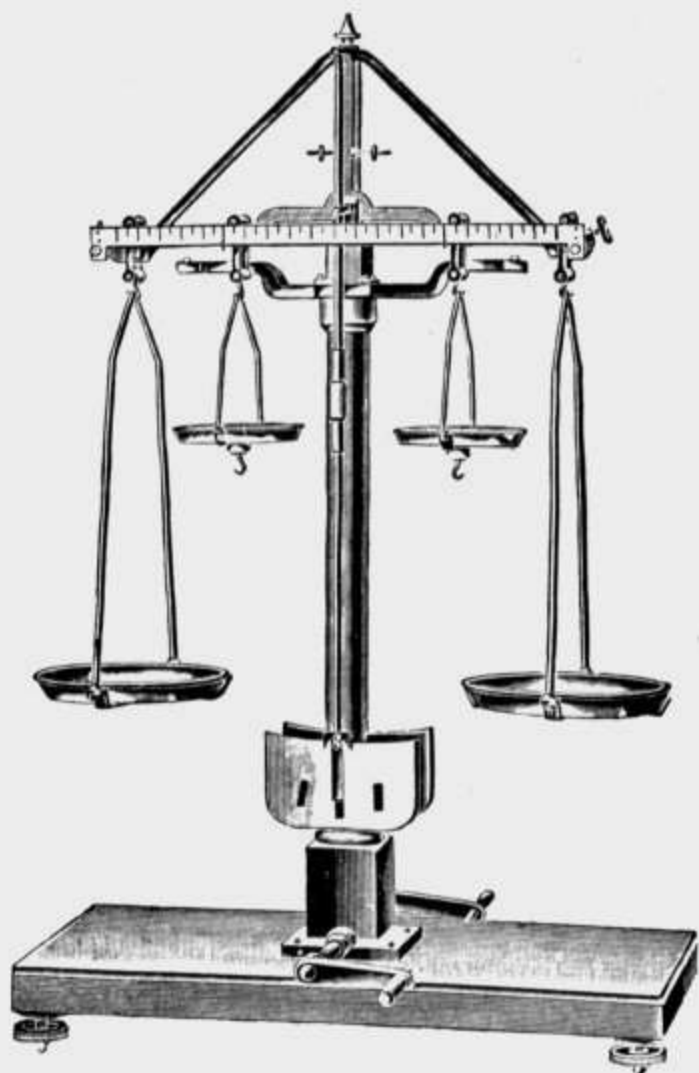
1.65

3823. **Balance, Hydrostatic**. Excellent for work in specific gravity experiments. Prismatic steel knife edges, adjustable rod supporting beam, and beam arrest. Beam can be so elevated that hook under short pan is 30 centimeters from the table. Mounted on neatly japanned iron base. Length of beam, 25 centimeters; diameter of pans, 10 centimeters; capacity, 200 grams; sensibility, 1 centigram....

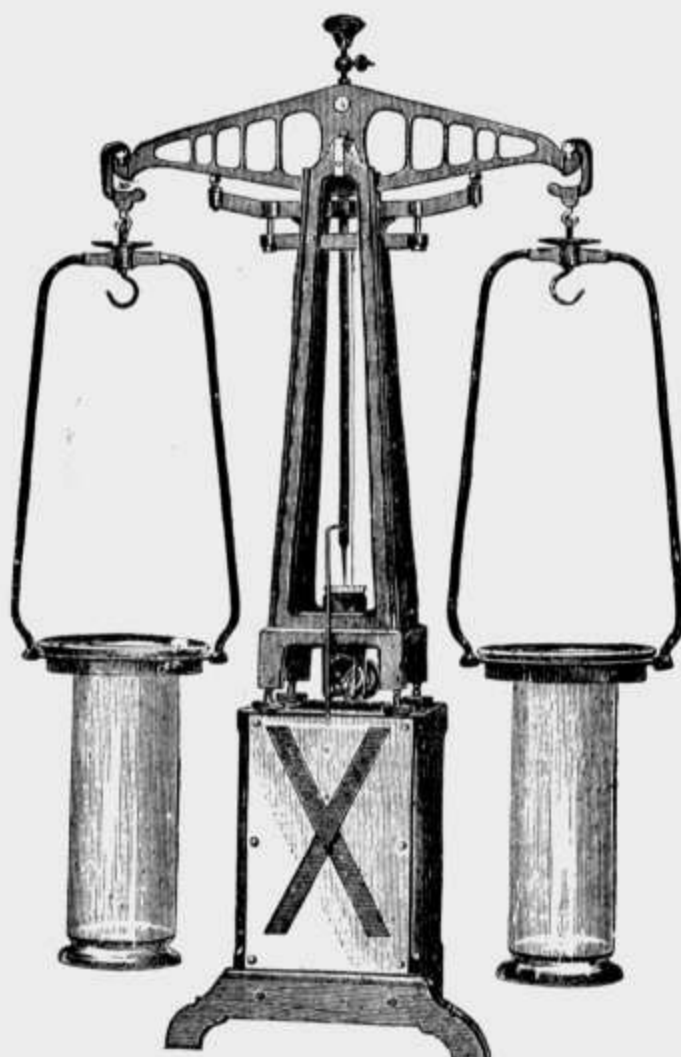
5.00



No. 3823.



No. 3825.



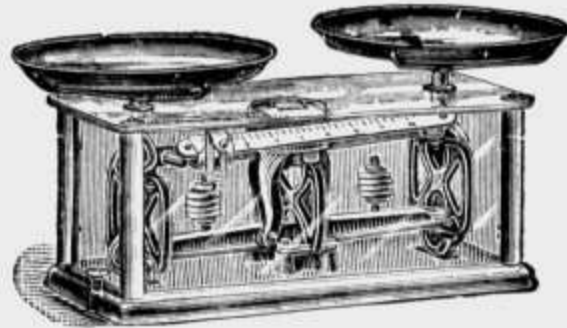
No. 3825A.

3825. **Lecture Table Balance.** A universally useful balance for the lecture table, for ordinary weighing, specific gravity work and hydrostatic work in general. Can also be used in the physical laboratory to demonstrate the laws of the lever. Capacity, 5 kilograms; sensibility, 100 milligrams. Provided with two pairs of pans with lever arms as 1:2 for proportional weighing. Graduated beam with eccentric arrestment, worked from either side; two pointers, the one facing the class, the other the lecturer. Handsomely finished .....Duty free \$ 54.00

3825A. **Balance,** for chemical lecture demonstration. For demonstrating the weight of gases and of atmospheric air, the increase of weight caused by oxidation, etc. With a charge up to 5 kg. in each pan, the deviation of the needle indicating a difference of 0.02 g. can clearly be observed at a distance of 50 meters. Complete with two glass cylinders of exactly the same weight, each one holding about two liters, two interchangeable polished glass discs, for hermetically closing the cylinders, and two horseshoe magnets of equal weight .....Duty free 99.00

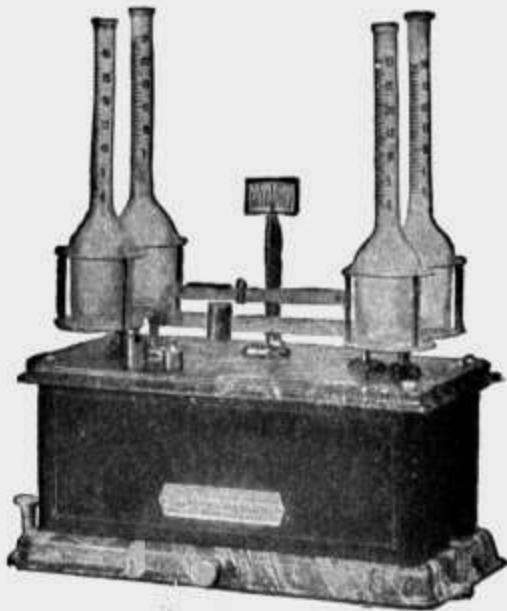


No. 3826.

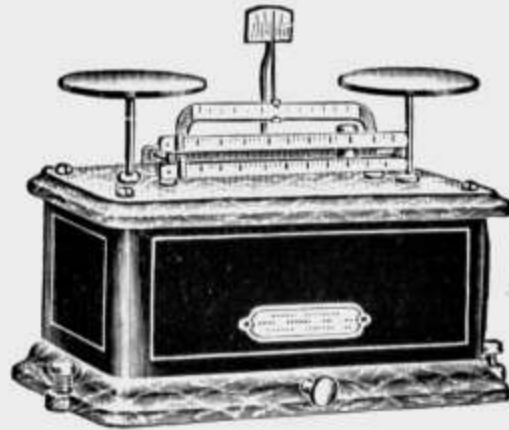


No. 3826A.

3826. **Torsion Balance**, suitable for all kinds of laboratory work. No knife edges, but built on the torsion principle. High poise, indicator and arrest. Slide beam reading to 10 grams by 1-10 gram divisions. Porcelain plates 6 inches in diameter. Capacity, 1 kilo.....Net \$ 18.00
- 3826A. **Torsion Balance**, in glass case, nickel plated throughout. Sensitive to  $\frac{1}{5}$  gram. May be loaded with 4.5 kilos without damage. Slide beam inside glass case reading to 100 grams by 1 gram.....Net 35.00
- 3826AA. **Torsion Balance**. Same as No. 3826A but sensitive to  $\frac{1}{15}$  gram....Net 40.00



No. 3826B.



No. 3826C.

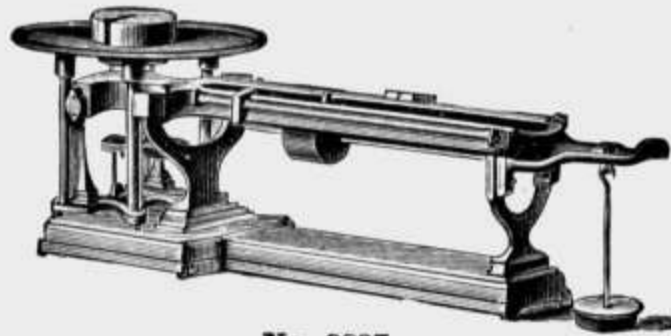
- 3826B. **Torsion Cream Test Scale**, sensitive to 1 centigram, has sliding tare poise, special bottle holders and arrest. For four bottles. With 9 and 18 gram weights.....Net 15.00

- 3826C. **Torsion Moisture Test Scale**, for determining amount of moisture in butter. This scale is constructed with percentage beams so that 0.1 per cent to 30 per cent of moisture can be determined without calculation when 10 gram samples of butter are used. By means of two tare beams one or more dishes can be balanced and recorded. With 10 gram weight.....Net 15.00



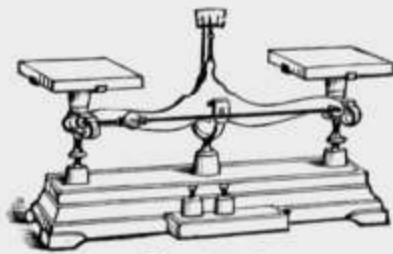
No. 3826D.

- 3826D. **Torsion Grain Test Scale**, designed according to suggestions of the U. S. Department of Agriculture expressly for the determination of moisture in grain. Sensitive to 7 centigrams. Capacity 1 kilo. Slide beam reads to 10 grams by  $\frac{1}{10}$ th gram. With arrest, scoop and block of special weights, 100 grams to 5 grams .....Net 17.50



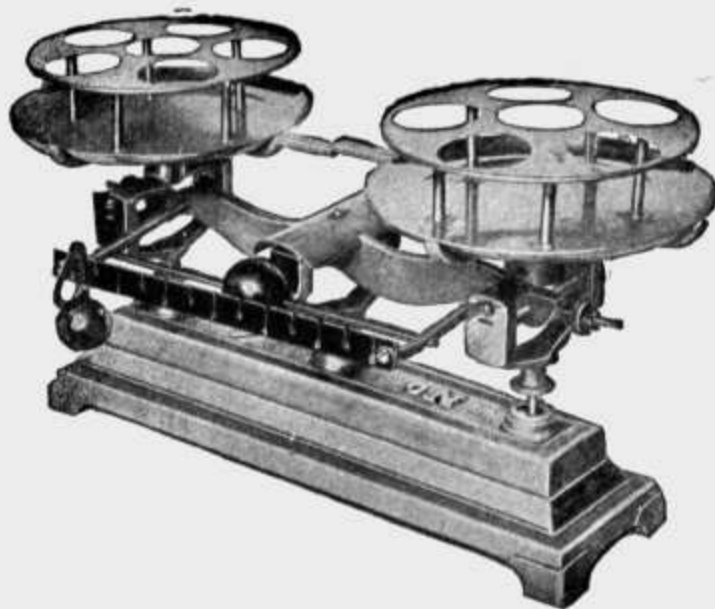
No. 3827.

3827. **Solution Balance**, provided with two weighing beams and sliding poises. One beam is divided into one hundred parts, each part representing one gram; the other beam is divided into ten parts, each part representing one hundred grams. A bar with sliding poise is placed under the weighing beams for the purpose of balancing the empty bottle or container, which is quickly done by sliding the poise along the bar until a correct balance is secured. This balance will be found indispensable in soil study where quantities up to 20 kilos need to be weighed with accuracy..... Net \$ 25.00



No. 3828.

3828. **Cream Testing Scale**, for use in connection with Babcock Test. Especially designed for very accurate weighing of cream. Metal parts galvanized to make them rust proof, porcelain plates and agate bearings. The bar in front of the balance is used for balancing bottle and is provided with the necessary weight. This scale is compact, being but 10½ inches long and being of careful construction is accurate..... Net 10.00



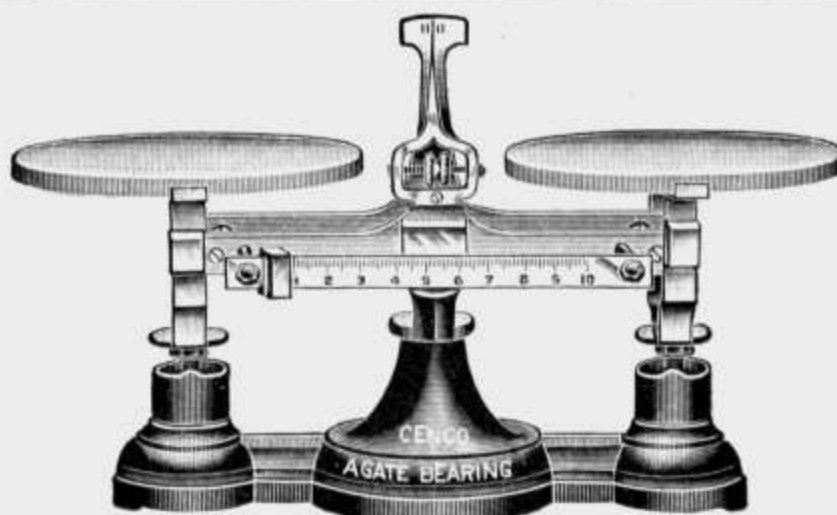
No. 3828A.



No. 3829.

3828A. **Cream Testing Scale**. This scale is designed to weigh 12 bottles at one time. On both sides of the scale there is a bottle rack holding six bottles each. The scale has a beam on the front divided into 12 parts, each part representing 9 grams; the divisions marked with whole numbers each representing 18 grams. Back of this beam is a tare beam with sliding brass weight, to balance bottles as placed in the rack; this does away entirely with the use of weights. The scale has agate bearings and is entirely galvanized to make it rust proof ..... Net 12.00

3829. **Standard Family Scale**, slanting white enameled dial, weighs 24 lbs. by 1 oz. divisions; with square sheet steel platform and tin scoop..... 1.35



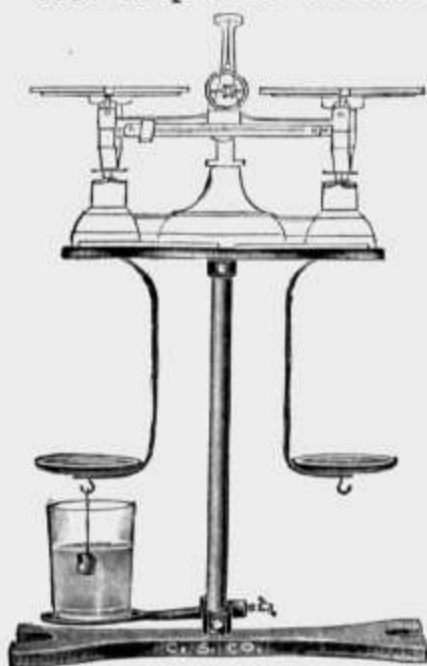
No. 3830.

3830. "Cenco" Agate Bearing Trip Scale, Harvard design. In this trip scale we have done away with the rough cast and forged iron parts used for years in the Harvard Trip Scale, and employ parts of brass and steel neatly formed by elaborate tools and machinery. This makes possible a degree of perfection never before attained in assembling this style of balance.

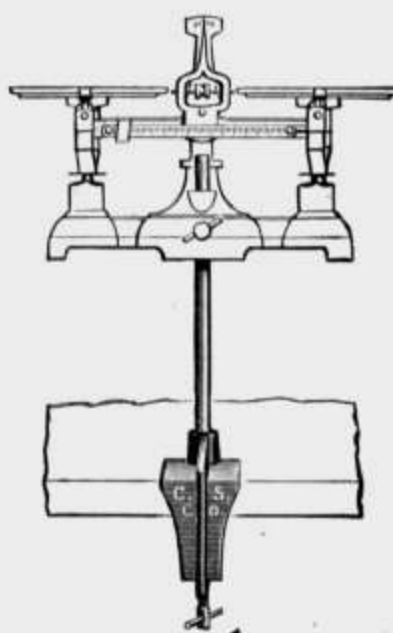
The BEARINGS consist of HARDENED STEEL PRISMS resting on SIX AGATE SHELVES of large dimensions. This construction adds very materially both to the initial sensibility of the scale and to its ability to retain its sensibility after long continued use. The graduated beam has a range of 10 grams in  $\frac{1}{10}$  gram divisions. The capacity of the scale is 2000 grams. Sensibility is guaranteed to be  $\frac{1}{10}$  gram. Actual tests show a much greater sensibility.

A very convenient feature of our latest design is a hook placed directly below the knife-edges of each scale pan, from which objects may easily be suspended for specific gravity work. A set screw is also provided by means of which the balance may be clamped to a 13 mm. support rod, and so elevated above the table top. (See No. 3831A Support.)

- |   |         |
|---|---------|
| 3830A. Funnel Scoop and Counterpoise, accurately adjusted, for use with No. 3830 Trip Scale | \$ 6.65 |
|   | 2.00    |



No. 3831.



No. 3831A.

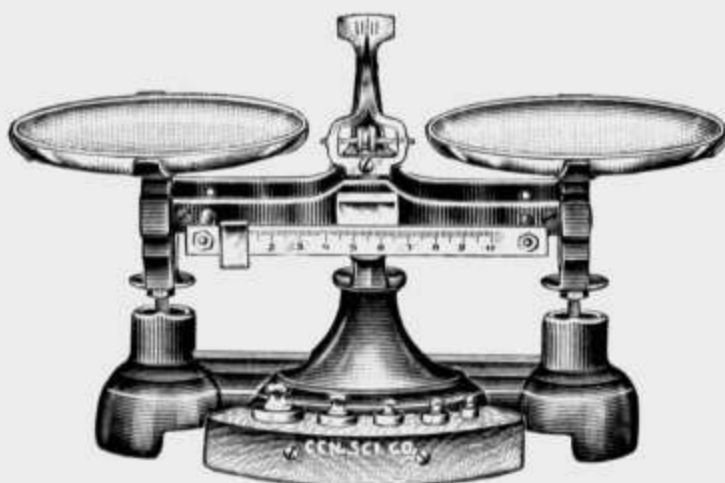
3831. "Cenco" Trip Scale Support. A convenient support which increases the utility of No. 3830. Illustration shows use in Specific Gravity experiments. Made entirely of metal, neatly finished in nickel plate and japan. Complete with hanger, scale pans and adjustable platform for tumbler

3831A. Support for No. 3830 Trip Scale. Consists of a table clamp of special design (No. 29A), and a No. 21 Support Rod, 20 cm. long. This forms a most convenient means of supporting No. 3830 Trip Scale (of the latest design) for specific gravity work, as the scale is provided with a set screw for clamping to a support rod, and with specially designed hooks for supporting specimens which are to be weighed under water

2.90

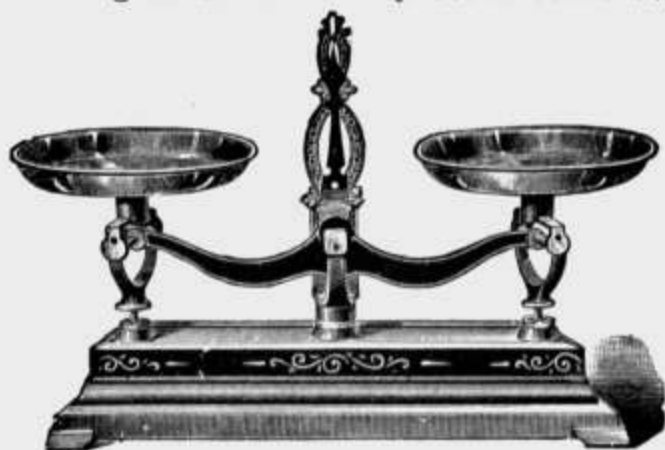
.90



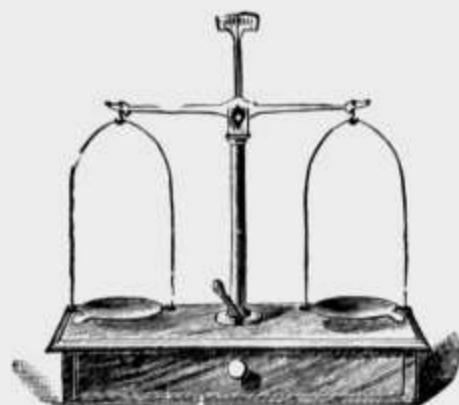


No. 3832.

3832. **Balance, Dispensing and Solution Scale, with AGATE BEARINGS** as described under No. 3830. This balance will be found ideal for laboratory and pharmaceutical work. The pans are of heavy nicked brass, 15 cm. in diameter. The graduated beam has a range of 10 g. in  $\frac{1}{10}$  g. divisions and brass weights from 10 g. to 100 g. are supplied, conveniently fitted into a projecting holder. Capacity, 2000 g. Sensibility is guaranteed to be  $\frac{1}{10}$  g.; actual tests show a much greater sensibility ..... \$ 8.00



No. 3833.



No. 3839.

3833. **Robervahl Balance.** This is the genuine imported Robervahl balance and is only adapted for coarse weighing. Removable scale pans  $4\frac{3}{4}$  inches in diameter, capacity  $\frac{1}{2}$  kilo..... 3.00
3835. **Robervahl Balance.** Same as No. 3833. Pans 5 inch, capacity 1 kilo... 3.35
3837. **Robervahl Balance.** Same as No. 3833. Pans  $5\frac{1}{2}$  inch, capacity 2 kilos 4.00
3839. **Army Prescription Balance, nickel plated, mounted on a box with drawer, 6 inch beam lifted by a lever. Capacity, 50 grams.....** 3.00



No. 3845.



Nos. 3847-3848.



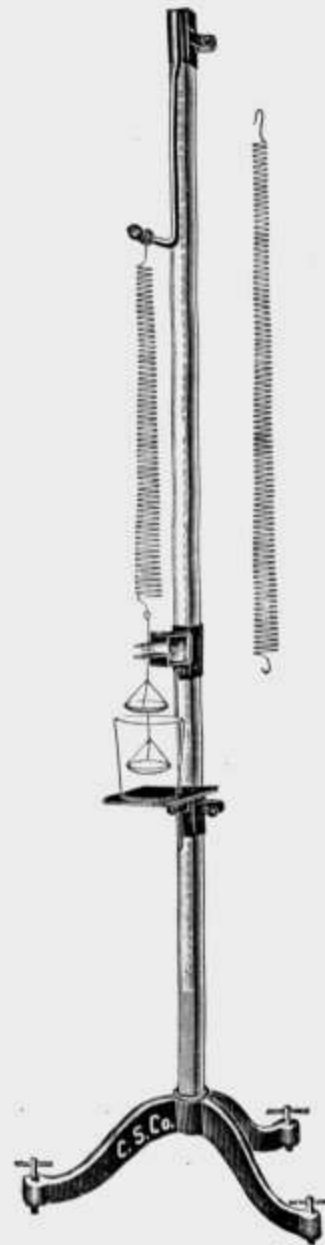
No. 3851.

3845. **Hand Balance, 5 inch brass beam with brass pans and set of brass weights 1 to 10 grams (grade of No. 3909) and German silver weights 10 to 500 mg. Superior to the cheap apothecaries' weights furnished by other dealers. Complete in box.....** 1.00
3847. **Hand Balance, 6 inch brass beam, with horn pans.....** 1.65
3848. **Hand Balance,  $7\frac{1}{2}$  inch brass beam, with horn pans.....** 2.00
3851. **Balance, of iron, with tin scoop and set of iron weights, 2 pounds down to  $\frac{1}{4}$  ounce, for coarse weighing only.....** 1.65
3853. **Balance Rests, for holding leveling screws of balances; of glass, giving perfect insulation. Per set of four.....** .33

3855. **Jolly's Spiral Spring Balance**, of our own new and improved design. The upright is nickel plated, 100 centimeters long, graduated in millimeters, and supported by a heavy japanned iron tripod base, fitted with leveling screws. The support for the spring is adjustable and can be inverted for light loads or heavier springs. As the upright rod is graduated for its full length this spring support may be set at any given point, and may be moved during an experiment provided the amount of its motion is added to or subtracted from the stretch of the spring. The indicator at the end of the spring may thus be kept at a convenient height during an entire experiment.

Attached to the sliding index is a small mirror with a horizontal line etched upon it, and a device for limiting the motion of the spring. The indicator attached to the end of the spring is a small metal disc which may be set very accurately in line with its own image and the etched line on the glass. The position of the index is then read directly from the scale. This method of reading embodies all the advantages of the mirror scale, and at the same time does away with the necessity of reading the position of the index while attempting to hold three objects in line with the eye.

The platform for holding the beaker of water or other liquid is of oxidized brass and slides on the upright, to which it can be clamped in any position. For experiments in cohesion or surface tension a device is provided by which the platform may be fastened to and moved with the sliding index. The lower pan is of glass suspended by fine platinum wires. The springs are of the best steel, conical in form, especially made for Jolly Balance work. Two springs, one high and one low tension, are supplied with the balance ..... \$ 11.10

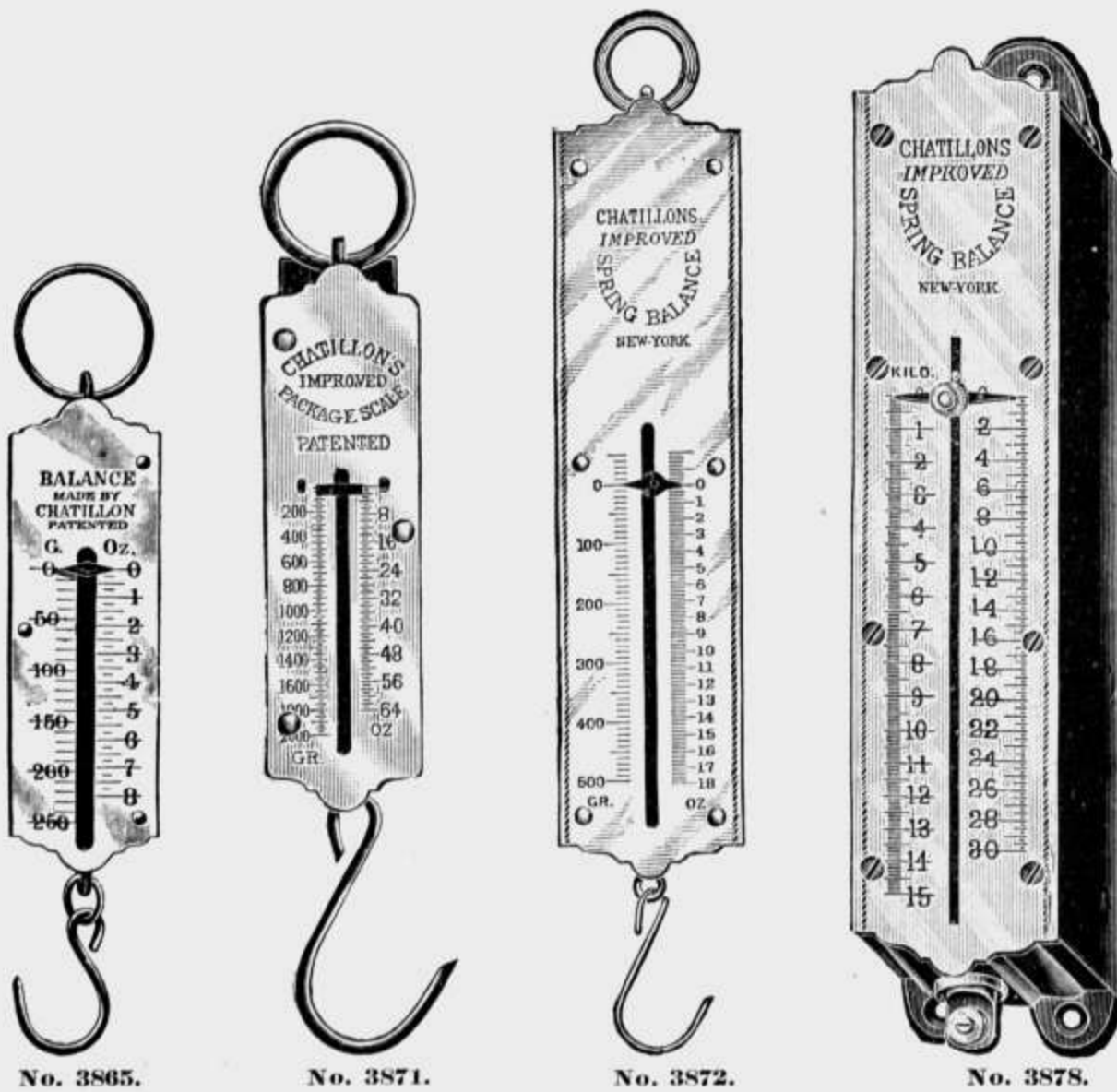


No. 3855.



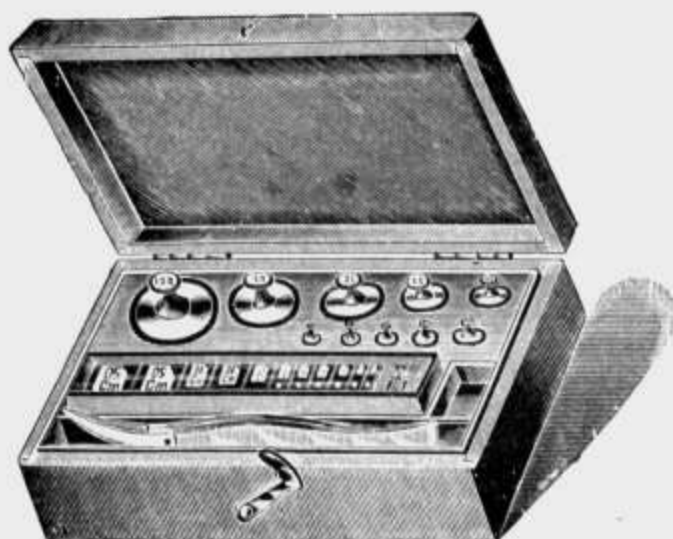
No. 3856.

- |  |      |
|--|------|
| 3856. <b>Jolly's Spiral Spring Balance</b> , made entirely of metal and nicely finished throughout. The upright is a nickel plated rod 100 cm. long supported by a japanned iron tripod base. The platform is of oxidized brass which slides along the rod and can be clamped in any position. The spring support is also adjustable and can be inverted for light loads or heavier spring allowing a larger range. An adjustable mirror scale 65 cm. long, graduated in millimeters, is provided. The pans are of aluminum..... | 5.00 |
| 3856A. <b>Scale Pan</b> for Jolly's Spiral Spring Balance. Lower pan of aluminum, with copper wires.....   | .28  |
| 3856B. <b>Scale Pan</b> for Jolly's Spiral Spring Balance. Upper pan of aluminum, with copper wires.....   | .28  |
| 3857. <b>Scale Pan</b> for Jolly's Spiral Spring Balance. Lower pan of glass, with platinum wires.....   | .55  |
| 3858. <b>Spring</b> for Jolly's Balance, light.....  | .50  |
| 3858A. <b>Spring</b> for Jolly's Balance, heavy.....   | .50  |



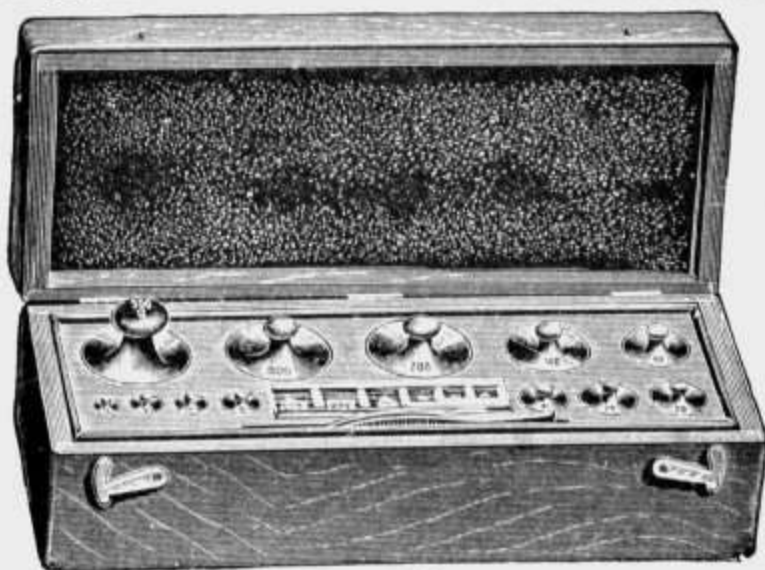
SPRING BALANCES.

3861.	Spring Balance, 25 lbs in 8 oz. divisions. Spring elongates 1½ in.....	\$ 0.16
3863.	Spring Balance, 50 lbs. in 1 lb. divisions. Spring elongates 1¾ in.....	.30
3865.	Spring Balance, English and Metric, 8 oz. in ¼ oz. divisions, and 250 grams in 10 gram divisions. Spring elongates 2¼ in.....	.77
3867.	Spring Balance, same as No. 3865, with flat back and broad pointer, for either perpendicular or horizontal reading.....	.90
3869.	Spring Balance, English and Metric, 64 oz. in 1 oz. divisions, and 2,000 grams in 25 gram divisions. Spring elongates 2¼ in.....	.45
3871.	Spring Balance, same as No. 3869, with flat back and broad pointer, for either perpendicular or horizontal reading.....	.55
3872.	Spring Balance. Capacity, 18 oz. in ½ oz. divisions and 500 grams in 10g. divisions. Has flat back and sharp pointer, and is provided with several divisions above the zero to compensate for the sharp pointer in horizontal readings. Spring elongates 4 in.....	2.25
3873.	Spring Balance, English and Metric, 30 lbs. in ¼ lb. divisions, and 15 kilos in 100 gram divisions. Spring elongates 5½ in.....	1.65
3875.	Spring Balance, same as No. 3873, with flat back.....	1.90
3878.	Spring Balance. In iron case with sliding index recorder. Especially designed for experiments in tensile strength, the indicator remaining at the breaking strain, instead of going back to zero when the strain is released, as in the case of the regular spring balances. English and Metric scales. 30 lbs. in ¼ lb. divisions, and 15 kilos in 100 gram divisions. Spring elongates 5½ in.....	6.00
3879.	Spring Balance, cylindrical pocket form, arranged to obviate the zero error. 15 lbs. in 4 oz. divisions. Spring elongates 2¼ in.....	.55



No. 3901.

3901. **Weights of Precision (Sartorius). Gold plated.** Brass weights, heavily plated with gold; fractional weights of platinum except the 5, 2 and 1 mg., which are of aluminum, two platinum riders. Put up in velvet lined mahogany case, with ivory tipped forceps. 1 milligram to 100 grams.....Duty free \$ 9.00
3902. **Weights of Precision (Sartorius).** Same as No. 3901, but furnished from stock .....Net 16.00
3903. **Weights of Precision (Sartorius).** Same as No. 3901, but 1 milligram to 50 grams.....Duty free 8.00
3904. **Weights of Precision (Sartorius).** Same as No. 3903, but furnished from stock .....Net 14.00
- 3904A. **Weights of Precision (Sartorius).** Same as No. 3901, but 1 milligram to 200 grams.....Duty free 13.20
- 3904B. **Weights of Precision (Sartorius).** Same as No. 3901, but 1 milligram to 500 grams.....Duty free 16.00
- 3904C. **Weights of Precision (Sartorius).** Same as No. 3901, but 1 milligram to 1000 grams.....Duty free 22.00



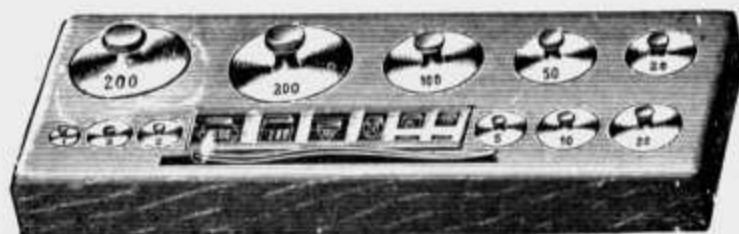
No. 3905.

3905. **Weights. Good grade.** Brass weights, with fractional weights of German silver (except the 5, 2 and 1 mg. weights, which are of aluminum). In fine mahogany box with brass forceps.

1 milligram to...	20 g.	50 g.	100 g.	200 g.	500 g.	1000 g.
Each .....	3.00	3.35	4.00	5.55	7.25	10.00

3906. **Weights,** same general description as No. 3905, but brass weights heavily nicked and adjusted within the following limits of error:

Weights, milligrams .....	1	2	5	10	20	50	100	200	500
Limit of error, milligrams..	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1
Weights, grams .....	1	2	5	10	20	50	100		
Limit of error, milligrams..	0.1	0.2	0.3	0.4	0.5	0.6	0.8		
Set 1 milligram to.....	20 g.		50 g.			100 g.			
Each .....	4.75		5.75			7.85			

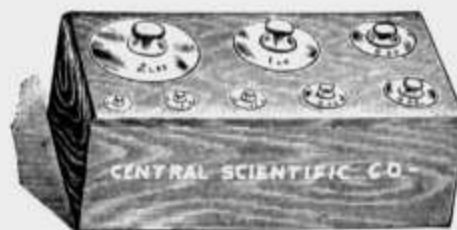


No. 3907.

3907. **Weights. Good grade.** Same as No. 3905, but in a polished hardwood block instead of a box. With brass forceps.  
 1 milligram to... 20 g. 50 g. 100 g. 200 g. 500 g. 1000 g.  
 Each ..... \$1.55 1.77 2.25 3.35 4.75 7.00
3909. **Weights.** Separate weights for No. 3905 or No. 3907.  
 Grams ..... 1 2 5 10 20 50 100  
 Each ..... .06 .06 .06 .09 .11 .22 .40



No. 3921.



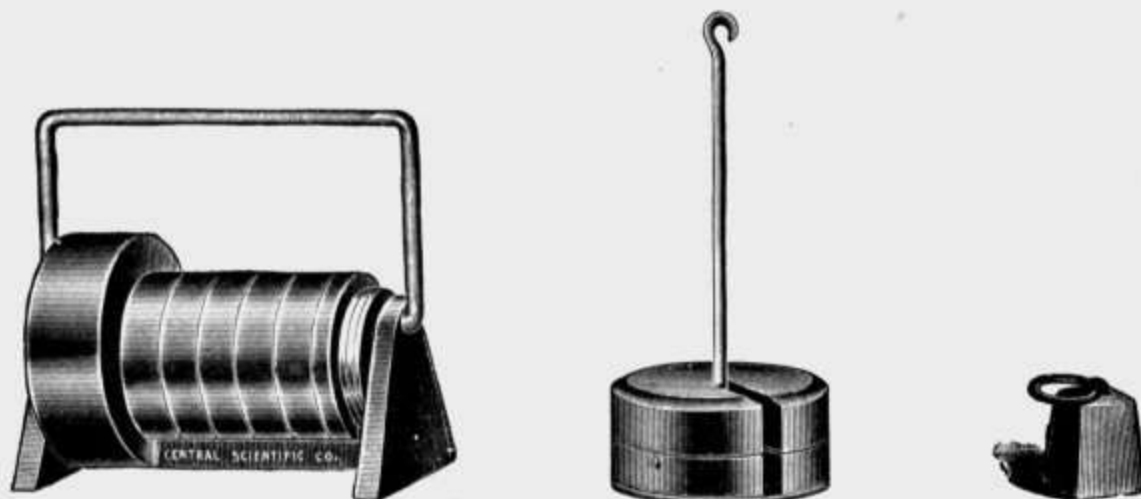
No. 3929.

3915. **Weights, brass, in block, 1 centigram to 20 grams.....** \$ 0.45  
 3917. **Weights, brass, in block, 1 centigram to 50 grams.....** .60  
 3919. **Weights, brass, in block, 1 centigram to 100 grams.....** .78  
 3921. **Weights, brass, in block, 1 gram to 500 grams.....** 1.77  
 3923. **Weights, brass, in block, 1 gram to 1,000 grams.....** 3.00  
 3925. **Weights, brass, single weights, same style as in above sets.**  
 Grams ..... 1 2 5 10 20 50 100 200 500 1,000  
 Each ..... .06 .06 .06 .09 .11 .17 .25 .45 .80 1.25
3927. **Weights, brass, in block, 1/4 oz. to 1 lb.....** 3.00  
 3929. **Weights, brass, in block, 1/4 oz. to 2 lb.....** 4.25



No. 3933.

3933. **Weights, iron, in nest, 5 grams to 1 kilo (duplicates of 20 and 200 grams) .....** 1.20  
 3934. **Weights, iron, in nest, 5 grams to 2 kilos (duplicates of 20 and 200 grams) .....** 1.95  
 3935. **Weights, iron, in nest, 5 grams to 5 kilos (duplicates of 20, 200 and 2,000 grams) .....** 4.20  
 3937. **Weights, iron, single weights, same style as No. 3933-3935.**  
 Kilos ..... 1 2 5  
 Each ..... .55 .75 1.50
3938. **Weights, iron, in nest, 1/2 oz. to 1 lb.....** 1.25



No. 3939.

Nos. 3062-3063.

No. 3943.

3939. **Weights, iron, slotted, 1-500, 5-100, 1-50, 2-20 and 1-10 gram weight, with holder.** These weights fit No. 750 Weight Hanger listed below. \$ 1.65
3062. **Weight Hanger, for attaching to pulleys, levers, sonometers, etc., for carrying slotted weights.** Made of iron with hook; weighs 1 kilogram, and will hold 20 kilograms of No. 3063 weights..... .55
3063. **Weights of Iron, with slot, for No. 3062 Weight Hanger.**
- |                         |     |     |     |      |
|-------------------------|-----|-----|-----|------|
| Weight, kilograms ..... | 1/2 | 1   | 2   | 5    |
| Each .....              | .45 | .55 | .75 | 1.65 |
750. **Weight Hanger, made of brass, weighs 50 grams, and will hold 1000 grams of No. 751 weights .....** .45
751. **Weights, nickel plated, accurately adjusted with slot to fit No. 750 Weight Hanger.**
- |                     |     |     |     |     |     |
|---------------------|-----|-----|-----|-----|-----|
| Weight, grams ..... | 10  | 20  | 50  | 100 | 500 |
| Each .....          | .20 | .25 | .30 | .35 | .55 |
3942. **Weights, iron, safety valve, 4 lb., .50; 8 lb.....** .85
3943. **Weights, iron, with ring handle.**
- |              |     |     |      |      |      |
|--------------|-----|-----|------|------|------|
| Pounds ..... | 1   | 2   | 4    | 10   | 14   |
| Each .....   | .72 | .72 | 1.40 | 2.05 | 2.50 |



No. 3945.

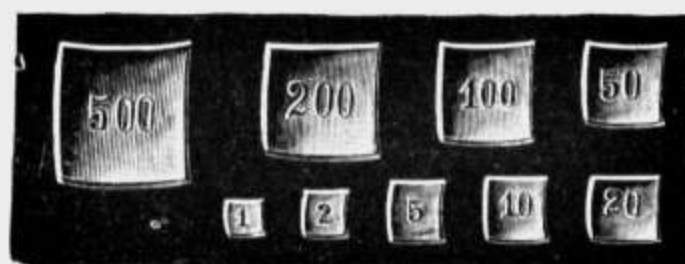


No. 3947.

3945. **Weights, aluminum, square, made concave so they can be picked up readily, 1/2 grain to 10 grains, in pasteboard box.....** .50
3947. **Weights, aluminum, 1/2 grain to 5 grains, in pasteboard box.....** .25



No. 3950.



Nos. 3951-3957.



No. 3959.

3950. **Weights, German Silver, 1 milligram to 500 milligrams, in box with sliding cover; each weight in a separate compartment; with brass forceps .....** 1.33
3951. **Weights, German silver, fractional parts of a gram, put up in sets, 1 mg. to 500 mg., with duplicates of the 2, 20 and 200 milligram pieces, 12 in all, in pasteboard box .....** .22
3953. **Weights, German silver, fractional parts of a gram, same as No. 3951; 1, 2, 5, 10, 20, 50, 100, 200, 500 milligram. Each.....** .05
3955. **Weights, platinum (1, 2, and 5 mg. aluminum), fractional parts of a gram, put up in sets, 1 mg. to 500 mg., with duplicates of the 2, 20 and 200 milligram pieces, 12 in all, in pasteboard box.....** 5.00
3957. **Weights, platinum (1, 2, and 5 mg. aluminum), same as No. 3955.**
- |            |     |     |     |     |     |     |     |     |      |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Mg. ....   | 1   | 2   | 5   | 10  | 20  | 50  | 100 | 200 | 500  |
| Each ..... | .20 | .20 | .22 | .30 | .33 | .45 | .60 | .85 | 1.50 |
3959. **Riders, of first quality.**
- |            |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|
| Mg. ....   | 1   | 2   | 5   | 6   | 10  | 12  |
| Each ..... | .40 | .40 | .30 | .25 | .25 | .25 |



No. 3965.

3965. **Weights, Universal.** These weights are of brass, finely finished, and are of a high degree of accuracy. They are provided with a hook at the top and an eye in the bottom, which is concave so that the weights can be stood upright on a platform balance. This is a distinctly high grade set of weights and will be found of great value in physical laboratory experiments with levers, pulleys, etc., as well as for general weighing. The set consists of nine weights ranging from 10 grams to 1 kilo, with duplicates of the 20 and 200 gram pieces. Complete in finely finished hardwood block..... \$ 3.00

3966. **Weights, same as No. 3965.**  
 Grams ... 10 20 50 100 200 500 1000  
 Each .... .18 .22 .27 .33 .38 .50 .65

3967. **Weights, Universal.** These weights are made of cast iron, neatly japanned, with the denomination in raised figures. Of same general nature as No. 3965, but much less finely finished and accurate. The set comprises nine weights ranging from 10 grams to 1 kilo, with duplicates of the 20 and 200 gram pieces ..... 2.00

3968. **Block of hardwood, with holes to fit No. 3967 weights ..... .55**

3969. **Weights, same as No. 3967.**  
 Grams 10 20 50 100 200 500 1000 2000  
 Each .11 .16 .18 .20 .25 .35 .55 1.00



No. 3967.



No. 3971.



No. 3973.

3971. **Forceps, ivory tipped, for handling weights..... .67**  
 3973. **Forceps, brass, curved points, plain..... .16**  
**Camel's Hair Brush, for scale pans, see No. 4606.**

APPARATUS FOR  
**"A LABORATORY COURSE IN ELEMENTARY PHYSICS"**  
 by  
**MILLIKAN AND GALE.**

NOTE.—Apparatus previously listed in this catalog is referred to in this list by its original number. Apparatus not previously mentioned is numbered according to the experiment with a prefix H (H1001, etc.).

**WRITE FOR COMPLETE ILLUSTRATED CATALOGUE OF SPECIAL APPARATUS  
 FOR MILLIKAN AND GALE'S "A LABORATORY COURSE IN  
 PHYSICS" AND "A FIRST COURSE IN PHYSICS."**

M. & G. Exp.	Cat. No.		\$
1	319.	Meter Stick .....	0.28
1	314.	Brass Disc, 7.5 cm. diameter.....	.11
2	1590A.	Hollow Cylinder with glass cover.....	.40
2	3816.	Laboratory Balance with Leveling Screws.....	12.75
2	3939.	Set of Weights, slotted with holder, 1-500, 5-100, 1-50, 2-20, 1-10 gram .....	1.65
2	131.	Vernier Caliper .....	2.50
	1608	Lead Shot, listed later, see Exp. 8.	
3	127A.	Micrometer Caliper, with Ratchet Stop, 25 mm.....	6.35
3	127B.	Micrometer Caliper, same as No. 127A, without ratchet.....	5.55
3	717.	Steel Sphere, $\frac{3}{4}$ -inch diameter (eight required), each.....	.08
		The following can be substituted if desired:	
	125.	Micrometer Caliper, with Friction Head, 15 mm.....	3.35
	717.	Steel Sphere, $\frac{1}{2}$ -inch .....	.06
3	6203.	Block, 4"x4"x2" (substitute for caliper method).....	.15
3	327.	Boxwood Rule, metric.....	.08
	1590A	Copper Cylinder, listed before, see Exp. 2.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
4	3871.	Spring Balance, flat back, 2,000 grams (three required), each	.55
4	720.	Board for Mounting Balances, 58 cm. x 84 cm.....	1.65
	319	Meter Stick, listed before, see Exp. 1.	
4	3969.	Iron Weight, 2 kilo.....	1.00
5	1022.	Glass Tube, 110 cm. x 4 cm., ends annealed, with rubber stop- pers .....	1.33
5	1022A.	Glass Manometer Tube (unmounted).....	.27
	319	Listed before, see Exp. 1.	
6	1108.	Jar with Two Manometers, Inlet Tube, pinchcock..	1.25
6	1108A.	Manometer Tube, each.....	.40
6	4547.	Bottle with Glass Stopper, 8 oz.....	.12
	319	Meter Stick, listed before, see Exp. 1.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
7	1142.	Aluminum Cylinder, with hook.....	.44
7	4215.	Beaker, glass, No. 4, 550 c.c.....	.25
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
	131	Vernier Caliper, listed before, see Exp. 2.	
8	1110.	Constant Weight Hydrometer Tube.....	.44
8	1111.	Constant Volume Hydrometer Tube.....	.33
8	1115.	Constant Weight Hydrometer, commercial form, for light liquids .....	.40
8	1608.	Lead Shot, per pound.....	.16
	1022	Glass Tube, listed before, see Exp. 5.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
9	5027C.	Battery Jar .....	.27
9	1143.	Sinker .....	.13
9	1137.	Wooden Block .....	.11
	319	Meter Stick, listed before, see Exp. 1.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
	327	Metric Rule, listed before, see Exp. 3.	
10	H1001.	†Boyle's Law Tube, 110 cm. long, 1 mm. bore, filled.....	1.35
10	H1001A.	Boyle's Law Tube, 110 cm. long, 1 mm. bore, unfilled.....	.13
10	H1002.	Set of Supports (Tripod, Rod, Clamp, Burette Holder).....	1.95
	319	Meter Stick, listed before, see Exp. 1.	
	1165	Barometer, see page 100.	

†We find it extremely difficult to ship these tubes in a filled condition, and cannot guarantee safe delivery.



M. & G. Exp.	Cat. No.		\$
11	1617.	Dew Point Apparatus, without Thermometer.....	0.66
11	5407.	Thermometer, 110°C .....	.40
11	4543.	Bottle, 125 c.c. (three required), each.....	.04
11	4847.	Evaporating Dish, No. 9, 2½-inch diameter (three required), each .....	.11
12	658A.	Mirror Scale, with Support.....	.80
12	658B.	Spring and Weight Holder, for Hooke's Law.....	.20
12	462.	Mirror Scale only of 658A.....	.30
12	H1203.	Steel Rod, for Bending Experiments.....	.06
12	H1204.	Pair of Wooden Support Blocks.....	.55
	3939	Weights, listed before, see Exp. 2.	
13	1515B.	Pressure Coefficient Apparatus, without support (H1002)....	1.65
13	H1302.	*Volume Coefficient Tube, filled.....	1.40
13	H1302A.	Volume Coefficient Tube, unfilled.....	.10
13	1586.	Steam Generator (three required), each.....	2.25
	4215	Glass Beaker, No. 4, listed before, see Exp. 7.	
	1593	Calorimeter, listed later, see Exp. 18.	
	1165	Barometer, see page 100.	
	H1002	Set of Supports, listed before, see Exp. 10.	
14	H1402.	Brass Tube and Pointer.....	.65
	H1204	Blocks, listed before, see Exp. 12.	
	658A	Scale and Support, listed before, see Exp. 12.	
	5407	Thermometer, listed before, see Exp. 11.	
	319	Meter Stick, listed before, see Exp. 1.	
	127A	Micrometer Caliper, listed before, see Exp. 3.	
	1586	Generator, listed before, see Exp. 13.	
15	726.	Demonstration Balance, consisting of knife edge clamp and support .....	.45
	319	Meter Stick, listed before, see Exp. 1.	
	3939	Weights, listed before, see Exp. 2.	
16	769A.	Inclined Plane with Pulley.....	.93
16	770.	Pulley only of No. 769A.....	.33
16	771.	Carriage .....	1.00
	319	Meter Stick, listed before, see Exp. 1.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
	H1002	Set of Supports, listed before, see Exp. 10.	
17	773A.	Clamp ..	.33
17	705.	Iron Ball, ¾-inch .....	.06
17	715.	Lead Ball, ¾-inch .....	.08
	774	Stop Watch, listed later, see Exp. 38.	
	319	Meter Stick, listed before, see Exp. 1.	
18	1593.	Calorimeter, double, with fiber ring.....	2.00
18	4625.	Bunsen Burner .....	.25
	5407	Thermometer, listed before, see Exp. 11.	
	1590A	Cup, listed before, see Exp. 2.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
19	H1901.	100 Grams Aluminum Pellets.....	.33
19	4980A.	Glass Stirring Rod, 8-inch x ¼-inch.....	.03
	1586	Generators (three), listed before, see Exp. 13.	
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
	5407	Thermometer, listed before, see Exp. 11.	
	4625	Bunsen Burner, listed before, see Exp. 18.	
	1608	Lead Shot, listed before, see Exp. 8.	
20	1585.	Tube for Mechanical Equivalent of Heat.....	.28
	5407	Thermometer, listed before, see Exp. 11.	
	1608	Lead Shot, listed before, see Exp. 8.	
	1590A	Cup, listed before, see Exp. 2.	
21		H1002 Set of Supports, listed before, see Exp. 10.	
	5407	Thermometer, listed before, see Exp. 11.	
	4625	Bunsen Burner, listed before, see Exp. 18.	
		Acetamide and Naphthaline (see Catalog R).	
22	H2201.	Stirrer .....	.10
	3816	Balance, listed before, see Exp. 2.	
	3939	Weights, listed before, see Exp. 2.	
	1593	Calorimeter, listed before, see Exp. 18.	
	5407	Thermometer, listed before, see Exp. 11.	
	1586	Generator, listed before, see Exp. 13.	
	4625	Bunsen Burner, listed before, see Exp. 18.	
23	H2301.	Glass U Tube, not filled.....	.22
	1593	Calorimeter, listed before, see Exp. 18.	
	5407	Thermometer, listed before, see Exp. 11.	
	4625	Bunsen Burner, listed before, see Exp. 18.	

\*We find it extremely difficult to ship these tubes in a filled condition, and cannot guarantee safe delivery.

M. & G. Exp.	Cat. No.		\$
24	1586A.	Manometer Tube .....	0.11
24	4921.	Glass Funnel, 4-inch .....	.16
24	4732.	Pinch Cock .....	.09
	1586	Generator, listed before, see Exp. 13.	
	5407	Thermometer, listed before, see Exp. 11.	
	319	Meter Stick, listed before, see Exp. 1.	
	4625	Bunsen Burner, listed before, see Exp. 18.	
	1165	Barometer, see page 100.	
25	.708.	Board for Magnet, large size.....	.33
25	1707.	Bar Magnet, special.....	.17
25	6263.	Blue Print Paper, 5x7 inches, per package of 24 sheets.....	.22
25	1729.	Iron Filings, per package.....	.11
25	1730.	Sifter .....	.11
25	1711.	Horseshoe Magnet with Armature.....	.13
	1761	Compass, 25 mm., listed later, see Exp. 29.	
26	1765.	Compass, high grade .....	1.45
26	1722.	Knitting Needles, per dozen.....	.11
26	1720.	Darning Needles, per package of 25.....	.06
26	1709.	Stirrup .....	.10
26	1716.	U Magnet, 2 inches between poles.....	.28
	4625	Bunsen Burner, listed before, see Exp. 18.	
27	1805.	Electroscope, simple .....	.50
27	1800.	Pair Condenser Plates, mounted.....	.25
27	1781.	Glass Friction Rod .....	.11
27	1783.	Wax Rod .. .. .	.11
27	1787.	Silk Pad .....	.40
27	1789.	Flannel Pad .....	.25
27	5130.	Glass Plate, 6x6 inches.....	.05
	1593	Calorimeter, listed before, see Exp. 18.	
	717	Steel Balls, listed before, see Exp. 3.	
28	2401.	Galvanometer Frame with three windings, without compass	1.25
28	2110.	Simple Voltaic Cell .....	.55
28	2110A.	Small Porous Cup .....	.11
	1765	Compass, listed before, see Exp. 26.	
	4625	Bunsen Burner, listed before, see Exp. 18.	
	2115	LeClanche Cell, see page 156.	
29	2641.	Commutator .....	.66
29	1761.	Exploring Compass, 25 mm. ....	.17
	2401	Galvanometer, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
30	H3001.	D'Arsonval Galvanometer, improved form, soft iron core, phosphor bronze suspension.....	2.75
30	1702A.	Soft Iron Horseshoe Core.....	.10
	2110	Simple Cell, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
	2641	Commutator, listed before, see Exp. 29.	
31	2460A.	Resistance Coil, 1000 ohms.....	.30
31	2110.	Zinc (d), Copper (e), Lead (f), Iron (g), Aluminum (h), and Carbon (j), Elements, each.....	.05
	2128	Daniell Cell, see page 157.	
	2401	Galvanometer, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
	2110	Simple Cell, listed before, see Exp. 28.	
	2110A	Porous Cup, listed before, see Exp. 28.	
	2111	Dry Cell, listed later, see Exp. 32.	
	2115	LeClanche Cell, see page 156.	
32	H3201.	Wheatstone's Bridge with Potentiometer Attachment.....	2.00
32	2111.	Dry Cells (two required), each.....	.28
	2641	Commutator, listed before, see Exp. 29.	
	319	Meter Stick, listed before, see Exp. 1.	
	2128	Daniell Cell, see page 157.	
	2401	Galvanometer, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
	2460A	Coil, 1000 ohm, listed before, see Exp. 31.	
33	2460.	Resistance Coil, 1 ohm.....	.20
	2401	Galvanometer, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
	319	Meter Stick, listed before, see Exp. 1.	
	2128	Daniell Cell, see page 157.	
	H3201	Bridge, listed before, see Exp. 32.	
	H3001	Galvanometer, listed before, see Exp. 30.	
34		2401 Galvanometer, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
	2128	Daniell Cell, see page 157.	
	2110	Simple Cell, listed before, see Exp. 28.	
	2110A	Porous Cup, listed before, see Exp. 28.	

M. & G. Exp.	Cat. No.		\$
35	2110F.	<b>Lead Strips (two required), each</b> .....	0.05
	2111	Dry Cell, listed before, see Exp. 32.	
	2460A	Resistance Coil, listed before, see Exp. 31.	
	2401	Galvanometer, listed before, see Exp. 28.	
	1765	Compass, listed before, see Exp. 26.	
36	2219.	<b>Coil for Induction (two required), each</b> .....	.55
36	2219A.	<b>Coil for Induction, larger hole, for use with magnets, 3/4-inch wide</b> .....	1.00
36	1702.	<b>Soft Iron Rod, 6-inch x 1/2-inch</b> .....	.11
	H3001	Galvanometer, listed before, see Exp. 30.	
	2111	Dry Cell, listed before, see Exp. 32.	
	1707	Magnet, listed before, see Exp. 25.	
	2641	Commutator, listed before, see Exp. 29.	
	1716	U Magnet, listed before, see Exp. 26.	
37	2672.	<b>Electric Bell</b> .....	.40
37	2756.	<b>Push Buttons (two required), each</b> .....	.09
37	2246.	<b>Dissectible Electric Motor (mounted)</b> .....	1.25
	2111	Dry Cell, listed before, see Exp. 32.	
	1761	Compass, listed before, see Exp. 29.	
38	774.	<b>Stop Watch</b> .....	7.25
38	H3802.	<b>Revolver</b> .....	2.25
38	791.	<b>Seconds Pendulum, with mercury contact</b> .....	6.00
	2111	Dry Cell, listed before, see Exp. 32.	
	2672	Bell, listed before, see Exp. 37.	
39	3040.	<b>Vibrograph</b> .....	3.60
39	3041.	<b>Tuning Fork for No. 3040</b> .....	1.35
39	3042.	<b>Extra Glass Tracing Plates, each</b> .....	.06
39	3033.	<b>Rubber Hammer</b> .....	.10
40	3012.	<b>Tuning Fork, 256 Vibrations</b> .....	1.10
40	3016.	<b>Tuning Fork, 384 Vibrations</b> .....	.80
40	3019.	<b>Tuning Fork, 512 Vibrations</b> .....	.70
	1022	Glass Tube, listed before, see Exp. 5.	
	4215	Beaker, No. 4, listed before, see Exp. 7.	
41	H4101.	<b>Sonometer Attachment to Inclined Plane</b> .....	.22
	769A	Inclined Plane, listed before, see Exp. 16.	
	3871	Spring Balance, listed before, see Exp. 4.	
	3012	Tuning Fork, listed before, see Exp. 40.	
	3019	Tuning Fork, listed before, see Exp. 40.	
42	3202.	<b>Piece of Glass, lacquered black on back</b> .....	.06
42	419.	<b>Protractor, 4 1/4-inch</b> .....	.27
	1137	Block, listed before, see Exp. 9.	
43	3306.	<b>Prism (two required), each</b> .....	.45
	327	Rule, listed before, see Exp. 3.	
44			
	3306	Prism, listed before, see Exp. 43.	
	419	Protractor, listed before, see Exp. 42.	
45	3205.	<b>Concave and Convex Mirror, brass, highly polished and nickel plated</b> . . . . .	.22
	319	Meter Stick, listed before, see Exp. 1.	
46	H4601.	<b>Convex Lens, with handle and wire screen</b> .....	.50
46	328.	<b>Paper Scales, per dozen</b> .....	.10
46	3357.	<b>Low Burner, with aluminum tip</b> .....	.44
46	3201.	<b>Plane Mirror</b> .....	.08
	H1002	Set of Supports, listed before, see Exp. 10.	
	1137	Block, listed before, see Exp. 9.	
47	7538.	<b>Linen Tester (two required), each</b> .....	.27
	319	Meter Stick, listed before, see Exp. 1.	
48			
	7538	Linen Tester, listed before, see Exp. 47.	
	H4601	Lens, listed before, see Exp. 46.	
	H1002	Set of Supports, listed before, see Exp. 10.	
	1137	Block, listed before, see Exp. 9.	
49	H4901.	<b>Tube and Scale</b> .....	.20
	7538	Linen Testers, listed before, see Exp. 47.	
	319	Meter Stick, listed before, see Exp. 1.	
50			
	H1002	Set of Supports, listed before, see Exp. 10.	
	3306	Prisms, listed before, see Exp. 43.	
	327	Ruler, listed before, see Exp. 3.	
51	3411.	<b>Simple Photometric Outfit, consisting of bed, single and quadruple candle holders, Bunsen screen and screen holder</b> .....	1.00
		<b>For LECTURE APPARATUS, send for SPECIAL CATALOG.</b>	

APPARATUS FOR  
HALL'S ELEMENTS OF PHYSICS (1912)

by  
**EDWIN H. HALL,**  
Professor in Harvard College.

NOTE.—All catalog numbers in this list, except the 6600 series, can be found in the front of this catalog, where complete descriptions of the apparatus are given.

List of Apparatus Referred to by Number in the "Exercises."

Appa- ratus No.	Cata- log No.	Article.	Catalog Price.
1	319.	Meter Stick, English and metric.....	\$ 0.28
2	327.	Metric Ruler, 30 cm. and 12 inch.....	.08
3	3872.	Spring Balance, with double pointer, 500 gm. x 10 gm., and 18 oz. x $\frac{1}{5}$ oz.....	2.25
4	3830.	Platform Balance, agate bearing.....	6.65
5	1137.	Waterproof Cherry Block, 7.5 cm. x 7.5 cm. x 3.8 cm.....	.11
6	5027C.	Glass Jar, 6x8 inches.....	.27
7	6602.	Sulphur Roll, 175 to 200 grams.....	.05
8	1143.	Lead Sinkers .....	.13
9	1145.	Waterproof Wooden Cylinder, 20 cm. x 1 cm. diameter.....	.06
10	1146.	Holder, for keeping No. 1145 upright in water.....	.17
11	5027A.	Glass Jar, 4x5 inches.....	.17
12	4547.	Glass Stoppered Bottle, 2 oz.....	.09
13 } 14 }	1106.	Balancing Column Apparatus .....	.80
15	1106A.	Wooden Support, with meter stick, for No. 1106.....	1.35
16	1051.	Boyle's Law Tube .....	.66
17	1165.	Barometer .....	Net 15.00
18	6604.	Baroscope Bottle, 2 liters, complete with rubber stopper, glass tube, rubber tube and pinch cock.....	.72
19	1107A.	Glass U Tube, 1 meter long.....	.33
20	1307.	Air Pump, exhausting and condensing.....	3.60
21	6606.	Lead Y Tube, with rubber tube connections.....	.30
22	6608.	Surface Tension Apparatus, complete with ring, spring and two weights, with support.....	2.75
23	9347.	Saucer, 6-inch, for use with No. 6608.....	.03
24	6610.	Graduated Lever, with hole for suspension.....	.28
25	6612.	Scale Pans, 6.5 cm. square, each weighing 1 oz. (three re- quired), each .....	.11
26	6614.	Set of Iron Weights, four of 1 oz., and two each 2 and 4 oz... .....	1.50
27	6616.	Cubical Block, 3.7 cm., on each edge, with slot to fit meter stick and with set screw.....	.15
28	6618.	Rulers of white pine, 30x5x1 cm. Per pair.....	.10
29	3873.	Spring Balance, 15 kilo and 30 lbs. (four required), each.. .....	1.65
30	6620.	Force Board, with four steel balls.....	1.65
31	6622.	Balance Bed (four required), each.....	.60
32A	651A.	Pine Rod, 102 cm. long x 1 cm. square.....	.06
32B	651B.	Pine Rod, 102 cm. long x 2 cm. x 1 cm.....	.07
33	651F.	Hardwood Triangular Prism (three required), each.....	.05
34	651E.	Indicator .....	.05
35	651D.	Scale, 10 cm., on base.....	.18
36	651G.	Scale Pan, 12 cm. square, with cords attached.....	.11
37	3933.	Set of Iron Weights, 1 kilo to 5 grams.....	1.20
38	6629.	Friction Board, 50 cm. x 15 cm. x 2 cm.....	.25
39	771.	Incline Car (two required), each.....	1.00
39A	6632.	Rubber Tube, pure gum, 50 cm. long (two required), each.. .....	.22
40	6634.	Inclined Plane Board, 120 cm. x 15 cm. wide, with elevating screw, cleat and pulley (two required), each.....	1.50
41	6636.	Set Iron Weights, four, 8 oz.....	1.00
42	6638.	Apparatus for Finding the Value of "g".....	1.25
43	6640.	Ivory Balls, one about 50 grams and the other about 150 grams, with hook for suspension.....	4.50
43A	6642.	Suspension Block .....	.33
43B	6644.	Baseboard, with meter sticks and adjustable sight and re- lease blocks .....	1.50
43C	6107.	1 oz. Copper Wire, bare, No. 30, B. & S.....	.11
44	1586.	Boiler, with screw top, water and pressure gauge, and dipper Dipper included with No. 1586.	2.25
45			

Apparatus No.	Catalog No.	Article.	Catalog Price.
46	5407.	<b>Thermometer</b> .....	\$ 0.40
47	4627.	<b>Bunsen Burner</b> .....	.20
48 } 49 } 50 }	1559.	<b>Linear Expansion Apparatus</b> .....	2.65
50A. 51	6646.	<b>Attachment for No. 1559, for experiment in gas expansion.. Glass Tube.</b> Directions for making and filling are given in Smith & Hall's "The Teaching of Chemistry and Physics."	1.50
52	1579.	<b>Galvanized Iron Ice Tray</b> .....	1.10
52A	6648.	<b>Leveling Table for use with No. 1579,</b> .....	2.25
53	277.	<b>Level</b> .....	.33
54	1589.	<b>Calorimeter, about 600 c.c. capacity.</b> .....	.40
55	1608.	<b>Lead Shot, per pound</b> .....	.16
56	1580.	<b>Ice Bag</b> .....	.17
57	1586B.	<b>Water Trap</b> .....	.25
58	3501.	<b>Telescope</b> .....	2.50
59	3099.	<b>Resonance Tube</b> .....	2.00
60	3012.	<b>Tuning Fork</b> .....	1.10
61	3040.	<b>Vibrograph</b> .....	3.60
62	{ 2286D.	<b>Incandescent Lamp, 4 c. p.</b> .....	.33
	{ 2288.	<b>Receptacle for 2286D.</b> .....	.10
63	3380.	<b>Candles, paraffin, per dozen.</b> .....	.18
64	6650.	<b>Cardboard Screen and Support.</b> .....	.15
65	3201.	<b>Mirror, Plane</b> .....	.08
65A	6652.	<b>Spring Clasps, per pair.</b> .....	.22
66	6653.	<b>Cubical Block, one side painted white, with vertical mark...</b>	.11
67	3210.	<b>Cylindrical Mirror</b> .....	.33
68	3301.	<b>Glass Plate for index of refraction.</b> .....	.20
69	3281.	<b>Double Convex Lens, 4 cm. diameter, 15 cm. focus.</b> .....	.11
69A	3352.	<b>Lens Holder</b> .....	.11
70	{ 3354.	<b>Cardboard Screen</b> .....	.05
	{ 3353.	<b>Screen Support</b> .....	.08
71	3385.	<b>Kerosene Lamp</b> .....	.25
71A	3386.	<b>Asbestos Shade</b> .....	.10
72	3351.	<b>Support Blocks, per pair.</b> .....	.13
73	6654.	<b>Right Angle Brass Wire.</b> .....	.04
74	6656.	<b>Lens, Double Convex, 1½-inch (12-inch focus).</b> .....	.28
75	6658.	<b>Lens, Double Convex, 1½-inch (2-inch focus).</b> .....	.55
76	6660.	<b>Screen, of tracing cloth.</b> .....	.28
77	1707.	<b>Bar Magnet, 15x1x1 cm.</b> .....	.17
78	1761.	<b>Compass, 25 mm.</b> .....	.17
79	2110.	<b>Demonstration Battery</b> .....	.55
80	2409.	<b>Galvanometer</b> .....	1.80
81	2127.	<b>Daniell Cell, quart size.</b> .....	.50
82	2641.	<b>Commutator</b> .....	.66
83	6662.	<b>Resistance Spool, 120 cm. G. S. wire, No. 30 B. &amp; S.</b> .....	.33
84	6664.	<b>Resistance Spool, 200 cm. G. S. wire, No. 30 B. &amp; S.</b> .....	.33
85	6666.	<b>Resistance Spool, 2000 cm. copper wire, No. 30 B. &amp; S.</b> .....	.50
86	2736.	<b>Triple Connector (two required), each.</b> .....	.16
87	2473.	<b>Wheatstone's Bridge</b> .....	3.00
88	2405.	<b>Astatic Galvanometer</b> .....	3.55
89	2442.	<b>Resistance Box</b> .....	6.00
90	125.	<b>Micrometer Caliper</b> .....	3.35
91	2466.	<b>Temperature Coil</b> .....	.90
92	2672.	<b>Electric Bell</b> .....	.40
93	2115.	<b>LeClanche Battery</b> .....	.45
94	2756.	<b>Push Button (two required), each.</b> .....	.09
95	489.	<b>Screw Driver</b> .....	.30
96	{ 2335A.	<b>Telegraph Key, Dissected</b> .....	.80
	{ 2339B.	<b>Telegraph Sounder, Dissected</b> .....	1.35
97	2245.	<b>Dissected Motor</b> .....	1.00
98	6668.	<b>Dissected Dynamo</b> .....	1.50
		(See No. 2256 for above Dynamo and Motor assembled.)	
99	2264C.	<b>Direct Current Motor, 110 volts.</b> .....Net	12.75
100	2518.	<b>Ammeter, 0-10 amperes</b> .....	10.00
101	2524.	<b>Voltmeter, 0-120 volts</b> .....	10.00
102	511.	<b>Speed Counter</b> .....	1.10

## CHEMICAL LABORATORY GLASSWARE AND APPARATUS.

Arranged Alphabetically.

### DUTY FREE IMPORTATIONS.

Schools, Colleges, Universities and Scientific Institutions are permitted, by act of Congress, to import apparatus free of duty, when it is intended for the institution's use and not for resale or exchange.

The growth of our import business during the past few years and our extended foreign connections, enable us to handle duty free business to the entire satisfaction of our customers.

We wish to state, however, that it is only of advantage to import on this basis when large quantities are ordered, since the European manufacturers will sell only in large quantities, and also since the expense of shipping, custom house fees, etc., on small lots is proportionately much higher than on large quantities, thus making the cost about as high as if bought "from stock," nor would the small difference compensate for the delay of three or four months—the usual time it takes for goods to arrive from abroad after placing the order.

Small instruments, or any goods that can be packed so as to bring the gross weight under 5 kilos, may be imported by parcels post in from six to eight weeks time.

The price of articles marked "duty free" is approximate. Net prices quoted upon application.

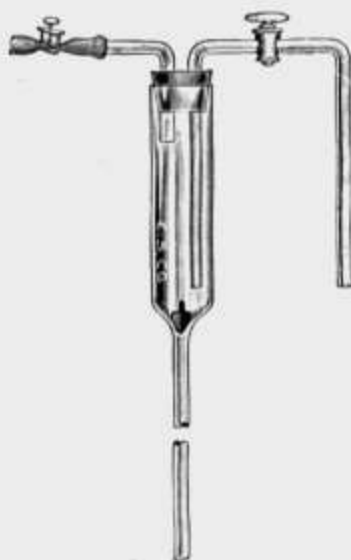
We are always glad to quote prices "duty free" on quantity lots, and can assure our customers that such orders will receive our most careful and prompt attention.

We wish to warn our customers against the promiscuous asking for bids on "duty free" glassware and chemical supplies without giving definite specifications as to the quality desired, since it is possible, especially in graduated ware, to procure glassware at almost any price, but the calibrations will be entirely unreliable. We have close connection with the best manufacturers only and can give reasonable prices.

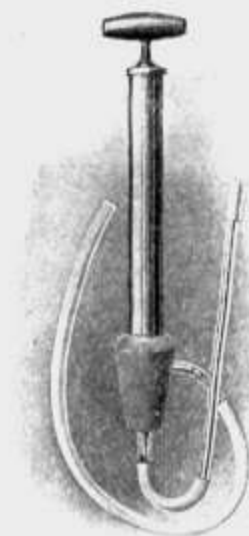
The majority of our German glassware is from the well-known firm of Greiner & Friedrichs, whose product has been used by the largest laboratories of this country for the past 25 years. We can guarantee the accuracy of their graduated ware, and the resistance and designs of their furnace goods, though it will be found that the cost is slightly greater than that of ordinary glass. Their catalogs will be sent to interested parties as an aid in preparing their lists, and we would ask that their numbers be specified.



No. 4195.



No. 4199.



No. 4200.



Nos. 4201-4203.



No. 4205.

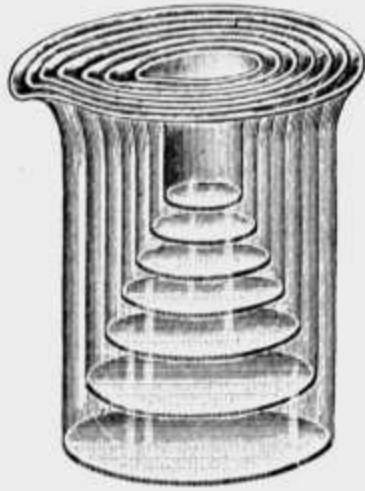


No. 4207.

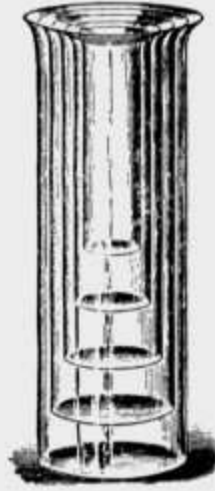
	Acid Basins, see Dessicator, Acid Dish, page 355.		
4195.	Acid Pitcher, of stoneware, with lip and handle.		
	Capacity, quarts .....	1	2
	Each .....	\$0.26	.30
4197.	Acid Pitcher, of stoneware, with lip and two handles. Capacity one gallon .....		\$ 1.10
4199.	Acid Pump (Siphon), of glass. Positive and rapid in action, cleanly and easily operated. Will reach to bottom of standard carboy.....		2.70
4200.	Acid Pump. A convenient and handy arrangement for drawing acid, etc., from carboys, bottles, etc. Will fit any container having a neck from 1 3/4 to 2 5/8 inches diameter .....	Net	5.00
	Albuminometer, see "Urine Analysis Apparatus," page 422.		
	Alkalimeter, see "Carbonic Acid Apparatus," page 337.		
4201.	Apron, for chemical laboratory use. (Acid ruins a suit of clothes and there is also danger of severe burns if it comes in contact with the skin.) Heavy-weight rubber, with drill cloth backing; width, 36 inches; length, 50 inches .....		.80
4203.	Apron, light-weight, with muslin cloth backing; width, 36 inches; length, 50 inches .....		.67
	N. B.—If the above aprons are too long they can easily be cut off to the required length.		
4205.	Over-Sleeves, rubber acid proof cloth, per pair.....		.40
	Aquaria, see Catalog N.		
4206.	Arsenic Plate, (Streak Plate), unglazed porcelain plate for arsenic tests, 6x10 cm.....		.17
4207.	Arsenic Tubes, of hard Bohemian glass; per set of four.....		.22
	Arsenic Tubes, separate, either a, b, c or d; per dozen.....		.60
4208.	Arsenic Tube, Marsh Test, glass part only.....		.33



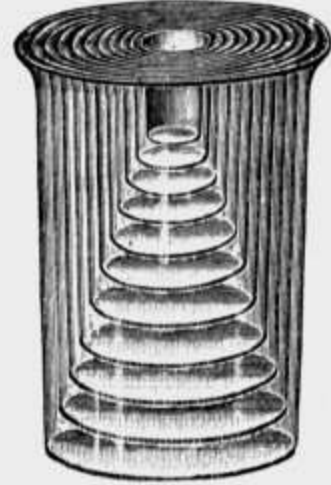




No. 4215.



No. 4225.



No. 4233.

4215. Beakers, Griffin form, lipped; of best Bohemian glass.

No.	000	00	0	1	2	3	4	5	6	7	8
Capacity, c. c.	30	50	75	130	230	350	550	750	1000	1400	1800
Each	\$0.06	.08	.09	.10	.15	.20	.25	.33	.41	.50	.60

Beakers, same as No. 4215, nested:

4216.	Nos. 000-0; 3 in nest.	Per nest	\$ 0.23
4217.	Nos. 0-2; 3 in nest.	Per nest	.34
4218.	Nos. 1-4; 4 in nest.	Per nest	.70
4219.	Nos. 0-4; 5 in nest.	Per nest	.79
4220.	Nos. 0-5; 6 in nest.	Per nest	1.12
4221.	Nos. 0-7; 8 in nest.	Per nest	2.03

4225. Beakers, extra tall form, without lip; of best Bohemian glass.

No.	1	2	3	4
Capacity, c. c.	100	180	270	400
Each	.10	.14	.17	.25

4233. Beakers, usual form, without lip; of best Bohemian glass.

No.	000	00	0	1	2	3	4
Capacity, c. c.	25	45	70	100	180	270	400
Each	.06	.06	.07	.09	.10	.15	.21

Beakers, Jena Glass, see page 315.

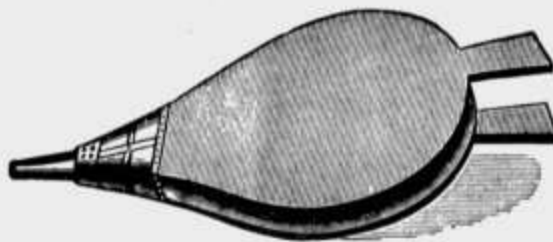
4235. Beakers, copper, Griffin form, with lip.

Capacity, ounces	4	8	16	32
Each	.55	.67	.88	1.25

4237. Beakers, aluminum, Griffin form, with lip.

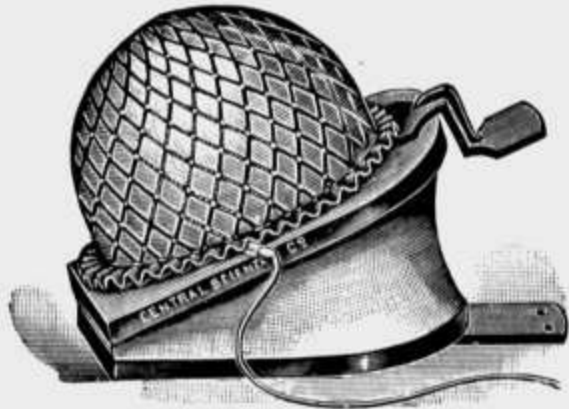
Capacity, ounces	4	8	16	32
Each	.50	.67	1.00	1.50

Beehive Shelves, see page 421.

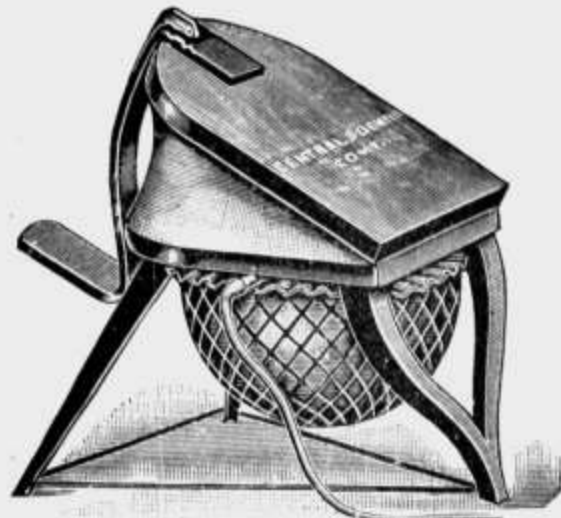


No. 111.

111.	Bellows, hand, width 7 inches	.80
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Nos. 4241-4243.



Nos. 4244-4246.

**Bellows, for blast lamps, blow pipes, etc.**

Catalog No. ....	4241	4242	4243
Size No. ....	9	9A	9B
Each .....	\$5.00	7.00	11.50

**Bellows, improved pattern, doing away with injury to rubber disc. More convenient to operate.**

Catalog No. ....	4244	4245	4246
Size No. ....	10	10A	10B
Each .....	6.00	8.00	12.50

**Rubber Disc for above Bellows.**

Catalog No. ....	4247	4248	4249
Adapted to Nos.....	9 and 10	9A and 10A	9B and 10 B
Diameter, inches .....	9	12	14
Each .....	.67	1.15	1.65

4250. Nets for any size of above Bellows, each..... \$ 0.45



No. 4260.



No. 4263.

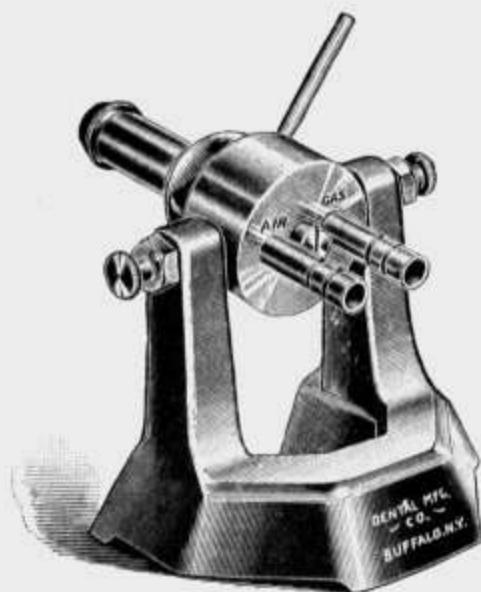
- 4260. **Blast Apparatus, Muencke s.** for compressing and exhausting. Water chamber of zinc; other parts of brass. Complete with aspirator, air outlet and stop cock for regulation. This is the most compact form of blast apparatus and with 30 lbs. water pressure will run two No. 441 Blast Lamps..... 11.65
- 4263. **Blast Apparatus.** Prof. Richards' modified form, for exhausting and compressing air where hydrant pressure is available. Desirable for quick filtering or as a blower for blast lamps. The larger size can be used simultaneously with lamp and filter flasks. With one Aspirator No. 4893A.....Net 7.00
- 4264. **Blast Apparatus,** same as No. 4263, with two Aspirators No. 4893A.Net 9.00
- 4265. **Blast Apparatus,** same as No. 4263, with one large Aspirator No. 4893B .....Net 12.60



No. 4440.

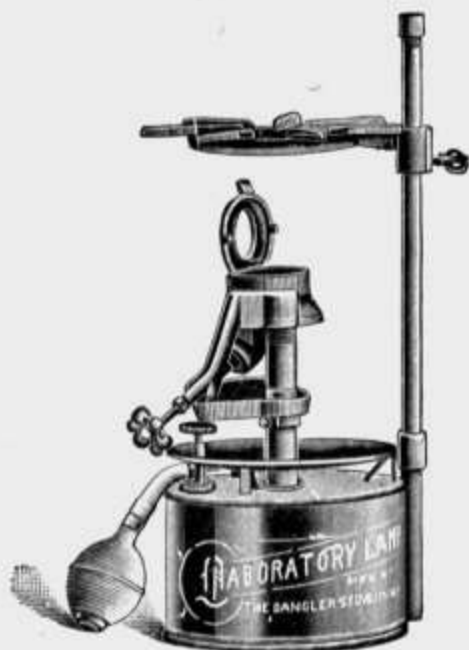


No. 4441.



No. 4445.

- |       |   |     |       |
|-------|---|-----|-------|
| 4440. | Blast Lamp, Alcohol, of copper; upright blast.....  | \$  | 2.25  |
| 4441. | Blast Lamp, Bunsen's; the oldest and best blast lamp made.....  |     | 3.30  |
| 4445. | Blast Lamp, Fletcher's compound, with a great range of power from a large brush flame to a delicate pointed jet. To be used with No. 9A, or larger bellows..... | Net | 10.00 |



No. 4453.

4453. Blast Lamp, Gasoline, "Dangler's Lamp." An excellent substitute for gas, giving a high or low flame. For Extra Bulbs for No. 4453 use No. 4611.

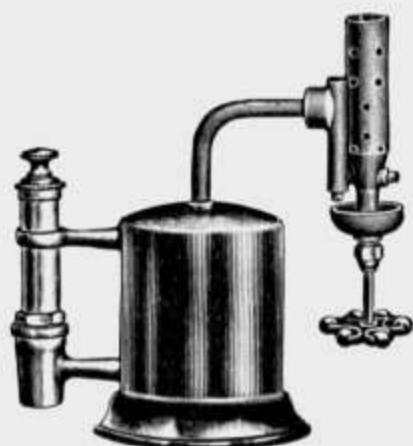
4455. Blast Lamp, "Baby" Gasoline Torch. Smallest torch made giving good results. Fits the hand and can be used in contracted places and corners. Burns equally well in all positions. Perfectly automatic, has no cocks or valves to get out of order or clog, is self-feeding, requires no pumping of air, lights with a match, and is always ready for use. It burns about two hours with one filling.....



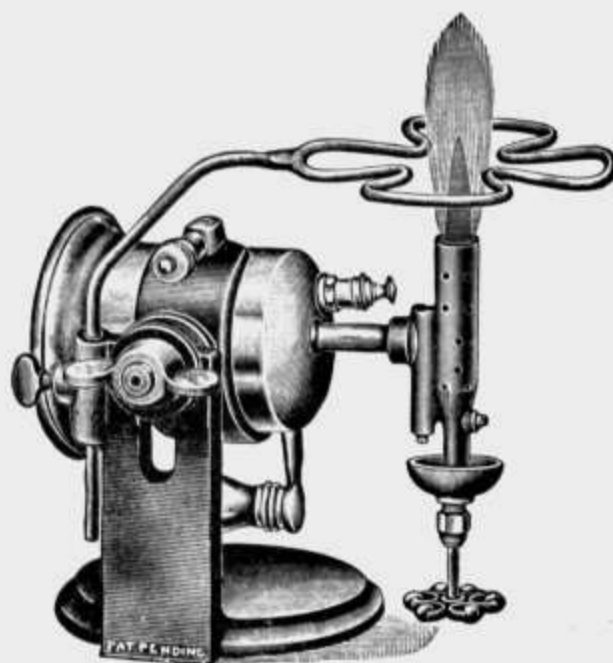
6.00

1.65

No. 4455.



No. 4456.



No. 4457.

- 4456 Laboratory Blast Lamp, designed for general work where the laboratory is not equipped with gas. The Burner is rigid and is made of special bronze generator metal. It can be regulated from a small pointed flame to a large brush flame. The tank is made of heavy seamless drawn brass, fitted with patented automatic brass pump in handle.....Net \$ 3.25
4457. Adjustable Laboratory Blast Lamp, Fitted With Adjustable Stand and Tripod. After nearly twenty-five years careful study on the part of the manufacturers, we offer our trade this outfit as the best and most convenient Laboratory Blast Lamp made. We call special attention to the many adjustable features. The adjustable stand permits the flame to be pointed in any position desired.
- The Lamp itself is adjustable, pint size, made of the very best material, and produces a perfect blue flame of intense heat that can be easily regulated. It is strong and durable and is equipped with patented automatic brass pump-in-tank. The tripod, which also is adjustable, will hold any ordinary laboratory vessel and can be swung out of the way when not in use.
- Complete with stand.....Net 5.00
4458. Blast Lamp only of No. 4457.....Net 3.25
4459. Stand only of No. 4457.....Net 2.00

REPAIR PARTS FOR NOS. 4456-7 BLAST LAMPS.



No. 4460.



No. 4460B.

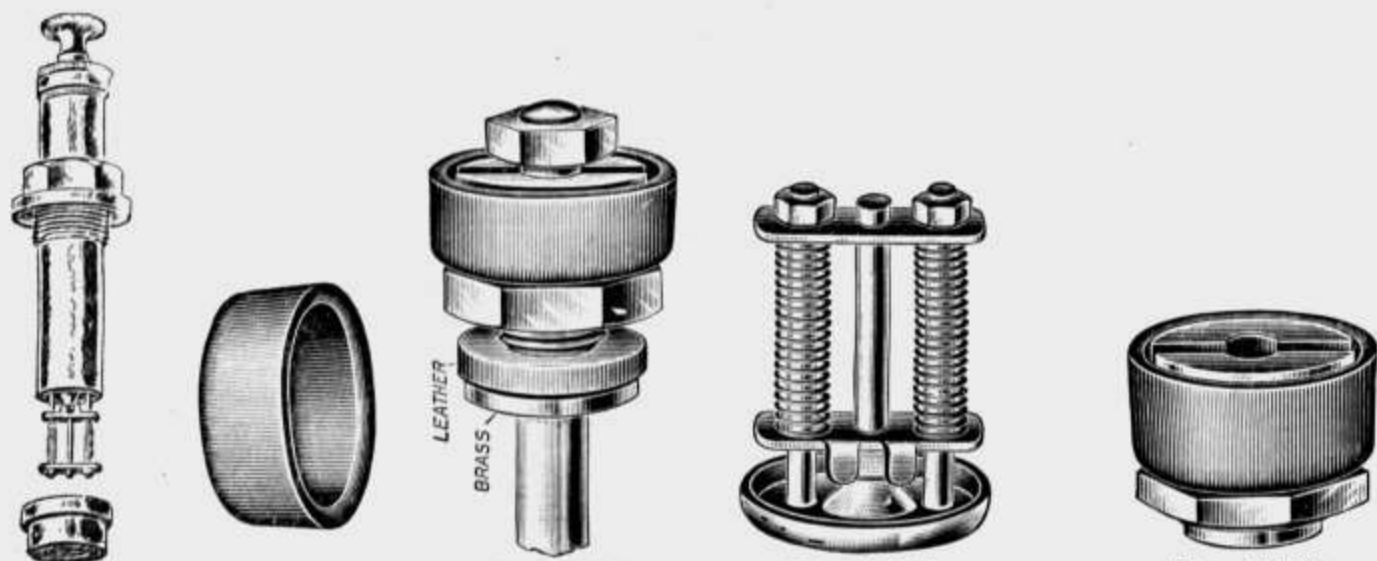


No. 4460E.

4460. Burner Body, Needle and Drip Cup for either No. 4456 or 4457....Net 1.40
- 4460B. Filler Plug for either No. 4456 or No. 4457.....Net .15
- 4460C. Drip Cup for either No. 4456 or 4457.....Net .25
- 4460E. Supply Pipe for No. 4456.....Net .25

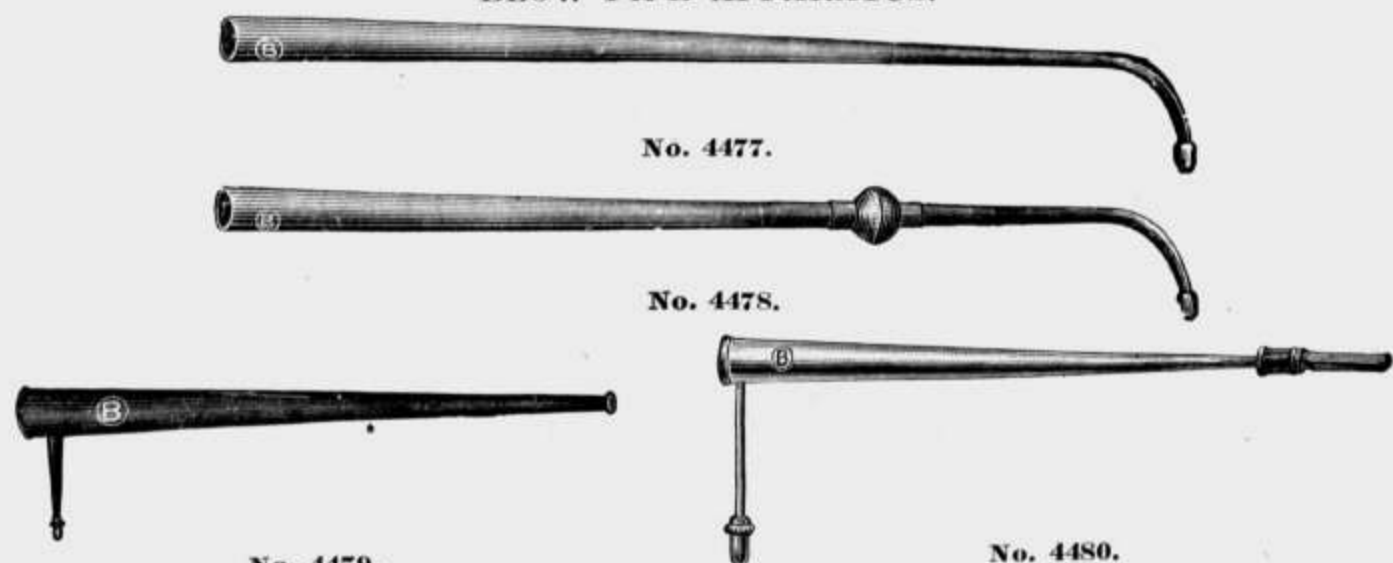
For other Repair Parts, see next page.

REPAIR PARTS for Nos. 4456-7 (Continued).



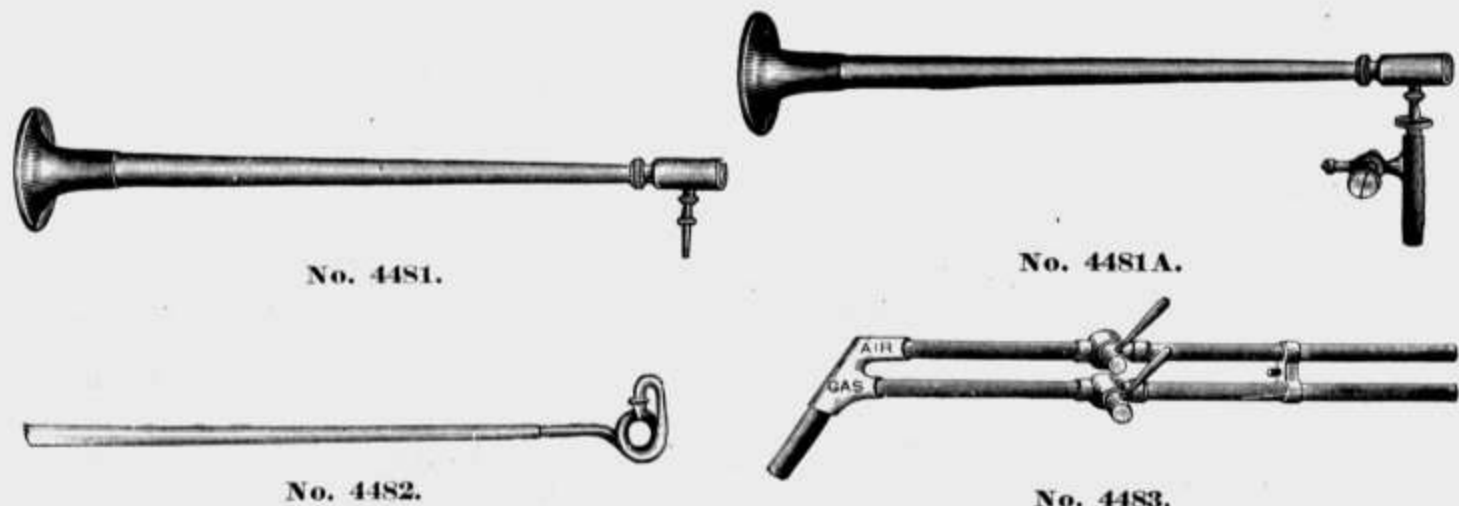
No. 4460G.	No. 4460H.	No. 4460Q.	No. 4460S.	No. 4460T.	
4460F. Pump for No. 4456.....					Net \$ 0.50
4460G. Pump for No. 4457.....					Net .50
4460H. Cup Leathers for No. 4456 or No. 4457.....					Net .03
4460I. Hex Nuts, any size, for No. 4456 or No. 4457.....					Net .01
4460J. Pump Caps for No. 4456 or No. 4457.....					Net .05
4460K. Plunger Knobs for No. 4456 or No. 4457.....					Net .05
4460L. Cork Washers for No. 4456 or No. 4457.....					Net .01
4460M. Springs for No. 4456 or No. 4457.....					Net .01
4460N. Cork Holder for No. 4456 or No. 4457.....					Net .05
4460O. Spring Plates for No. 4456 or No. 4457.....					Net .05
4460P. Plunger Rod for No. 4456 or No. 4457.....					Net .10
4460Q. Plunger Rod, complete with knob, cap and slide, for No. 4456 or No. 4457.....					Net .25
4460R. Pump Collar for No. 4456 or No. 4457.....					Net .10
4460S. Pump Bottom for No. 4456 or No. 4457.....					Net .25
4460T. Pump Slide for No. 4456 or No. 4457.....					Net .25

BLOW PIPE APPARATUS.



	No. 4479.		No. 4480.	
4476. Anvil, Plattner's steel, 1½x1½ inches.....				.40
4477. Blow Pipe, brass, plain.				
Length, inches.....		8	10	12
Each.....		.09	.10	.12
4478. Blow Pipe, brass, with bulb.				
Length, inches.....		8	10	12
Each.....		.18	.20	.22
4478A. Mouth Piece, of wood, for No. 4477 or 4478. Each 0.09; per dozen...				1.00
4479. Blow Pipe, Black's, japanned tin, removable brass tip.....				.22
4479A. Brass Tips, for No. 4479, per dozen.....				.55
4480. Blow Pipe, Black's, new form, brass, with removable tip and wooden mouthpiece.....				.55

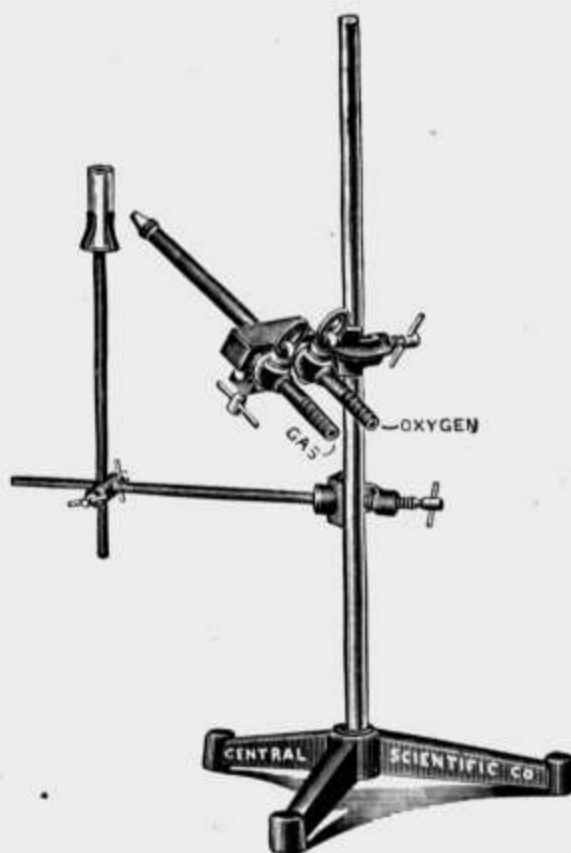
**BLOW PIPE APPARATUS (Continued).**



- 4481. **Blow Pipe, Plattner's**, of brass, nickel plated, with removable platinum tip and hard rubber mouthpiece..... \$ 2.75
- 4481A. **Blow Pipe, Plattner's**, with side arm for attaching directly to gas supply, giving a powerful blow pipe flame. With stop cock..... 2.50
- 4482. **Blow Pipe, brass, hot blast**..... .90
- 4483. **Blow Pipe, Brazing**, quick in operation and of great heating power, requiring  $\frac{3}{8}$  inch gas supply..... 2.10



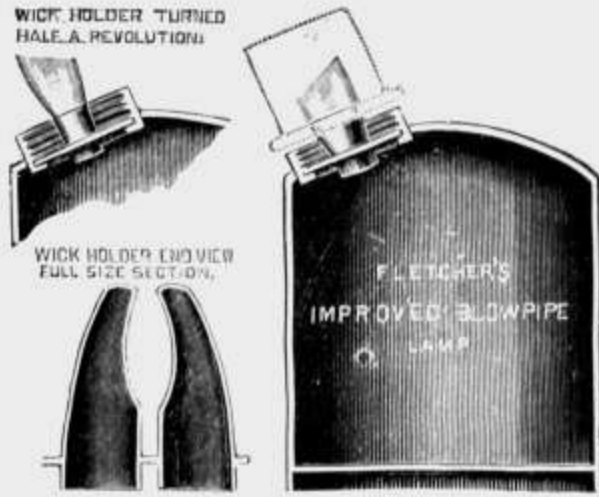
No. 4484.



No. 4485.

- 4484. **Blow Pipe, for alcohol**. This blow pipe burns wood or denatured alcohol and produces a needle pointed flame of remarkably high temperature. The double jet construction of the burner generates the maximum degree of heat from the fuel (over 3,000° F.). The flame is perfectly clean and non-oxidizing. The burner is swiveled so that it can be turned in any position.  
Capacity, one pint; consumption, one-quarter pint per hour.....Net 5.00
- 4485. **Blow Pipe, Oxy-Hydrogen**, all brass, on stand, with movable lime cylinder holder and two stop cocks..... 6.65
- 4487. **Blow Pipe Lamp**, of brass (see illustration on next page)..... 1.33
- 4488. **Bunsen Burner**, with blow pipe tip..... .50
- 4489. **Button Brush** ..... .50
- 4490. **Carbon Block**, moulded..... .40
- 4491. **Carbon Block Holder**..... .40
- 4492. **Carbon Cylinder**, moulded,  $1\frac{1}{8}$ x3 inches..... .22
- 4493. **Charcoal Borer**, club shape (see illustration on next page)..... .65
- 4494. **Charcoal Borer**, four cornered..... .40
- 4495. **Charcoal Borer**, with spatula..... .45

BLOW PIPE APPARATUS—Continued.



No. 4487.



No. 4507.

No. 4523.

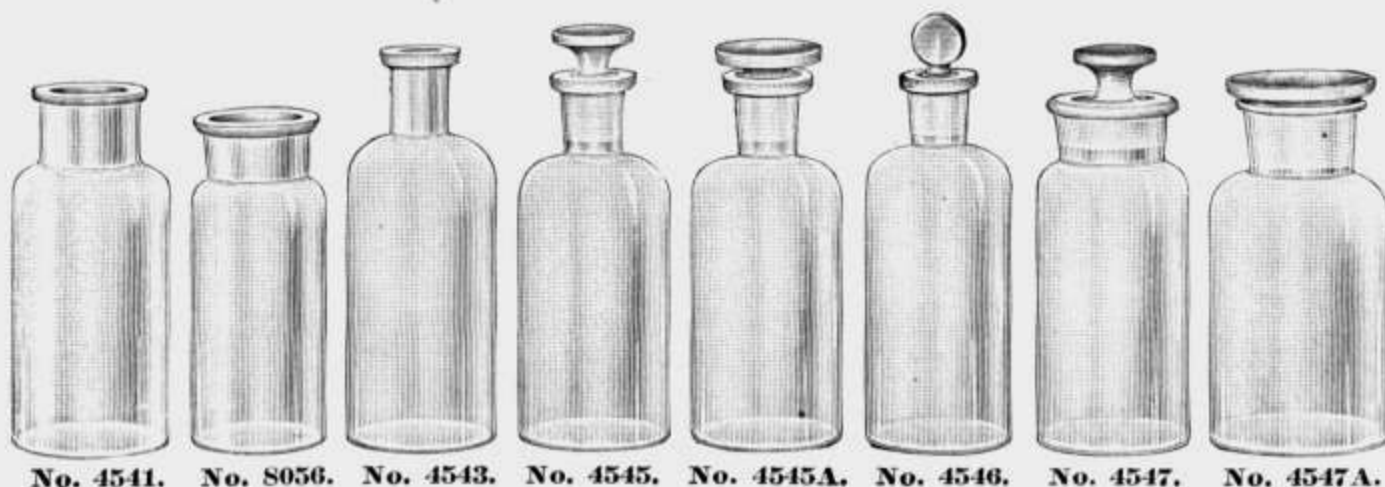


No. 4493.



No. 4508.

4497.	Charcoal Crucibles.	Per dozen.....	\$ 0.27
4498.	Charcoal Holder,	with platinum wire and shield.....	2.50
4500.	Charcoal Sticks,	natural willow wood, 1x1x3 inches. Per dozen.....	.45
4501.	Charcoal Squares,	with covers, for charcoal holder. Per dozen.....	1.80
4502.	Charcoal Saw	.....	.45
4503.	Clay Capsules,	per dozen .....	.33
4504.	Clay Crucibles,	per dozen.....	.35
4505.	Cupels, bone ash,	1¼ inch, per dozen.....	.28
4506.	Cupels, bone ash,	1½ inch, per dozen.....	.45
4507.	Cupel Holder,	with two moulds and one stamp.....	1.90
4508.	Forceps, Plattner's,	with platinum tips.....	Net about 4.40
4509.	Forceps, French Form,	with platinum tips.....	Net about 4.40
4510.	Hammer, Plattner's,	wooden handle.....	.50
4512.	Ivory Spoon	.....	.23
4515.	Matrasses, German glass,	flask shape, per dozen.....	.40
4517.	Matrass Holder	.....	.30
4519.	Minerals for Blow Pipe,	25 specimens, small size, each in box.....	2.25
4520.	Minerals for Blow Pipe,	50 specimens, small size, each in glass tube..	3.00
4521.	Minerals for Blow Pipe,	100 specimens, put up in boxes with glass covers and index.....	6.25
4522.	Minerals for Blow Pipe,	100 specimens, Plattner's, put up in boxes, in box with catalog.:.....	10.00
	Minerals, per pound,	see Catalog R.	
4523.	Mould, of boxwood,	for clay capsules.....	.68
4524.	Mould, of boxwood,	for clay crucibles.....	1.15
4525.	Platinum Wire,	with solid glass handle, for borax beads, etc., each..	.40
	Platinum Goods,	see page 394.	
4526.	Pliers, for assay buttons.....		.55
4529.	Reagents, set of 14 1-ounce reagent bottles filled with chemically pure blow pipe reagents, according to Fresenius.....		5.00
4530.	Scale, Plattner's, of ivory, for silver beads.....		3.35
4531.	Scale of Hardness, without diamond, 9 specimens.....		2.25
4532.	Silver Foil; per ounce.....		1.65
4533.	Soda Papers, per box.....		.18
4206.	Streak Plate, porcelain.....		.17
4537.	Test Lead Measure.....		.45
4538.	Test Lead Sieve .....		.90
4539.	Tubes, hard glass, 4x¼ inches, open at both ends. Per dozen.....		.50
4540.	Tubes, hard glass, 4x¼ inches, closed at one end. Per dozen.....		1.00



4541. **Bottles, round, wide mouth, flint glass.**

Capacity, ounces .....	1	2	4	6	8	12	16	32
Per dozen .....	\$ .26	.30	.42	.50	.60	.70	.90	1.30

4542. **Bottles, round, wide mouth, green glass.**

Capacity, gallons .....	$\frac{1}{2}$	1	2
Each .....	.20	.29	.67

8056. **Bottles, extra wide mouth, flint glass.**

Capacity, ounces .....	3	6
Per dozen .....	.38	.53

4543. **Bottles, round, narrow mouth, flint glass.**

Capacity, ounces .....	1	2	4	6	8	12	16	32
Per dozen .....	.25	.28	.38	.45	.50	.70	.85	1.25

4544. **Bottles, round, narrow mouth, green glass.**

Capacity, gallons .....	$\frac{1}{2}$	1	2
Each .....	.18	.31	.60

4545. **Bottles. "Tinctures," flint glass, mushroom stopper.**

Capacity, ounces .....	1	2	4	8	16	32
Per dozen .....	.80	1.00	1.25	1.50	2.10	2.75

4545A. **Bottles, "Tinctures"; best German flint glass, with flat topped glass stoppers carefully ground in, without mould marks. An excellent bottle for permanent use for reagents or solutions.**

Capacity, ounces	1	2	4	8	16	32	$\frac{1}{2}$ gal.	1 gal.
Per dozen.....	1.11	1.25	1.50	2.00	2.66	3.75	6.65	11.00

4546. **Bottles, acid, green glass.**

Capacity .....	Pint.	Quart.	$\frac{1}{2}$ Gal.
Each .....	.18	.25	.33

4547. **Bottles, "Salt Mouth," flint glass, mushroom stopper.**

Capacity, ounces .....	1	2	4	8	16	32
Per dozen .....	1.00	1.05	1.33	1.50	2.10	2.90

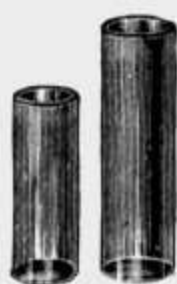
4547A. **Bottles, "Salt Mouth," best German flint glass, with flat glass stoppers carefully ground in, heavy, nicely finished, without mould marks.**

Capacity, ounces .....	1	2	4	8	16	32
Per dozen .....	1.25	1.40	1.60	2.25	3.10	4.50

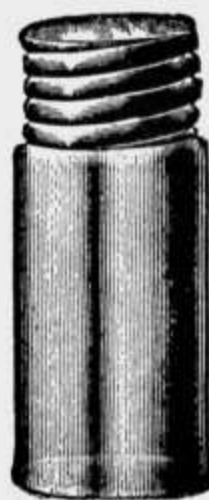




No. 4549.



No. 8065.



No. 4550.



No. 4551.



No. 4555.



No. 4558.



No. 8061.



No. 8062.



No. 8064.

4549. **Bottles, Homeopathic Vials.**

Capacity in drams.....	1	2	3	4	6	8
Per gross .....	\$9.95	1.00	1.20	2.00	3.00	3.35

8065. **Bottles, Shell Vials, round, straight wall.**

No. ....	1	2	3	4	5
Height, mm. ....	50	60	70	80	75
Diameter, mm. ....	12	13	15	16	25
Capacity, c. c. ....	4	7	11	14	34
Per dozen .....	.14	.17	.20	.22	.45

4550. **Bottles, metal screw capped, for samples.**

Capacity or size....	1	2	4 dram	3½x7/8	5½x7/8 in.
Per dozen .....	.66	.75	1.05	.55	.72

4550A. **Bottles, screw cap, page 501.**

4551. **Bottles, Aspirator, with glass stopper and stop cock.**

Capacity .....	½ gal.	1 gal.	2 gal.
Each .....	2.30	3.35	5.00

4553. **Bottles, Aspirator, same as No. 4551, tubulature at bottom, but without glass stopper and stop cock.**

Capacity .....	1 pt.	1 qt.	½ gal.	1 gal.	2 gal.
Each .....	.42	.60	.83	1.30	2.40

4555. **Bottle, Dropping, Schuster's, plain.....** \$ 0.17

4557. **Bottle, Dropping, Schuster's, glass stoppered.....** .22

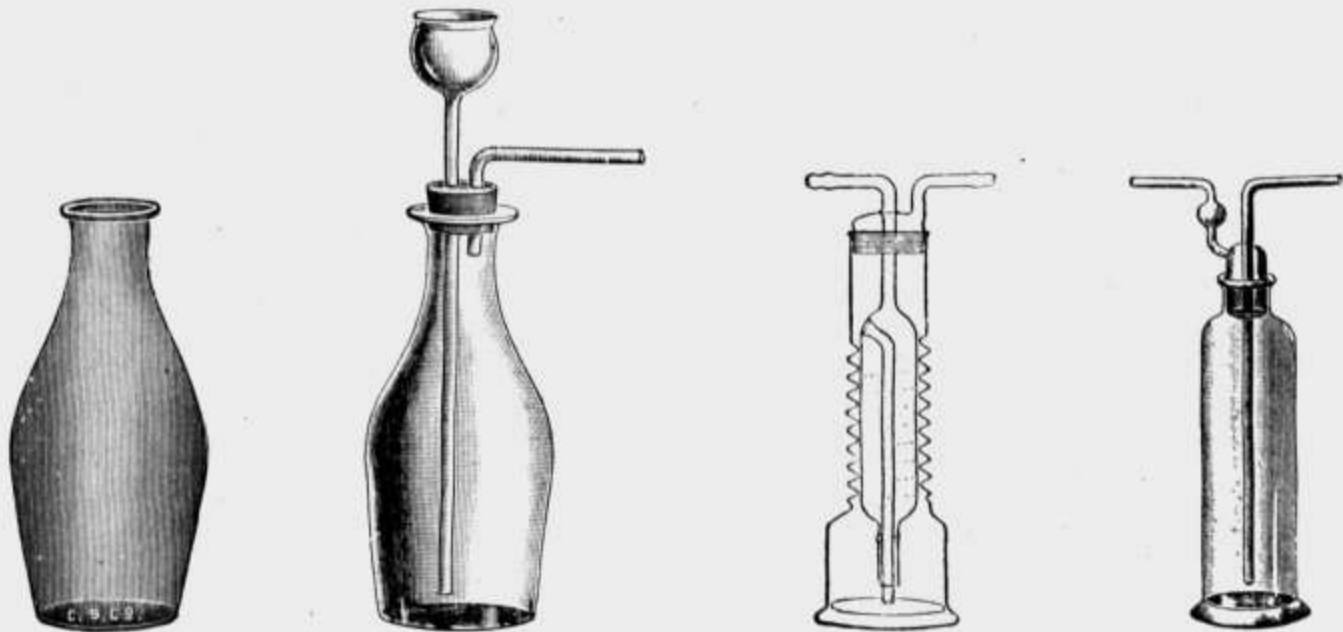
4558. **Bottle, Dropping.** A groove on one side of the neck of the bottle and a vent on the other connect with two grooves in the peg of the stopper and allow the contents to flow out drop by drop. A quarter turn of the stopper closes the bottle tightly. Capacity, 1 ounce..... .27

4558A. **Bottle, Dropping, same as No. 4558, but capacity 2 ounces.....** .30

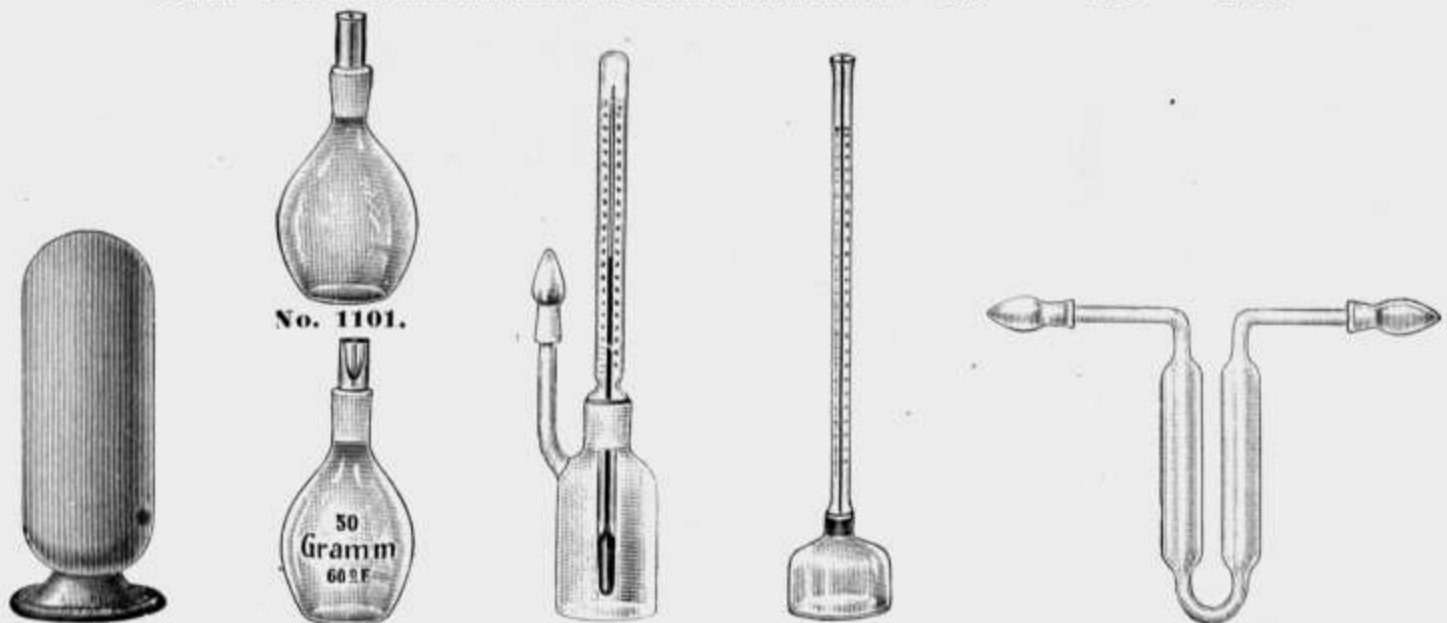
8061. **Bottle, Dropping.** With Barnes pipette stopper, square shape, 30 c. c. Each .....

8062. **Bottle, Dropping.** Ground stopper, capped pipette; 15 c. c..... .22

8064. **Bottle, Dropping.** Ground stopper, bulb pipette; 30 c. c..... .22



	No. 4559.	No. 4561.	No. 4564.	No. 4565.	
4559.	Bottles, Gas, plain. Capacity, pints..				
		1/2	1	2	4
	Each .....	\$0.17	.22	.30	.50
4561.	Bottles, Gas Generating or Evolution Flask, same as No. 4559, fitted with rubber stopper, funnel and delivery tubes.				
	Capacity, pints .....	1/2	1	2	4
	Each .....	.45	.50	.67	.90
4563.	Bottles, Gas Washing, same as 4559, with rubber stopper and fittings.				
	Capacity, pints .....	1/2	1	2	
	Each .....	.35	.45	.63	
4564.	Gas Washing Bottle, NEW; SCREW TYPE. So constructed that the gas bubbles are compelled to pass through a spiral about 120 cm. long, which insures a very efficient absorption. The inner tube is reflux, which prevents the liquid from rising to the top, and insures a continual circulation. With ground-in stopper.....				\$ 3.35
4565.	Bottles, Gas Washing, Drechsel's, with tubes ground into the neck, high form. Capacity, c.c.....				
		125	250	500	
	Each .....	.65	.84	1.05	



	No. 4566.	No. 1101.	No. 1105.	No. 1105B.	No. 1105C.	
4566.	Bottles, Inverted Show. Capacity, pints.....					
			1	2	4	
	Each .....		.22	.33	.60	
1101.	Bottles, Specific Gravity, unadjusted, perforated stopper, for student adjustment. Approximate capacity.....					
			25 c.c.	50 c.c.		
	Each .....		.30	.40		
1103.	Bottles, Specific Gravity, very accurately adjusted.					
	Exact capacity at 15° C.....	25 c.c.	50 c.c.	100 c.c.		
	Each .....	.67	.92	1.10		
1105.	Bottle, Specific Gravity, Geissler's, with thermometer ground in central neck and a capillary stopper ground in side neck. 25 c.c.....					2.50
1105A.	Bottle, Specific Gravity, same as No. 1105. Capacity, 50 c.c.....					2.75
1105B.	Bottle, Specific Gravity, Schumann's, for cement, with tube. Graduated to 50 c.c. in 1/10ths.....					2.10
1105C.	Bottle, Specific Gravity, Sprengel's, with ground-on caps.....					.85



No. 9138A.



No. 4567.



No. 4569.



No. 4571.

9138A. Bottles, Sterilizer, capacity 8 oz. Per dozen.....					\$ 0.50
4567. Bottles, Washing, with rubber stopper and flexible delivery tube.					
Capacity, ounces .....	8	12	16	24	32
Each .....	.33	.42	.45	.55	.65
4569. Bottles, Washing, all glass, with tubes ground in the neck.					
Capacity, ounces .....	8				16
Each .....	.90				1.10
4571. Bottles, Weighing, conical form, very light, glass stoppered.					
Capacity, ounces .....	1/2	1			2
Each .....	.30	.35			.45



No. 4573.



No. 4574.



No. 4577.



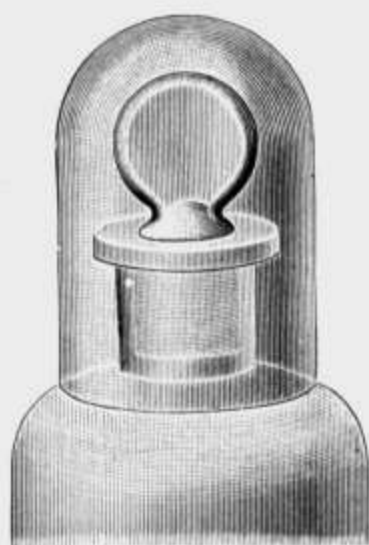
No. 4580.

4573. Bottles, Weighing (Weighing Tubes), flat bottom, glass stoppered.					
Height, mm. ....	60	80			90
Width, mm. ....	10	12			18
Each .....	.17	.21			.25
4574. Bottles, Weighing, without neck, with ground-in stoppers.					
Height, mm. ....	40	50	60	60	80
Diameter, mm. ....	25	40	30	50	40
Each .....	.25	.33	.35	.50	.45
4576. Bottles, Wouff's, with two necks.					
Capacity, pints .....	1/4	1/2	1	2	4
Each .....	.35	.40	.55	.70	1.05
4577. Bottles, Wouff's, with three necks.					
Capacity, pints .....	1/4	1/2	1	2	4
Each .....	.40	.45	.60	.83	1.25
4578. Bottles, Wouff's, with two necks and opening at bottom.					
Capacity .....				Pint.	Quart.
Each .....				.85	1.05
4580. Bottle Rest, of composition rubber, to put under bottles containing acid, oil, etc., for protecting table; diameter 4 inches. Each.....					.17

**BOTTLES FOR REAGENTS.**



No. 4587.



No. 4593.



No. 4589.

The labels on these bottles are of raised letters blown in the glass, the surface of each letter being ground so as to render it perfectly distinct. The letter is therefore indestructible. The following lists will be found to contain the names of all the test solutions referred to in the United States Pharmacopoeia.

No bottle WITH OTHER LABELS in this type of bottle is manufactured. If, however, any name not in the list is especially desired, it may be engraved on blank bottles at an additional charge of 9c net per bottle.

**PLEASE ORDER BY BOTTLE NUMBER.**

4585. **Reagent Bottles.** 1 oz., height 3<sup>5</sup>/<sub>8</sub> inches. Per dozen..... \$ 1.40

- |      |                         |                                   |  |
|------|-------------------------|-----------------------------------|--|
| No.  |                         |                                   |  |
| 326. | Cobaltous Nitrate ..... | Co(NO <sub>2</sub> ) <sub>2</sub> | 325. Silver Nitrate (Amber)..AgNO <sub>3</sub> |
| 336. | Gold Chloride .....     | AuCl <sub>3</sub>                 | 341. Blank.                                    |
| 327. | Platinic Chloride ..... | PtCl <sub>4</sub>                 |  |

4586. **Reagent Bottles.** Wide Mouth, 1 oz., height 3<sup>1</sup>/<sub>8</sub> inches. Per dozen... 1.50

- |      |                          |  |                               |
|------|--------------------------|--|-------------------------------|
| No.  |                          |  |                               |
| 374. | Ammonium Phosphate...    | (NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub> | 372. Test Paper.              |
| 361. | Am. Sod. Phosphate.....  | NaNH <sub>4</sub> HPO <sub>4</sub>               | 353. Sodium Acetate .....     |
| 351. | Borax .....              | Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>    | 369. Sodium Bitartrate .....  |
| 364. | Copper .....             | Cu   | 350. Sodium Carbonate .....   |
| 365. | Ferrous Sulphate .....   | FeSO <sub>4</sub>                                | 370. Sodium Nitrate .....     |
| 366. | Ferrous Sulphide .....   | FeS  | 376. Sod. Pot. Carbonate..... |
| 367. | Potassium Chlorate ....  | KClO <sub>3</sub>                                | 371. Starch.                  |
| 358. | Potassium Cyanide .....  | KCN  | 373. Zinc.                    |
| 368. | Potassium Ferricyanide.. | K <sub>3</sub> Fe(CN) <sub>6</sub>               | 375. Blank.                   |
| 354. | Potassium Nitrate.....   | KNO <sub>3</sub>                                 |                               |

4587. Reagent Bottles, 4 oz., height 5¼ inches. Per dozen.....	\$ 1.95
No.	No.
3. Acetic Acid ..... $\text{HC}_2\text{H}_3\text{O}_2$	24. Magnesium Sulphate ... $\text{MgSO}_4$
30. Alcohol ..... $\text{C}_2\text{H}_5\text{OH}$	25. Mercuric Chloride ..... $\text{HgCl}_2$
18. Ammonium Carbonate... $(\text{NH}_4)_2\text{CO}_3$	100. Mercuric Potass. Iodide.
17. Ammonium Chloride... $\text{NH}_4\text{Cl}$	86. Mercurous Nitrate ..... $\text{Hg}_2(\text{NO}_3)_2$
15. Ammonium Hydroxide... $\text{NH}_4\text{OH}$	415. Methyl Alcohol ..... $\text{CH}_3\text{OH}$
82. Ammonium Molybdate... $(\text{NH}_4)_6\text{Mo}_7\text{O}_{21}$	411. Methyl-Orange.
19. Ammonium Oxalate... $(\text{NH}_4)_2\text{C}_2\text{O}_4$	88. Nessler's Solution.
16. Am. Sulphide (Amber)... $(\text{NH}_4)_2\text{S}$	5. Nitric Acid ..... $\text{HNO}_3$
31. Am. Sulphocyanide ..... $\text{NH}_4\text{CNS}$	422. Nitric Acid, Con..... $\text{HNO}_3$
97. Am. Sulphydrate ..... $\text{NH}_4\text{HS}$	93. Oxalic Acid ..... $\text{H}_2\text{C}_2\text{O}_4$
33. Barium Carbonate ..... $\text{BaCO}_3$	423. Phenol ..... $\text{C}_6\text{H}_5\text{OH}$
20. Barium Chloride ..... $\text{BaCl}_2$	412. Phenolphthalein.
32. Barium Hydroxide ..... $\text{Ba}(\text{OH})_2$	94. Picric Acid ..... $\text{C}_6\text{H}_2\text{OH}(\text{NO}_2)_3$
401. Barium Nitrate ..... $\text{Ba}(\text{NO}_3)_2$	37. Platinic Chloride ..... $\text{PtCl}_4$
406. Bromine Water.	8. Potassium Carbonate... $\text{K}_2\text{CO}_3$
21. Calcium Chloride ..... $\text{CaCl}_2$	96. Potassium Chromate... $\text{K}_2\text{CrO}_4$
23. Calcium Hydroxide .... $\text{Ca}(\text{OH})_2$	13. Potassium Dichromate... $\text{K}_2\text{Cr}_2\text{O}_7$
22. Calcium Sulphate ..... $\text{CaSO}_4$	11. Potassium Ferricyanide... $\text{K}_3\text{Fe}(\text{CN})_6$
83. Carbon Disulphide ..... $\text{CS}_2$	6. Potassium Ferrocyanide... $\text{K}_4\text{Fe}(\text{CN})_6$
407. Chloroform ..... $\text{CHCl}_3$	12. Potassium Hydroxide... $\text{KOH}$
408. Cochineal.	10. Potassium Iodide ..... $\text{KI}$
409. Coralline.	9. Potassium Sulphate ..... $\text{K}_2\text{SO}_4$
36. Cupric Sulphate ..... $\text{CuSO}_4$	7. Potass. Sulphocyanide... $\text{KCNS}$
35. Ether ..... $(\text{C}_2\text{H}_5)_2\text{O}$	26. Silver Nitrate (Amber)... $\text{AgNO}_3$
58. Fehling's Solution.	404. Silver Sulphate ..... $\text{Ag}_2\text{SO}_4$
29. Ferric Chloride ..... $\text{Fe}_2\text{Cl}_6$	60. Sodium Acetate ..... $\text{NaC}_2\text{H}_3\text{O}_2$
28. Ferrous Sulphate ..... $\text{FeSO}_4$	59. Sodium Carbonate ..... $\text{Na}_2\text{CO}_3$
2. Hydrochloric Acid ..... $\text{HCl}$	416. Sodium Cobaltic Nitrite.
419. Hydrochloric Acid, Con... $\text{HCl}$	61. Sodium Hydroxide ..... $\text{NaOH}$
428. Hydrogen Peroxide.	14. Sodium Phosphate ..... $\text{Na}_2\text{HPO}_4$
1. Hydrogen Sul. (Amber)... $\text{H}_2\text{S}$	417. Sodium Thiosulphate ... $\text{Na}_2\text{S}_2\text{O}_3$
87. Indigo Solution.	81. Stannous Chloride ..... $\text{SnCl}_2$
414. Iodine Solution ..... $\text{I} + \text{KI}$	4. Sulphuric Acid ..... $\text{H}_2\text{SO}_4$
27. Lead Acetate ..... $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$	420. Sulphuric Acid, Con..... $\text{H}_2\text{SO}_4$
410. Litmus.	413. Turmeric.
90. Magnesia Mixture.	38. Blank.
4588. Reagent Bottles. Set of 40 of the above bottles (No. 4587), including the most common names used in the chemical laboratory. Includes Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 59, 61 and 3 blanks. Complete set in box.....	6.50
4588A. Reagent Bottles, 4 oz., set of 24 according to Fresenius. Includes Nos. 2, 3, 4, 5, 6, 7, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 25, 26, 27, 29, 32, 36, 59 and 61. Per set.....	3.90
4588B. Reagent Bottles, 4 oz., set of 12, consisting of Nos. 1, 2, 3, 4, 5, 15, 16, 20, 23, 26, 27 and 61. Per set.....	1.95
4589. Reagent Bottles. Wide Mouth, 4 oz., height 4¾ inches. Per dozen...	2.20
314. Ammonium Sulphate ... $(\text{NH}_4)_2\text{SO}_4$	313. Sod. Am. Hyd. Phos. $\text{Na}(\text{NH}_4)\text{HPO}_4 + 4\text{H}_2\text{O}$
304. Borax ..... $\text{Na}_2\text{B}_4\text{O}_7$	301. Sodium Carbonate..... $\text{Na}_2\text{CO}_3$
305. Ferrous Sulphate ..... $\text{FeSO}_4$	312. Test Paper.
303. Potassium Cyanide ..... $\text{KCN}$	307. Blank.
302. Potassium Nitrate ..... $\text{KNO}_3$	
4590. Reagent Bottles, 8 oz., height 6½ inches. Per dozen.....	2.50
131. Acetic Acid ..... $\text{HC}_2\text{H}_3\text{O}_2$	152. Lead Acetate ..... $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$
126. Alcohol ..... $\text{C}_2\text{H}_5\text{OH}$	153. Mercuric Chloride ..... $\text{HgCl}_2$
110. Ammonium Carbonate... $(\text{NH}_4)_2\text{CO}_3$	103. Nitric Acid, Con..... $\text{HNO}_3$
109. Ammonium Chloride... $\text{NH}_4\text{Cl}$	104. Nitric Acid, Dil..... $\text{HNO}_3$
108. Ammonium Hydroxide... $\text{NH}_4\text{OH}$	150. Potassium Hydroxide... $\text{KOH}$
155. Ammonium Molybdate... $(\text{NH}_4)_2\text{MoO}_4$	145. Silver Nitrate (Amber)... $\text{AgNO}_3$
130. Ammonium Oxalate... $(\text{NH}_4)_2\text{C}_2\text{O}_4$	112. Sodium Carbonate ..... $\text{Na}_2\text{CO}_3$
122. Am. Sulphide (Amber)... $(\text{NH}_4)_2\text{S}$	111. Sodium Hydroxide ..... $\text{NaOH}$
114. Barium Chloride ..... $\text{BaCl}_2$	129. Sodium Phosphate ..... $\text{Na}_2\text{HPO}_4$
151. Calcium Hydroxide ..... $\text{Ca}(\text{OH})_2$	156. Stannous Chloride ..... $\text{SnCl}_2$
154. Ferrous Sulphate ..... $\text{FeSO}_4$	101. Sulphuric Acid, Con..... $\text{H}_2\text{SO}_4$
105. Hydrochloric Acid, Con... $\text{HCl}$	102. Sulphuric Acid, Dil..... $\text{H}_2\text{SO}_4$
106. Hydrochloric Acid, Dil... $\text{HCl}$	116. Blank.
107. Hydrogen Sul. (Amber)... $\text{H}_2\text{S}$	
4591. Reagent Bottles, 16 oz. (pint), height 7¾ inches. Per dozen.....	3.60
204. Ammonium Hydroxide... $\text{NH}_4\text{OH}$	222. Hydrochloric Acid, Con... $\text{HCl}$
227. Am. Hydroxide, Dil..... $\text{NH}_4\text{OH} + \text{Aq}$	226. Hydrodisodic Phosphate... $\text{Na}_2\text{HPO}_4$
229. Am. Sulphide, Dil..... $(\text{NH}_4)_2\text{S} + \text{Aq}$	216. Nitric Acid ..... $\text{HNO}_3$
218. Barium Chloride ..... $\text{BaCl}_2$	219. Nitric Acid, Con..... $\text{HNO}_3$
223. Calcium Hydroxide .... $\text{Ca}(\text{OH})_2$	221. Potassium Hydroxide... $\text{KOH}$
225. Calcium Sulphate ..... $\text{CaSO}_4$	228. Sodium Hydroxide, Dil... $\text{NaOH} + \text{Aq}$
230. Ether ..... $(\text{C}_2\text{H}_5)_2\text{O}$	215. Sulphuric Acid ..... $\text{H}_2\text{SO}_4$
224. Ferrous Sulphate ..... $\text{FeSO}_4$	220. Sulphuric Acid, Con..... $\text{H}_2\text{SO}_4$
217. Hydrochloric Acid ..... $\text{HCl}$	211. Blank.
4592. Reagent Bottles, 32 oz. (quart), height 9½ inches. Per dozen.....	4.45
505. Hydrochloric Acid, Con... $\text{HCl}$	501. Sulphuric Acid, Con..... $\text{H}_2\text{SO}_4$
506. Hydrochloric Acid, Dil... $\text{HCl}$	502. Sulphuric Acid, Dil..... $\text{H}_2\text{SO}_4$
503. Nitric Acid, Con..... $\text{HNO}_3$	511. Blank.
504. Nitric Acid, Dil..... $\text{HNO}_3$	
4593. Caps, for reagent bottles. Will fit Nos. 4585-4586, per dozen.....	.75
4594. Caps, for reagent bottles. Will fit Nos. 4587-4589, per dozen.....	.80
4595. Caps, for reagent bottles. Will fit No. 4590-4591, per dozen.....	1.00



No. 4596.



No. 8084.



No. 9136A.

4596. Boxes, glass, with metal screw cap; valuable for samples, etc.				
Capacity, ounces .....	2	4	8	
Per dozen .....	\$0.85	1.33	2.10	
8084. Boxes, glass, with glass cover.				
Diameter, inches .....	1 $\frac{5}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{2}$	
Each .....	.15	.17	.25	
9136A. Boxes, seamless tin, one pint capacity, round with tight fitting lids; especially adapted for samples, soils, etc. Per dozen.....				\$ 0.75
9136B. Boxes, aluminum, with screw cap (Clements' Soil Cans). Diameter 2 $\frac{1}{4}$ inches, depth 2 $\frac{1}{2}$ inches, each .....				.50



No. 4597-S.



No. 4599.



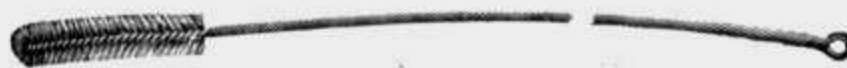
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No. 4601.

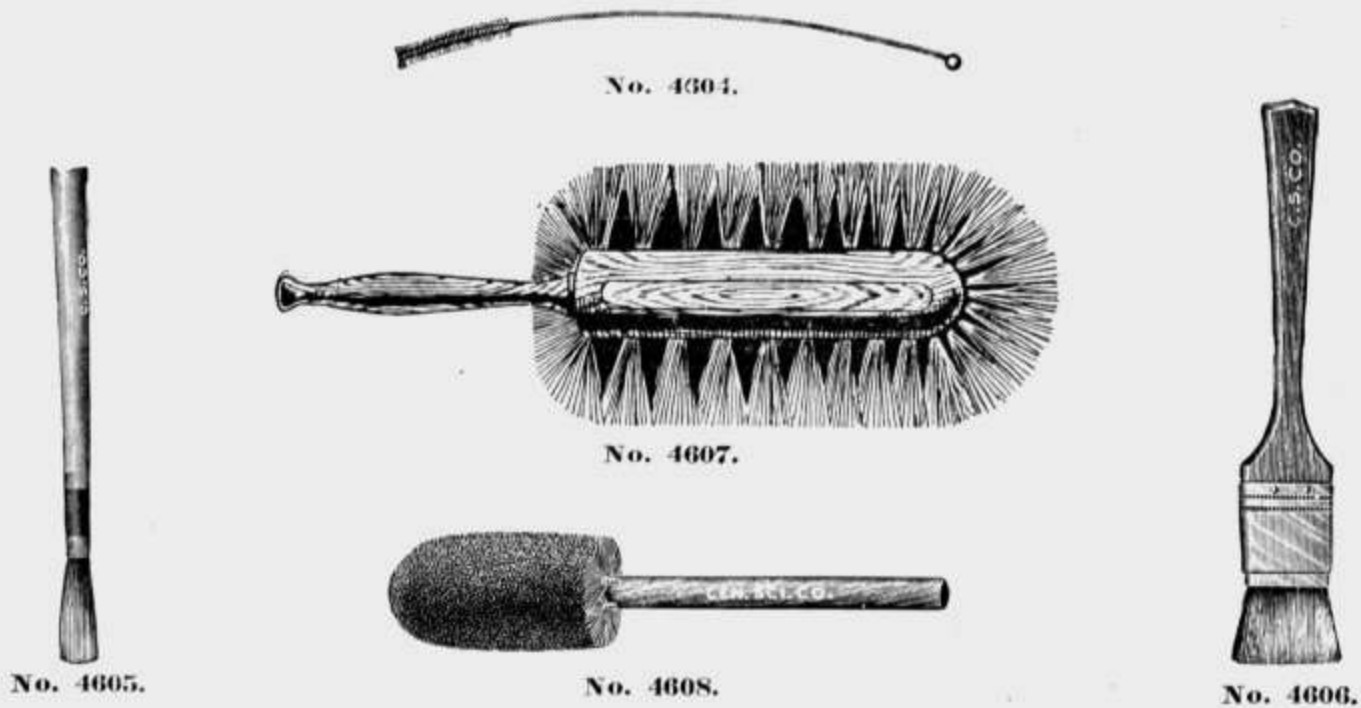


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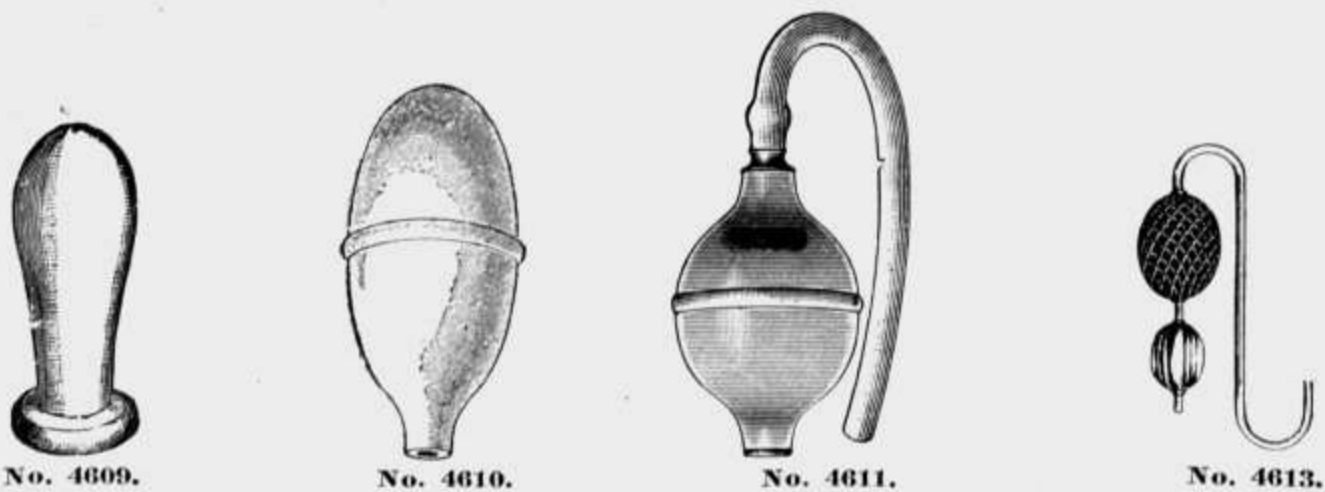


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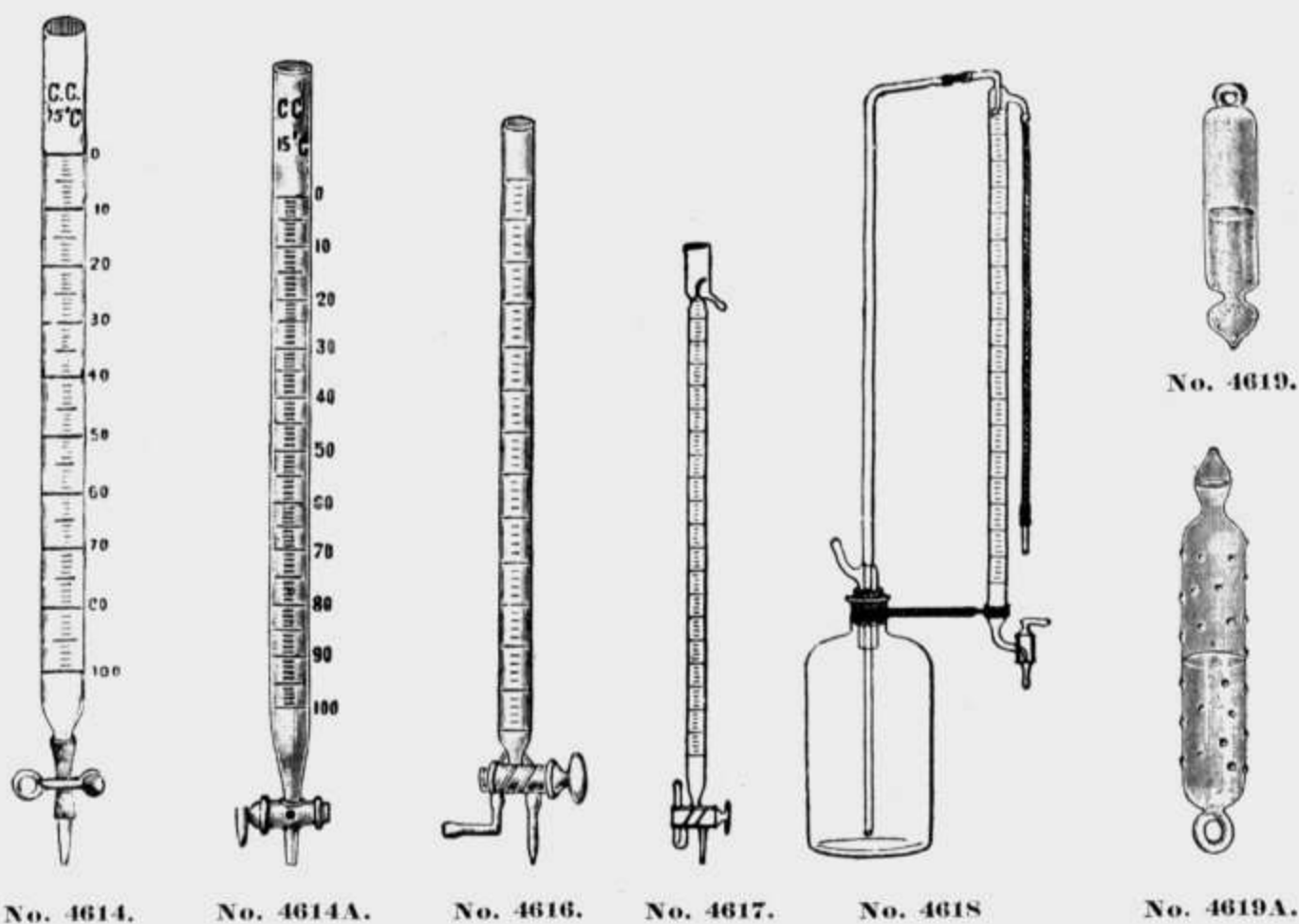
4597. Brushes, Test Tube, bristle or tufted end, brass wire. Per dozen....	.67
4598. Brushes, Test Tube, bristle or tufted end, tinned wire. Per dozen...	.45
4599. Brushes, Test Tube, plain, tinned wire. Per dozen.....	.40
4600. Brushes, Test Tube, sponge end, brass wire. Per dozen.....	.67
4600A. Brushes, Test Tube, sponge end, tinned wire. Per dozen.....	.55
4601. Brushes, Beaker, wood handle. Each.....	.22
4602. Brushes, Burette (also for long tubes), 3 feet long, tinned wire. Each	.10
4603. Brushes, Funnel, taper end, wood handle. Each.....	.20
4603A. Brushes, Flask, with pliable end, which adapts itself to the curvature of the flask. Each.....	.33



4604.	Brushes, Small Tube, bristle on tinned wire. Per dozen.....	\$	0.12		
4605.	Brushes, camel hair. "Pencils."				
	Size .....	Small.	Medium.	Large.	
	Per dozen .....	.15	.20	.27	
4606.	Brushes, camel hair, for cleaning scale pans, instruments, etc. Flat, with wood handle.				
	Width, inches .....	1/2	1	1 1/2	2
	Each .....	.15	.18	.22	.33
4607.	Brush, "Counter Brush." All pure bristles. A laboratory necessity.				
	Each .....		.50		
4608.	Brushes, with wooden handle, for cleaning cylinders and jars, 12 inches long. Four rows of bristles. Each.....		.25		
5060Z.	Brushes, for cleaning Babcock Milk Test Bottles, bristle on tinned wire. Per dozen .....		.55		
9152.	Brushes, Soil Tube, bristle on tinned wire, 6 1/2 inches long. Each.....		.27		
6253.	Brushes, Lacquer, camel hair, 1/2 inch wide, long wooden handle. Each		.20		
11051.	Brushes, Paste. Per dozen.....		.66		



4609.	Bulbs, Rubber, for pipettes, etc.		
	Capacity, c.c. ....	2	5
	Each .....	.04	.05
4610.	Bulbs, Rubber, for pipettes, etc.		
	Capacity, c.c. ....	25	50
	Each .....	.18	.20
4611.	Bulbs, Rubber, with hard rubber valves for exhaust or pressure Capacity, 50 c.c. ....		.30
4613.	Bulb, Rubber, double, one with net, for constan. blast.....		1.20
	Bulb Expander, see page 403.		



4614. Burettes, Mohr's, with tip and connection for pinch cock, but without pinch cock.	Capacity, c. c.....	10	25	50	100	
	Graduated to .....	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	
	Each .....	\$0.45	.67	1.00	1.80	
4614A. Burettes, Mohr's, with glass stop cock.	Capacity, c. c.....	10	25	50	100	
	Graduated to .....	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	
	Each .....	1.00	1.25	1.65	2.20	
4615. Burettes, Schellbach's, with white back and dark colored lines, showing the meniscus plainly. With tip and connection for pinch cocks.	Capacity, c. c.....	25	50	100		
	Graduated to .....	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$		
	Each .....	1.00	1.33	2.25		
4615A. Burettes, Schellbach's, same as above, but with glass stop cock.	Capacity, c. c.....	25	50	100		
	Graduated to .....	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$		
	Each .....	1.67	2.20	3.00		
4616. Burettes, Greiner and Friedrich's, with three-way stop cock for filling and discharging.	Capacity, c. c.....	25	50			
	Graduated to .....	$\frac{1}{10}$	$\frac{1}{10}$			
	Each .....	2.00	2.50			
4617. Burettes, Automatic, with zero point and overflow cup. Greiner and Friedrich's three-way stop cock for filling and discharging reservoir.	Capacity, c. c.....	25	50			
	Graduated to .....	$\frac{1}{10}$	$\frac{1}{10}$			
	Each .....	2.50	3.30			
4618. Burette, Automatic, best form, complete with clamp and reservoir.	Capacity of burette, 50 c.c.; graduated to $\frac{1}{10}$ c.c.....					\$ 4.15
4619. Burette Float, Erdmann's.....						.25
4619A. Burette Float, Erdmann's, with points to prevent adherence to the side of the burette.....						.40
4620. Burette Caps, glass, for protecting the contents and inside of burettes from dust. Per dozen.....						.50

Normal Burettes, listed on page 408,



**BURNER ATTACHMENTS.**  
For Burner With 7-16 Inch Tube.



No. 4621A.



No. 4621B.



No. 4621C.



No. 4621D.



No. 4621E.



No. 4621F.



No. 4621G.

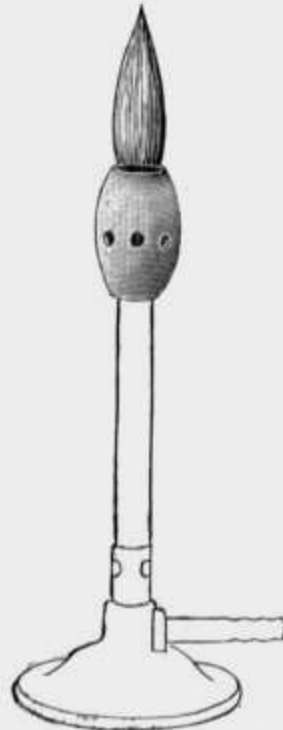


No. 4621H.

4621A. Blow Pipe Tube, for yellow flame.....	\$	0.13
4621B. Blow Pipe Tip, with rest, for blow-pipe.....		.13
4621C. Wing Top, for use in bending glass tubing.....		.09
4621D. Crown Top, giving round flame, for heating dishes.....		.38
4621E. Tripod, for holding dishes.....		.18
4621F. Gauze Top, giving large round flame.....		.25
4621G. Chimney .....		.14
4621H. Star, for supporting chimney.....		.22



No. 4622.



No. 3443.



No. 8070.

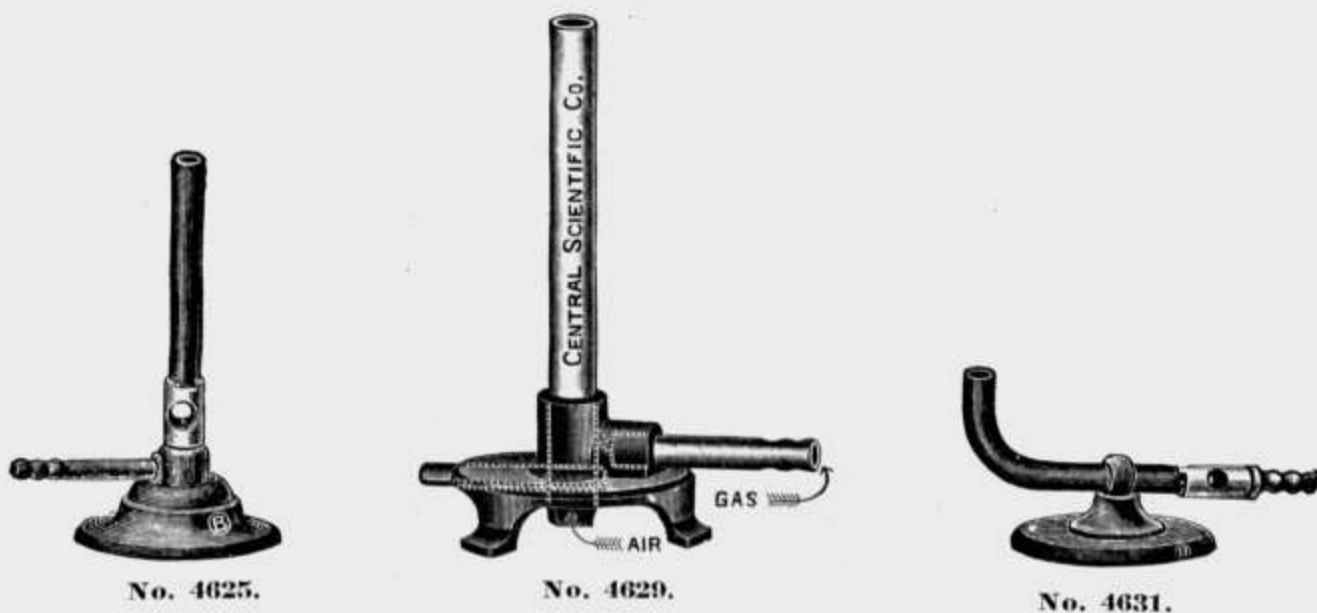


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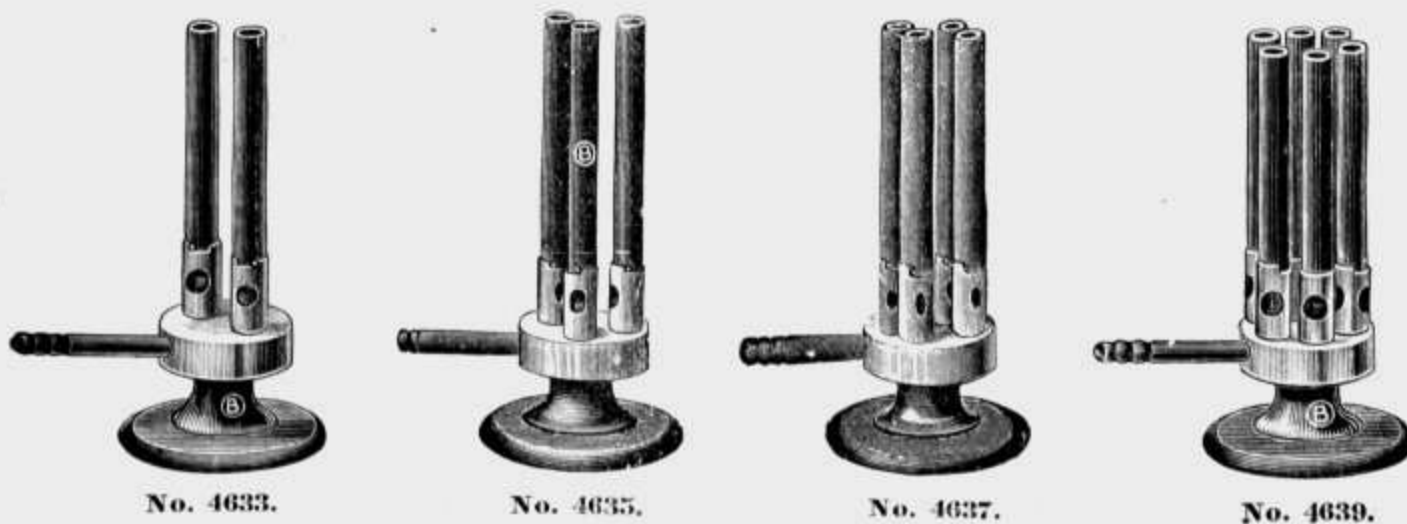


No. 4624.

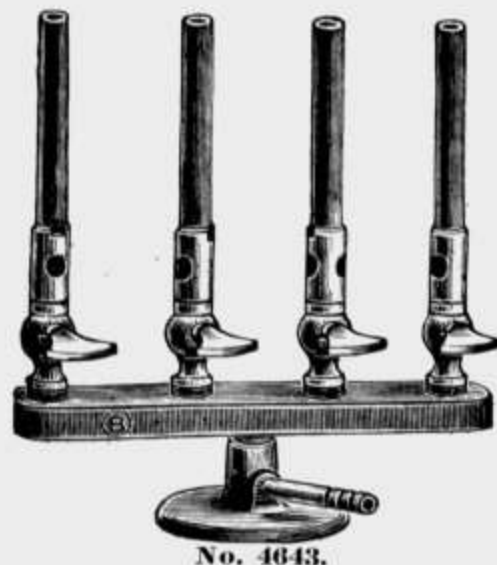
4622. Burner Guard, of vitrified earthenware for protecting a flame from drafts. Will also be found a rigid and convenient support. Measures 9 inches high, 8 inches diameter at base, 5 inches diameter at top. It is provided with a hole for rubber tubing and inlets for air to support combustion. Each.....	.40
3443. Monochromatic Flame Burner, see full description, page 258.	
8070. Burner, Koch's Safety, with automatic stop-cock to close off the gas when flame has gone out; on iron base; height, 5 inches.....	5.00
4623. Burner, Micro, 50 mm. high. Tube 6 mm. diameter, nickel plated...	.50
4624. Burner, Argand, with mica chimney, very desirable where uniform temperature is necessary .....	.90



- |       |  |         |
|-------|--|---------|
| 4625. | Burner, Bunsen, ordinary form, with air regulator.....   | \$ 0.25 |
| 4627. | Burner, Central Draft. A new departure for students' use. Consists of only three pieces. No tip to clog up. Substances accidentally dropped into the tube will fall clear through to the table. Perfect combustion, long lived, inexpensive; each, .20; per dozen..... | 2.00    |
| 4629. | Burner, same as No. 4627, fitted with air damper. Each, 22c; per doz..   | 2.50    |
| 4631. | Burner, Bunsen, low form, with air regulator.....  | .41     |
| 4632. | Burner, Bunsen, for acetylene gas, with air regulator.....   | 1.00    |



- |       |  |      |
|-------|--|------|
| 4633. | Burners, Bunsen, 2 tubes, with air regulators.....                                       | 1.05 |
| 4635. | Burners, Bunsen, 3 tubes, with air regulators.....                                       | 1.25 |
| 4637. | Burners, Bunsen, 4 tubes, with air regulators.....                                       | 1.65 |
| 4639. | Burners, Bunsen, 6 tubes, with air regulators.....                                       | 2.50 |
| 4641. | Burners, Bunsen, 4 tubes in one row, with air regulators .....                           | 2.50 |
| 4643. | Burners, Bunsen, 4 tubes in one row, with stop cock and air regulator for each tube..... | 4.00 |



See new Flexible Steel Tubing for connecting burners to gas supply, page 403.



No. 4645.



No. 4646.



No. 4647.



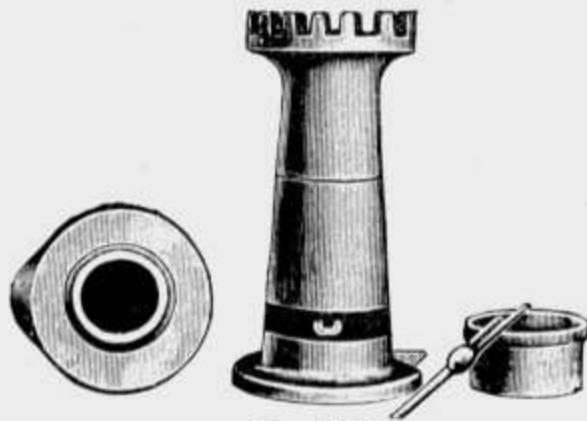
No. 4649.

4645. **Burner, Boyce's Adjustable**, improved regulator. Burns either coal gas or gasoline gas. The best low priced burner on the market, and the only adjustable burner made whose tube is stationary, whereby all attachments can be used with it to perfection..... \$ 0.75
4646. **Burner, Venable**. Burns either coal gas or gasoline gas. The inflow of gas is adjusted by a needle valve of special construction, by which the velocity of the gas is maintained even though the volume is diminished. The inflow of air is so governed as to secure an absolutely correct adjustment. This burner gives a flame varying from one large and powerful to one very small, and whether large or small it may be sharply concentrated, or rendered soft and verging on yellow..... 1.10
4647. **Burner, Boyce's "Acme."** Considered by all who have used it to be the most perfect burner made. Burns either coal gas or gasoline gas, with regulator for both gas and air. **Flame cannot strike back.** Perfect combustion with either a high or low flame..... 1.40
4648. **Burner, Boyce's**, same as No. 4647, without base. This is the only make of adjustable burner that can be mounted on a supply tube in any number for constructing different forms of heating apparatus for the chemist ..... 1.10
4649. **Burner, Tyrrell's**, completely adjusted for both coal and gasoline gas. Substantially constructed with regulator for both air and gas, and considered to be one of the best burners..... 1.10

4650. **Burner, Chaddock's**. Incorrodible, and therefore clean and durable. Designed especially for use in hoods where metal burners easily corrode, causing a smoky flame. No support or wire gauze is necessary.

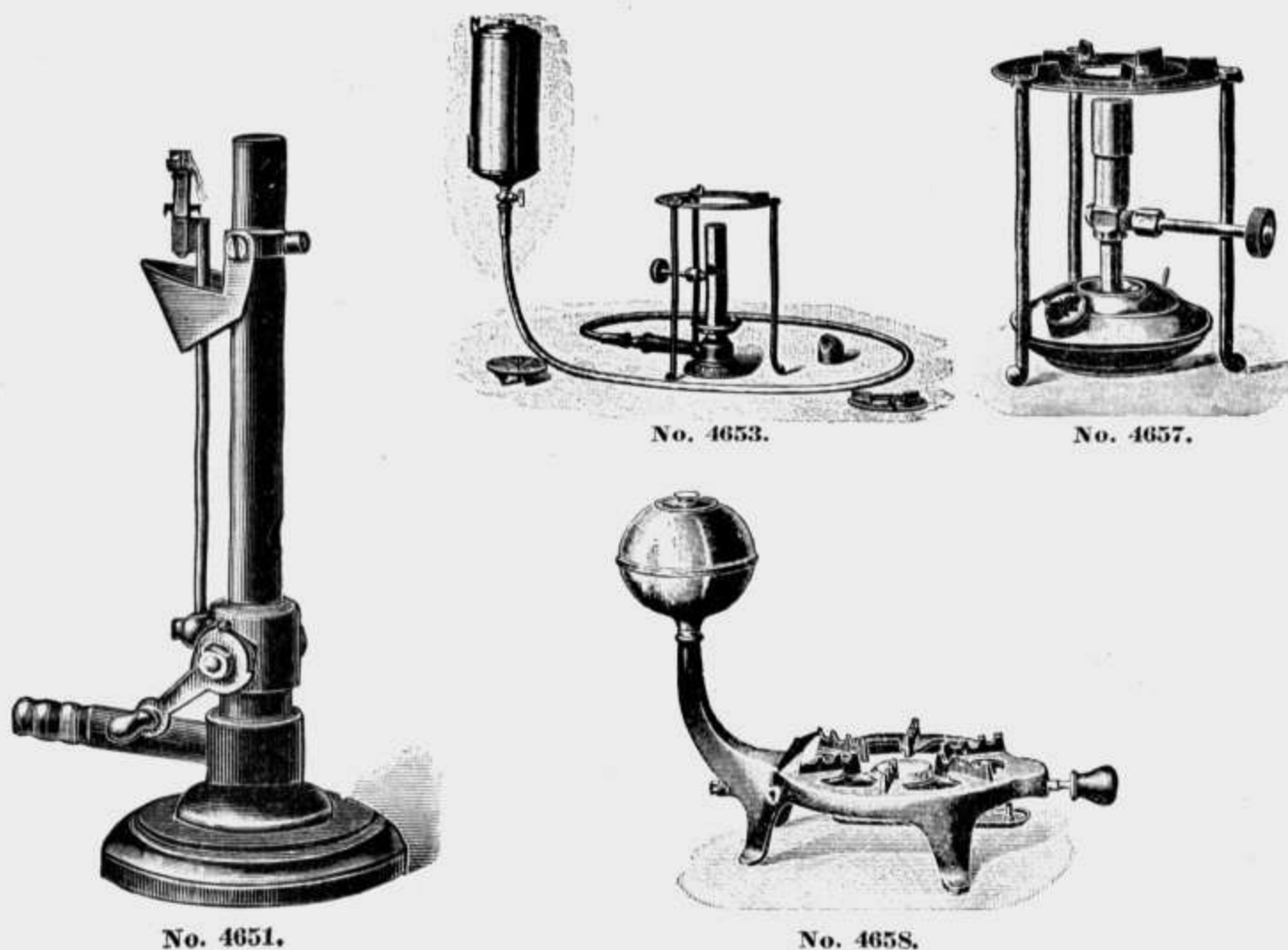
Burner, complete with air regulator, support for dishes, chimney for triangle, and three asbestos pads .....

2.00



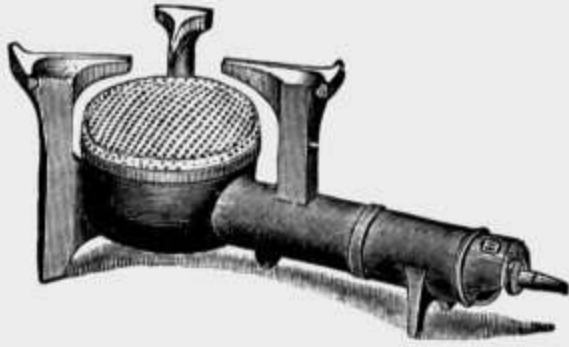
No. 4650.

4652. **Meker Burners**, page 501.

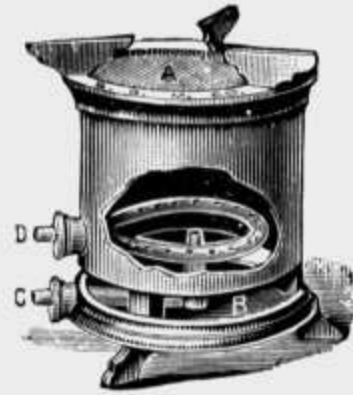


- 4651. **Burner, Self-Lighting Bunsen.** This burner is especially adapted for the lecture table, as it does not require a match to light. Simply turning the gas-cock admits the gas and ignites it at the same instant by means of a platinum and magnesium pellet. These igniting pellets last for years and improve by frequent use. They have a protective shield, shown dropped down in the illustration. Flame is regulated by stopcock. Full instructions accompany each burner ..... \$ 2.75
- 4653. **Burner, Barthel's, for Alcohol.** Requires no wick, very powerful. Complete with 1½ meters flexible metallic tubing and reservoir of 1 liter capacity. Without tripod ..... 7.50
- 4655. **Burner, Barthel's, same as No. 4653, but without tubing.....** 5.35
- 4657. **Burner, Barthel's, for Gasoline.** More powerful than the ordinary Bunsen Burner, for which it is an excellent substitute. Requires no wick. Without tripod..... 5.50
- 4658. **Burner, Barthel's, for Alcohol.** This lamp is superior to most other alcohol lamps or stoves, as it manufactures its own gas by vaporizing the alcohol. No wick is used; safe, smokeless, size of flame readily adjusted. Substantial in construction; reasonable in price, and with denatured alcohol (which is entirely suitable for use) economical of maintenance. One filling of the reservoir (about 1 pt.) will last with full flame about 1½ hours, with medium flame, 5 to 6 hours..... 3.50

**Burner, New Alcohol Stove,** recommended as the best substitute for gas. See illustration and description on page 382.



No. 4661.



No. 4665.

4661. **Burner, Solid Flame.** Gas consumption, 35 feet per hour. This burner will boil  $\frac{1}{2}$  gallon of water in 5 minutes and melt 6 pounds of lead or solder in an iron ladle in 7 minutes. Diameter  $4\frac{1}{2}$  inches..... \$ 2.00  
 4663. **Burner,** same as No. 4661, but for gasoline gas, with wheel valve.... 3.50  
 4665. **Burner, Low Temperature.** This burner gives a complete range of temperature, from a gentle current of warm air to a clear, red heat and is perfectly under control. For very low temperature the ring must be lighted through the opening B. For boiling, etc., the light must be applied on the surface of the gauze, thereby providing a large body of blue flame, which can be urged by the blast pipe C. ....Net 2.00  
 4667. **Burner, Low Temperature,** without blast pipe C.....Net 1.75

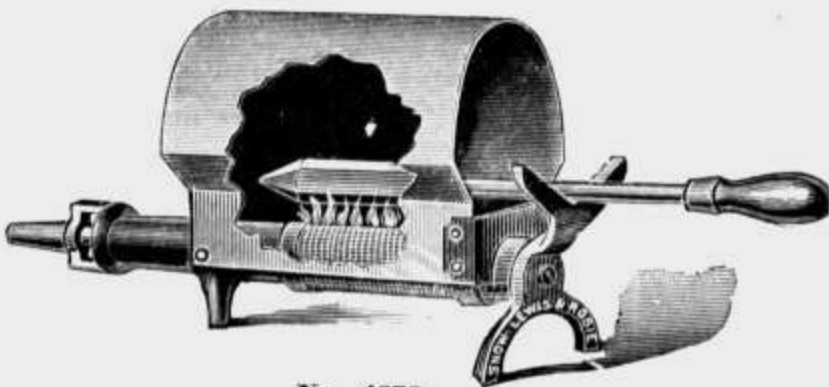


No. 4669.



No. 4671.

4669. **Burner, Fletcher's Evaporating,** of copper... 4 in. 5 in.  $6\frac{1}{2}$  in.  
 Each .....Net \$1.50 2.00 2.50  
 4671. **Burner, Ring Form,** to be attached to support with a right angle clamp.  
 Diameter ..... 3 in. 4 in. 5 in. 6 in.  
 Each ..... 1.10 1.35 1.55 1.80

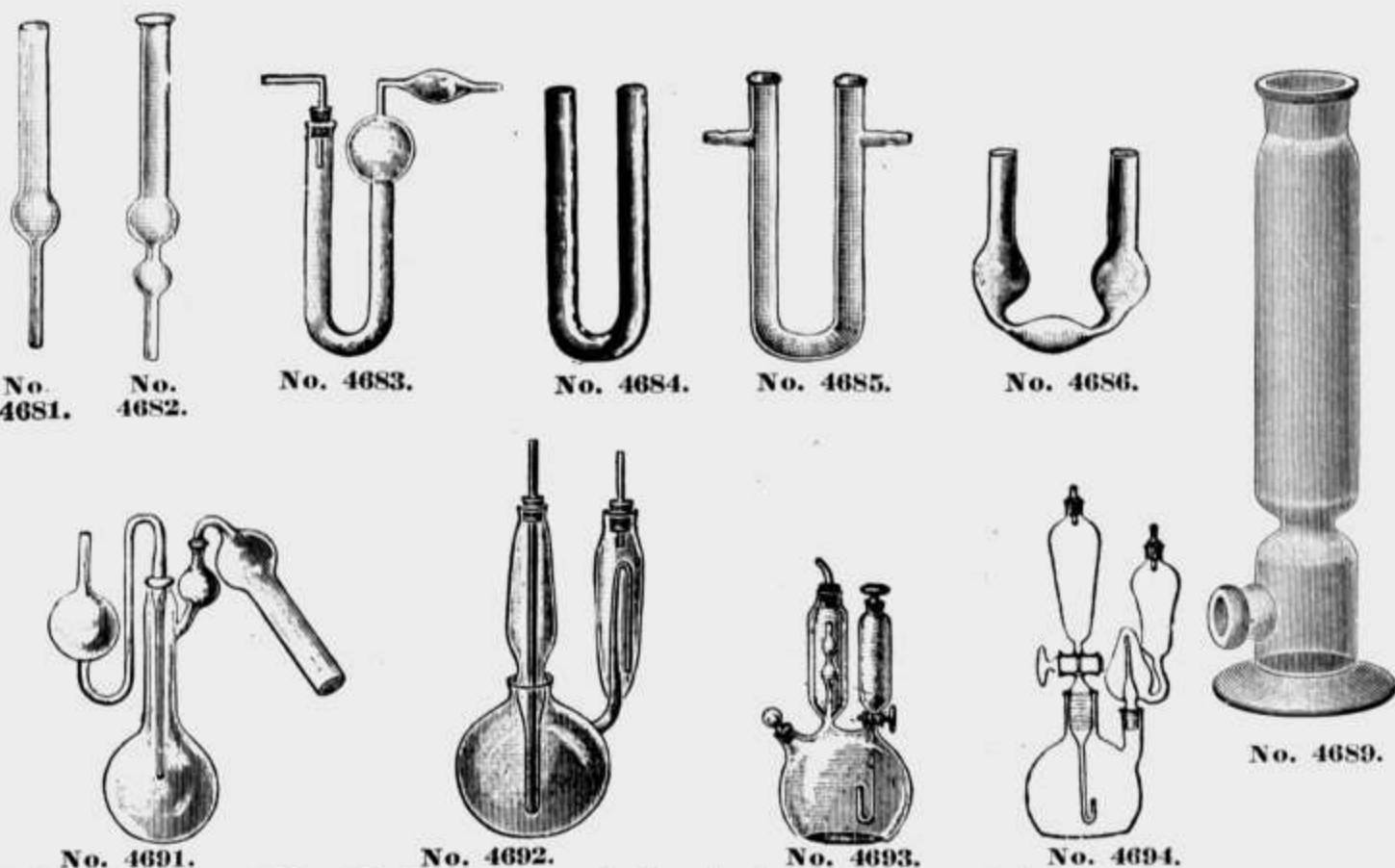


No. 4672.



No. 4673.

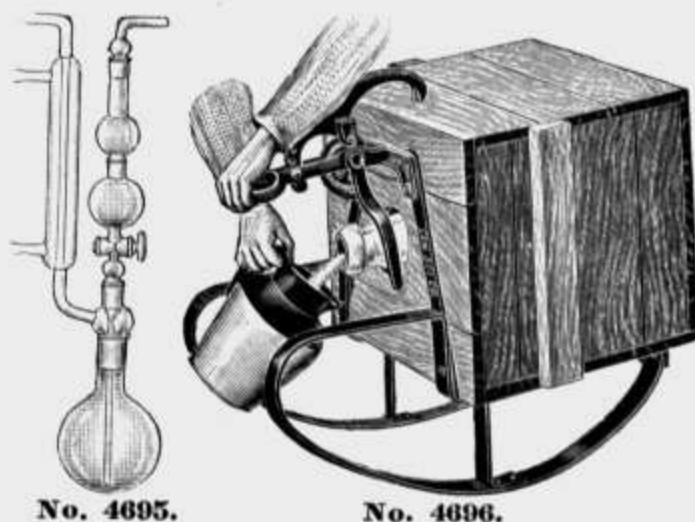
4672. **Burner, Soldering Iron Heater.** Simple construction, superior make, standard design, without soldering iron..... 1.40  
 For Soldering Coppers and Soldering Sets, see page 49.  
 4673. **Burner, Gas.** A portable gas table stove with cast iron top and base and Russia iron body. A steel drip pan is under the burner and the top is raised. Diameter, 9 inches; height,  $4\frac{1}{2}$  inches. Very useful in the laboratory ..... 1.10  
 4673A. **Burner, Gasoline,** same as No. 4673, furnished with valve and air regulator for burning gasoline gas..... 2.00  
 4673B. **Burner, Gas.** Cast iron, neatly japanned. Extreme length,  $12\frac{1}{2}$  inches; height,  $4\frac{1}{2}$  inches..... .77

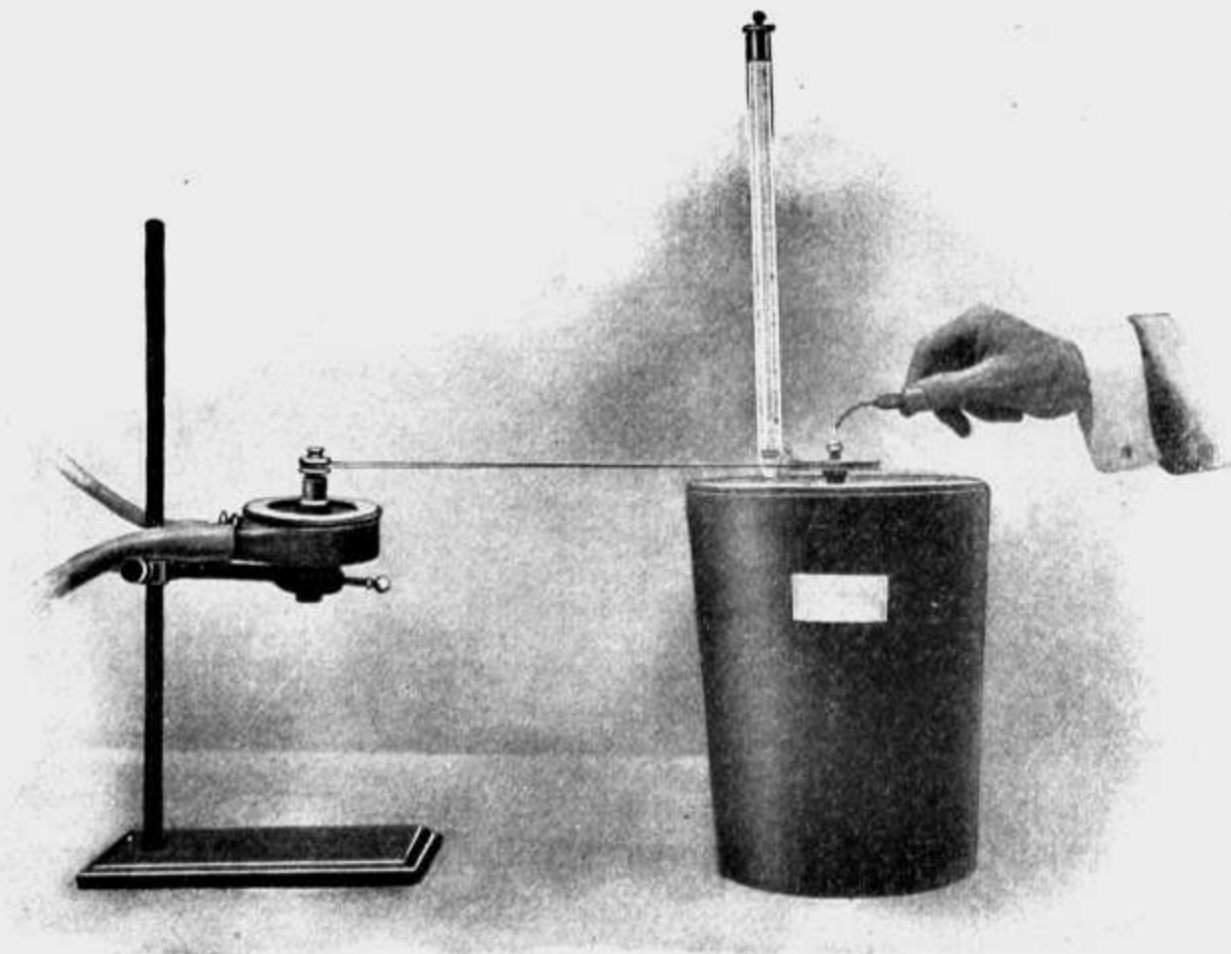


4681.	Calcium Chloride Tubes, one bulb, straight delivery tube.			
	Length, inches	4	6	8
	Each	\$0.09	.10	.12
4682.	Calcium Chloride Tubes, two bulbs, straight delivery tube.			
	Length, inches	4	6	8
	Each	.09	.12	.15
4683.	Calcium Chloride Tubes, Marchand's.			
	Length, inches		4	6
	Each		.25	.33
4684.	Calcium Chloride Tubes, U form, plain.			
	Length, inches	4	5	6
	Each	.11	.15	.17
4685.	Calcium Chloride Tubes, U form, with side neck.			
	Length, inches	4	6	8
	Each	.15	.23	.30
4686.	Calcium Chloride Tubes, Pelligot's.			
	Length, inches		5	8
	Each		.35	.67
4689.	Calcium Chloride Jar (Drying Tower).			
	Height, inches	8	10	12
	Each	.42	.50	.62
4691.	Carbonic Acid Apparatus (Alkalimeter), Bunsen's.			\$ 1.00
4692.	Carbonic Acid Apparatus (Alkalimeter), Geissler's			1.50
4693.	Carbonic Acid Apparatus (Alkalimeter), Schroedter's			1.65
4694.	Carbonic Acid Apparatus (Alkalimeter), Mohr's latest form.			1.90

4695. Carbonic Acid Apparatus, Knorr's, for determination of carbonic acid in carbonates, especially baking powder, recommended by the Association of Agricultural Chemists ..... Net \$6.75

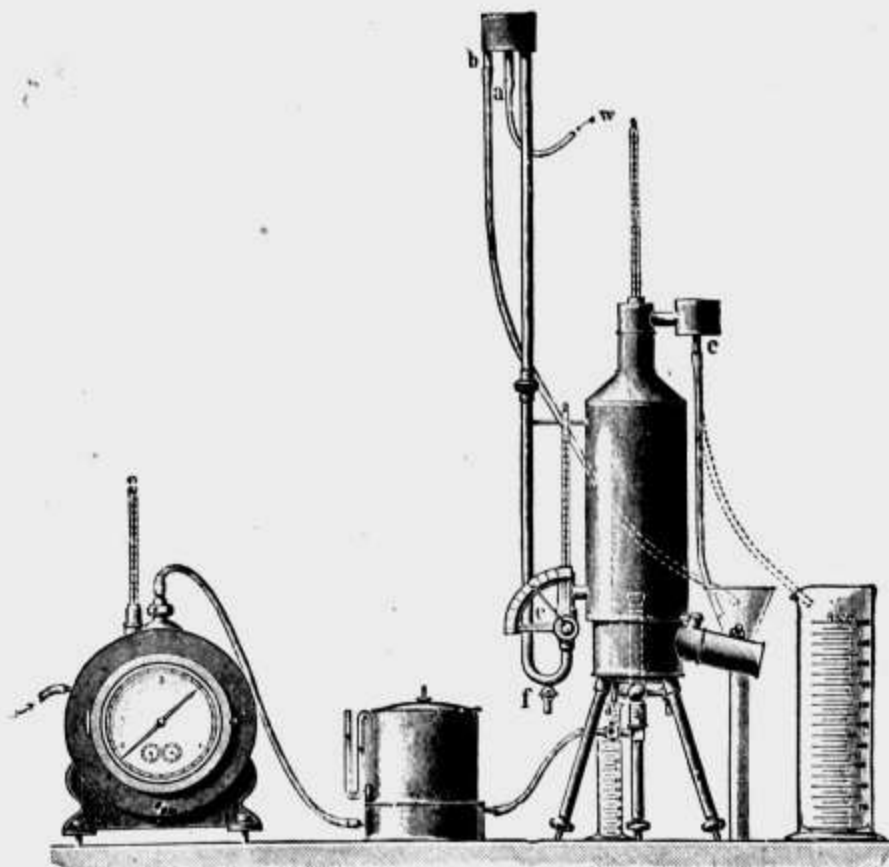
4696. Carboy Inclinator, Flaherty's. A lever locks the carboy to the inclinometer, and on account of the shape of the rockers the carboy always returns to an upright position when released. A very convenient method of tilting a heavy carboy ..... Net \$5.00





No. 4697.

4697. **Calorimeter, Parr's**, for determining the heat units in coal, coke, lignite and oils. Very accurate and easy of manipulation. Does not require the use of oxygen gas under pressure. The outfit includes the calorimeter, a guaranteed thermometer reading to  $1/20^{\circ}$  F, a reading lens, a two liter measuring flask, measuring cup, 5 inch brass sieve, 100 mesh, with bottom, forceps, camels hair brush, and igniting wire; chemicals for 50 determinations, including special chemicals for petroleum, etc. Complete for wire ignition, without motor .....Net \$ 70.00
- 4697A. **Calorimeter**, same as above, but complete for electrical ignition, including battery, but without motor.....Net 75.00
- Extras that will be found desirable in laboratory for use in connection with Parr's Calorimeter.
- 4697B. **Electric Motor**, for two dry cells.....Net 5.00
- 4697C. **Electric Motor**, for 110 or 220 volts.....Net 12.50
- 4697D. **Water Motor and Support**.....Net 5.00
- 4697E. **Hot Air Oven**, 6x8 inches.....Net 5.00
- 4697F. **Thermometer**, for oven.....Net 1.40
- 4697G. **Mortar and Pestle** .....Net .75
- 4697H. **Watch Glasses**, with clip.....Net .50
- 4697J. **Thermometer**, 65 to 90° F, with certificate.....Net 10.00
- 4697K. **Thermometer**, 65 to 105° F, with certificate.....Net 15.00
- 4697L. **Ignition Wire**, electric, per roll.....Net .50
- 4697M. **Ignition Wires** (hot wires), per dozen.....Net .25
- 4697N. **Chemical**, per  $1/4$  lb. can .....Net .65
- 4697O. **Chemical**, per  $1/2$  lb. can.....Net 1.25
- 4697P. **Chemical**, per 1 lb can.....Net 2.00
- 4697Q. **Accelerator**, per bottle.....Net .50
4698. **Parr Gas Calorimeter**, page 56.



Nos. 4698-4698A-4698B.

4699. **Calorimeter, Junker's, for gas.** The accepted standard for determining the thermal units of gases. Quick and accurate results may be obtained by an inexperienced person. The outfit includes the following: Calorimeter proper with gas burner, 2 thermometers 0-50° C. in  $\frac{1}{10}^\circ$ , 2 magnifying glasses, 4 rubber stoppers, 15 feet rubber tubing, and carrying case.....Duty free \$ 125.00  
 To use this calorimeter for liquid fuels the following three additional pieces of apparatus will be needed:
- 4699A. **Gas Meter**, in liters or cubic feet, with two thermometers 0-60° in 1° divisions, 1 each graduated cylinder of 2000 and 100 c.c. capacity, in carrying case.....Duty free 38.50  
 4699B. **Pressure Regulator**, in carrying case.....Duty free 15.70  
 4699C. **Balance**, accurate, with tare weight, and burner for liquid fuels with burner head .....Duty free 31.50  
 See also No. 1603 **Junker Calorimeter**.



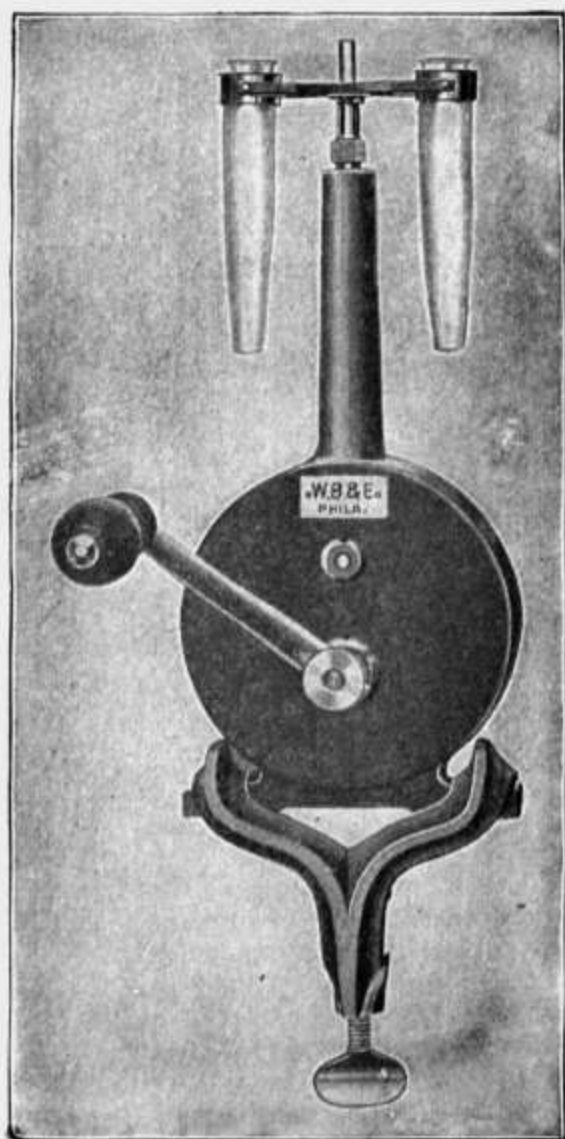
No. 4700.



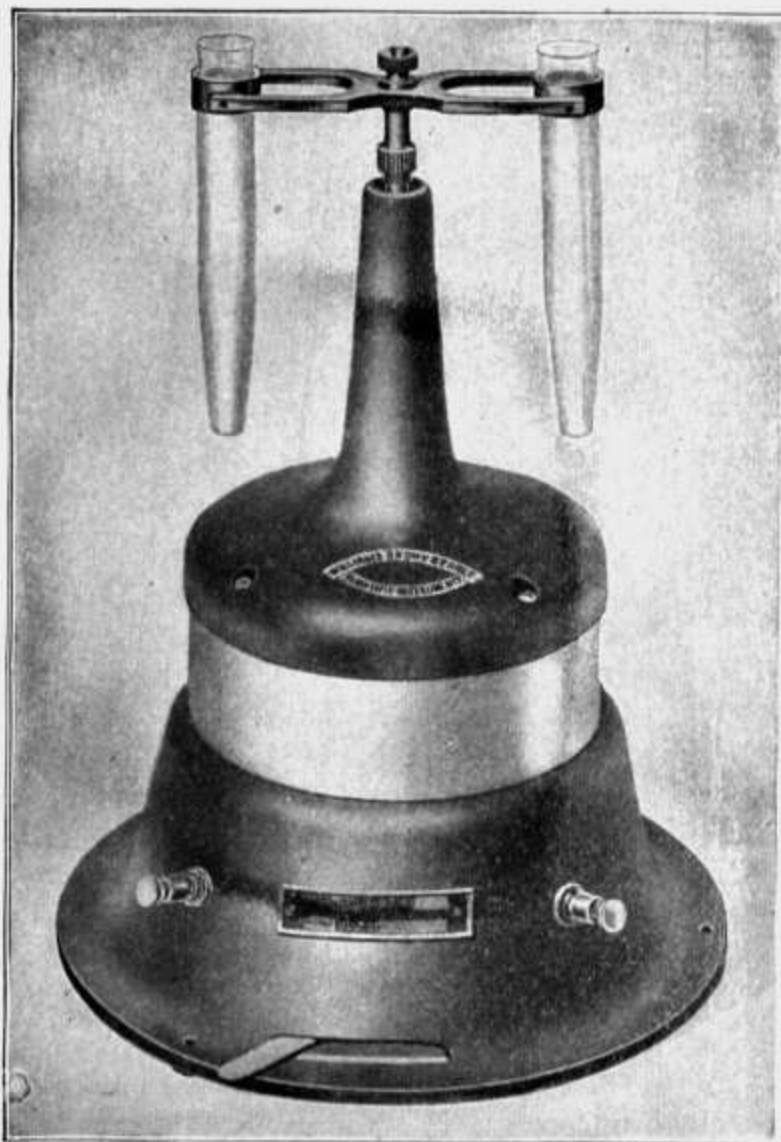
No. 4701.

4700. **Casserole.** Royal Berlin Porcelain, with lip and porcelain handle, without cover.
- |                   |     |     |     |     |      |      |
|-------------------|-----|-----|-----|-----|------|------|
| No. ....          | 1   | 2   | 3   | 3A  | 4    | 5    |
| Capacity, c.c.... | 30  | 75  | 150 | 210 | 375  | 750  |
| Diameter, mm.     | 50  | 70  | 85  | 95  | 110  | 135  |
| Each .....        | .40 | .55 | .60 | .85 | 1.00 | 1.96 |
4701. **Casserole**, best German porcelain, lipped, with cover and wooden handle.
- |                     |     |     |     |
|---------------------|-----|-----|-----|
| Capacity, c.c. .... | 125 | 250 | 500 |
| Diameter, mm. ....  | 90  | 100 | 135 |
| Each .....          | .45 | .50 | .80 |
4703. **Casserole**, of agateware.
- |                        |     |     |     |
|------------------------|-----|-----|-----|
| Capacity, ounces ..... | 16  | 32  | 64  |
| Each .....             | .22 | .30 | .40 |





No. 4704.



No. 4705.

**Centrifuges**, hand driven. High speed, giving from 1,000 to 3,000 revolutions per minute, for the rapid and accurate analysis of urine, sputum, blood, pus, milk and the precipitation of solids in any liquid. The case is of iron, well finished, the bearings accurate, the gear wheels cut by special machinery, and the pitch so calculated as to render the machine almost noiseless. It can be supplied with arms that will carry two or four tubes and the haematocrit.

4704. **Centrifuge**, for the examination of urine, arranged to carry two tubes, with two aluminum shields, one plain and one graduated glass tube.... \$ 10 00
- 4704A. **Centrifuge**, same as No. 4704, but with arm for holding four tubes, with four aluminum shields, two graduated and two plain tubes. This machine is capable of doing the work of two ordinary centrifuges..... 15 00
- 4704B. **Centrifuge**, same as No. 4704, with two tubes for the examination of urine and haematocrit for the examination of blood and sputum.... 16 00
- 4704C. **Centrifuge**, same as No. 4704, with four tubes for the examination of urine and with haematocrit for the examination of blood and sputum 20 00

**Purdy Electric Centrifuge**, mounted upon a heavy iron base to insure the rigidity essential for accurate work. They are made for either 110 volt direct or 110 volt, 60 cycle alternating current, and can be used on the incandescent lighting circuit, as there is a controlling lever mounted in base to regulate the speed.

Note.—When ordering, give voltage of the current, whether direct or alternating 60 cycles. If your current is 220 volts, add \$11.00 to the list price given below.

4705. **Purdy Electric Centrifuge**, for examination of urine, with urine arm carrying two tubes, two plain glass sediment tubes and two graduated percentage tubes ..... 35 00
- See **International Centrifuges**, pages 508-510.

4705A. <b>Purdy Electric Centrifuge</b> , same as No. 4705, with addition of Haematocrit arm for examination of blood and sputum.....	\$ 41.00
4705B. <b>Purdy Electric Centrifuge</b> , same as No. 4705, with addition of precipitating arm for manipulation of micro-organisms.....	41.00
4705C. <b>Purdy Electric Centrifuge</b> , same as No. 4705, with addition of both Haematocrit and precipitating arms.....	47.00

## CENTRIFUGE ATTACHMENTS.

## WILL FIT ALL CENTRIFUGES Nos. 4704 TO 4705C.

4706. <b>Dome Protector</b> for Purdy Electric Centrifuges. To protect the operator from flying particles or liquid and to avoid contact with the rapidly moving arms. It also lessens the air resistance and proportionately increases the speed. Fits Centrifuges Nos. 4705-4705C. Net	9.00
4707. <b>Graduated Urine Tube</b> , designed by Dr. Charles W. Purdy for use with the Purdy Electric Centrifuge, and wherever his methods are employed. This tube is fully graduated to 15 c.c., with very tapering tip for the measurement of very small quantities of sediment. Net	.50
4707A. <b>Plain Ungraduated Tube</b> , same size as No. 4707..... Net	.15
4707B. <b>Aluminum Shield</b> , to carry tubes Nos. 4707 and 4707A..... Net	.75
4708. <b>Arm</b> , with two metal tube shields and two 50 c.c. cement tubes for testing cement and for use when the percentage of sediment to be measured is very small..... Net	10.00
4708A. <b>Arm</b> , with two metal tube shields and two Goetz tubes for phosphorus determination with graduated tips..... Net	14.00
4708B. <b>Graduated Tube</b> . Length $4\frac{1}{8}$ inches, outside diameter $\frac{1}{8}$ inch, graduated to 10 c.c. .... Net	.35
4708C. <b>Plain Tube, Ungraduated</b> . Length of tube $4\frac{1}{8}$ inches, outside diameter $\frac{1}{8}$ inch..... Net	.18
4708D. <b>Aluminum Shield</b> , for carrying tubes Nos. 4708B and 4708C..... Net	.25
4708E. <b>Haematocrit</b> , with two graduated blood tubes and two plain sputum tubes ..... Net	5.00
4708F. <b>Precipitating Arm</b> , with two tapering tubes for the manipulation of micro-organisms ..... Net	5.00
4708G. <b>Goetz Tube</b> , for phosphorus determination, with graduated tip.... Net	.90
4708H. <b>Metal Shield</b> , for carrying No. 4708G Goetz Tube..... Net	1.00
4708J. <b>Cement Tube</b> , with 50 c.c. graduation, with tip graduated to $\frac{1}{50}$ c.c. for cement testing and for use where the proportion of sediment is extremely small ..... Net	1.50
4708K. <b>Metal Shield</b> , for carrying No. 4708J Cement Tube..... Net	1.00
4708L. <b>Percentage Tube</b> , for blood analysis, for use with Haematocrit.... Net	.75
4708M. <b>Plain Sputum Tube</b> , for use with Haematocrit..... Net	.30
4708N. <b>Precipitating Tube</b> , with plug and six washers, for the manipulation of micro-organisms ..... Net	.54
4708P. <b>Tube for Milk Analysis</b> . To obtain absolutely reliable test of either breast or cow's milk, we have devised the graduated milk tube. It will give results accurate to within $\frac{1}{5}$ of 1% of fat..... Net	.50
4708Q. <b>Dropper</b> , new construction, for filling the blood tubes..... Net	.22
4708R. <b>Lancet</b> , spear point, for pocket..... Net	1.00

## CHARTS.

4709. <b>Chart, Atomic Weight</b> . Compiled by Dr. F. W. Clarke and reported to the American Chemical Society. Corrected up to 1911. Size 42x62 inches. Mounted on common rollers.....	1.35
4709A. <b>Chart, Periodic System</b> . The periodic arrangement of the elements according to Mendelejeff, on the basis of O=16. Revised and corrected up to 1911 by Dr. F. W. Clarke. American Nomenclature. Size 42x62 inches. Mounted on common rollers.....	1.50
3449. <b>Chart, Spectrum, Large</b> , mounted on linen back, size of each spectrum 52 cm. long, 5.5 cm. wide. Includes the spectra: K, Rb, Cs, Tl, Na, Li, Ca, Sr and Ba.....	4.45
3449A. <b>Chart, Spectrum</b> , same as No. 3442, with the following spectra: In, C, Bo, Mn, Pb, Cu, Co, Ni and Fe.....	4.45

4709B. **Charts, Technological, Lithographed**, size 170x125 cm. Mounted on linen, with rollers. Each.....Duty free \$ 9.00

1. Bessemer Steel Manufacturing, by Prof. A. V. Kerpely.
2. Glover Tower, Manufacturing of Sulphuric Acid, by H. Schaffner.
3. Ammonia Ice Machine, by F. Carré.
4. Beer Brewing, by Gustav Noback.
5. Condensation of Hydrochloric Acid, by H. Schaffner.
6. Sugar Refining.
7. Diffusion Apparatus, for continual diffusion, by Julius Robert.
8. Martin Steel Manufacturing, by Siemens.
9. Iron Furnace for Cokes; producing from 50 to 60 tons a day. Latest model.
10. Puddling Furnace, by Dr. Jos. Schmiedhamer.
11. Sulphur Distillation, by Dr. Pasqualini.
12. Tile Making: Hoffmann's Ring Oven.

4709C. **Charts, Technological**, for showing chemical processes, after G. & J. von Schroeder, revised by A. Harpf. Size of each chart 78x116 centimeters.

Single Chart, mounted on linen with rollers.....Duty free 1.65  
 Any Complete Series of 5 Charts, mounted on linen with rollers.....  
 .....Duty free 7.00

The following are the subjects:

Series A.

1. Production of Sulphur.
2. Refining Crude Sulphur.
3. Preparation of Nitric Acid.
4. Preparation of Sulphurous Acid by combustion of pyrites for use in the manufacture of sulphuric acid.
5. (a) Furnace for Lump Pyrites.  
(b) Furnace for Fine Pyrites.

Series B.

6. Sulphuric Acid Factory, ground plan.
7. Sulphuric Acid Factory, vertical section.
8. Details in the Process of Manufacturing Sulphuric Acid.
9. Concentration of Acid.
10. Preparation of Fuming Sulphuric Acid.

Series C.

11. Salt Garden.
12. Graduation House.
13. Salt Boiling.
14. Soda Manufacture.
15. Condensation of Muriatic Acid.

Series D.

16. { Manufacture of
17. { Illuminating
18. { Gas.
19. Manufacture of Phosphorus.
20. System of Regenerative Heating, Siemens'.

Series E.

21. Gas Generator.
22. Glass Pot Furnace.
23. Glass Trough Furnace.
24. Glass Stretching Furnace (for making plate glass).
25. Hofmann's Ring Furnace.

Series F.

26. Lime Kiln.
27. Manufacture of Porcelain.
28. Manufacture of Sodium.
29. Manufacture of Aluminum.
30. Electrical Phosphorus Oven.

Series G.

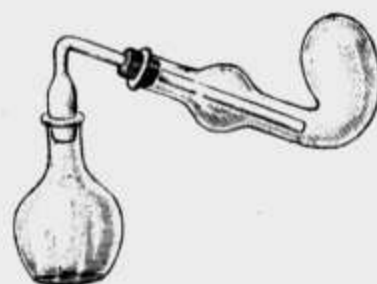
31. Charring of Wood.
32. Coke Furnace.
33. Furnace for Roasting Iron Ores.
34. Iron Blast Furnace (Hochofen).
35. Blast Superheater (Winderheizer).

Series H.

36. Refiner's Fire (Frischfeuer).
37. Puddling Furnace.
38. Bessemer Converter.
39. Martin Furnace.
40. Rolling Mill.

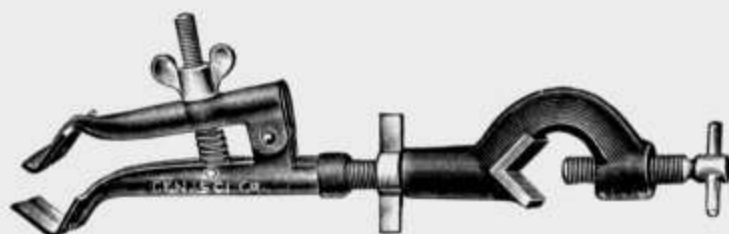
Series I.

41. Lead Furnace.
42. Silver Furnace.
43. Copper Furnace.
44. Zinc Furnace.
45. Mercury Furnace.



No. 4710.

4710. **Chlorine Absorption Apparatus, Bunsen-Fresenius** ..... .75  
 4710A. **Chlorine Tube**, page 502.



No. 4711.

4711. **Clamp, Burette**, jaws stamped out of steel, check nut to adjust to any position, clamp holder. An excellent clamp for general use..... \$ 0.33



No. 4712.



No. 4713.

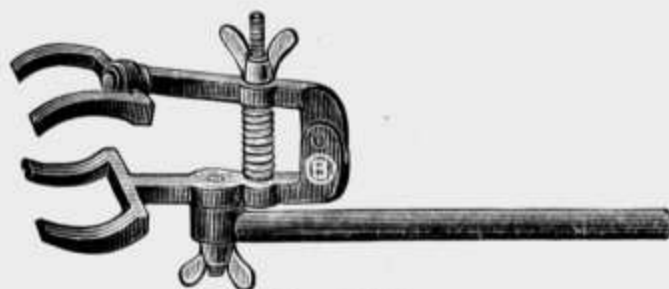
4712. **Clamp, Burette**, for two burettes, designed by Prof. Lincoln of University of Illinois. Burettes are held perpendicular and are easily removed. A very convenient and rigid clamp and nicely made.... 1.00

4713. **Clamp, Chaddock's**, for holding beakers Nos. 0 to 2..... .22

4713A. **Clamp, Chaddock's**, for holding beakers Nos. 2 to 4..... .22



No. 4714.



No. 4715.

4714. **Clamp, Hofmann's**, double..... .83

4715. **Clamp, Universal**, with swivel jaws adapting themselves to irregular shapes ..... .60

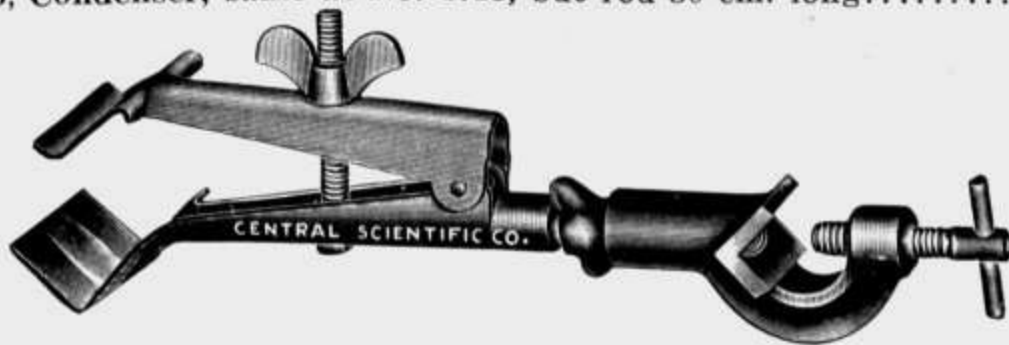
4716. **Clamp, Universal**, same as No. 4715, large size..... .85



No. 4718.

4718. **Clamp, Condenser**, of stamped steel, will firmly hold tubes from 1/4 inch up to 2 1/2 inches in diameter. Rod 10 mm. diameter and 15 cm. long ..... .33

4718A. **Clamp, Condenser**, same as No. 4718, but rod 30 cm. long..... .45



No. 4718B.

4718B. **Clamp Universal**, same clamp as No. 4718, provided with check nut to adjust to any position, and with clamp holder attached..... .75



No. 4720.

4720. **Clamp, new form.** Similar to No. 4711, but mounted on a rod 10 mm. in diameter and 15 cm. long..... .25



No. 4723.



No. 4725.

4723. **Clamp Holder, iron,** for fastening clamps to rod of support..... .18  
 4725. **Clamp Holder,** same as No. 4723, with universal swivel movement.... .45



No. 4727.

4727. **Clamp, Stoddard's Dish,** for holding evaporating dishes and other dishes up to 4½ inches in diameter. Made of brass, white plated... .11

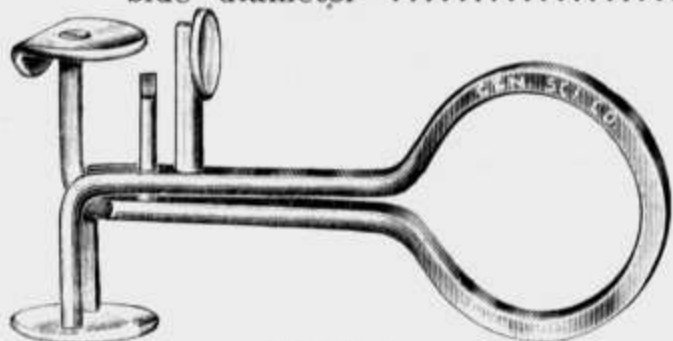


No. 4728.



No. 4728 (open).

4728. **Clamp, Screw Compressor,** new form, of brass, nickel plated; a combination of the old form and Hofmann's form; can be placed upon any tubing up to ⅝ inch inside diameter, without disconnecting apparatus ..... .20  
 4728A. **Clamp,** same as No. 4728, but for tubing up to ½ inch inside diameter ..... .21  
 4728B. **Clamp,** same as No. 4728, but for pressure tubing up to ½ inch inside diameter ..... .22



No. 4731.



No. 4732.

4731. **Clamp, Mohr's Pinch Cock,** with spring catch for holding clamp open until released. Length 56 millimeters..... .18  
 4731A. **Clamp, Mohr's,** same as No. 4731, but length 68 millimeters..... .22  
 4732. **Clamp, Mohr's,** of brass, nickel plated, for burettes, etc.; suitable for light and medium wall tubing up to ⅝ inch inside diameter. Length, 60 millimeters ..... .09  
 4733. **Clamp, Mohr's,** same as No. 4732. Length, 80 millimeters..... .10



No. 4737.



No. 4740.



No. 4741.

- 4737. Clamp, Cut-off, of brass, nickel plated; small, per dozen..... \$ 0.30
- 4738. Clamp, Cut-off, same as No. 4737; large, per dozen..... .50
- 4740. Clamp, Test Tube, of wood, improved form, with brass spring..... .08
- 4741. Clamp, Test Tube, Stoddard's, of spring brass wire..... .08

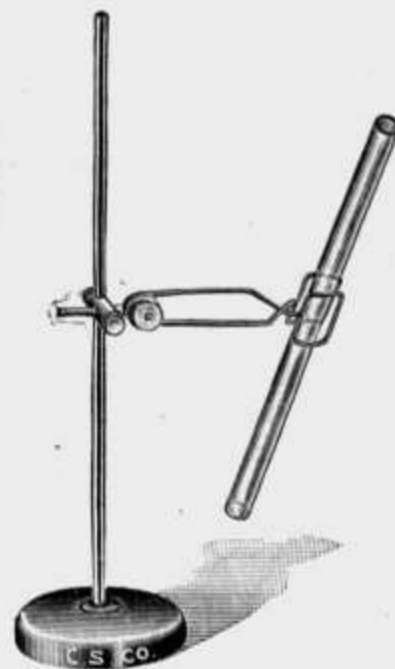


No. 4741A.

- 4741A. Clamp, Test Tube, Chaddock's, of japanned wire, shaped as shown in illustration . . . . . .22



No. 4742A. (Shown in connection with No. 4741.)



Nos. 4741-42-43.

- 4742. Clamp Holder, Stoddard's, an ingenious device for rigidly holding Stoddard Wire Test Tube Holder (No. 4741) in any position. Provides for vertical and horizontal adjustment to any angle, and will adapt itself to a great many uses in the laboratory. Clamp Holder with right angle clamp, but without Test Tube Holder No. 4741. .... .28
  - 4742A. Clamp Holder, same as No. 4742, but without right angle clamp..... .11
  - 4742B. Right Angle Clamp only of No. 4742..... .17
  - 4743. Base and Rod for use with No. 4742 as shown in illustration. Base is heavy and stable even with excessive load..... .35
- For Stoddard's Funnel Holders, see page 411.

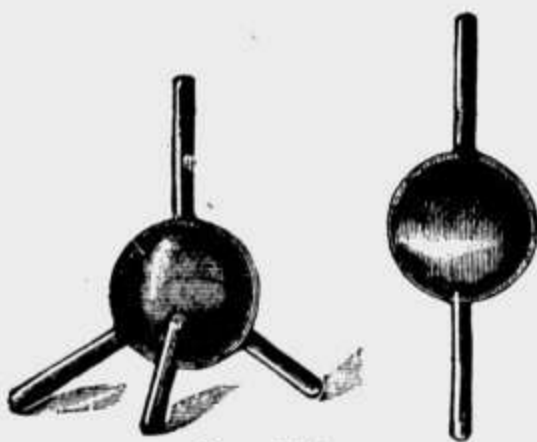


No. 4745.



No. 4746.

- 4745. Clamp, Watch Glass, of brass, for 2 to 2½ inch glasses..... .11
- 4746. Clamp, Watch Glass, of brass, for 2½ inch glasses..... .10



No. 4747.

4747. **Collection of Atom Models**, after Kekulé, improved by von Baeyer, for geometrical representation of chemical formulae, consisting of

- (a) 15 Connecting Rods, nickeled.
- (b) 20 Black Spheres, with 4 wires.
- (c) 10 Red Spheres, with 2 wires.
- (d) 30 White Spheres, with brass tubular attachments.
- (e) 10 Gold Spheres, with brass tubular attachments.
- (f) 10 Green Spheres, with brass tubular attachments.
- (g) 10 Violet Spheres, with brass tubular attachments.
- (h) 10 Silver Spheres, with brass tubular attachments.

The complete set.....Duty free \$ 12.00

4747A. **Collection of Molecular Models** (Configuration Models), after Wislicenus, for organic chemistry. Length of blocks, 5 cm. The collection illustrates the following 18 typical stereochemical formulae and propositions:

Methane, Ethane, Ethylene, Acetylene, Propane, Normal Butane, Isobutane, Physical Isomerism, Geometric Isomerism, Isomerism of the Sugars, Trimethylene, Tetramethylene, Pentamethylene, Hexamethylene, Heptamethylene, the Benzene Formula, "Cis" and "Trans" Isomerism, Condensed Benzene Nuclei.

The complete set.....Duty free 19.00

4748. **Collection of 14 Metals**, pure, in sticks, 8 cm. long x 4.5 cm. thick, including: Aluminum, Aluminum Bronze, Bismuth, Cadmium, Copper, Iron, Lead, Magnesium, Nickel, Selenium, Silver, Tellurium, Tin and Zinc. In case.....Duty free 21.00

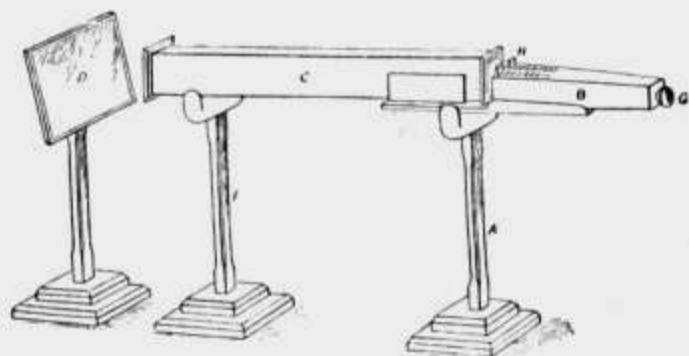
4748A. **Collection of 14 Metals**, after Arendt, 3 to 5 cm. broad x 12 to 15 cm. long, including: Alfenide, Brass, Cadmium, Copper, Copper burnished, Copper planished, German Silver, Iron, Lead, Nickel, Pinchbeck, Steel, Tin, Zinc. In case.....Duty free 5.40

4748B. **Collection of 17 Metal Alloys**, in sticks 80 mm. long x 10 mm. thick.

Difficultly Fusible.		Easily Fusible.
1. Soft Solder.	7. Pinchbeck.	14. Rose's Metal.
2. Hard Solder.	8. Bell Metal.	15. Wood's Metal.
3. Pewter.	9. Gun Metal.	16. Lipowitz' Metal.
4. Type Metal.	10. Satin Bronze.	17. Newton's Metal.
5. Shot.	11. Specular Metal.	
6. Brass.	12. Aluminum Bronze.	
13. German Silver.		

In case .....Duty free 7.00

4749. **Collection of 16 Fluorescent Liquids**. Each labeled. In suitable case. ....Duty free 8.00



No. 4750.

**COLOR COMPARATOR, "LOVIBOND'S TINTOMETER."**

An instrument to determine and record accurately all colors, giving a record which can be reproduced at any time. Invaluable in the analytical laboratory. These sets consist of a series of graded standard colored glasses numbered according to depth of color, and an optical instrument for holding the glasses and object to be tested. A great variety of outfits for special work can be obtained, so only the general laboratory sets will be listed.



No. 4753.

- 4750. **Investigator's Laboratory Set**, for all purposes, including the Monocular Optical Instrument, in plain box, with stands and reflector, 24 and 12 inch brass cells, 2, 1, 1/2, 1/4, 1/8, 1/16 inch silvered and 1, 1/2, 1/4, 1/8, 1/16 inch vulcanite cells, one capillary film holder, 6 blocks, 6 trays, presser for powder, standard white, shoe for opaque work, and filtering apparatus, without standard glasses. (See No. 4753C) ..... Duty free. Net \$ 123.00
- 4750A. **Educational Set**, for demonstrating the color composition of white light by the absorptive method. Consists of a supporting stand for holding the glasses while demonstrating, 18 standard glasses and diagrammatic illustrations as to use. This set may also be used for demonstrating the theory of color and color nomenclature.....Duty free. Net 27.00
- 4750B. **Color Vision Set**. Includes Color Vision Instrument, box, stand, screen and 72 standard glasses.....Duty free. Net 90.00
- 4750C. **Set for Estimating the Percentage of Ammonia in Nessler's Ammonia Test**. Includes the Improved Optical Instrument, glass cell, reflector and 30 standard glasses.....Duty free. Net 54.00
- 4750D. **Set for Estimating the Value of Flour**, including the Improved Optical Instrument, standard white, 6 trays, pressing apparatus and 90 standard glasses..... Duty Free. Net 95.00
- 4753. **Colorimeter**, as used in the laboratory of the Bureau of Soils, U. S. Department of Agriculture. After designs by Oswald Schreiner. All parts of the instrument which come in contact with the solutions are of glass. Broken parts can readily be replaced. For full description, see "Journal of the American Chemical Society, Vol. XXVII, Sept. 9, 1905," and "Bulletin No. 31, U. S. Department of Agriculture, Bureau of Soils." Complete with graduated and plain tubes.. 16.65
- 4753A. **Graduated Tubes** only of No. 4753, per pair..... 3.30
- 4753B. **Plain Tubes** only of No. 4753, per pair..... .90
- 4753C. **Standard Colored Glasses**, Lovibond's, for use with Tintometer or Colorimeter, each ..... 1.50

For Nessler's Tubes, see page 380.



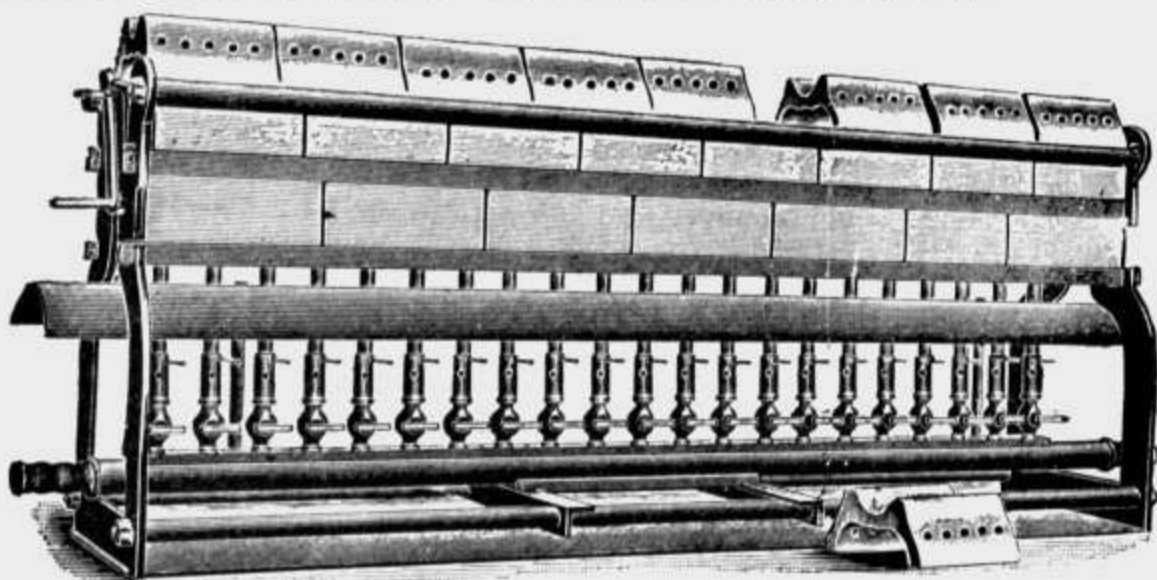


No. 4755.

4755. **Combustion Boat**, of porcelain.

Length, mm. ....	60	75	75	100
Width, mm. ....	10	11	15	18
Each .....	\$0.22	.22	.22	.27

4757. **Alundum Boats**, page 503. 4759. **Silica Boats**, page 502.



No. 4765.

4765. **Combustion Furnaces**, Glaser's, modified by Anschuetz and Kekule. Provided with mica plates for watching the flame during combustion. The row of burners is movable in a furrow, the burners are provided with spring stopcocks and nickel plated air regulators. Complete with top plates of clay.

Length, inches .....	15	23	30	36
Number of burners.....	10	16	21	26
Each .....	25.00	33.30	41.65	50.00

4766. **Combustion Furnaces**, same as No. 4765, but for gasoline gas.

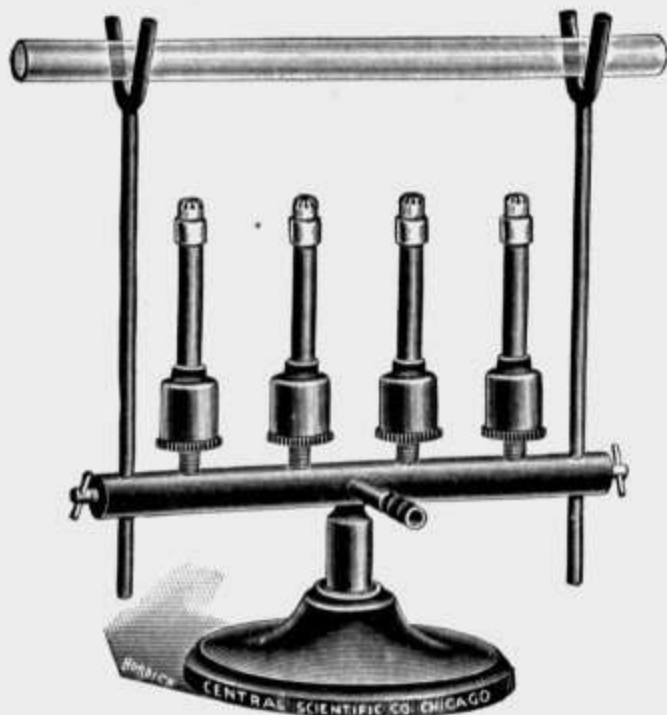
Number of burners.....	10	16	21
Each .....	32.00	41.65	51.70

4767. **Extra Top Clays** for above, each, .25; per dozen.... 3.00

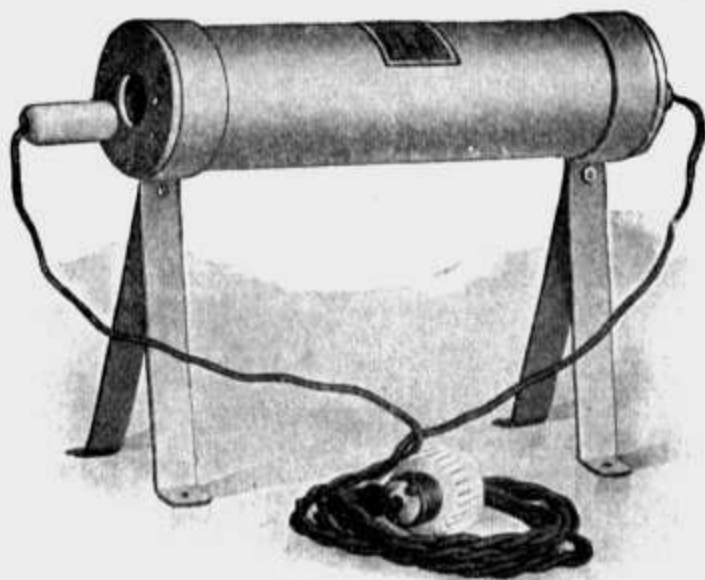
4767A. **Extra Side Clays** for above, each ..... .25

4767B. **Extra Gutters** for above, each ..... .15

4768. **Combustion Furnace, Simple Form.** Consists of four adjustable burners having regulators for both gas and air and burning either coal gas or gasoline gas, mounted on gas supply tube with adjustable forks for holding combustion tubes. An inexpensive combustion furnace suitable for all elementary work ..... 10.00



No. 4768.



No. 4770.



No. 4770A.

4770. **Combustion Furnace, Electric.** The tube is 1 inch inside diameter and 12 inches long; 10 inches of this length is uniformly heated to a constant temperature of 1,000 degrees C. Operates equally well on direct or alternating circuits and is made for 110 or 220 volts; other voltages made to order. Requires 6 amperes at 110 volts and 3 amperes at 220 volts. This makes an excellent furnace for rapid determinations and is very cheaply repaired. For determining carbon contents of steel it is unexcelled. In ordering state voltage of your circuit. Should be used with a rheostat.....Net \$ 25.00

4770A. **Rheostat**, for use with above to control the temperature of the furnace within the safe working limits.

Voltage .....	110	220
Resistance .....	15	60
Each .....	Net 8.00	8.00



No. 4771.

4771. **Combustion Tube (Reduction Tube)**, of Bohemian hard glass, with bulb on end. Length, 15 cm..... .18



No. 4771A.

4771A. **Combustion Tube (Reduction Tube)**, of Bohemian hard glass, with bulb in center. Length, 15 cm..... .20

4771B. **Combustion Tube**, of Bohemian hard glass, straight, open at both ends, well annealed.

Length, cm. ....	30	45
Inside diameter, mm.....	10	19
Each .....	.17	.50



No. 4772.

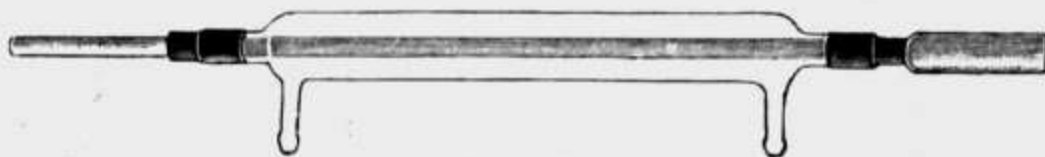
4772. **Combustion Tubes**, of German porcelain, glazed inside.

Length, cm. ....	30	45	60
Diameter, outside, mm.....	15	15	15
Each .....	.42	.80	1.40

4772A. **Combustion Tubes**, fused silica, melting point about 1,500 degrees C.; unaffected by sudden changes in temperature.

Length, cm. ....	60	60	60
Inside diameter, mm.....	15	18	21
Each, net .....	3.50	4.20	4.60

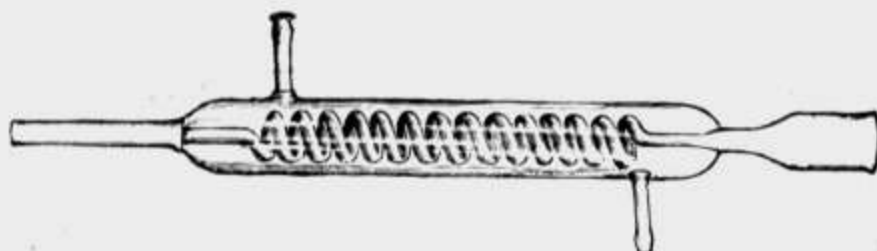
**Combustion Tubing**, see **Glass Tubing**, page 376.



No. 4773.

4773. Condensers, Liebig's, glass, with rubber connections.

Length, inches .....	15	20	24
Each .....	\$0.95	1.10	1.50



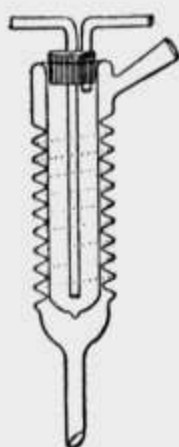
No. 4773A.

4773A. Condensers, of glass, with condensing tube in form of coil sealed in water jacket.

Length, inches .....	8	12
Each .....	1.65	2.00



No. 4773B.



No. 4773C.



No. 5285B.

4773B. Condenser, Reflux, Hopkins'. Jacket 30 cm. long. Excellent for quick condensation, as the cold water jacket is in the center of the condensation chamber ..... \$ 1.65

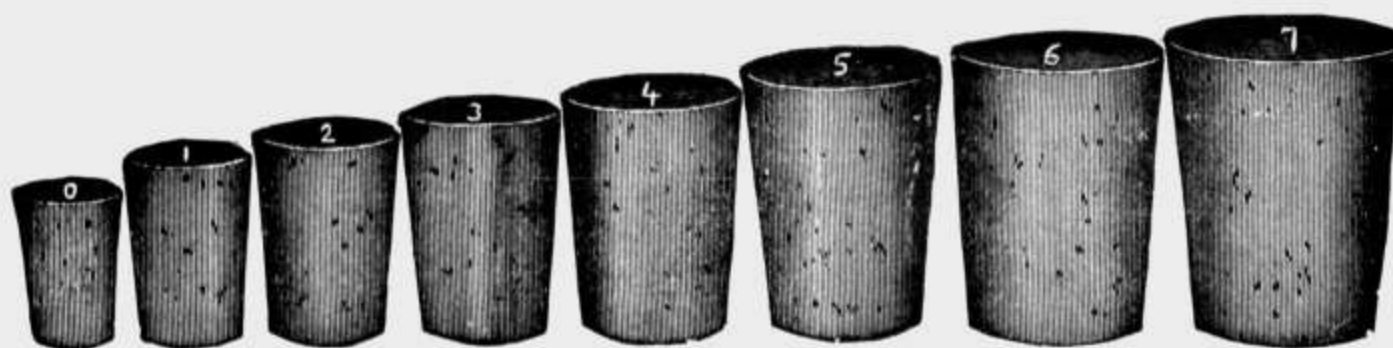
4773C. Condenser, Reflux and Screw Type. These condensers consist of a light blown glass screw, which fits closely into the outer jacket. This screw is about 10 cm. long and has 10 turns of about 4 cm. diameter forming a spiral about 120 cm. long, through which the vapor to be condensed is required to pass. The cold water is introduced into the center of the glass screw. This condenser has a large condensation surface and is as efficient as a worm condenser of three times the size. As there is sufficient space between the screw and jacket, the condensed liquid can run straight down, and "gushing," common to the spiral form, is avoided..... 1.90

5285B. Condenser, Zinc, with heavy block tin worm.

Size, for still of gallons....	½	1	2	3	5
Each .....	3.20	4.00	4.60	5.70	8.15

For Kjeldahl's Condensers, see Nitrogen Determination Apparatus, page 389.

For Soxhlet's Condenser, see Extraction Apparatus, page 361.



No. 4775.

4775. Corks, Regular Length, XX quality. Diameters given are for the large end.

No. ....	0	1	2	3	4	5	6	7	8	9	10
Diam. in.	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
Per dozen	.03	.03	.03	.03	.03	.04	.05	.06	.07	.08	.09
Per gross	.15	.17	.17	.21	.23	.30	.33	.45	.55	.65	.80
No. ....	11	12	13	14	15	16	18	20	22	24	26
Diam. in.	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{3}{16}$	$1\frac{1}{4}$	$1\frac{5}{16}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2
Per dozen	.10	.11	.12	.14	.16	.18	.22	.30	.35	.45	.55
Per gross	.90	1.00	1.05	1.20	1.35	1.65	1.95	2.20	2.90	3.50	4.00

4776. Corks, same as No. 4775. No. 0 to No. 11, assorted, in gross packages only ..... \$ 0.50

4777. Corks, Regular Length, XXX quality. Diameters same as No. 4775.

No. ....	0	1	2	3	4	5	6	7	8	9	10
Per dozen	.05	.05	.05	.05	.06	.07	.07	.08	.09	.10	.12
Per gross	.22	.28	.30	.33	.37	.50	.55	.70	.80	1.00	1.25
No. ....	11	12	13	14	15	16	18	20	22	24	26
Per dozen	.15	.16	.17	.18	.22	.25	.30	.40	.50	.60	.75
Per gross	1.33	1.40	1.55	1.65	1.95	2.45	2.90	3.75	4.80	5.70	6.80

4778. Corks, Flat (Specie Corks), XX quality. Diameters given are for large end.

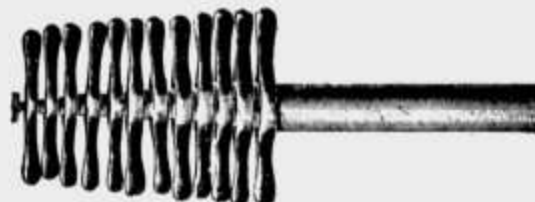
Diam. in..	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{2}$	4
Length, in.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{3}{4}$
Per dozen.	.08	.11	.15	.20	.25	.33	.44	.60	.70	1.00	1.40

Corks, Rubber, see Rubber Stoppers, page 402.



No. 4781.

- 4779. Cork Borer, smallest size ( $\frac{3}{16}$  inch), with punch..... .22
- 4780. Cork Borers, brass, with punch, set, 1-3..... .55
- 4781. Cork Borers, brass, with punch, set 1-6..... .90
- 4782. Cork Borers, brass, with punch, set 1-9..... 1.50
- 4783. Cork Borers, brass, with punch, set 1-12..... 2.05
- 4784. Cork Borers, brass, with punch, set 1-15..... 3.35



No. 4786.

- 4785. Cork Borers, of best English steel, each borer supplied with a handle, set 1-3 ..... 1.10
- 4786. Cork Borers, same as No. 4785, set 1-6..... 2.25

4787. **Cork Boring Machine.** Can be screwed firmly to a table. With this machine it is possible to drill rapidly both rubber and wood corks. Complete with 8 interchangeable steel drills of from 4 to 15 mm. diameter..... Net \$ 8.00



4788. **Cork Borer Sharpener.** Steel cone with knife..... 1.00



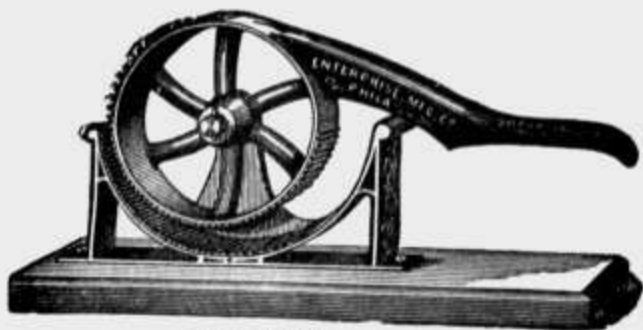
251. **Cork Knife,** good steel blade 4 inches long. Round wood handle. The most useful form for the laboratory..... .20

4789. **Cork Mats, "Suberite,"** of compressed cork, for supporting beakers, etc. Diameter, 12 cm.; thickness, 1 cm. Each..... .25

4789A. **Cork Rings, "Suberite,"** of compressed cork, for supporting flasks, etc. These rings are highly recommended as a substitute for straw rings.

Inside diameter, cm.....	3	6	9	12
Each .....	.22	.33	.40	.50

8016. **Cork Sheet,** for lining insect boxes and cabinets. 10 x 30 cm., 5 mm. thick; X quality, per dozen sheets..... 1.50



No. 4790.



No. 4791.



No. 4793.

4790. **Cork Press,** wheel form ..... .62  
 4791. **Cork Press,** flat form, cast iron..... .22  
 4793. **Corkscrew,** wood handle..... .10  
 4795. **Corkscrews,** twisted wire, per dozen..... .11



No. 4800.



No. 4807.



No. 4809.



Nos. 4810-4813.

4800. Crucibles, Hessian, Sand, round form. Dimensions are outside measurements.

No	A	B	C	D	E
Height, mm. . . . .	66	76	89	101	114
Diameter, mm. . . . .	41	47	57	60	73
Each . . . . .	\$0.03	.04	.05	.06	.07
Per dozen . . . . .	.25	.33	.45	.50	.66

4807. Crucibles, Royal Berlin Porcelain, glazed inside and outside, with cover.

No.	000	00	0	1	2	3	4	5
Capacity, c.c. . . . .	5	10	15	30	57	95	155	280
Diameter, mm. . . . .	26	30	35	41	52	62	72	87
Height, mm. . . . .	19	25	27	35	43	50	59	72
Each . . . . .	.20	.23	.31	.38	.54	.57	.66	.89

4809. Crucibles, Wrought Iron, light, with cover.

Capacity, c.c. . . . .	20	50	100	200
Diameter, mm. . . . .	38	53	63	79
Height, mm. . . . .	32	38	51	60
Each . . . . .	.25	.30	.33	.40

4810. Crucibles, Nickel, spun from pure sheet nickel, with cover.

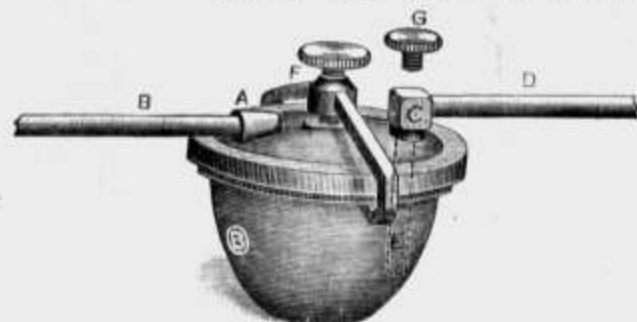
Capacity, c.c. . . . .	20	50	100	250
Diameter, mm. . . . .	38	44	60	82
Height, mm. . . . .	35	51	63	82
Each . . . . .	.66	.83	1.40	2.25

4811. Crucibles, Copper, with cover.

Capacity, c.c. . . . .	20	50	100	250
Diameter, mm. . . . .	38	44	60	82
Height, mm. . . . .	35	51	63	82
Each . . . . .	.55	.63	.90	1.65

4813. Crucible, Silver, spun from pure sheet silver, with cover.

Capacity, c.c. . . . .	20	30	50	75	100
Diameter, mm. . . . .	38	41	44	51	60
Height, mm. . . . .	35	44	51	57	63
Each, Net . . . . .	3.15	4.00	5.25	7.00	9.00



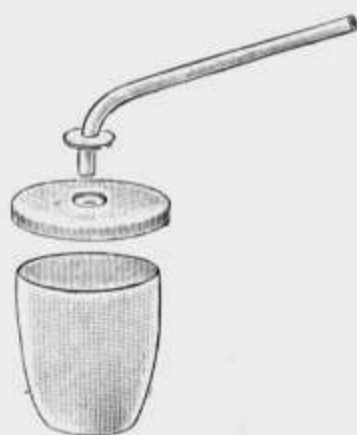
No. 4815.

an open crucible, a closed crucible, or a retort; and, being of thin metal, is easily brought to a red heat in the flame of an ordinary burner. All parts interchangeable. Capacity, about 1½ ounces. . . . \$ 1.00

4815A. Crucible, Normal School, same as No. 4815 but of 6 oz. capacity. . . . \$ 1.50

4815. Crucible, Normal School, devised by Prof. S. T. Skidmore, of the Philadelphia Normal School. This is a spun iron crucible for the individual use of the laboratory student, or for general experimenting. It may be used equally well as

4810A. Kawin's Crucible and 4810B. Pennock & Martin's Crucible, page 502.



No. 4817.



No. 4819.



No. 4820.

4817. **Crucibles, Rose's**, unglazed porcelain, with perforated cover and tube.

Capacity, c.c. ....	15	30
Each .....	\$0.45	.65

4819. **Crucibles, Gooch's**, Royal Berlin Porcelain, glazed inside and outside, with perforated bottom.

No. ....	2	3	4
Capacity, c.c. ....	10	25	35
Diameter, mm. ....	27	35	40
Height, mm. ....	30	40	43
Each .....	.35	.50	.55

4820. **Crucibles, Fused Silica**, 99.8% SiO<sub>2</sub>. May be subjected continuously to temperatures up to 1200°C., and for short periods to much higher temperatures. Not affected by rapid changes of temperature, nor by acids, except hydrofluoric, and, above 400°C., phosphoric.

No. ....	00	0	1	2	3
Diameter, mm. ....	40	41	47	57	67
Height, mm. ....	20	25	28	37	45
Each, net .....	.60	.60	.75	.90	1.25

4821. **Crucible Covers, Fused Silica**.

No. ....	1	2	3	4
Diameter, mm. ....	45	51	60	70
Each, net .....	.50	.60	.75	.90

**Alundum Crucibles**, page 503.



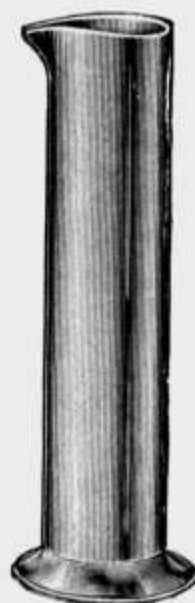
No. 4823.

4823. **Crucibles, Black Lead**, Dixon's genuine.

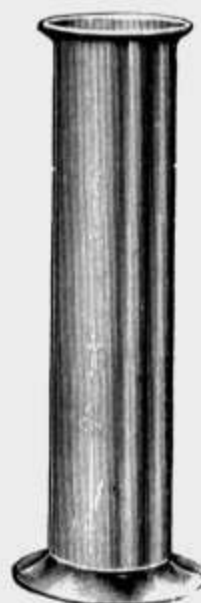
No. ....	00	0000	1	2	3	4
Capacity, oz. 2	3	4 1/4	6 1/2	11	16	
Height, in. ... 2 3/8	3	3 5/8	4 1/2	5 1/4	5 5/8	
Diam., in. .... 1 7/8	2 3/8	3 1/8	3 3/4	4 1/4	4 5/8	
Each, net ..	.20	.25	.30	.35	.40	.45

**Crucibles, Platinum**, see page 394.

**Crucible Tongs**, see page 419.



No. 1125.



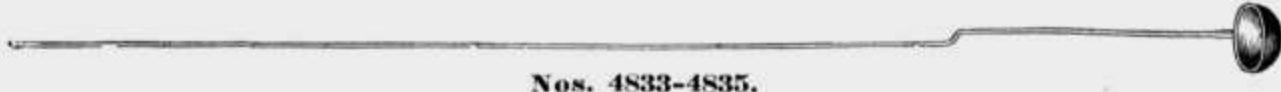
No. 1127.

1125. **Cylinders, with lip**, best German glass.

Height, inches .....	10	12	15	15	18
Diameter, inches .....	1 1/2	2	2	3	3
Each .....	.30	.40	.50	.83	1.10

1127. **Cylinders, with flange**, same sizes and prices as No. 1125.

**Cylinders, Graduated**, see page 377.



Nos. 4833-4835.

4831. **Deflagration Globe**, for combustions in oxygen. Diameter of globe, 12 inches; diameter of opening, 2 inches. Globe only ..... \$ 2.25  
 4831A. **Support and Cup** for above..... .60  
 4833. **Deflagration Spoon**, of iron,  $\frac{3}{4}$  inch cup..... .08  
 4835. **Deflagration Spoon**, of brass,  $\frac{3}{4}$  inch cup..... .11  
 4836. **Dessicator, or Acid Dish**, of porcelain.



Nos. 4831-4831A.

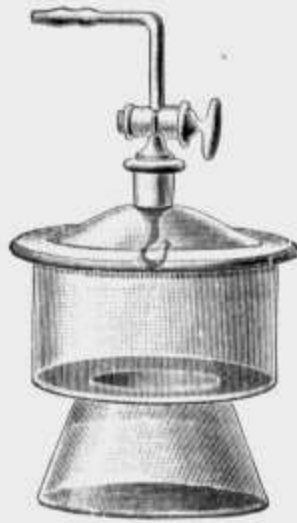
Diameter, cm.....	12	14.5
Each .....	.90	1.15



No. 4836.



No. 4837.



No. 4839.



No. 4840.

4837. **Dessicator, Scheibler's**, of Bohemian glass, cover ground air tight.  
 Diameter, inside, inches.....  $3\frac{1}{2}$       5      6  
 Each ..... .60      1.00      1.20  
 4839. **Dessicator, Scheibler's**, vacuum, with stop-cock and hook, inside diameter,  $5\frac{1}{2}$  inches ..... 3.10  
 4840. **Dessicator, Atwater's**. Inside diameter,  $4\frac{1}{2}$  inches; with triangle.... 1.65



No. 4841.



No. 4842.

4841. **Dessicator**. Consisting of a bell jar ground air tight upon a heavy glass plate, with porcelain acid dish.  
 Diameter of acid dish, cm..... 12      14.5  
 Diameter of bell jar, cm..... 15      20  
 Glass plate, square, cm..... 20      25  
 Each ... 2.50      3.00  
 4842. **Dessicator Plates**, of porcelain, with three small feet and with 3 or 4 holes, according to size of plate.  
 Diameter, inches .....  $3\frac{1}{8}$        $4\frac{3}{4}$        $5\frac{1}{2}$   
 Each ..... .67      .84      1.10





No. 4843.



No. 4843A.

4843. **Dialyzer, Bell Glass Form**, with parchment and jar complete.  
 Diameter of bell glass, cm..... 11 15  
 Each ..... \$1.25 1.65
- 4843A. **Dialyzer, Graham's**. A glass cylinder with inside cylinder fitted with parchment paper.  
 Diameter of cylinder, cm..... 11 15  
 Each ..... 1.35 1.90

For Parchment Paper, see No. 1391.



No. 238.

238. **Diamond**, for cutting or writing on glass. Finished in best manner possible and nickel plated. Diamond is guaranteed to re-set several times and to give entire satisfaction. Cuts "single thick".....Net \$ 5.40
4979. **Diamond Ink**, for writing on glass, in one oz. ceresine bottles... Net .30
4844. **Diffusion Shell, S. & S. No. 579**. Used for dialyzing, taking the place of parchment paper, and requiring only a small outside vessel.  
 Size, mm. .... 100 x 16 100 x 35-40  
 Each ..... Net .20 .40  
 Per box of 25..... Net 3.15 7.35



No. 4845.



No. 4846.



No. 4846A.

4836. **Dish, Acid**, of porcelain, see preceding page.
4845. **Dishes, Crystallizing**, of light glass, with flat bottom and straight sides.  
 Diameter, inches 2 3 4 5 6 8 10  
 Each ..... .10 .15 .22 .30 .40 .67 1.00
4846. **Dishes, Evaporating**, of steel, with acid proof enamel inside and outside, with handles.  
 Approximate capacity, c.c..... 250 500 1000 2000 4000  
 Each ..... .45 .50 .63 1.00 1.45
- 4846A. **Dishes, Graniteware**.  
 Diameter, cm. .... 15 18 22  
 Capacity, liters ..... 1/2 1 2  
 Each ..... .17 .20 .22



Nos. 4847-4849.



No. 4851.

4847.	Dishes, Evaporating, of German porcelain, glazed inside.											
	No. ....	9	8	7	6	5	4	3	2	1		
	Diameter, inches .....	2½	3	3½	4	4½	5	5½	6	6¼		
	Capacity, ounces .....	1	2	2½	3½	6	7½	10	13	16		
	Each .....	\$ 0.11	.13	.17	.19	.22	.27	.30	.40	.50		
4848.	Dishes, Evaporating, of German porcelain, same as No. 4847, but larger, with heavy rim.											
	No. ....	6	5	4	3	2	1	0				
	Diameter, inches .....	7¾	8¼	9½	10½	11¼	12½	14½				
	Capacity, ounces .....	28	38	50	75	92	120	200				
	Each .....	.60	.67	.75	1.25	1.40	1.65	2.65				
4849.	Dishes, Evaporating, of Royal Berlin porcelain, glazed inside and outside.											
	No. ....	00	0	1	2	3	4	5	6	7	8	9
	Diameter, in. ....	2¾	3	3¼	3½	4	4¼	4¾	6	7	8¾	10¼
	Capacity, oz. ....	2	3	3½	4½	6½	8	10	16	28	48	70
	Each .....	.22	.25	.33	.38	.43	.48	.65	.76	1.05	1.25	1.80
4850.	Dishes, Evaporating, of Fused Silica, with lip. Unaffected by sudden or extreme changes of temperature. See further description under No. 4820.											
	No. ....	1	3	5	7	9						
	Diameter, mm. ....	51	70	83	89	98						
	Depth, mm. ....	21	25	30	22	30						
	Each, Net .....	1.00	1.15	1.25	1.35	1.60						
4851.	Dishes, Lead. Diameter, inches .....											
	Each .....				2	3	4					
	Each .....				.10	.15	.20					



No. 4853.



No. 4853A.

4852.	Dishes, of Jena Glass. "Evaporating Basins," flat bottom, with lip; may be used instead of porcelain evaporating dishes.				
	Diameter, mm. ....	60	80	100	125
	Each .....	.21	.28	.40	.62
4853.	Dishes, Milk, of aluminum, flat bottom, straight sides.				
	Diameter, inches .....	2	3	4	
	Height, inches .....	½	¾	1	
	Each .....	.21	.33	.50	
4853A.	Dishes, Nickel, pure, with lip.				
	Diameter, mm. ....	50	78	88	
	Capacity, c.c. ....	40	100	200	
	Each .....	.55	.88	1.25	

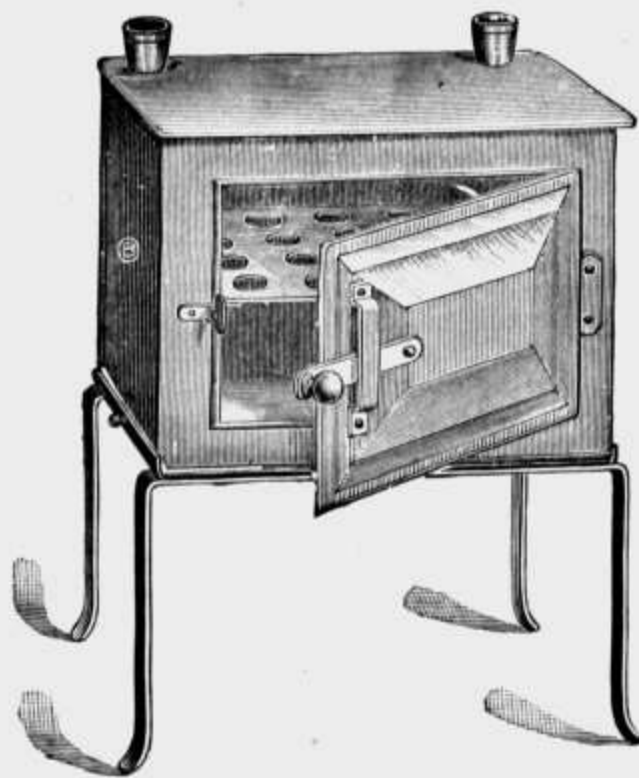
Dishes, Iron, see Sand Baths, page 404.

Dishes, Platinum, page 394.

Distillation Apparatus, see Stills, page 407.



No. 4854.



Nos. 4858-4860B.

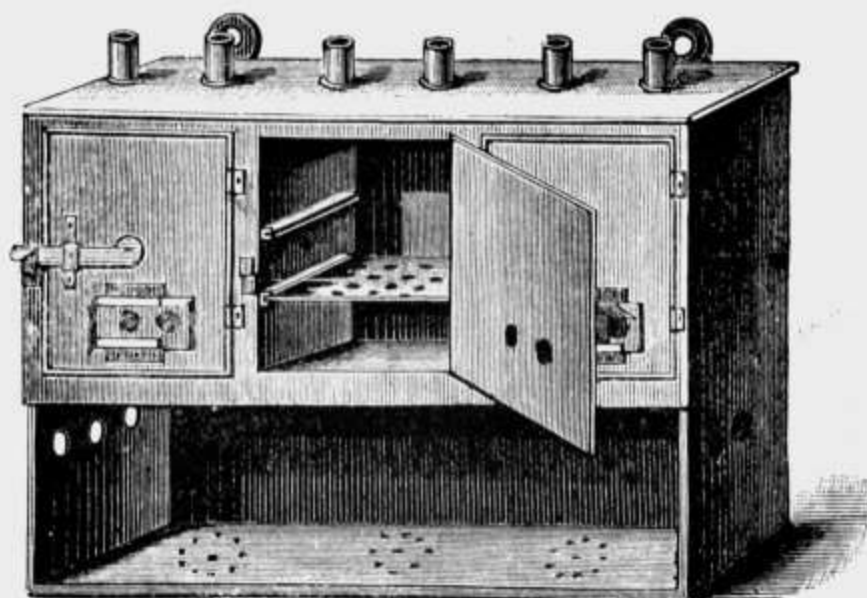
4854. **Dissolving Tube**, after Freas, of the Kent Chemical Laboratory, designed for dissolving solids which are difficultly soluble without the aid of heat or mechanical agitation and filtering the solution at the same time. The crystals are placed in A upon a plug of asbestos or cotton. Suction is applied at B, which is then closed, and a circulation starts upward through D and E down through C and F on account of the different densities of the liquids. This will continue until the entire solution is of the same density. WITHOUT BOTTLE ..... \$ 4.50

### DRYING OVENS.

Drying Ovens Nos. 4855-4860B are of heavy planished copper with tubulations for thermometer and gas regulator, and are mounted on separate iron support provided with false bottom of sheet iron to protect the copper.

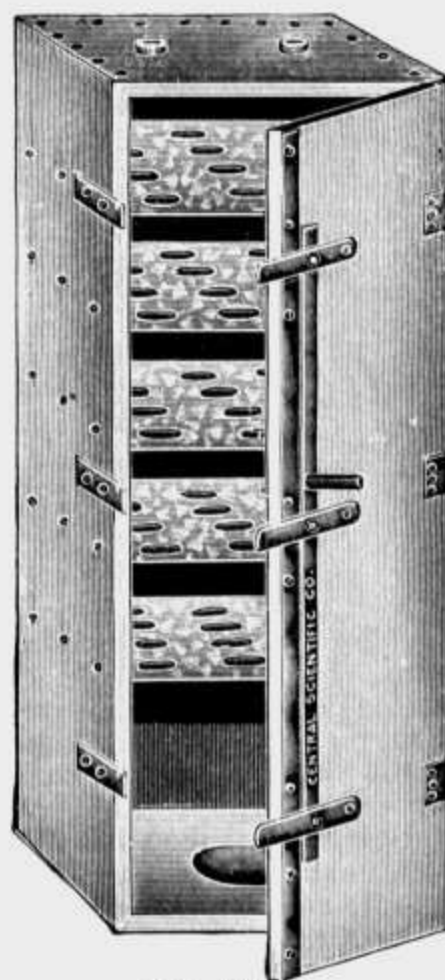
	Wall.	Height outside, inches.	Width outside, inches.	Depth outside, inches.	Price
4855. <b>Drying Oven</b> .....	Single	6	8	6	\$ 5.00
4856. <b>Drying Oven</b> .....	Single	8	10	8	6.75
4857. <b>Drying Oven</b> .....	Single	10	12	10	8.50
4857A. <b>Drying Oven</b> .....	Single	18	24	18	30.00
4857B. <b>Drying Oven</b> .....	Single	18	36	18	52.00
4858. <b>Drying Oven</b> .....	Double	6	8	6	7.00
4859. <b>Drying Oven</b> .....	Double	8	10	8	9.50
4860. <b>Drying Oven</b> .....	Double	10	12	10	12.50
4860A. <b>Drying Oven</b> .....	Double	18	24	18	50.00
4860B. <b>Drying Oven</b> .....	Double	18	36	18	75.00

For Thermo-Regulators, see page 413.



No. 4860C.

**4860C. Drying Oven.** Single wall, three compartments. Of heavy polished copper; 21 inches long, 8 $\frac{3}{4}$  inches high, 7 inches deep, with three chambers, each 7 inches deep and 7 inches wide; separate doors, ventilators, and two tubulatures for each. Provided with sheet iron back and support, arranged for table or wall.....

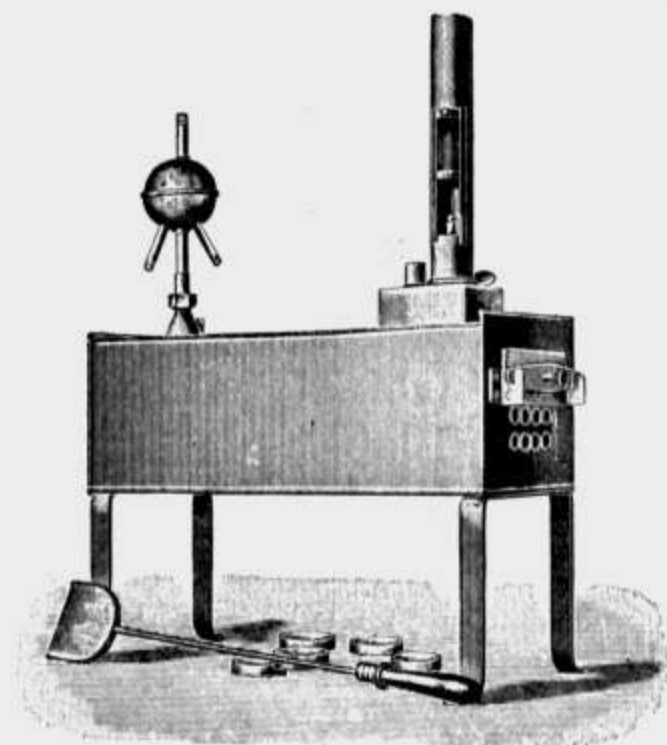


No. 4860D.

**4860D. Drying Oven, Asbestos,** of the type used in the U. S. Bureau of Soils. This oven is very substantially made of heavy asbestos board, and measures 13 inches deep, 18 inches wide, and 48 inches high. Openings are provided at the top for thermometer and gas regulator and near the bottom for gas inlet tube. Very satisfactory for drying large quantities of soil samples. Complete with 5 removable shelves of sheet iron.....

\$ 22.00

50.00



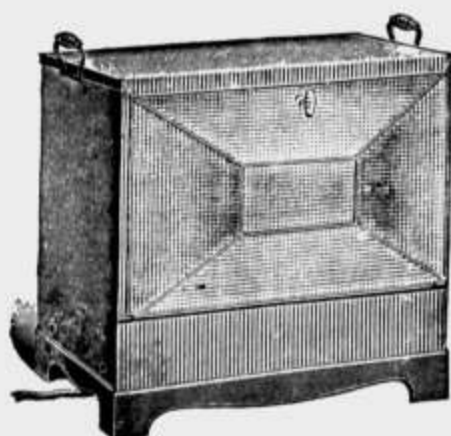
No. 4860E.

**4860E. Drying Oven, Soxhlet's,** of copper, with Soxhlet copper bulb condenser, for the rapid determination of moisture. A determination of solids in milk can be made in about 18 minutes. Drying chamber 470 mm. long by 95 mm. wide by 30 mm. high. The water space between the double walls is to be filled with salt solution. Furnished complete with 5 nickel dishes, one cover, shovel for dishes and thermometer..Duty free

44.50



No. 4861.



No. 4861A.



No. 4861B-C.

### DRYING OVENS, ELECTRIC.

The Electric Oven is the only device for laboratory work that gives the same measured amount of heat every time, distributes that heat evenly and is absolutely free from drafts. The double walls are packed with asbestos to conserve the heat, and when the door is closed it becomes an air-tight box. Within, at the top and the bottom of the oven, are the two heating plates. As soon as the current is turned on, these at once become hot throughout their whole area and give a steady, measured heat to every part of the oven, a heat that comes from above as well as below; a heat that is the same every time with the same position of the switch, and the effect can be measured by the clock.

4861. <b>Drying Oven, Electric.</b> Inside dimensions, 12" wide, 12" deep, 14" high. Weighs 30 lbs. Three heats. Four feet cord and plug switch. 1100 watts .....	Net	20.00
4861A. <b>Drying Oven, Electric.</b> Inside dimensions, 19" wide, 12" deep, 13" high. Weighs 60 lbs. Three heats. Four feet cord and plug switch. 1600 watts .....	Net	25.00
4861B. <b>Drying Oven, Electric.</b> Inside dimensions, 15" wide, 18" deep, 11½" high. Weighs 75 lbs. Three heats. Four feet cord and indicating snap switch on front. 1600 watts.....	Net	40.00
4861C. <b>Drying Oven, Electric.</b> Inside dimensions, 15" wide, 18" deep, 11½" high. Weighs 76 lbs. Same style as No. 4861B, with thermometer. Three heats. Four feet cord and indicating snap switch on front. 1600 watts .....	Net	45.00

In ordering above Ovens, please state voltage.

Drying Tubes, see Calcium Chloride Tubes, page 337.

Electrolysis Apparatus, see page 187.

Electrolytic Supports, see page 412.

4862 and 4863. Electric Ovens, page 505.



No. 4872.



No. 4873.

4871. <b>Eudiometers, Bunsen's, with platinum electrodes; graduated in 1/5 c.c.</b>		
Capacity, c.c. ....	50	100
Each .....	1.85	2.50
4872. <b>Eudiometers, Bunsen's, with platinum electrodes; graduated in mm.</b>		
Length of graduation, mm.....	300	500
Each .....	2.05	2.50
4873. <b>Eudiometer, Ure's, U form, with platinum electrodes, 50 c.c.; graduated in 1/5ths.....</b>		2.25



No. 4874.

4874. <b>Eudiometer, Mitscherlich's, with stop-cock, 50 c.c., in 1/5ths.....</b>	3.35
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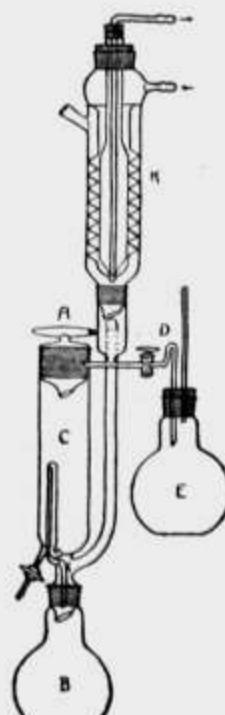
**EXTRACTION APPARATUS.**



No. 4875.



No. 4876.



No. 4876A.

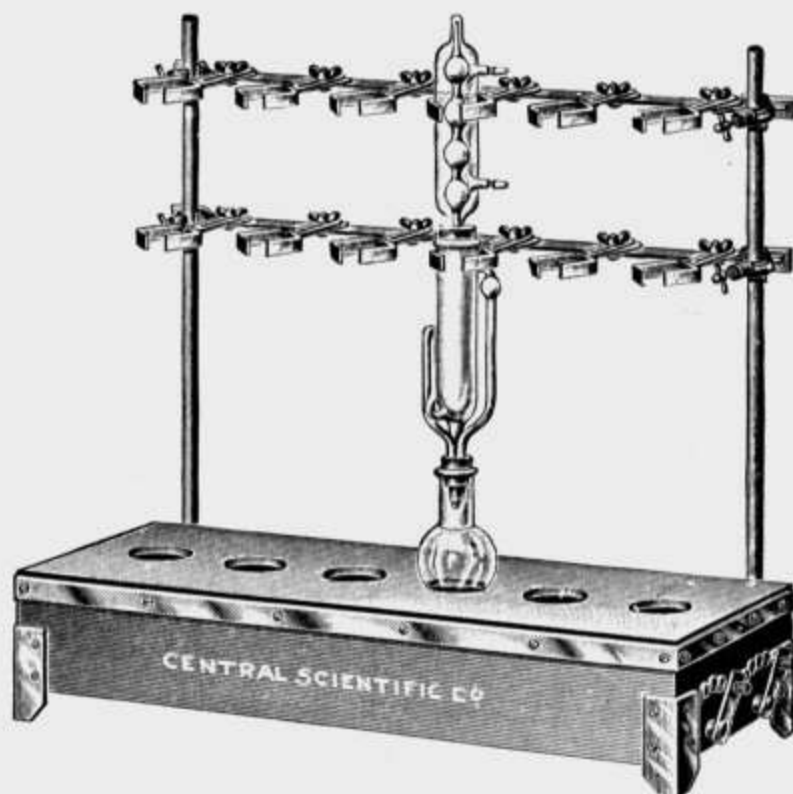


No. 4876B.

4875. **Extraction Apparatus.** Soxhlet's, complete, consisting of flask, extractor, and Allihn's condenser; adapted for extraction of fat in milk analysis.
- |   |        |       |        |
|---|--------|-------|--------|
| Capacity to top of siphon, c.c.....         | 60     | 100   | 200    |
| S. & S. extraction shells to be used, mm... | 22x80  | 33x80 | 43x123 |
| Complete as above without shells.....       | \$2.75 | 3.00  | 3.75   |
- 4875A. **Extraction Tubes, only of No. 4875.**
- |                        |      |      |      |
|------------------------|------|------|------|
| Capacity, c.c. . . . . | 60   | 100  | 200  |
| Each . . . . .         | 1.10 | 1.35 | 2.10 |
4876. **Extraction Apparatus,** Soxhlet's with Hopkin's inner cooled condenser, with ground-in joint, extraction tube, and Knorr's mercury sealed flask, making an ideal combination, as the condensation is more rapid and no moisture gathers on outside.
- |                                     |      |      |
|-------------------------------------|------|------|
| Capacity to top of siphon, c.c..... | 60   | 100  |
| Each . . . . .                      | 4.00 | 5.00 |
- 4876A. **Extraction Apparatus,** Friedrichs'. (Journal of the American Chemical Society, Volume XXXIV, No. 11, 1912.) This new form has the following advantages:
1. The condenser may be rigidly connected with the water supply.
  2. The extraction and also the recovery of the solvent by distillation may be accomplished in the same apparatus.
  3. The manipulation of the apparatus is convenient and rapid.
  4. Danger of breakage is reduced as the apparatus may be fixed securely and only the perforated stopper and flask need be removed.
  5. The reflux screw condenser insures efficient condensation with minimum amount of water.
- Complete with five flasks of resistance glass..... \$ 12.50
- 4876B. **Extraction Apparatus,** Underwriters' Laboratories Pattern. See Journal of Industry and Engineering, Chemical Volume IV, No. 7, June, 1912. A rapid and simple form; the apparatus consists of a reflux condenser made of a spiral metal tube, from which is suspended a porcelain Gooch crucible. This system is placed in a wide, long necked, conical flask as illustrated. As the entire apparatus is only 6 inches high and 3 inches wide, it takes a minimum amount of space. This form conforms to the Underwriters' Standard Specifications for testing rubber compounds..... 2.25
4878. **Extraction Apparatus.** Soxhlet's Condenser, globe-shaped, copper, nickel plated, tinned inside, 4-in. diameter..... 2.70
4908. **Flasks, Extraction, Knorr's, for mercury seal.**
- |                        |        |     |
|------------------------|--------|-----|
| Capacity, c.c. . . . . | 60     | 100 |
| Each . . . . .         | \$0.30 | .35 |

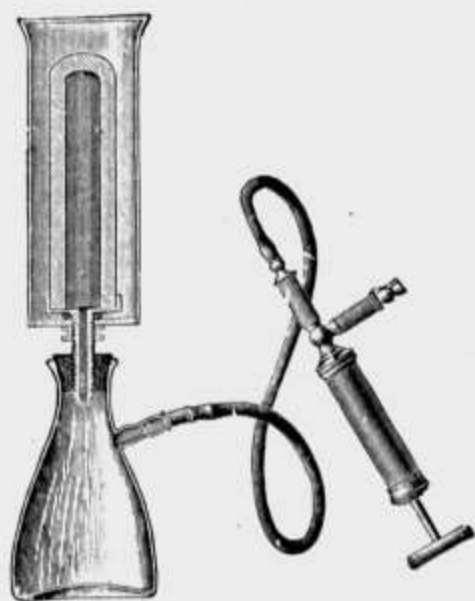


No. 4877.

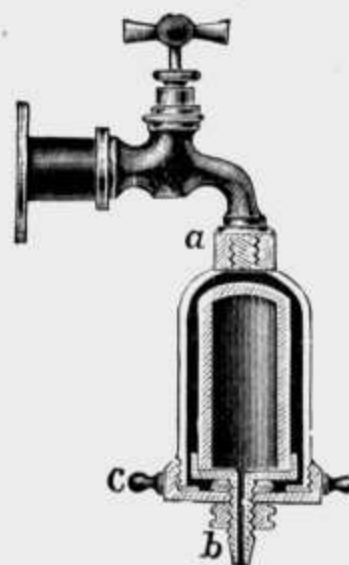


No. 5095A.

4877. **Extraction Apparatus**, Knorr's, as modified by Walter & Goodrich (Circ. No. 69, Bur. of Chem., U. S. Dept. of Agr.). Complete with condenser and adapter, extraction tube with perforated nickel lower disk, and flask for mercury seal, but without spring or upper perforated disk..... \$ 4.35
- 4877A **Condenser** of No. 4877, with adapter sealed on..... 3.00
- 4877B. **Extraction Tube** of No. 4877, without perforated disk..... .45
- 4877C. **Spring** for No. 4877..... .25
- 4877D. **Disk, upper**, for No. 4877, of nickel..... .25
- 4877E. **Disk, upper**, for No. 4877, of platinum..... Market price
- 4877F. **Disk, lower**, for No. 4877, of nickel..... .30
- 4877G. **Disk, lower**, for No. 4877, of platinum..... Market price
- 4877H. **Flasks, only**, for No. 4877, with holes in neck for return flow of ether..... .60
- 4877P. **Extraction Apparatus**, Knorr's, original form. Complete with No. 4908 Flask, 100 c.c., No. 4877A Condenser, and No. 4877R Extraction Tube ..... 5.75
- 4877R. **Extraction Tube**, Knorr's original form with perforated platinum disc sealed in ..... 2.50
4879. **Extraction Shells**, of Fat Free Paper, for extraction apparatus, Schleicher & Schuell's, seamless so that it is impossible for any of the substance to find its way into the solution. These shells can be used repeatedly. Diam. mm..... 22 33 43  
 Length, mm. .... 80 80 123  
 Each . . . . .Net .09 .10 .20  
 Per box of 25.....Net 1.65 1.85 3.70
- 4879B. **Extraction Shells** of Glass, easily cleaned, may be used repeatedly, and exact weight determined. Length, 80 mm.  
 Diameter, mm. .... 22 33  
 Each ..... .30 .42
- For Alundum Extraction Shells, see page 504.
- 5095A. **Cenco Electric Heater**, W. H. Ross' design, consists of a box 80x20x12 cm. of asbestos board, containing a series of resistance coils over which is supported a sheet iron pan. The top of the box is removable and has openings for flasks which rest upon the bottom of the iron pan. By this method the flasks rest upon a hot plate and are surrounded by hot air, thus requiring a minimum current. By means of a simple switch arrangement, currents from 1 to 4 ampères at 110 volts, in 9 steps, may be obtained, giving a wide range of temperature for solvents at various boiling points. This may be used as an ordinary hot plate by removing the top, or as a liquid bath by using water in the iron box. The supports are adjustable in height with clamps for each extractor and condenser.....Net 40.00
- 5095B. **Electric Heater**, for extraction. Similar in general construction to No. 5095A but provided with six 110 volt electric lamps instead of the system of heating coils, and without the iron tray.....Net 30.00



Nos. 4880H-J.



No. 4880K (H5).

4880H. **Berkefeld Laboratory Filters** for sterilizing all liquids and completely filtering beef tea, infusions, etc., containing bacteria. They will yield a clear blood serum, free from microbes, and from milk a perfectly clear and colorless milk serum, free from fat. It is probably safe to say that in every laboratory in the world where Toxin is filtered, the Berkefeld Laboratory Filters are used.

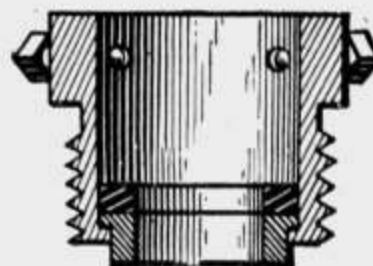
The prices listed below are for cylinders and glass mantles only, as the flasks used are the ordinary filter flasks found in every laboratory. For Exhaust Pump see No. 4880J, below.

Order No. ....	1	2	3
Size of Cylinder, in.....	10x2	8x1	2½x 5/8
Size of Glass Mantle, in.....	14x4	11x2½	4x1
Each .....	Net \$5.25	4.25	2.00

4880J. **Exhaust Pump** for use with Berkefeld Laboratory Filters.....Net \$ 5.00

4880K. **Berkefeld House Filters**, nickel plated, and designed to be attached to any 3/4 inch hose bibb faucet. A clear filtrate free from germs and solid particles is produced. The filtering cylinder is made from infusorial earth and may be easily cleaned by a sponge or soft brush. All parts are removable to admit of frequent sterilizing. Capacity stated below is at 40 lbs. pressure.

Order No. ....	H5	H2	H4
Length, mm. ....	138	163	288
Diameter, mm. ....	63	68	68
Minutes per gal.....	6	4	2
Each .....	Net \$3.00	4.00	10.00



No. 4880P.

4880L. **Cylinder** only for No. H5.....Net \$ 1.00

4880M. **Cylinder** only for No. H2.....Net 1.50

4880N. **Cylinder** only for No. H4.....Net 2.50

4880P. **Hose End** for use in attaching No. 4880K Filters to any plain faucet ..... Net .50

4880R. **Wrench** for opening No. 4880K Filters ..... Net .50



No. 4880R.





No. 4880.



No. 4880A.



No. 4880B.



No. 4880C.

4880. Faucet Connection, for rubber tubing, with thread for kitchen bibb...	\$	0.42
4880A. Fermentation Tubes, Smith's, on glass foot.....		.30
4880B. Fermentation Tubes, Smith's, without glass foot.....		.22
225. Files, round (rat tail), bastard cut.		
Length, inches .....	4	5
Each .....	.09	.10
.....		.11
.....		.13
227. Files, triangular (slim tapers), single cut.		
Length, inches .....	4	5
Each .....	.07	.09
.....		.10
.....		.13
233. File Handles, for any of the above, each.....		.03
4880C. Filter Apparatus, consisting of glass plate and bell jar, fitted with rubber stopper and funnel .....		1.75

4880D. Filter Apparatus, Fitzgerald's Constant Level, consisting of a glass reservoir, with a capacity of 300 c.c., having openings as shown and a long glass rod fitted with a ground stopper for closing the lower opening. The upper opening is closed by a perforated rubber stopper through which the glass rod passes, and which allows the glass stopper to be pushed down so as to close the lower opening when filling the apparatus, and which also holds the glass stopper in position while filtering. The opening at the side is fitted with a rubber stopper, which is removed only to pour in the liquid to be filtered .....

2.65



No. 4880D.



No. 9118.

4880H to 4880R. Berkefeld Filters, page 361B.

4880E to 4880G. Alundum Filters, etc., page 504.

9118. Filter, Briggs' design, for the filtration of soil solutions. Made of brass, nickel-plated outside, silver-plated inside, and therefore especially suited for plant-culture experiments. Capacity of reservoir approximately 800 c.c. Complete with Pasteur-Chamberland filter tube....

10.00

9118A. Filter Tube, Pasteur-Chamberland, French make, for No. 9118 Filter. ....Net

1.50

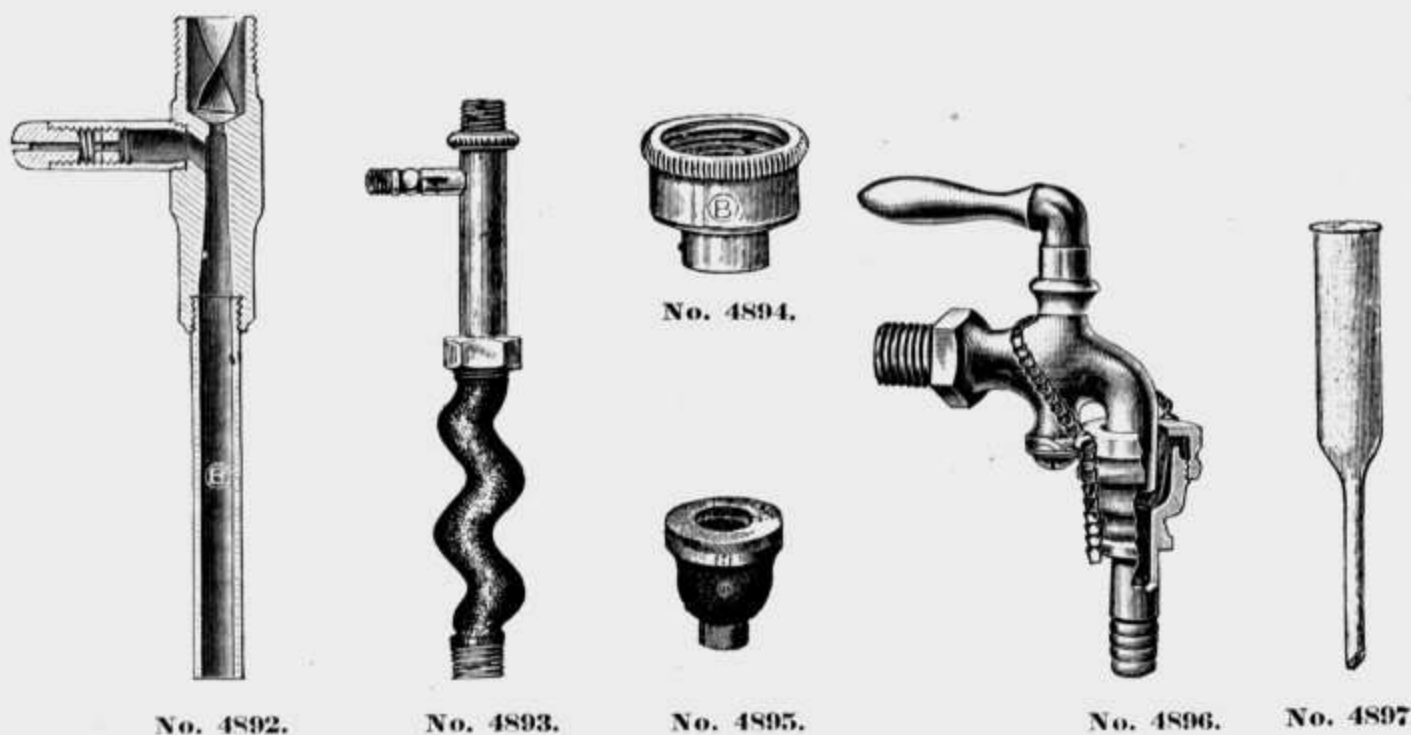


No. 4881.



Nos. 4883-4884.

4881. **Filter Paper.** A pure white paper of superior quality, strong and rapid. For qualitative work. Cut in round filters, 100 in a package.  
 Diameter, inches ..... 3 4 5 6 8 10 13  
 Per package of 100.... \$0.10 .12 .15 .20 .30 .45 .60
4882. **Filter Paper,** same quality as No. 4881, in sheets 19x19 inches. Per quire, 40 cents; per ream..... \$ 6.65
4883. **Filter Paper, J. T. Baker's.** Finest quality Swedish hand-made paper, carefully selected and washed. Put up in boxes holding 100 filters. Perfectly "ashless." Washed in hydrochloric and hydrofluoric acids.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per box of 100..... .45 .55 .60 .83 1.10 1.25
4884. **Filter Paper, J. T. Baker's, "Washed."** Same as No. 4883, but washed in hydrochloric acid only.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per box of 100..... .17 .28 .45 .55 .65 .88
4885. **Filter Paper, Munktell's Swedish, No. 1F,** for quantitative work. The most perfect filters made. Of best linen material, cut round.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per package of 100..... .11 .16 .25 .30 .40 .50
4886. **Filter Paper, Munktell's Swedish, No. 0,** same as No. 4885. Washed with hydrochloric acid, removing traces of iron, alumina, lime, etc. Adapted to the most precise requirements of analytical work.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per package of 100..... .20 .27 .42 .55 .63 .85
4887. **Filter Paper, Munktell's Swedish, No. 00,** same as No. 4885. Washed with hydrofluoric and hydrochloric acids.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per package of 100..... .50 .55 .80 1.00 1.10 1.25
4890. **Filter Paper, Schleicher & Schuell's, No. 595.** A good light paper, free of chlorine, grained surface.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per package of 100....Net .10 .11 .16 .18 .20 .28
- 4890A. **Filter Paper, Schleicher & Schuell's, No. 575.** A thin, hard paper, specially adapted for use with the filter pump, and retaining the finest precipitates. Useful in filtering caustic liquids and strong acids.  
 Diameter, cm. .... 5.5 7 9 11 12.5 15  
 Per package of 100....Net .52 .56 .82 1.00 1.10 1.30
- 4890B. **Filter Paper, Schleicher & Schuell's, No. 597.** A heavy paper, perfectly white and quick filtering.  
 Diameter, cm. .... 7 9 11 12.5 15  
 Per package of 100....Net .16 .22 .28 .30 .38
- 4890C. **Filter Paper, Schleicher & Schuell's, No. 589<sup>2</sup>, "White Ribbon,"** washed with hydrochloric and hydrofluoric acids. This paper is sent as No. 589 when not otherwise ordered.  
 Diameter, cm. .... 7 9 11 12.5 15  
 Per package of 100....Net .55 .82 1.00 1.10 1.30
- S. & S. No. 589 "Blue Ribbon" and "Yellow Ribbon" on next page.



4891. Universal Water Jet Vacuum Pump, page 505.

4890D. Filter Paper, Schleicher & Schuells, No. 5893, "Blue Ribbon," washed with hydrochloric and hydrofluoric acids. Suitable for the finest precipitations or opaqueness.

Diameter, cm. ....	7	9	11	12.5
Per package of 100.....	Net \$ 0.55	.82	1.00	1.10

4890E. Filter Paper, Schleicher & Schuell's, No. 5894, "Yellow Ribbon," same as No. 4890D, but also washed with ether.

Diameter, cm. ....	7	9	11	12.5
Per package of 100.....	Net .10	1.05	1.25	1.40

4890F. Filter Paper, Schleicher & Schuell's, No. 590. Washed with hydrochloric and hydrofluoric acids, in which the washing has been carried to the utmost limit.

Diameter, cm. ....	7	9	11	12.5
Per package of 100.....	Net .70	1.05	1.25	1.40

4892. Filter Pump (Aspirator). New design. Constructed of brass on an entirely new idea and will produce a higher vacuum in less time and using one-third less water than any other pump made. Small size, 1/8 inch I. P. thread..... \$ 1.25

4892A. Filter Pump, same as No. 4892, large size, 3/8 inch, I. P. thread..... 2.00

4893. Filter Pump, Prof. Richards', of brass, small size, 1/8 inch I. P. thread 1.50

4893A. Filter Pump, Prof. Richards', of brass, large size, 3/8 inch I. P. thread. 1.80

4893B. Filter Pump, Prof. Richards', of brass, extra large size, 3/4 inch I. P. thread ..... 6.67

4894. Filter Pump Coupling, to connect Nos. 4892 or 4893 with threaded faucet ..... .30

4894A. Filter Pump Coupling, to connect Nos. 4892A or 4893A with threaded faucet ..... .50

4894B. Filter Pump Coupling, to connect No. 4893B with threaded faucet... 2.25

4895. Filter Pump Coupling, to connect No. 4892 or 4893 with smooth faucet. .50

4895A. Filter Pump Coupling, to connect No. 4892A or 4893A with smooth faucet ..... .50

4895B. Filter Pump Coupling, to connect No. 4893B with smooth faucet..... 2.25

4896. Filter Pump Coupling, Universal. This coupling is not threaded, but merely slipped on a faucet and fastened with a chain. Can be attached to any water faucet in a minute. The best and simplest device for attaching filter pumps, stills, water motors, turbines and centrifuges to a common faucet. It is practical, self-tightening and air tight ..... 2.00

4897. Filter Tubes, Carbon Filters, to fit Gooch crucibles.  
 Diameter at top, mm. .... 25 30 35  
 Each ..... .22 .25 .30



No. 4901.



No. 4901A.



No. 4902.



No. 4903.

4901. Flasks, Flat Bottom, best German glass.

Capacity, ounces	1	2	4	6	8	12	16	24	32	64
Each	\$0.07	.08	.09	.10	.13	.14	.18	.22	.27	.45

4901A. Flasks, Ring Neck, best German glass, flat bottom.

Capacity, ounces	4	8	16	32
Each	.09	.13	.18	.27

4901B. Flasks, Flat Bottom, new Jena glass, vial mouth.

Capacity, c.c.	50	100	200	500	700	1000
Each	.14	.15	.20	.31	.40	.50

4902. Flasks, Round Bottom, best German glass.

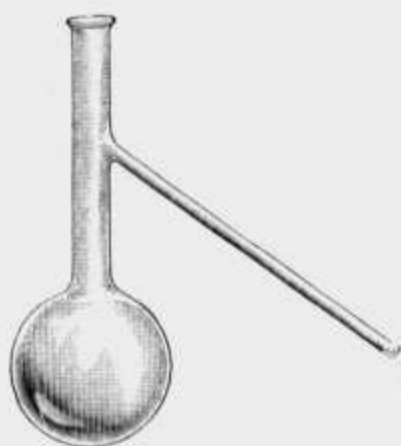
Capacity, ounces	2	4	6	8	12	16	24	32	64
Each	.08	.09	.10	.13	.14	.18	.22	.27	.45

4903. Flasks, Erlenmeyer's, best German glass.

Capacity, ounces	2	4	6	8	12	16	32
Each	.08	.09	.11	.14	.16	.18	.30

4903A. Flasks, Erlenmeyer's, new Jena glass, vial mouth.

Capacity, c.c.	50	100	250	500	750	1000
Each	.12	.14	.17	.30	.35	.50



No. 4904.



No. 4905.



No. 4906.

4904. Flasks, Fractional Distillation, best German glass, side neck.

Capacity, ounces	2	4	8	16
Each	.18	.22	.30	.40

4905. Flasks, Filter, Erlenmeyer's form with side neck, best German glass.

Capacity, ounces	8	16	32
Each	.30	.35	.55

4906. Flasks, Kjeldahl's, digesting, pear shaped. Bohemian glass.

Capacity, c.c.	250	500
Each	.20	.35

4906A. Flasks, Kjeldahl's, digesting, pear shaped, in extra long necks, new Jena glass.

Capacity, c.c.	200	500	1000
Each	.23	.40	.60



No. 4907.



No. 4908.



No. 4909.



No. 4910.



No. 4911.

4907. Flasks, Extraction, Soxhlet's, low form, with extra wide mouth for extraction apparatus.					
Capacity, c.c. ....	60	125	250		
Each .....	\$0.09	.12	.22		
4907A. Flasks, Extraction, Soxhlet's, New Jena glass, low form, extra wide mouth.					
Capacity, c.c. ....	100	250			
Each .....	.17	.25			
4908. Flasks, Extraction, Knorr's, for mercury seal; capacity, 100 c.c.....					\$ 0.35
4909. Flasks, Volumetric, or liter flasks, volume fixed with one mark on the neck, very accurate.					
Capacity, c.c. ....	50	100	250	500	1,000
Each .....	.22	.25	.35	.50	.63
4910. Flasks, Volumetric, same as No. 4909, with ground glass stopper.					
Capacity, c.c.....	50	100	250	500	1,000
Each .....	.26	.30	.50	.67	.75
4911. Flasks, Volumetric, glass stopper, with two marks, so that exact amounts may be received and delivered.					
Capacity, c.c. ....	100	500	1,000		
Each .....	.45	.90	1.25		
9312B. Flasks, for Moisture in Grains, as used by the Bureau of Plant Industry, U. S. Department of Agriculture. Made of New Jena glass..					1.50

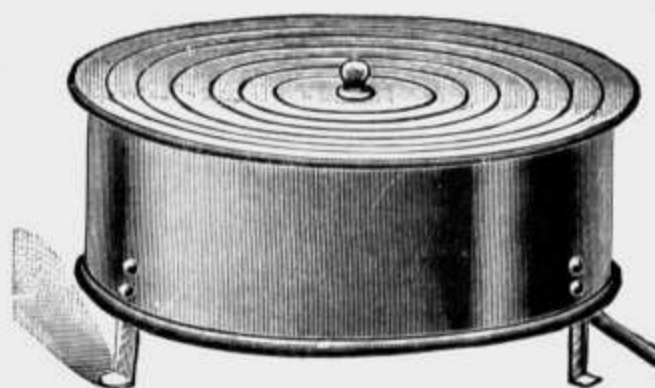
4910A. Normal Flasks, see page 408.



No. 4912.



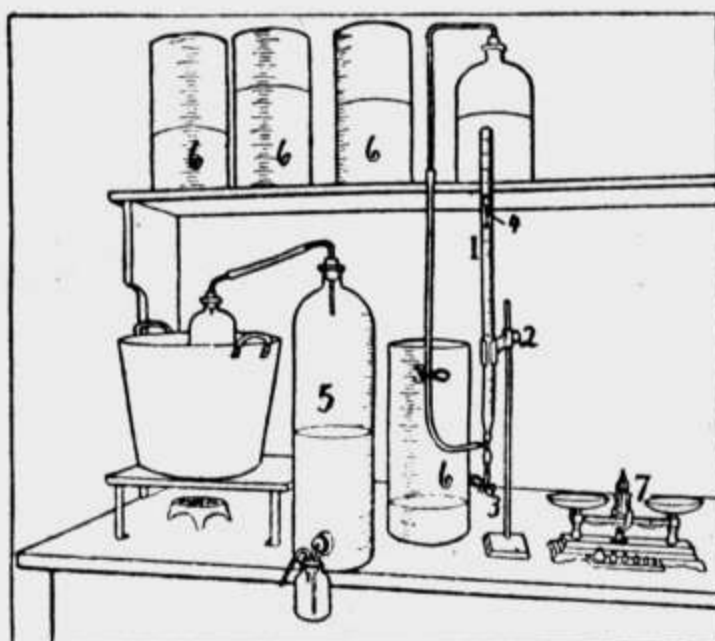
No. 4913.



No. 4913A.

4912. Flasks, Copper.					
Capacity, ounces .....	8	16	32	64	
Each .....	1.65	1.80	2.25	2.75	
4913. Flask Heater, Electric, for distilling ether and other inflammable liquids that should not be exposed to a naked flame, with 110-volt incandescent lamp .....					Net 4.00
4913A. Flask Heater, Electric. Top of copper concentric rings, 8½ inches in diameter; will give three heats. With cord and switch.....					Net 12.00
4789A. Flask Holders. "Suberite" (compressed cork) rings; for supporting flasks, etc. Prevent breakage, and much more durable than straw rings.					
Inside diameter, cm. ....	3	6	9	12	
Each .....	.22	.33	.40	.50	

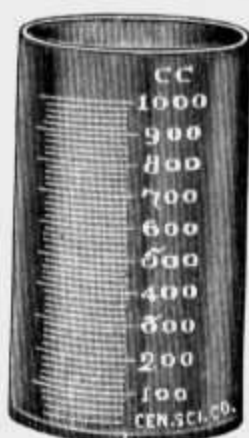
**FLOUR TESTING APPARATUS.**



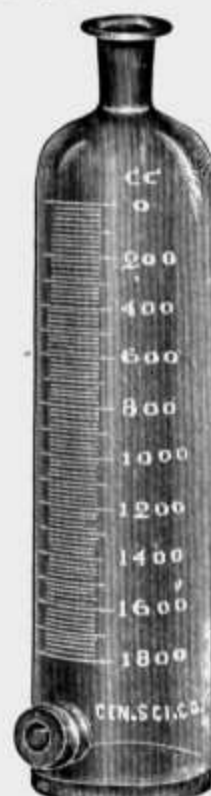
The apparatus listed on this page, a typical assortment of which is shown in the illustration above, is the standard equipment for testing the baking qualities of flour, and is used in the principal commercial laboratories and in the private laboratories of large milling plants.



**No. 4914.**



**No. 4914A.**



**No. 4914B.**

4914. Baking Cylinders, with graduated indicator and detachable cup of definite capacity. (Two desirable.) Each.....	Net \$	8.00
4914A. Expansion Jar, for testing the rising qualities of dough. (No. 6 in the illustration.) Graduated to 1000 c.c. in 20 c.c. divisions.....	Net	2.25
4914B. Gas Collector. Graduated to 1800 c.c. in 20 c.c. divisions, with accessory bottles and tubing. (No. 5 in the illustration).....	Net	4.65
4616. Burette, 50 c.c. in $\frac{1}{10}$ , with side filling tube. (No. 1 in the illustration)		2.50
4619. Erdmann's Float. (No. 4 in the illustration).....		.25
5001. Cylindrical Graduate, 250 c.c.....		.80
5263. Horn Spatula, 6 inches.....		.06
5121. Pipette, Volumetric, 10 c.c.....		.17
4914C. Oven Thermometer, 600° F., 6 inches long, oxidized scale.....		1.50
1533. Chemical Thermometer, 360°.....		1.33
5325. Tripod Support, small. (No. 3 in the illustration).....		.30
4711. Clamp. (No. 2 in the illustration).....		.33
4910. Volumetric Flask, 100 c.c.....		.30
3832. Balance, with Metric Weights, agate bearing. (No. 7 in the illustration) .....		8.00
4861A. Electric Oven .. .. .	Net	25.00



No. 3971.



No. 3973.

- |       |  |    |      |
|-------|--|----|------|
| 3971. | Forceps, ivory tipped, for handling weights..... | \$ | 0.67 |
| 3973. | Forceps, brass, curved points, plain.....        |    | .16  |



No. 4508.



No. 4509.

- |       |   |     |      |
|-------|---|-----|------|
| 4508. | Forceps, Plattner's, with platinum tips.....  | Net | 4.40 |
| 4509. | Forceps, French Form, with platinum tips..... | Net | 4.40 |



Nos. 4915-4916.

- |       |   |     |     |
|-------|---|-----|-----|
| 4915. | Forceps, Steel, heavy, for general laboratory work.           |     |     |
|       | Length, inches .....  | 4   | 5   |
|       | Each .....  | .09 | .10 |
| 4916. | Forceps, Brass, same style as No. 4915. Length, 5 inches..... |     | .17 |



No. 4917.

- |       |   |          |      |
|-------|---|----------|------|
| 4917. | Forceps, Platinum Tipped, for general laboratory work. .... | Each net | 6.00 |
|-------|---|----------|------|



No. 7840.

- |       |  |  |     |
|-------|--|--|-----|
| 7840. | Forceps, Steel, polished, fine, straight, sharp, points. Length 4 3/8 inches ..... |  | .11 |
|-------|--|--|-----|



No. 7842.

- |       |   |  |     |
|-------|---|--|-----|
| 7842. | Forceps, Steel, nickel plated, fine, straight, sharp, points. Length 3 1/2 inches ..... |  | .20 |
|-------|---|--|-----|



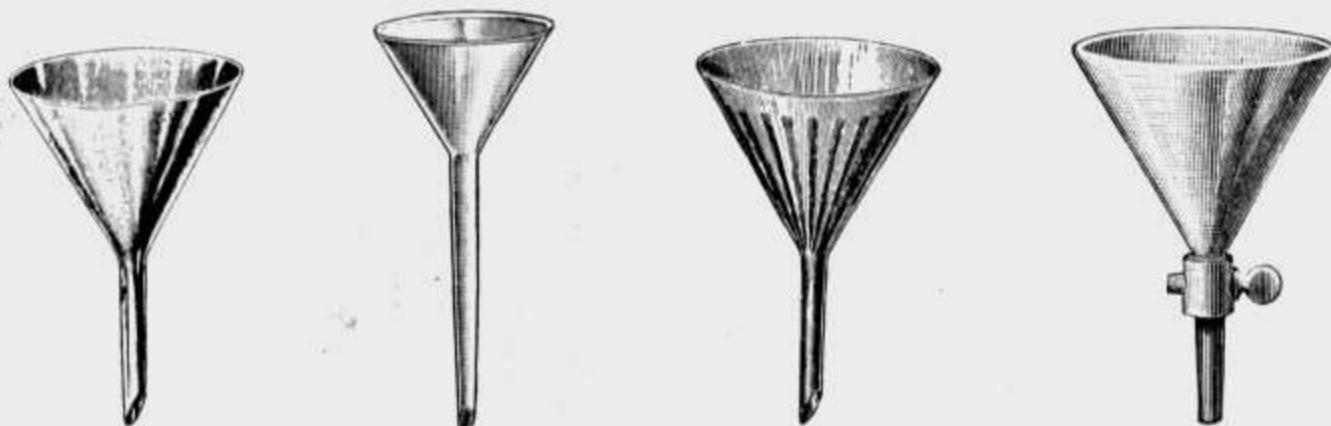
No. 7846.

- |       |  |  |     |
|-------|--|--|-----|
| 7846. | Forceps, Steel, nickel plated, fine curved points, with guide pin, corrugated handle and file-cut points. Length 4 inches..... |  | .40 |
|-------|--|--|-----|



No. 7848.

- |       |  |  |     |
|-------|--|--|-----|
| 7848. | Forceps, Steel, nickel plated, heavy (so-called "Swansea style") corrugated handle and file cut points. Length 5 inches..... |  | .35 |
|-------|--|--|-----|



No. 4921.

No. 4921A.

No. 4921C.

No. 4922.

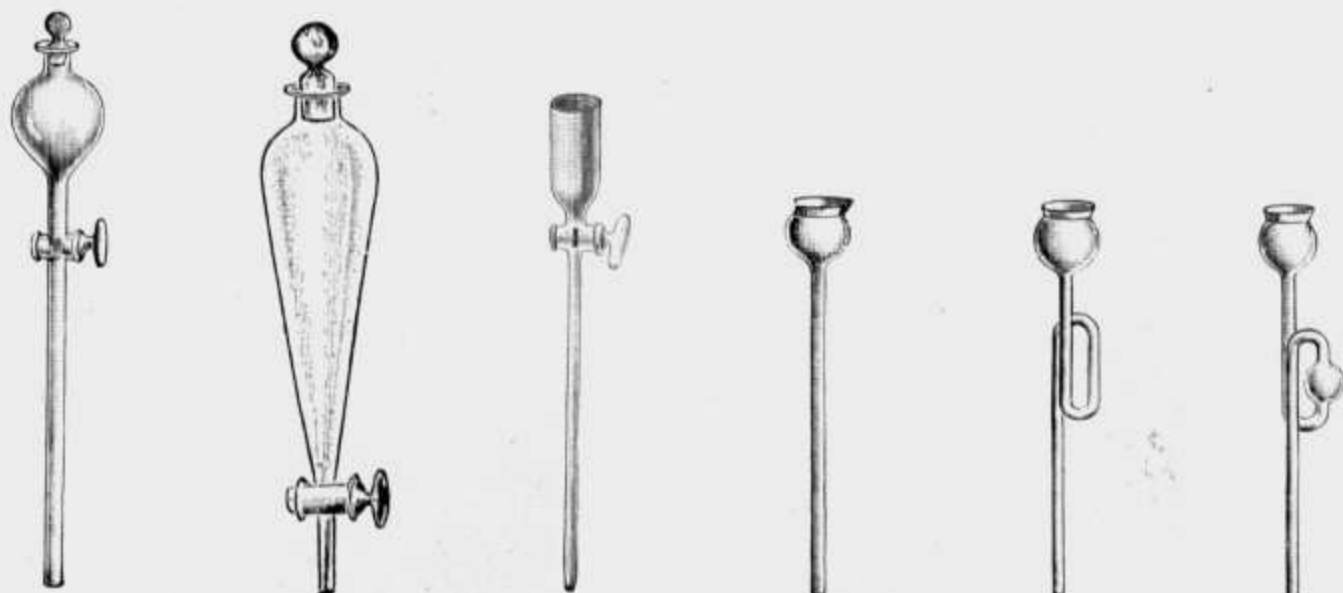
4921. **Funnels, glass, angle of 60°, stem ground to a point.**  
 Diameter, inches... 1½ 2 2½ 3 3½ 4 5 6 8  
 Each .....\$0.07 .08 .09 .12 .14 .16 .20 .22 .38

4921A. **Funnels, Bunsen, angle exactly 60°, with ground rim and long stems ground to a point. Chemists should select this funnel for accurate work, as its use will insure rapid and safe filtration.**  
 Diameter, inches..... 2 2½ 3 3½ 4  
 Each ..... .09 .11 .13 .15 .18

4921B. **Funnels, Nest of 3; 1 each 7/8, 1 and 1 1/8 inches diameter. Per nest.. \$ 0.27**

4921C. **Funnels, glass, ribbed.**  
 Diameter, inches ..... 3½ 4 6  
 Each ..... .14 .16 .22

4922. **Funnels, Separatory, ordinary shape, 60°.**  
 Diameter, inches ..... 4 6  
 Each ..... 1.25 1.65



No. 4923.

No. 4923A.

No. 4924.

No. 4926.

No. 4927.

No. 4928.

4923. **Funnels, Separatory, light glass, globe shape, with glass stopper, stop-cock and long stem.**  
 Capacity, c.c. .... 50 100 150 250  
 Each ..... .90 1.10 1.25 1.35

4923A. **Funnels, Separatory, Squibb's, cone shape, with glass stopper.**  
 Capacity, c.c. .... 75 125 250  
 Each ..... 1.35 1.40 1.80

4924. **Funnels, Separatory, cylindrical.**  
 Capacity, c.c. .... 50 100  
 Each ..... .84 1.05

4926. **Funnel Tube, thistle top, straight stem..... .08**

4927. **Funnel Tube, thistle top, simple safety stem..... .17**

4928. **Funnel Tube, thistle top, one bulb safety stem..... .18**





Nos. 4934-5.



No. 4936.



No. 4938.



No. 4938A.

4933. **Funnels, Agateware.**

Capacity .....	1/2 pint.	1 pint.	1 quart.	
Each .....	\$0.27	.33	.40	

4934. **Funnel, Hot Water, of tin, double wall.** ..... \$ 2.25

4935. **Funnel, Hot Water, same as No. 4934, but made of heavy polished copper** ..... 3.00

4936. **Funnel, Hot Water, of heavy polished copper, single wall, on three legs** ..... 3.30

4938. **Funnel, Porcelain, Hirsch's, with permanent perforated porcelain plate for pressure filtration.**

Diameter, cm. ....	6.5	9	11
Each .....	.55	.60	.80

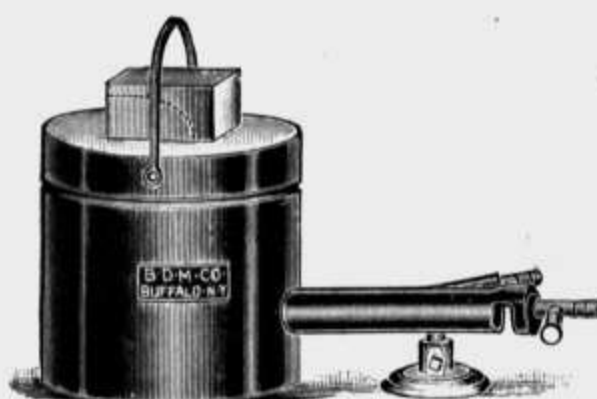
4938A. **Funnel, Porcelain, Buechner's, straight walls and stationary perforated plate.**

Diameter, cm. ....	5	7	10
Each .....	.55	.83	1.30

**Funnel Holders, see page 411.**



No. 4939.



No. 4940.

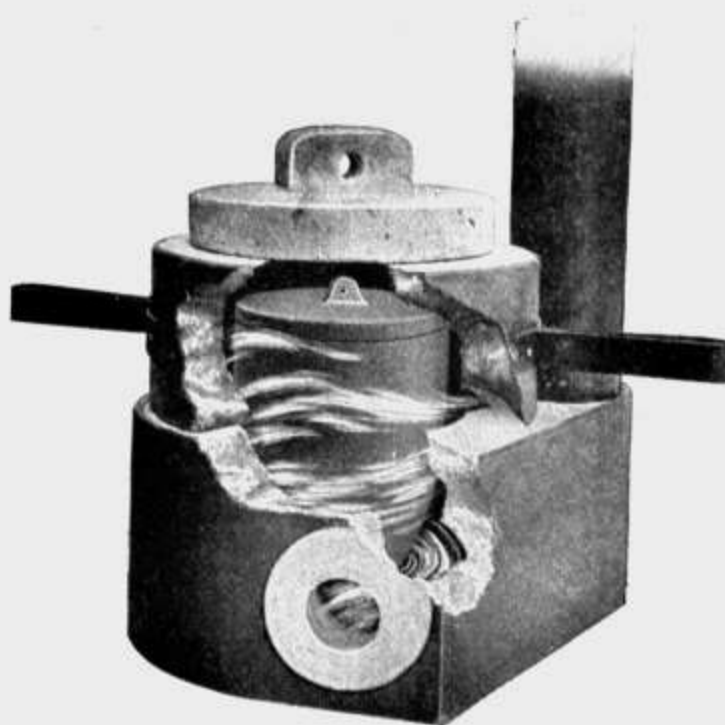
4939. **Furnace, Crucible.** The simplest gas furnace ever constructed, consisting of a simple pot for holding the crucible, with a lid and a blowpipe, all mounted on a suitable cast iron base. Gas from a 3/8 inch supply pipe will work the furnace efficiently; about 10 cubic feet of gas per hour is sufficient. The crucible will hold about 10 ounces. No. 9A or 10A Foot Blower (see page 317) will operate the furnace satisfactorily. Complete, with crucible.....Net 3.50

4939A. **Extra Crucibles (plumbago), each**.....Net .27

4940. **Furnace, Fletcher's Perfected Injector, for gas. Complete, with crucible holding two pounds**.....Net 4.50

4940A. **Extra Crucibles, each**.....Net .35

4941. **Furnace, Case Melting.**  
 For use with gasoline or oil. Flame blow-in is located so that the flame blows in on a tangent and does not hit the crucible until there is a complete combustion. The hot gases circle around the crucible, thereby preventing loss of crucible by cracking. Made in three sections and will take No. 7 Black Lead Crucible. Net weight, 40 pounds.  
 Net ..... \$ 7.20



No. 4941.

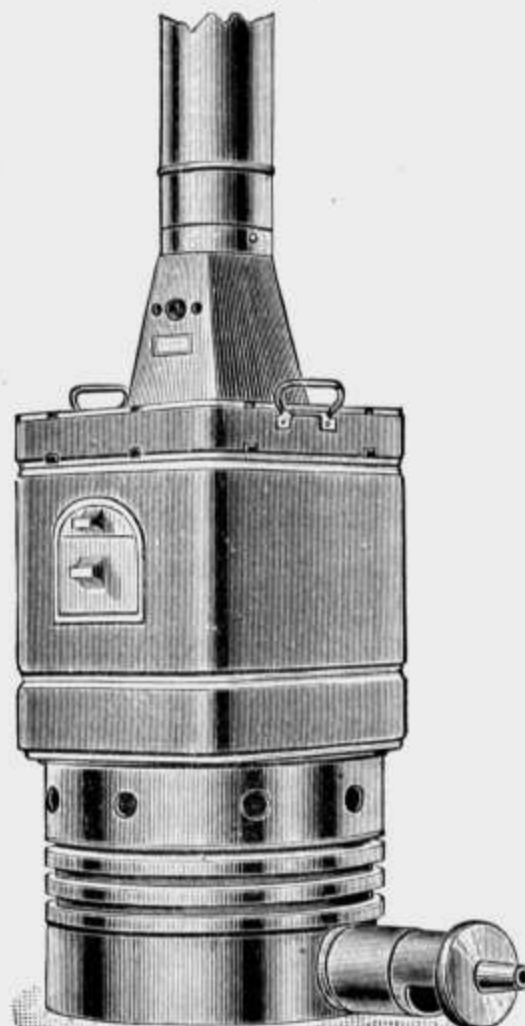
4941A. **Tank.** To operate No. 4941 Furnace it is necessary to have a blow-pipe tank and burner. Tanks are of pressed steel and built to stand 300 pounds pressure. Fitted with large, substantial pump with 10 feet of 1/4 inch pipe, elbow, etc. Capacity, 2 gallons. Complete .....Net \$ 14.00

4941B. **Hydro-Carbon Burner,** for use with above tank.....Net 6.00

9917. **Furnace, Muffle,** for all work where exact temperatures are desired not exceeding the fusing point of copper. May be operated with illuminating gas, natural gas, or gasoline gas without alteration. Each furnace is complete with muffle, dome, crucible tongs and six feet of chimney pipe and burner best suited to the size purchased. Inside muffle space, 3 x 4 x 2 3/8 inches high; requires 1/2 inch clear bore gas pipe and tap; clay parts 7 3/4 x 7 3/4 x 8 inches high; inside space 5 1/4 x 5 3/4 x 5 1/4 inches high. Height from table to top of lid, 16 inches.....Net 17.00

9918. **Furnace, Muffle,** same as No. 9917. Inside muffle space 3 7/8 x 5 7/8 x 3 inches high; requires 3/4 inch clear bore gas pipe and tap; clay parts 10 x 9 x 11 inches high; inside space 7 1/2 x 6 1/2 x 5 3/4 inches high; height from table to top of lid, 19 1/2 inches.....Net 22.00

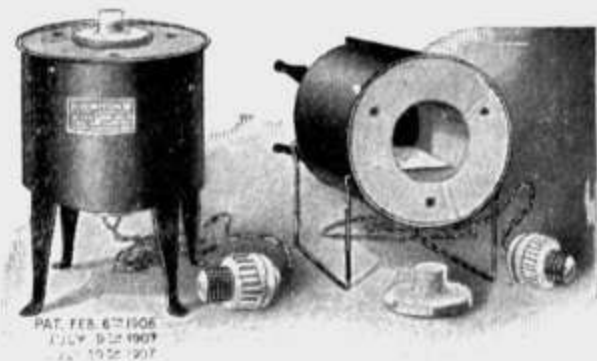
9919. **Furnace, Muffle,** same as No. 9917. Inside muffle space 4 7/8 x 6 5/8 x 4 inches high; requires 1 inch clear bore gas pipe and tap; clay parts 11 3/4 x 10 3/4 x 14 inches high; inside space 8 3/4 x 7 3/4 x 6 3/4 inches high; height from table to top of lid 23 inches.....Net 35.00



Nos. 9917-9919.

**Muffles for above furnaces:**

Number .....	9917A.	9918A.	9919A.
Each .....	Net 1.20	1.40	1.75



No. 4942.



No. 4942A.

4942. **Furnace, Electric, Combination Crucible and Muffle.** Size of chamber  $2\frac{1}{8} \times 2\frac{1}{2}$  inches. Requires but  $3\frac{1}{2}$  amperes at 110 volts and is perfectly safe at any voltage from 100 to 125 volts, either alternating or direct circuit. With 115 volts it will give a temperature of  $1,100^{\circ}$  C., the melting point of gold. Requires no special wiring, as furnace may be connected directly with the lamp socket. Guaranteed against a "burn out" up to  $1,000^{\circ}$  C. Should, however, through carelessness, a "burn out" occur, new heating elements may be obtained at low cost .....Net \$ 18.00

4942A. **Rheostat**, for use with above where it is desired to hold the temperature stationary at some point, or to control the variation in temperature, as in annealing.

Voltage .....	110	220
Resistance, ohms. ....	25	100
Each .....	Net 5.00	5.00

Note—The use of a Pyrometer with the above combination is desirable, as it will enable the operator to know at all times the exact temperature within the furnace chamber.

**Electric Pyrometer**, page 399.  
**Furnace, Combustion**, see page 348.

- 4943. **Gas, Ammonia**, liquefied, in steel cylinders of about 50 lbs. Per lb. .Net .50  
**Cylinder**, for same, extra.....Net 20.00
- 4943B. **Gas, Carbonic Acid**, liquefied, in cylinders of 20 lbs. Per lb.....Net .25  
**Cylinder**, for same, not returnable for credit, extra.....Net 15.00
- 4943D. **Gas, Chlorine**, liquefied, in cylinders of about 100 lbs. Per lb.....Net .25  
**Cylinder**, for same, extra .....

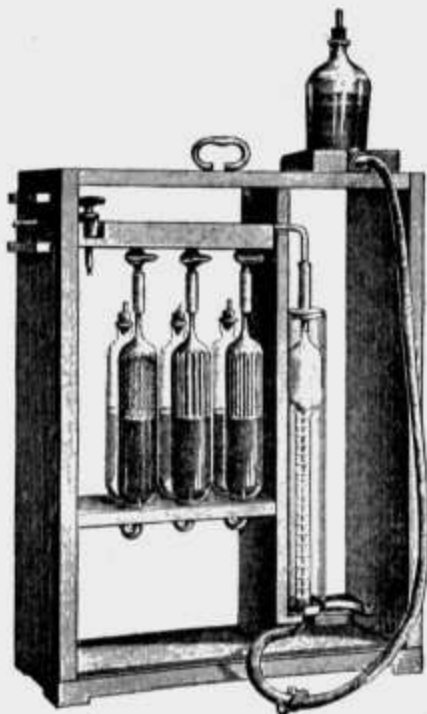
4943F. **Gas, Hydrogen (Pure)**, compressed in steel cylinders of 25, and 50 cubic feet. Per cubic foot.....Net .10  
**Cylinders** for same \$16.50 and \$22.50 net.

4943G. **Gas, Nitrous Oxide**, liquefied, in cylinders of 100 gallons.....Net 8.00

4944. **Gas, Oxygen**, pure, in steel cylinders holding 40 gallons, under pressure of 1800 lbs. per square inch. (Cylinder 6.00, gas 2.00)....Net 8.00

4944A. **Gas, Oxygen**, same as above, in cylinders of 100 gallons. (Cylinder 12.00, gas 5.00) .....

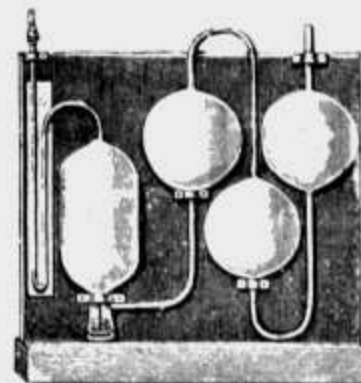
4944B. **Wheel Valve and Yoke**, for rubber tubing .....Net 1.75  
**Cylinders** for Ammonia, Chlorine and Hydrogen are returnable for full credit within one month, after which time a rental charge of 25 cents per week will be made.



No. 4945.

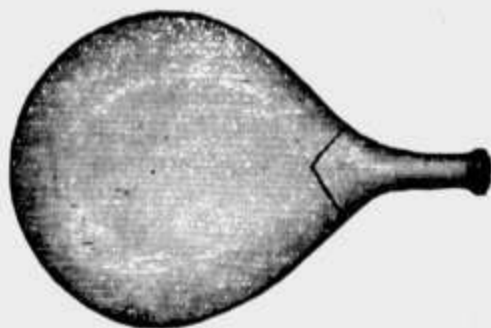


No. 4946.

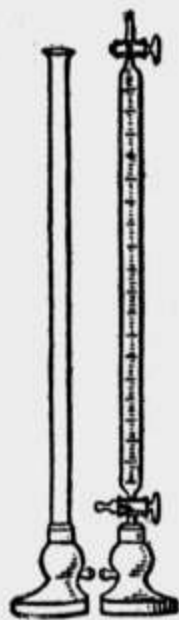


No. 4947.

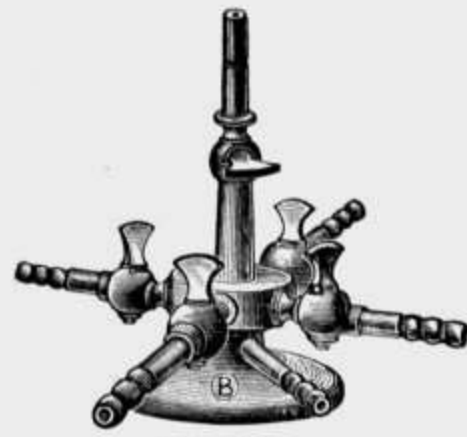
4945. **Gas Analysis Apparatus**, after Orsat, modified by Muencke, for the analysis of CO<sub>2</sub>, CO and O, especially adapted for furnace and flue gases. Consists of three absorption pipettes, stop cock tube with three stop cocks, burette with jacket and sedimentation flask. Complete in lacquered wooden case ..... \$ 22.50
4946. **Gas Absorption Pipette**, single, for solid and liquid reagents..... 2.65
- 4946A. **Gas Absorption Pipette**, same as No. 4946, glass parts only..... 1.50
4947. **Gas Absorption Pipette**, double, for solid liquid reagents..... 3.55
- 4947A. **Gas Absorption Pipette**, same as No. 4947, glass parts only..... 2.00
4948. **Gas Absorption Pipette**, for explosions..... 5.50
- 4948A. **Gas Absorption Pipette**, same as No. 4948, glass parts only..... 3.35
4949. **Palladium Tube**, for absorption of hydrogen, filled with palladium. ....Net 6.50



No. 4951.



No. 4953.



No. 4954.

4951. **Gas Bags**, pure rubber, oval form.  
Capacity ..... 1 gal. 2 gal. 3 gal. 5 gal.  
Each ..... 2.20 2.75 3.35 3.75
4952. **Gas Bags**, same as No. 4951, with brass stop-cock.  
Capacity ..... 1 gal. 2 gal. 3 gal. 5 gal.  
Each ..... 3.25 3.75 4.40 5.00
- For Stop-cocks for No. 4952, see No. 1342G.
4953. **Gas Burette**, with stop-cocks and leveling tube; heavy bases..... 6.50
4954. **Gas Distributor**, with four side tubes and center burner, all with stop-cocks ..... 5.25
- 4954A. **Gas Distributor**, with three side tubes with stop-cocks, and no center burner ..... 3.75



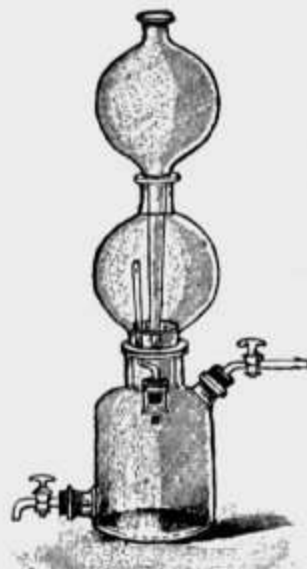
No. 4955.



No. 4956.



No. 4957.



No. 4958.

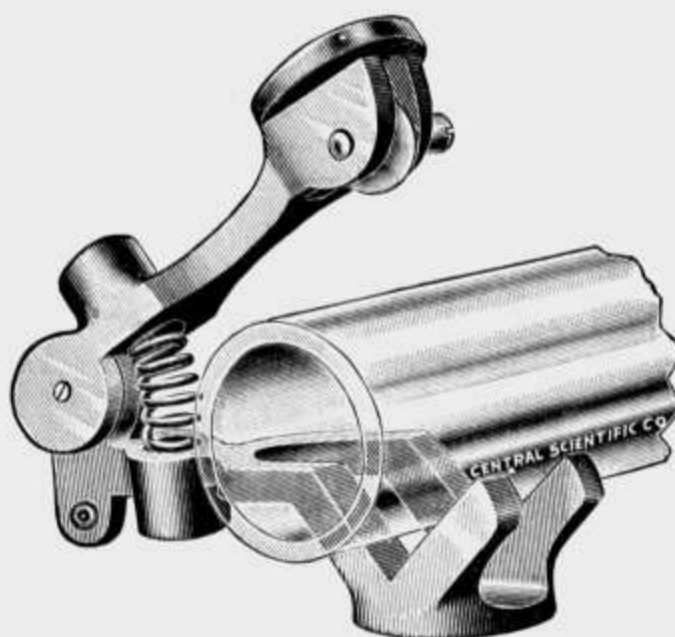
4955. **Gas Generator, Dropping**, after Prof. Freas, of Kent Chemical Laboratory, University of Chicago. An effective, cleanly, economical method of obtaining any gas desired for use. Substance acted upon is placed in flask and if possible in form of a paste. The agent is placed in the funnel and is allowed to drop into the flask and react with the contents. The gas generated passes out through the delivery tube or through the side tube, to increase the pressure in the funnel ..... \$ 4.00
4956. **Gas Generator, for Oxygen.** Made of metal, 9½ inches high; weight 2½ pounds. Generates a steady supply of pure oxygen as wanted, from Peroxide of Sodium in cartridge form, in which shape it is known as "Oxone." The cartridges come in hermetically sealed tin cans, which, when placed in the generator, are punctured. Each cartridge will furnish about 14 to 15 gallons of oxygen, which, if passed through a wash bottle containing water, will be 100 per cent pure. As it comes from the generator it is 99.3 per cent pure...Net 15.00
- 4956A. **Cartridges for No. 4956.** Each .....Net .50
4957. **Gas Generator, Kipp's Apparatus.**
- |                |       |        |           |
|----------------|-------|--------|-----------|
| Capacity ..... | Pint. | Quart. | ½ Gallon. |
| Each .....     | 3.35  | 4.45   | 5.95      |
4958. **Gas Generator, McCoy's Automatic.** Designed by Dr. J. N. McCoy, of the University of Chicago. Arranged to deliver the acid in drops, thus producing a steady and constant current of gas. There is no waste of chemicals and the spent acid is removed at the lower stopcock.
- |                |          |           |
|----------------|----------|-----------|
| Capacity ..... | 1 Quart. | ½ Gallon. |
| Each .....     | 7.00     | 8.85      |
4960. **Gas Lighter**, page 506.



Nos. 4963-4966.

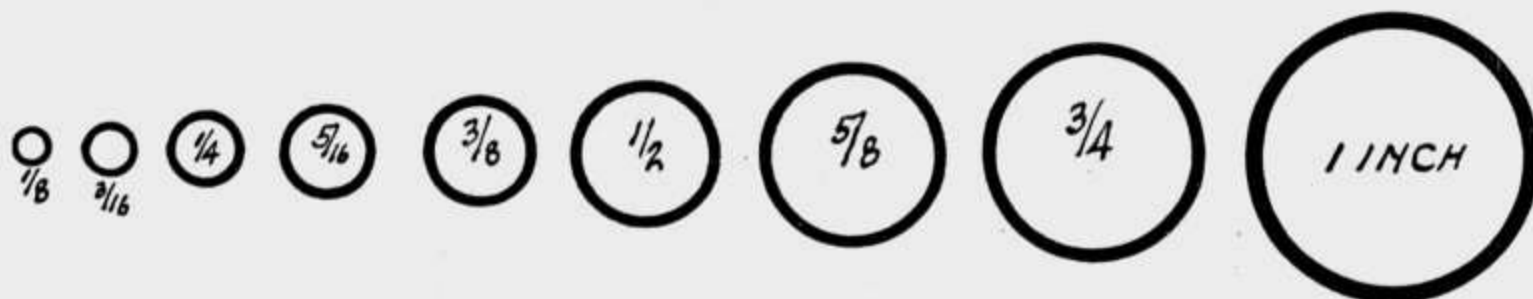


No. 4971.



No. 239.

4963.	Gasometer, Berzelius' (gas holder), improved form, made of zinc, capacity 5 gallons				\$ 15.00
4964.	Gasometer, same as No. 4963, capacity 10 gallons				20.00
4965.	Gasometer, same as No. 4963, of copper, capacity 5 gallons				19.50
4966.	Gasometer, same as No. 4965, capacity 10 gallons				23.00
4971.	Gasometer Tubes.				
	Capacity, c.c.	25	50	100	
	Graduated to	$\frac{1}{5}$	$\frac{1}{10}$	$\frac{1}{5}$	
	Each	.67	1.00	1.33	
4972.	Gasometer Tube, with glass stop-cock, capacity 50 c.c. in 1/10ths				2.00
4973.	Gauze, Iron Wire, 20 mesh, to put under dishes.				
	Size, inches	4x4	5x5	6x6	sq. ft.
	Each	.04	.06	.07	.27
4974.	Gauze, Iron Wire, 5x5 inches, with asbestos center				.10
4975.	Gauze, Brass Wire, 20 mesh, to put under dishes.				
	Size, inches	4x4	5x5	6x6	sq. ft.
	Each	.08	.12	.15	.50
4977.	Gauze, Copper Wire, for combustion, etc.				
	Mesh	40	60	80	100
	Per square foot	.55	.67	.90	1.80
4978.	Glass Beads, used to create a large surface in tubes for absorption of gases, per lb.				1.00
237.	Glass Cutter, steel wheel, polished and bronze finish				.07
238.	Glass Cutter. Glazier's diamond, for cutting or writing on glass. Finished in best manner possible and nickel plated. Diamond is guaranteed to re-set several times and to give entire satisfaction. Cuts "single thick"				Net 5.40
239.	Glass Cutter. This is the only glass cutter by which the pressure on the cutting wheel may be regulated so as to be firm and even. The cutting wheel may readily be renewed when worn				.90
239A.	Extra Cutting Wheel, for 239				.11
239B.	Extra Screw, for cutting wheel of No. 239				.07
	For other Glass Cutters, see pages 26-7.				
4979.	Glass Ink, "Diamond Ink," for writing on glass, in one ounce ceresine bottles				Net .30
	Glass Plates, see page 393.				
4980.	Glass Rod, best German glass, free from lead, in five foot lengths, from $\frac{1}{8}$ to $\frac{1}{2}$ inch, per lb.				.44
4980A.	Glass Rods, Stirring Rods, with rounded ends.				
	Size, inches	$5 \times \frac{3}{16}$	$8 \times \frac{1}{4}$	$10 \times \frac{1}{4}$	
	Per dozen	.16	.33	.50	
4980B.	Glass Rod, blue, for sealing in platinum, per lb.				2.00
4976.	Nichrome Wire Gauze, rust proof, see page 504.				



No. 4981.

**GLASS TUBING IS LISTED BY OUTSIDE DIAMETERS.**

- 4981. Glass Tubing, best German soft glass, in five foot lengths, sizes  $\frac{1}{8}$  to 1 inch, per lb. .... \$ 0.44
- 4982. Glass Tubing, best German soft glass, sizes  $1\frac{1}{4}$ ,  $1\frac{3}{8}$ ,  $1\frac{1}{2}$ ,  $1\frac{3}{4}$  and 2 inches, per lb. .... .55
- 4982A. Glass Tubes, Annealed Ends. Glass tubes of large diameter are not satisfactory unless ends are annealed to prevent longitudinal cracking. We list below a few sizes but can supply any size desired.

Diameter, cm.	Length, cm.	Price.	Diameter, cm.	Length, cm.	Price.
2.5	150	.55	4.5	60	.80
3	100	.55	4.5	80	.90
3	120	.75	4.5	90	1.00
4	45	.45	4.5	100	1.10
4	60	.60	4.5	120	1.30
4	80	.70	5	45	.67
4	90	.80	5	60	.90
4	100	.90	5	90	1.10
4	110	1.00	5	120	1.40
4	120	1.10	5	150	1.60

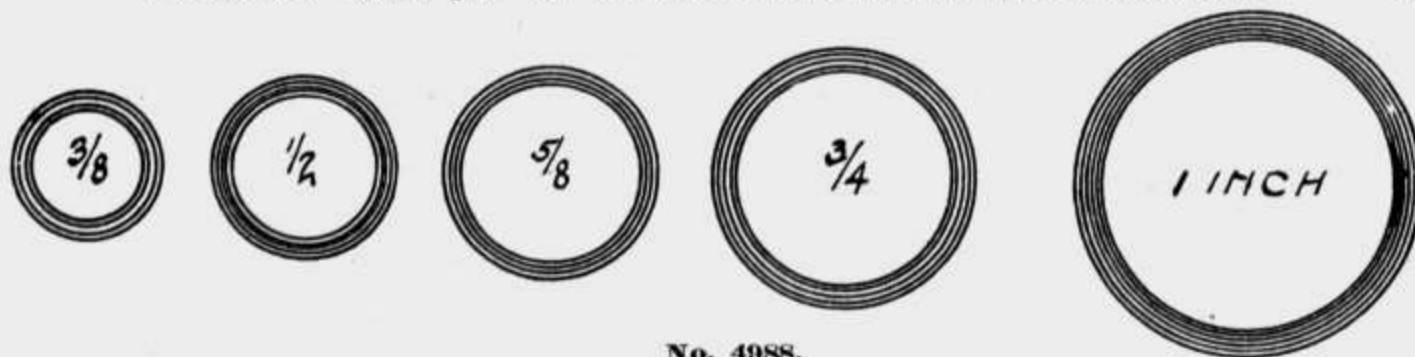
- 4983. Glass Tubing, Barometer, heavy wall 3 to 5 millimeter bore, 7 to 10 millimeter outside diameter, per lb. .... .44



No. 4986.

**CAPILLARY TUBING IS LISTED BY INSIDE BORE.**

- 4986. Glass Tubing, Capillary, 6-7 mm. diameter,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1,  $1\frac{1}{4}$ ,  $1\frac{1}{2}$ ,  $1\frac{3}{4}$  millimeter bore, per lb. .... .67



No. 4988.

**COMBUSTION TUBING IS LISTED BY INSIDE DIAMETERS.**

- 4988. Glass Tubing, Combustion, best Bohemian hard glass, from  $\frac{3}{8}$  to 1 inch inside diameter, per lb. .... .75  
Bohemian Glass Tubes, with annealed ends, see page 349.
- 4989. Glass Tubing, Combustion, new Jena glass, in 100 cm. lengths only.  
Diameter, outside, mm. .... 12    18    20    25  
Per length ..... .22    .33    .55    .67
- 4990. Glass Tubing, Thermometer Tubing, with white back, per lb. .... 1.10
- 4995. Glass Wool, best imported, per oz. .... Net .50



No. 4998.



No. 5000A.

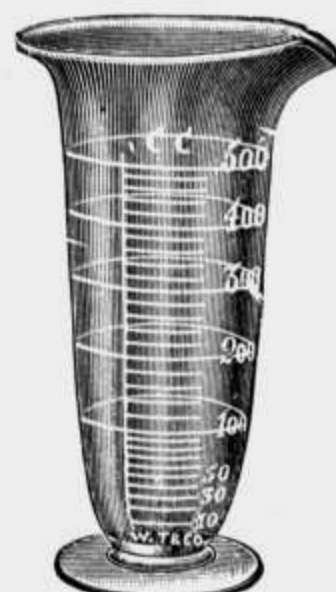
4996. Gloves, Asbestos Mittens. Per pair.....	\$ 3.35
4998. Gloves, Rubber, Acid Gloves, heavy, gauntleted.	
Sizes for women, 6 to 9. Per pair.....	2.50
Sizes for men, 10 to 12. Per pair.....	2.50
4998A. Gloves, Rubber, pure gum, short, per pair.....	1.10
Sizes 6 to 10. (Example: Kid Glove No. 8 takes Rubber Glove No. 10.)	
4999. Gold Beaters' Skin, six inches square.....	.11
5000. Goggles, Colored Glass, for protecting the eyes. Per pair.....	.27
5000A. Goggles, Rubber, with mica front, gas tight.....	1.65



No. 5001.



No. 5003.

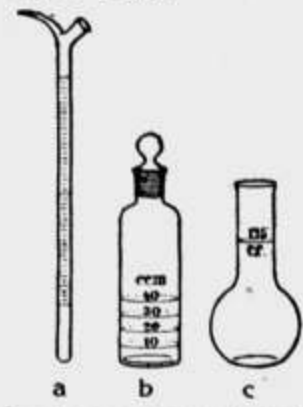


No. 5007.

5001. Graduate, Cylindrical, German. Double graduation, so that the divisions may be read up or down.	
Capacity, c.c. ....	10 25 50 100 200 250 500 1000
Each .....	.27 .35 .45 .56 .75 .80 1.05 2.00
5003. Graduate, Cylindrical, same as No. 5001, with glass stopper.	
Capacity, c.c. ....	50 100 250 500 1000
Each .....	.60 .76 1.05 1.50 2.25
5007. Graduate, glass, cone shape, metric measure.	
Capacity, c.c. ....	30 60 100 200 250 500 1000
Each .....	.25 .28 .33 .40 .55 .83 1.25
5009. Graduate, glass, cone shape, metric and English measure, double graduation.	
Capacity, ounces .....	1 2 3 6 8 16 32
Capacity, c.c. ....	30 60 100 200 250 500 1000
Each .....	.30 .37 .45 .55 .65 1.00 1.65
5009A. Enameled Graduates, page 506.	

5010. **Hardness of Water Apparatus** (Hydrotimeter). Bourdon and Bourdet's, for determination of hardness of water by means of soap solution. Consists of a burette on foot, with scale of hardness marked on, sample flask for shaking, graduation up to 40 c.c. in tenths, boiling flask of 125 c.c. with mark, with directions

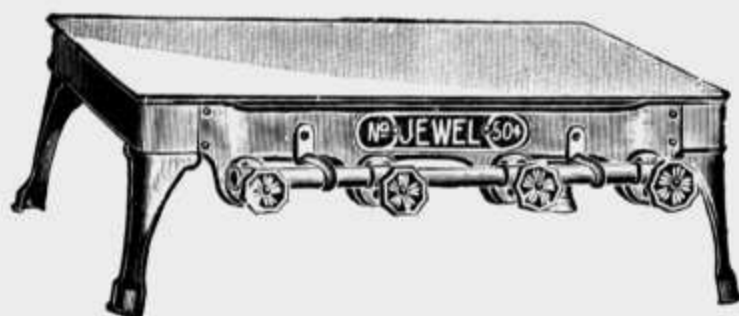
3.00



No. 5010.

5002. Normal Graduated Cylinders, page 408.





No. 5012.



No. 5014.

5012. **Hot Plates or Drying Tables** for use with gas. The top is of one piece of steel, with polished surface. The legs and frame are of cast iron. Flame easily regulated. Gives an even temperature.

Size of plate, inches.....	10 x 18½	14½ x 18½	18½ x 25½
Number of burners.....	1	2	3
Each .....Net	6.25	9.00	14.00

5013. **Hot Plates**, same as No. 5012, but for use with gasoline gas.

Size of plate, inches.....	10 x 18½	14½ x 18½	18½ x 25½
Each .....Net	6.90	10.00	15.40

**Hot Plates, Electric**, round form, free from all odor and soot and can be used without danger of fire, and do not heat up the room. Mounted on enameled slate base and furnished with six feet of cord and lamp socket plug. May be used on either direct or alternating circuits.

Catalog No.	No. of Heats	Diameter, in.	Consumption, Watts.		Price, Net
5014A.	1	4½	220		\$ 4.00
5014B.	1	6	440		6.00
5014C.	1	8	735		9.00
5014D.	1	10	1100		12.00
5014E.	1	12	1300		15.00
			Min.	Max.	
5014F.	3	4½	55	220	6.00
5014G.	3	6	110	440	8.00
5014H.	3	8	185	735	11.00
5014J.	3	10	275	1100	15.00
5014K.	3	12	325	1300	18.00



No. 5015.

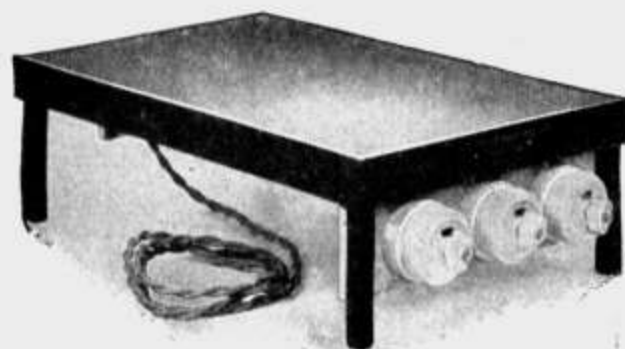
**Hot Plates, Electric**, rectangular form, with 4 feet of cord and lamp socket plug.

Catalog No.	No. of Heats	Size, inches	Consumption, Watts	Price, Net
5015A.	1	9 x 12	880	\$ 11.00
5015B.	1	12 x 18	1550	16.50
5015C.	1	18 x 24	2800	30.00
5015D.	3	9 x 12	880	13.00
5015E.	3	12 x 18	1550	18.50
5015F.	3	18 x 24	2800	34.00

Note—In ordering Electric Hot Plates, please state VOLTAGE.



No. 5016.

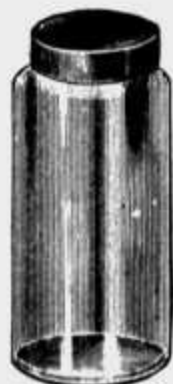


No. 5017.

5016. **Hot Plate, Electric, Hoskins'**, for use on either alternating or direct circuits. Size of plate, 12 x 12 inches. Requires only 5 amperes at 110 volts and 2½ at 220 volts. Heated at center, covering 5 inches in diameter. Will boil water in center and evaporate to dryness contents of beakers placed around the edges. Includes 6 ft. of twin-conductor flexible cord with attachment plug.....Net \$ 8.00
5017. **Hot Plate, Hoskins'**. Variable temperature. Three heats: to 177°C (350°F), to 232°C (450°F), to 288°C (550°F). Watts 600, 1200, 1800. Serviceable for continuous use; size 18x12 inches; with 6 ft. twin-conductor flexible cord. This requires use of a double pole knife switch for connection.....Net 25.00
- See also **Flask Heaters**, page 366. No. 5017C, D and E, **Hot Plates**, page 506.

**HYDROMETERS.**

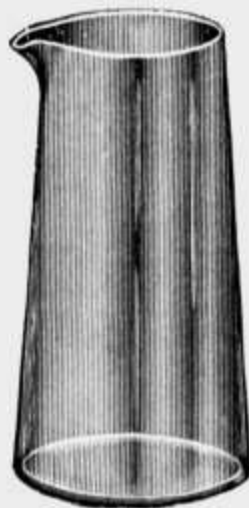
1115. **Hydrometer**, for light liquids, with Beaumé scale 70°-10°, and specific gravity scale 0.700 to 1.000..... .40
1117. **Hydrometer**, for heavy liquids, with Beaumé scale 0°-70°, and specific gravity scale 1.000 to 2.000..... .40
1119. **Hydrometer, Universal**, standard, weighted with mercury, for both light and heavy liquids, combining Nos. 1115 and 1117..... 1.00
- 5018A. **Hydrometers, Beaumé Scale**, for light liquids, 10°-30° in 1/10° divisions ..... 1.25
- 5018B. **Hydrometers, Beaumé Scale**, for light liquids, 10°-70° in 1/2° divisions ..... 1.25
- 5018C. **Hydrometers, Beaumé Scale**, for heavy liquids, 0°-70° in 1° divisions ..... .85
- 5018D. **Hydrometers, Beaumé Scale**, for heavy liquids, 10°-20° in 1/10° divisions ..... .85
- 5018E. **Hydrometers, Specific Gravity Scale**. Resistance glass; set of 13 spindles; 30 cm. long, of the following values:
- |                    |                    |                     |
|--------------------|--------------------|---------------------|
| No. 1. 0.700-0.800 | No. 5. 1.100-1.200 | No. 10. 1.600-1.700 |
| No. 2. 0.800-0.900 | No. 6. 1.200-1.300 | No. 11. 1.700-1.800 |
| No. 3. 0.900-1.000 | No. 7. 1.300-1.400 | No. 12. 1.800-1.900 |
| No. 4. 1.000-1.100 | No. 8. 1.400-1.500 | No. 13. 1.900-2.000 |
|                    | No. 9. 1.500-1.600 |                     |
- Per set ..... 15.00
- 5018F. **Hydrometers**, same as No. 5018E, per spindle. .... 1.50
- 5018G. **Normal Hydrometers**, Jena glass-16mm, set of six. The spindles have the following values:
- |                    |                    |
|--------------------|--------------------|
| No. 1. 0.700-0.850 | No. 4. 1.250-1.500 |
| No. 2. 0.850-1.000 | No. 5. 1.500-1.750 |
| No. 3. 1.000-1.250 | No. 6. 1.750-2.000 |
- With cylinder and thermometer in case.....Duty free 6.50
- \*5018H. **Normal Hydrometers**, same as No. 5018G, but with thermometer in each spindle. Per set of six, in case.....Duty free 8.00
- 5018K. **Hydrometer**, for Acids, Beaumé Scale, 0°-70° in 1° divisions..... .50
- 5018L. **Hydrometer**, for Acids, Specific Gravity Scale, to be used in Babcock Milk Test. 1800°-1850° in 2° divisions ..... .75
- 5018M. **Hydrometer**, for Alcohol, Proof & Tralle Scale..... .55
- 5018N. **Hydrometer**, for Batteries, Specific Gravity Scale. 1.050-1.300 in 5°, 7 inches long, flat body..... .85
- 5018P. **Hydrometer**, for Batteries, Specific Gravity Scale. 1.150-1.300 in 5°, round body:..... 60
- 5018R. **Hydrometer**, for Gasoline, Beaumé Scale, 40°-90° in 1°..... .75
- Hydrometer Jars**, see **Cylinders**, page 354.



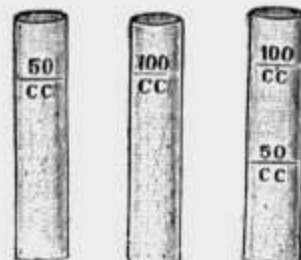
No. 5019.



No. 8091.



No. 5021.

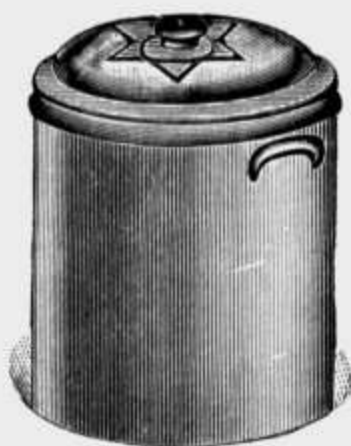


No. 5023.

5019. Jars, Specie, for collecting gases and storage of chemicals.  
 Capacity, quarts ..... 1 2 4  
 Each ..... \$0.22 .30 .45
8091. Jars, "Lightning" Sealing, for storage of chemicals, etc.  
 Capacity ..... Pint. Quart.  
 Per dozen ..... 1.50 1.65
5021. Jars, Precipitating. Capacity, pints..... 1/2 1 2  
 Each ..... .21 .27 .40
5023. Jars, Nessler's, for ammonia tests in water analysis, of clear glass with ground and polished bottoms.  
 Graduated ..... 50 c.c. 100 c.c. 50 and 100 c.c.  
 Each ..... .40 .50 .60
5024. Jar, Nessler's, tall form, 225 mm. high, graduated at 50 c.c..... \$ 0.50  
 5024A. Jars, Nessler's, same as above, but in sets of six to agree. Per set.. 2.75



No. 8095.



No. 5025.



No. 5026.

8095. Jars, Calcutt's. The best medium priced jar for storage or preservation. Made entirely of glass, so that there is no danger of corrosion from chemicals and air. Capacity..... Pint. Quart.  
 Per dozen ..... 1.50 2.00
5025. Jars, Stoneware, with handles and covers for storing of ordinary chemicals. Are preferable to a galvanized iron can for the refuse from the chemical laboratory.  
 Capacity, gallons ..... 1/2 1 2 4 6 8  
 Each ..... .33 .45 .50 .95 1.40 1.80
- Waste Can, of galvanized iron, see page 423.
5026. Jars, Stoneware, with cover and nickel plated metal stop-cock, for storing distilled water, etc.  
 Capacity, gallons ..... 3 5 8 10 15  
 Each ..... 1.40 2.00 2.75 3.20 5.50
- 5027A. Jar, Battery, round form, 4 x 5 inches, capacity 1 quart..... .17  
 5027B. Jar, Battery, round form, 5 x 7 inches, capacity 1/2 gal..... .22  
 5027C. Jar, Battery, round form, 6 x 8 inches, capacity 1 gal..... .27  
 For Hydrometer Jars, see Cylinders, page 354.  
 For Specimen Jars of all kinds. see Catalog N

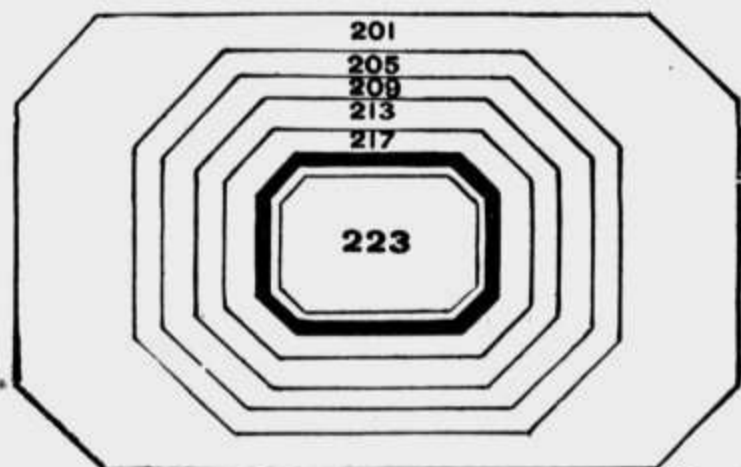


No. 5029.

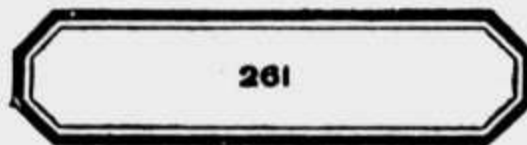
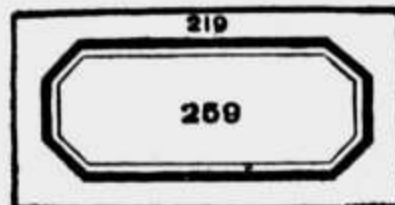


No. 5030.

5029. **Kettles, graniteware, tin cover.**  
 Capacity, quarts ..... 2            4            8  
 Each ..... \$0.40            .50            .75
5030. **Kettles, Infusion, of graniteware.**  
 Capacity of inner kettle, quarts..... 1            2            4  
 Each ..... 1.10            1.25            1.65



No. 5035.



5035. **Labels, red border, gummed, rectangular.**  
 Number ..... 223    217    213    209    205    201    261    259    219  
 Per box ..... .07    .07    .07    .07    .07    .07    .07    .07    .07
- Note—Nos. 201, 205, 209, 213, 217 and 223 are shown full size in cut.  
 No. 219 measures 18x40 mm., No. 259 measures 14x33 mm., No. 261  
 measures 15x50 mm.
5036. **Labels, red border, gummed, oval shape.**  
 Number ..... 241            239            229  
 Size, inches ..... 1/2x3/4            3/4x1 1/8            1 1/4x1 3/4  
 Per box ..... .07            .07            .07
5037. **Labels, red border, gummed, rectangular.**  
 Number ... 2001    2002    2003    2004    2005    2006    2007  
 Size, inches. 1 1/2x3 7/8    1x3 7/8    2x4 3/4    1x2 3/4    1 7/8x4    1 5/8x4    1 5/8x2 7/8  
 Per box .... .25            .21            .42            .17            .33            .30            .20

## POTASS. CHROMIUM SULPHATE

CHROME ALUM.  
 $K_2Cr_2(SO_4)_4 + 24H_2O.$

No. 5039.

5039. **Label Book, containing labels for the most used chemicals and reagents, each label having name and symbol. Gummed, perforated, and arranged so that they may easily be removed without destroying the book. [Labels should be covered with melted paraffine after being put on the bottle, to protect them from acids, etc.]**  
 Per book ..... \$ 0.45

252. **Ladle, of wrought iron, with lip, 2 1/2 inch bowl ..... .20**



No. 252.



No. 5045.



No. 5047.



No. 5049.

5045.	Lamps, Alcohol, Bohemian glass, with ground cap, wick and wick holder.		
	Size, ounces .....	4	8
	Each .....	\$0.25	.40
5047.	Lamps, Alcohol, Bohemian glass, with side tubulation glass stoppered, ground cap, wick and wick holder.		
	Size, ounces .....	4	8
	Each .....	.40	.50
5049.	Lamps, Alcohol, brass, with cap and wick.		
	Size, ounces .....	2	4
	Each .....	.45	.50



No. 5050.

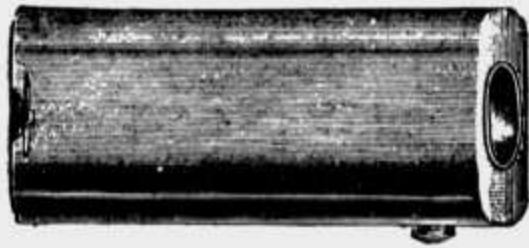


No. 5054.

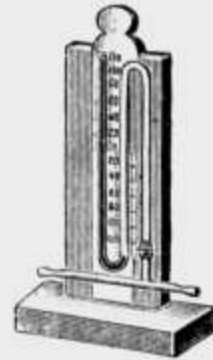


No. 5055.

5050.	Lamp, Alcohol, glass, with nine facets on the font, so that it can instantly be adjusted to any position. This lamp has a wick 1/2 inch in diameter, and will therefore give a much more powerful flame than the ordinary alcohol lamp. We recommend this lamp as the most satisfactory substitute for gas. Each.....	\$	1.00
5051.	Lamp Wicks, for alcohol lamps Nos. 5045-5049. Per dozen.....		.08
5051A.	Lamp Wicks, for alcohol lamp No. 5050. Per dozen.....		.50
5052.	Lamp Wick Holders, brass, for Nos. 5045 and 5047. Per dozen.....		.20
5053.	Lamp Caps, glass, for No. 5045 or No. 5047, 4 oz. size. Per dozen.....		.85
5053A.	Lamp Caps, glass, for No. 5045 or No. 5047, 8 oz. size. Per dozen.....		.85
5054.	Lamp, Alcohol Stove, of brass, nickel plated. A powerful burner producing more heat than any other alcohol stove. Adopted by U. S. army and most European armies. It generates its own gas, has an invisible wick which never requires renewal, is smokeless and odorless. Weight, 8 ounces; capacity, 7 ounces.....		1.00
5055.	Lamp, Illuminating, for laboratory tables; height, 12 inches.....		.83
5055A.	Lamp, Illuminating, similar to No. 5055, but with Welsbach burner and mica chimney, as used at the University of Chicago. Height, 10 inches from table to center of light.....		2.25



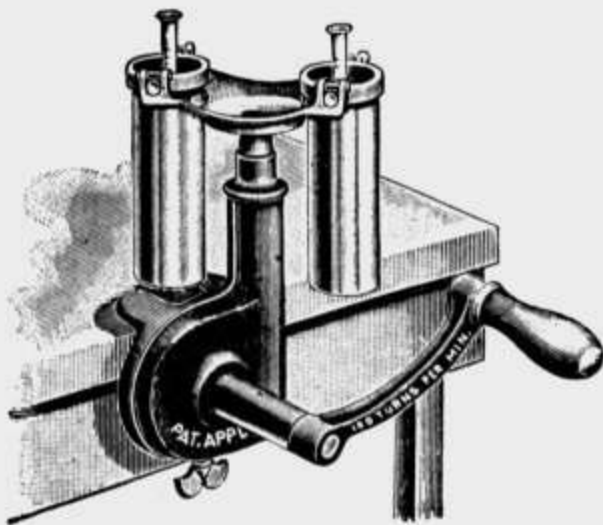
No. 5055B.



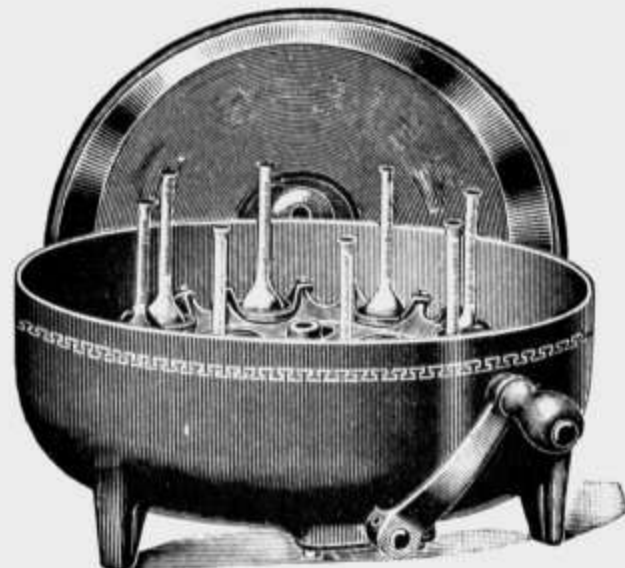
No. 5055D.

- 5055B. Lamp, Pocket Flash, for use in store rooms. Nickel plated case  $1\frac{1}{2} \times 2\frac{7}{8}$  inches, with TUNGSTEN bulb, and battery..... \$ 1.33
- 5055C. Extra Batteries for No. 5055B, each..... .40
- Lamps. Blast, see pages 318 to 320.
- Litmus Paper, see page 392.
- Litmus Pencils, see page 392.
- Magnets, see page 137.
- 5055D. Manometer, mounted on stand, with movable mirror scale and glass stopcock; filled with mercury..... 6.67

**MILK ANALYSIS APPARATUS.**



No. 5056.



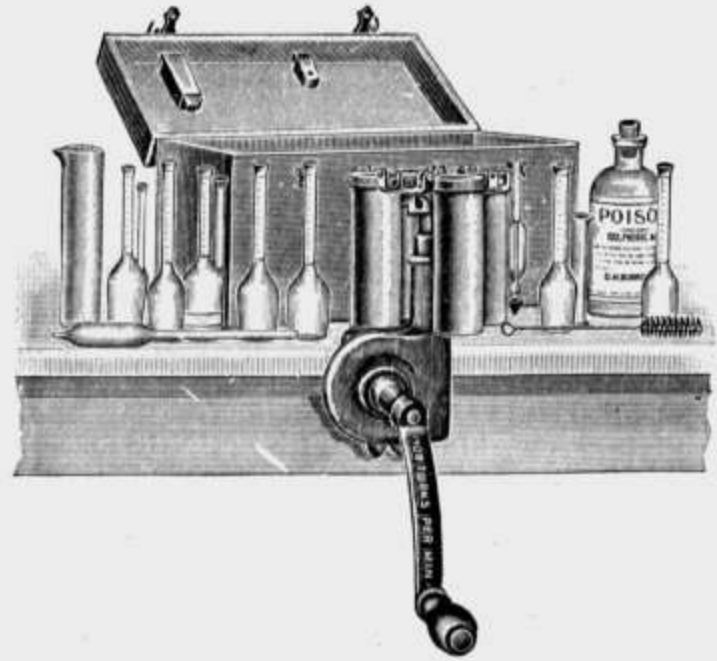
No. 5058.

5056. Babcock Milk Tester, for hand power. Turns very easily, without vibration or jar, and can be readily attached for operation to any bench or table. Deep seamless brass swinging pockets are provided. The head is so constructed that it may be rotated at all speeds without danger of its flying off. Includes full set of glassware, consisting of test bottles, pipette and acid measure, test bottle brush and full directions for use. Two-bottle machine complete for testing milk ..... Net 4.00
- 5056A. Babcock Milk and Cream Tester, same as No. 5056, with addition of two cream test bottles and combined pipette for cream testing. Complete ..... Net 4.50
5057. Babcock Milk and Cream Tester. Same as No. 5056A, but four-bottle size. With extra glassware complete.....Net 5.50
5058. Babcock Milk Tester, Improved Iron Frame. Handsome iron case and cover, cut spur and worm gearing, pressed bottle carriers, seamless, brass detachable swinging pockets for holding test bottles, enclosed gearings. Bottles perfectly horizontal when rotating. Turns easily and runs smoothly and noiselessly at very high speed. Prices include full set glassware, comprising test bottles, pipette and acid measure, test bottle brush and full directions for tests.
- |                        |      |       |       |       |
|------------------------|------|-------|-------|-------|
| Number of bottles..... | 6    | 8     | 10    | 12    |
| Each .....             | 9.00 | 10.00 | 12.00 | 14.00 |
5059. Bottle of Acid.....Net .35

NOTE: We no longer furnish Acid with the Testers as the Interstate Commerce Regulations prescribe that it must be sent under a separate bill of lading.



No. 9601.



No. 9605.

9601. Babcock Milk Tester, motor driven, same style as No. 5058, with motor and starting box mounted on the tester frame. Speed 200-1200 R. P. M.

Number of bottles.....	6	8	12
110 volt D. C. ....Net	\$44.00	45.00	49.00
110 volt A. C., 60 cycle...Net	59.00	60.00	64.00

9603. Babcock Test Traveling Outfit, consists of No. 5056 Babcock Tester and following accessories:

3 Babcock Full Milk Test Bottles.	1 Glass Thermometer.
2 Cream Test Bottles.	1 Bottle Acid.
2 Double Neck Skim Milk Bottles.	1 Acid Measure.
1 Cream and Milk Pipette.	1 Small Quevenne's Lactometer.
1 Test Bottle Brush.	1 Copy "Milk and Cream Testing."

In handsomely finished hardwood case with separate compartments for glassware and acid .....Net \$ 9.00

9605. Traveling Outfit, same as No. 9603, but with No. 5057 Babcock Tester; four bottle .....Net 10.00



No. 5060A.



No. 5060B.

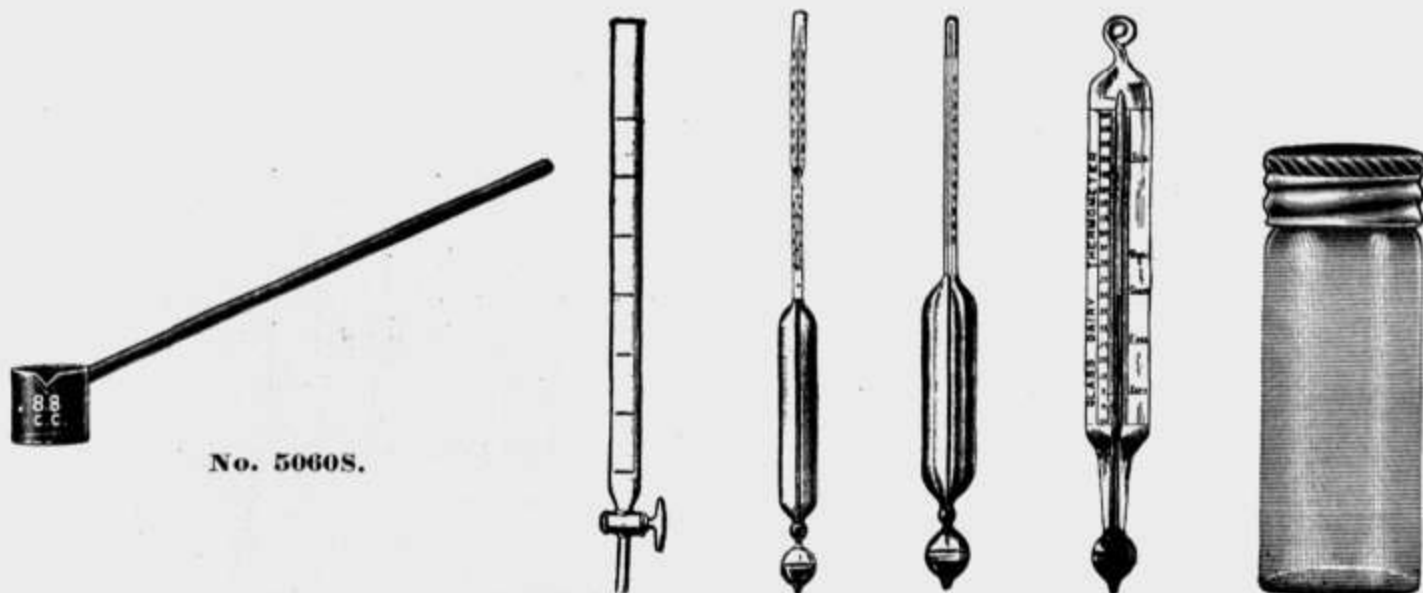


No. 5060F.

5060A. Milk Test Bottle, 10 per cent. Graduated to 1/5 per cent.....	.17
5060B. Cream Test Bottle, 30 per cent. Graduated to 1/2 per cent.....	.22
5060C. Cream Test Bottle, 40 per cent. Graduated to 1 per cent.....	.22
5060D. Cream Test Bottle, 50 per cent. Graduated to 1 per cent.....	.22
5060E. Cream Test Bottle, 50 per cent. 9 gram bottle, graduated to 1/2 per cent.	.25
5060F. "Perfect" Skim Milk Bottle, graduated to 1/100 per cent.....	.60
5060G. Cream Test Bottle, 30 per cent. 9 inch, graduated to 1/5 per cent.....	.40
5060H. Cream Test Bottle, 50 per cent. 9 inch, graduated to 1/2 per cent.....	.30
5060J. Cream Test Bottle, 55 per cent. 9 inch, graduated to 1/2 per cent.....	.30
5060K. Cream Test Bottle, 100 per cent. 9 inch, graduated to 1 per cent.....	.45

Milk Dish, of Aluminum, see No. 4853.

For Brushes especially adapted for cleaning above bottles, see No. 5060Z.



No. 5060S.

No. 5060T. No. 5062. No. 5063. No. 5064. No. 5065.

5060L. Pipette, for milk, 17.6 c.c. ....	\$	0.15
5060M. Pipette, for cream, 18 c.c. ....		.15
5060N. Pipette, 17.6-18 c.c. combined. ....		.19
5060P. Pipette, 9 c.c. ....		.15
5060Q. Pipette, 8.8 c.c. ....		.17
5060R. Acid Dipper (Nafis' Style), 17.5 c.c. ....		.40
5060S. Acid Dipper (Nafis' Style), 8.8 c.c. ....		.40
5060T. Acid Burette.		
Number of charges.....	3	6
Each .....	2.00	2.25
		12
		25
		4.45
5060U. Acid Measures, cylindrical jar with lip, 17.5 c.c. ....		.17
5060V. Butter Fat Oil Test Tubes, plain, 9x $\frac{3}{4}$ inches. Per dozen.....		1.00
5060W. Butter Fat Oil Test Tubes, with line 5 inches from bottom. Per dozen.....		1.00
5060Y. Cream Test Tubes, heavy, for samples, 5x1 $\frac{1}{4}$ inches. Per dozen.....		.55
5060Z. Brushes for cleaning milk test bottles. Per dozen.....		.55
5060ZX. Brushes for cleaning cream test bottles. Per dozen.....		.55
169. Brass Dividers, 4 $\frac{1}{2}$ inches, for reading graduations on test bottles....		.25
9606. Casein Tube, Hart's, for estimating of casein in milk.....		.60
5061. Lactometer, graduated 0° to 120° in 2° divisions.....		.45
5062. Lactometer, Quevenne's combined lactometer with thermometer.....		1.60
5063. Lactometer, N. Y. State Board of Health Pattern, with thermometer.....		1.65
9615. Lactometer, Spence's, combined with thermometer and correction scale, 0°-120° in 1 degree divisions, with certificate.....		3.25
5063A. Creamometer, Chevalier's, to show percentage of cream.....		.67
5064. Thermometer for dairy use; 8 inches long, weighted to float upright.		.30
5065. Aluminum Screw Cap Bottles for holding samples of cream. With cork washer. One ounce capacity. Per dozen.....		.90
5066A. Corrosive Sublimate Tablets for keeping milk samples sweet. Used in making composite tests. Small size, will keep samples sweet for two weeks. Per box of 50 tablets.....		.22
5066B. Corrosive Sublimate Tablets, large size, will keep samples sweet for four weeks. Per box of 50 tablets.....		.33
5066C. Alkaline Tablets, Farrington's. Per box of 50 tablets.....		.25
5066E. Acid Pipette, Automatic, Farrington's. Consists of a two-neck Woulff bottle, one neck being fitted with a No. 5124 Automatic Pipette, delivering 17.6 c.c.; the other neck with a No. 4613 Double Rubber Bulb. Complete .....		4.00



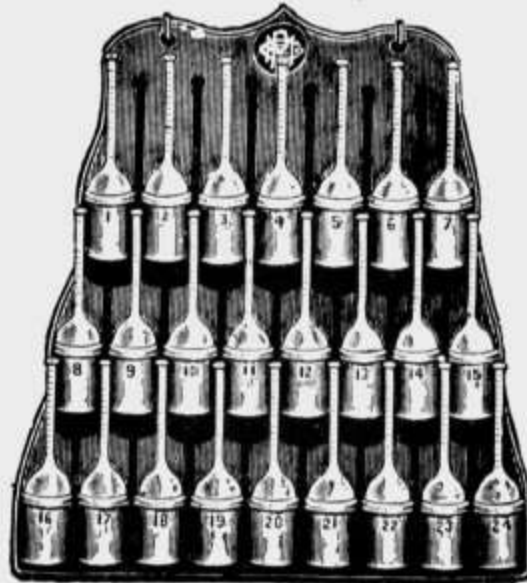
No. 5067.

5067. Slide Scale, Richmond's, for calculating the total solids in milk, with scale for temperature correction of specific gravity. Each.....	\$	3.50
Refractometers for Butter Examination, see page 400.		
For Scales for Cream Testing, see pages 297-8.		





No. 9608.



No. 9611.

9607. **Fat Extracted Paper**, for Milk Analysis, Schleicher & Schuell's No. 571, for determination of fat, according to Adams' method. Per box of 50 strips, 560x65 mm. . . . . \$ 1.95
9608. **Combined Acid Bottle**. By tipping the bottle forward and then letting it come back to upright position the pipette will fill with the requisite amount of acid. . . . . 3.35
- 9608A. **Acid Bottle Trunnion**. Convenient for handling No. 9608 Acid Bottle. Base of wood covered with lead, which is not acted on by sulphuric acid. Bottle automatically returns to position after tipping. . . . . 1.15
9611. **Babcock Test Bottle Rack**, of tin. Hangs flat against the wall; the bottles stand upright and are easily filled. Capacity, 24 bottles. . . . . 2.25
9613. **Milk Bottles**, for composite tests. These are the cheapest and best sample bottles in use and being made of the best flint glass will stand much hard usage.
- |                           |     |     |      |
|---------------------------|-----|-----|------|
| Capacity, pints . . . . . | 1/2 | 1   | 2    |
| Per dozen . . . . .       | .66 | .80 | 1.25 |

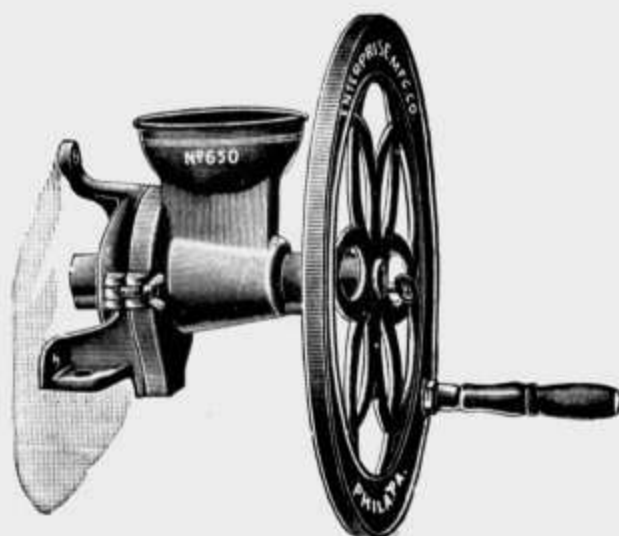
5068. **Mill**, with conical plate, for general work; very simple, strong and easily adjusted. Can readily be taken apart; all parts are interchangeable. Any degree of fineness may be obtained and parts can be readily cleaned. Mounted on separate stand, with dustproof box, and 22 inch hand wheel. . . . . Net 35.00
- 5068A. **Mill only** of No. 5068, for bolting direct to table . . . . . Net 28.50



FIG. 1  
No. 5068.



No. 5068B.



No. 9123.

5068B. **Mill, Laboratory and Drug**, for grinding herbs, roots and other dry substances.

No. ....	2	3	5	7
Height, inches .....	12½	15	17	20
Each .....	Net \$4.25	6.00	8.25	9.00

9123. **Mill, Grinding and Pulverizing**, for pulverizing soils ready for the sieves. Will also grind dry bones, corn, rock phosphates, etc. Height, 11 inches; length, 12 inches; width, 9 inches; diameter of throat, 3x2 inches; wheel, 19 inches diameter; weight, 47½ lbs. Compact, strong and durable.....

7.50

These Mills can be furnished for power fitted with 12x3 inch single pulley for \$5.00 extra, or with double pulley for \$10.00 extra.

9312. **Moisture Apparatus**. For the determination of moisture in grain. (See Bulletin No. 99 and Circular No. 72, Bureau of Plant Industry, U. S. Department of Agriculture.) Evaporating chambers of asbestos board; Bunsen burners with stopcock, adjustable in height; condensing tank of copper; special glass flasks of Jena glass and graduated cylinders. With three compartments complete with glassware, but without thermometers .....

65.00

9312A. **Moisture Apparatus**. Same as No. 9312, but with six compartments. Complete with glassware, but without thermometers .....

77.75

9312B. **Flasks only** of Nos. 9312 and 9312A, Jena glass, 1000 c.c. Each .....

1.15

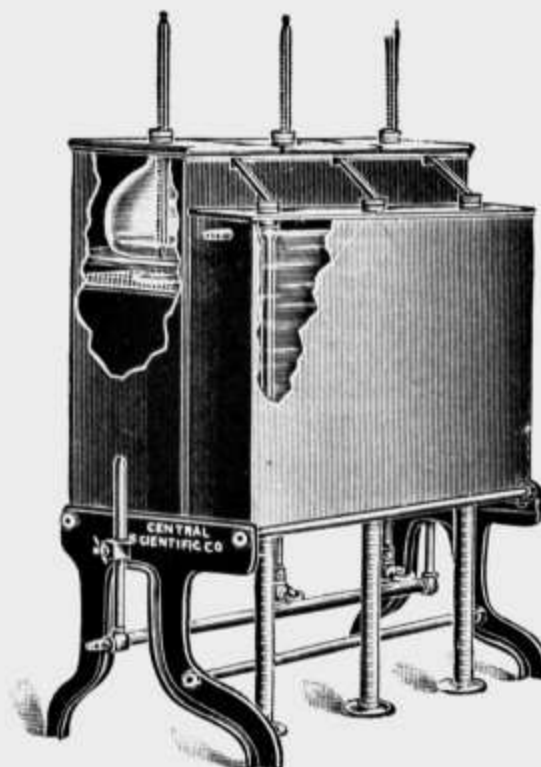
9312C. **Graduated Cylinders only** of Nos. 9312 and 9312A; capacity, 25 c.c., graduated in ½ c.c. Each.....

.67

9312D. **Thermometers**, 0° to 200° Centigrade. Special design for Moisture Apparatus. Each .....

2.00

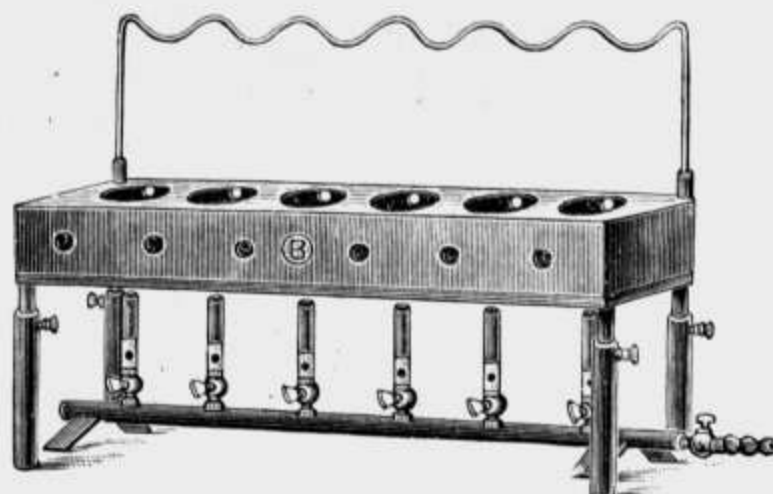
SEE NEW MOISTURE TESTERS on page 511.



No. 9312.



**NITROGEN DETERMINATION APPARATUS.**

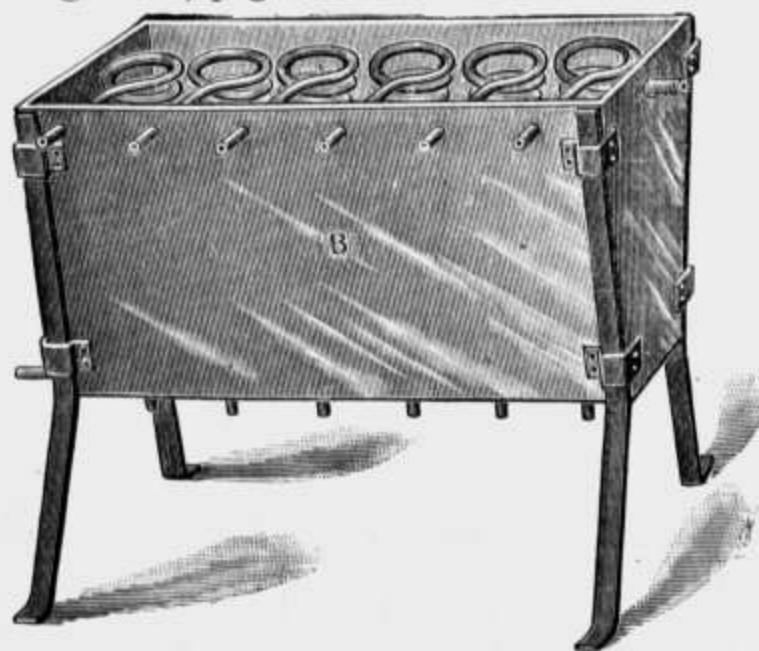


**No. 5086.**

5086. **Digesting Shelf** (Kjeldahl's), oblong form, made of sheet iron, with rod to support flasks. The shelf is supported on adjustable legs. Six burners in a row with stop-cocks. Size of apparatus, 24 inches long, 5½ inches wide, 9½ inches high..... \$ 15.00

5086A. **Digesting Shelf** (Kjeldahl's), same as above, with 10 burners. Size of apparatus, 40 inches long, 5½ inches wide, 9½ inches high..... 20.00

5087. **Electric Digesting Shelf**, page 507.



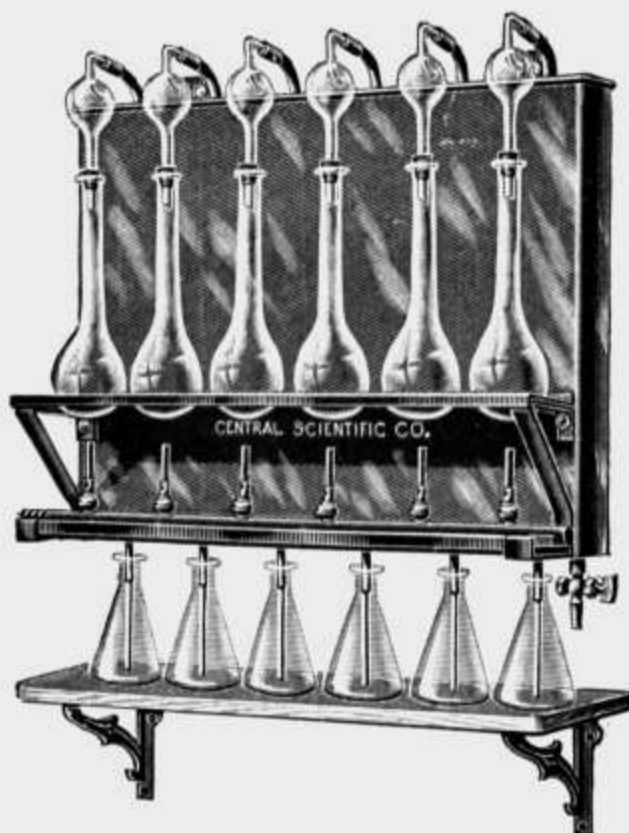
**No. 5088.**

5088. **Condenser** (Kjeldahl's), copper, tin lined, with six coils of pure block tin tubing. Size of apparatus 24 inches long, 6½ inches wide, 14 inches deep; height, including legs, 24 inches..... 22.00

5088A. **Condenser.** (Kjeldahl's), same as No. 5088, but with 10 coils. Size of apparatus, 40 inches long, 6½ inches wide, 14 inches deep; height, including legs, 24 inches ..... 35.50

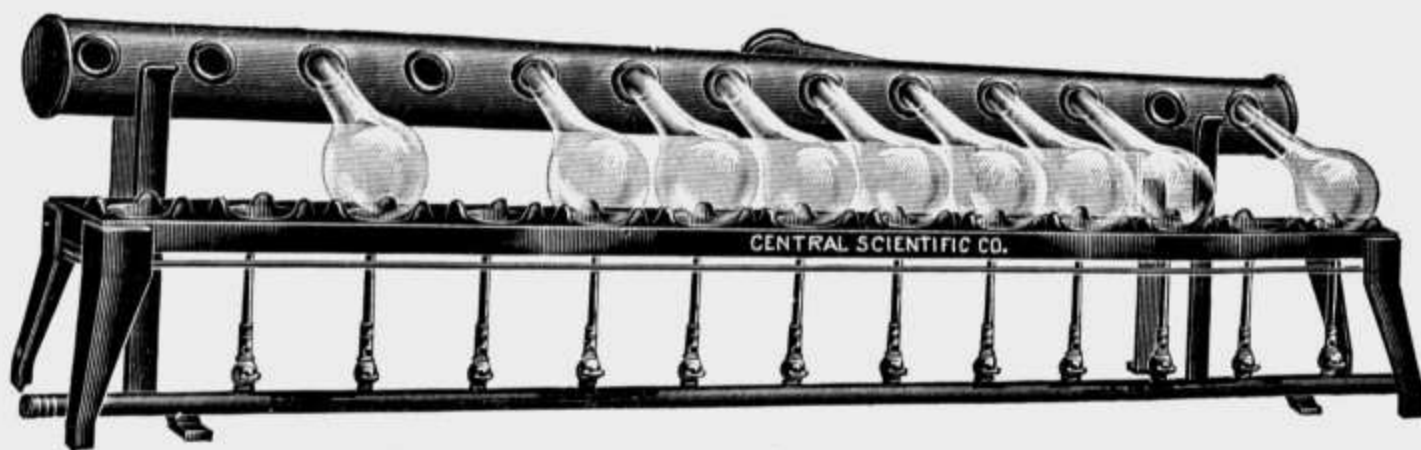
5090. **Kjeldahl's Apparatus**, consists of No. 5086 Digesting Shelf (6 burners) and No. 5088 Condenser ..... 37.00

5090A. **Kjeldahl's Apparatus**, consists of No. 5086A Digesting Shelf (10 burners) and No. 5088A Condenser ..... 55.50



No. 5092.

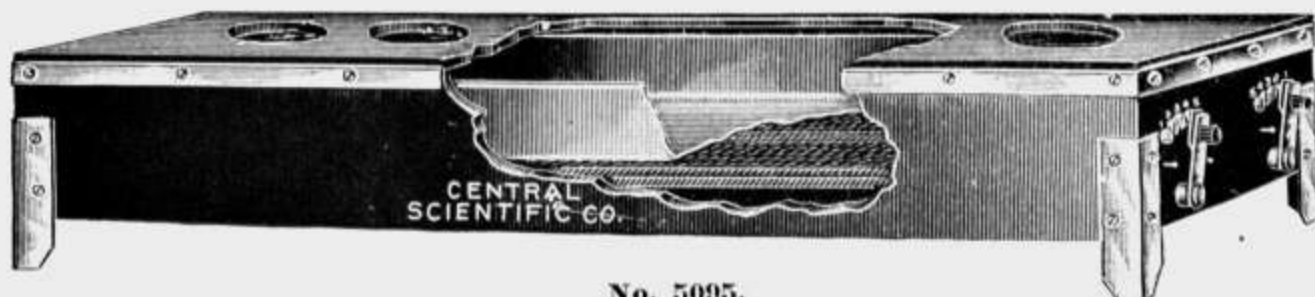
5092. **Distilling Apparatus, Kjeldahl's, wall form.** The most convenient form of this apparatus offered. All working parts of the apparatus are readily accessible from the front. The burners are provided with stop-cocks for individual regulation so that any or all of the burners may be used at once. The condenser tank is of heavy copper with block tin condenser tubes. With 6 burners but without glassware ..... \$ 42.00
- 5092A. **Distilling Apparatus, Kjeldahl's, same as No. 5092, but with burners for gasoline gas** ..... 42.00



No. 5094.

5094. **Digesting Shelf, Johnson's, as used in Agricultural Experiment Stations.** Shelf of iron about 60x6x8½ inches high, with 13 holes 4½ inches from center to center, of such shape as to support Kjeldahl flasks. The necks of the flasks rest in holes in a large lead tube connected with a chimney so that all fumes are carried away. Complete with 13 stop-cock Bunsen burners, but without flasks or lead pipe ..... 21.00
- 5094A. **Lead Tubing, for use with No. 5094.**

Diameter inside, inches.....	3½	4
Per foot .....	.55	.83

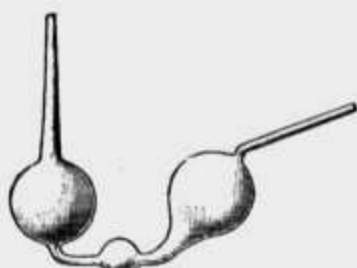


No. 5095.

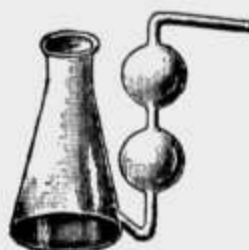
5095. **Electric Heater, for Volatile Fluids** (after designs by Prof. W. H. Ross of the University of Arizona). A box 80x20x12 cm. of asbestos board containing a system of resistance coils, above which is supported a sheet iron pan. The top of the outer box is removable and has six openings through which pass the flasks of the extraction apparatus which rest on the bottom of the iron pan below. The flasks thus rest on a hot plate and are surrounded by a heated atmosphere so that little current is needed. A simple switch arrangement permits the use of currents of from 1 to 4 amperes at 110 volts, the change from minimum to maximum being made in nine steps if desired. This gives a wide range of temperature so that not only ether but acetone, chloroform and other solvents may be used. After extraction the solvent may be evaporated without danger of ignition. With top removed the heater becomes an ordinary hot plate. By placing a liquid in the iron box the heater becomes a liquid bath. Complete with covers for holes.... \$ 27.75
- 5095A. **Electric Heater**, page 361A.



No. 5096.



No. 5097.



No. 5098.

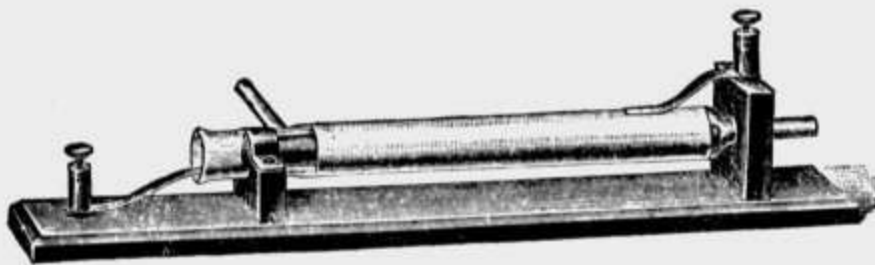


No. 5099.

5096. **Connecting Bulbs, Kjeldahl's, modified by Hopkins**..... .60
- 4906A. **Flasks, Kjeldahl's, digesting and distilling, pear shaped, extra long neck. New Jena glass.**
- |                     |     |     |       |  |
|---------------------|-----|-----|-------|--|
| Capacity, c.c. .... | 200 | 500 | 1,000 |  |
| Each .....          | .25 | .42 | .65   |  |
5097. **Nitrogen Bulbs, Will-Varrentrapp's** ..... .30
5098. **Nitrogen Bulbs, Fresenius'** ..... .45
5099. **Nitrogen Bulbs, Volhard's** ..... .40

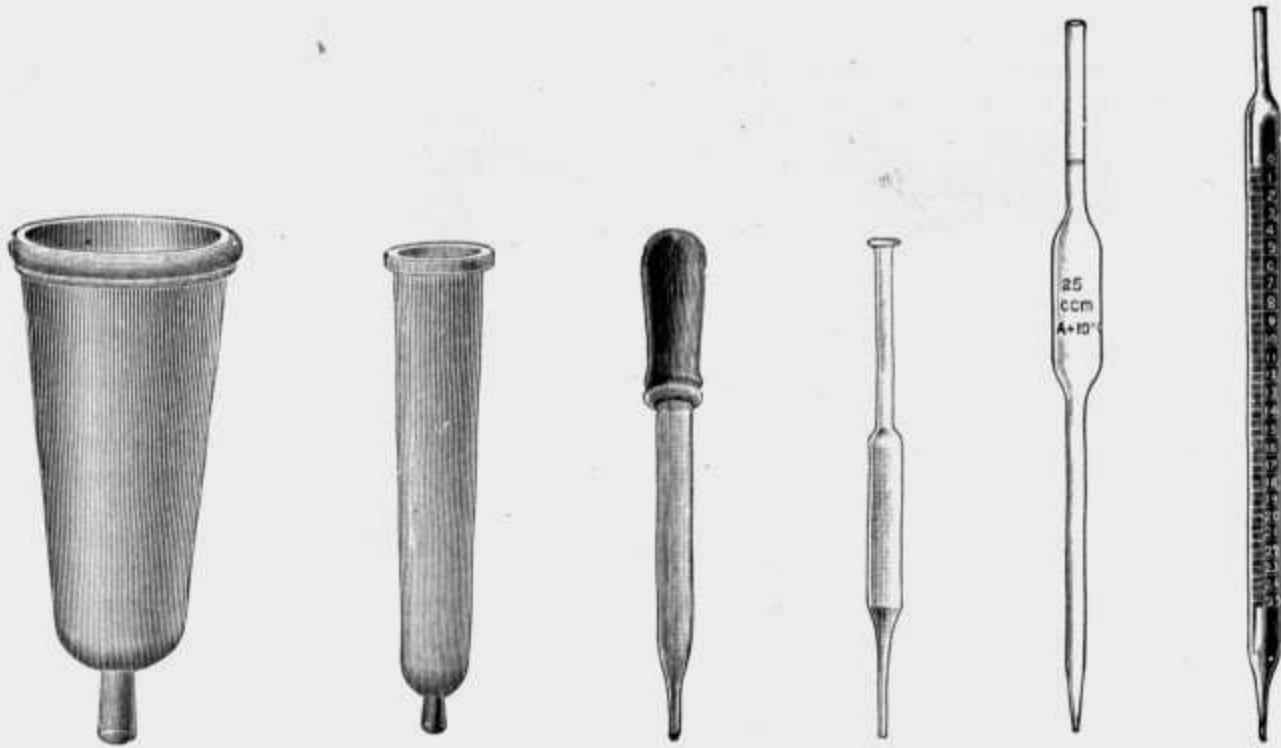


No. 5100.



No. 5101.

5100. **Nitrometer, Schiff's, graduated to 100 c.c., on support with reservoir and clamp and connections** ..... 5.55
5101. **Ozone Apparatus, Siemens', for showing the formation of ozone by the discharge of an electric current. Complete on wooden support** ..... 5.25



No. 5109.                      No. 9205.                      No. 5111.                      No. 5117.                      No. 5121.                      No. 5123.

5102.	Paper, Congo Red.	Per sheet, \$0.05; per quire.....	\$	0.90
5102A.	Paper, Glazed, white, for collecting filter ashes, etc.; in sheets 10 x 12 inches.	Per quire .....		.25
5102B.	Paper, Glazed, yellow.	Per quire.....		.25
5102C.	Paper, Glazed, black.	Per quire.....		.25
5102D.	Paper, Litmus, blue.	Per sheet, .04; per quire.....		.67
5102E.	Paper, Litmus, blue, in books of 25 strips.	Per book.....		.06
5102F.	Paper, Litmus, blue, in glass vials, containing 100 strips each.....			.38
5102G.	Paper, Litmus, blue, in tape form, perforated strips in small tin box of 100 strips.	Each .....		.10
5102H.	Paper, Litmus, red.	Per sheet, .04; per quire.....		.67
5102J.	Paper, Litmus, red, in books of 25 strips.	Per book.....		.06
5102K.	Paper, Litmus, red, in glass vials, containing 100 strips.	Each.....		.08
5102L.	Paper, Litmus, red, in tape form, perforated strips in small tin box of 100 strips.	Each .....		.10
5102M.	Paper, Logwood.	Per sheet, .05; per quire.....		.90
5102N.	Paper, Parchment, vegetable, per pound.....	Net		.40
5102P.	Paper, Parchment, genuine animal product.	Per sheet, 17x22 inches.		1.10
5102Q.	Paper, Turmeric.	Per sheet, .05; per quire.....		.85
5102R.	Paper, Wrapping, genuine Swedish Kraft, in rolls.	Width, inches .... 9            15            24            30            36		
		Each .....	1.00    1.60    3.00    3.80    4.40	
5102S.	Paper Racks, with cutter, for holding No. 5102R, to be screwed to table.	Any size .....		2.00
5103.	Pencil, Blue, for writing on glass, porcelain, etc. (Red and Yellow, page 507) .....			.17
5105.	Pencil, Litmus, chemically pure litmus, made like an ordinary lead pencil, one end blue, the other end red.....	Net		.25
5109.	Percolators, heavy glass, conical shape.	Capacity .....	1 pint.    1 quart.	
		Each .....	.27        .40	
9205.	Percolators, Oldberg's, heavy glass, narrow form, almost cylindrical.	Capacity .....	½ pt.    1½ pt.    2½ pt.	
		Each .....	.30        .40        .55	
6207.	Pipes, Clay, per dozen.....			.16
5111.	Pipettes, Medicine Droppers, rubber bulb, per dozen.....			.30
5117.	Pipette, long bulb, small.....			.09
5119.	Pipette, long bulb, large.....			.10
5121.	Pipettes, Volumetric, accurately graduated.	Capacity, c.c. ... 1    5    10    12    15    20    25    30    50    75    100    200		
		Each .....	.09    .13    .17    .20    .21    .22    .27    .30    .33    .40    .45    .60	
5123.	Pipettes, Mohr's, accurately graduated in $\frac{1}{10}$ c.c.	Capacity, c.c. .... 1    2    5    10    20    25    50		
		Each .....	.22    .27    .37    .44    .55    .67    1.00	

Normal Pipettes, page 408.



No. 5124.



No. 5126.



No. 5129.



No. 5365.

5124. **Pipette, Overflow, Automatic**, with patent three-way stop cock, and reservoir for collecting the excess.
- |                     |        |      |      |
|---------------------|--------|------|------|
| Capacity, c.c. .... | 10     | 25   | 50   |
| Each .....          | \$2.00 | 2.25 | 2.50 |
- 5124A. **Pipette, Overflow, Automatic**, same as No. 5124 with capacity of 17.6 c.c. for milk testing. .... \$ 2.25
5126. **Pipette Rest**, of porcelain. .... 0.55
5365. **Pipette Support**, revolving, for 12 pipettes. .... 2.25
5127. **Plates, Glass**, of blue cobalt glass.
- |                    |     |     |     |     |     |
|--------------------|-----|-----|-----|-----|-----|
| Size, inches ..... | 2x2 | 2x3 | 3x3 | 3x4 | 4x4 |
| Each .....         | .04 | .05 | .06 | .07 | .08 |
5128. **Plates, Glass**, circular, for covering beakers, dishes, etc.
- |                    |     |     |     |     |     |
|--------------------|-----|-----|-----|-----|-----|
| Diameter, cm. .... | 6   | 8   | 10  | 12  | 15  |
| Each .....         | .04 | .05 | .08 | .09 | .13 |
5129. **Plates, Glass**, same as No. 5128, but with hole at side for stirring rod.
- |                    |     |     |     |     |     |
|--------------------|-----|-----|-----|-----|-----|
| Diameter, cm. .... | 6   | 8   | 10  | 12  | 15  |
| Each .....         | .21 | .25 | .28 | .30 | .35 |
- Plates, Glass**, all colors, see page 262.
5130. **Plates, Glass**, square, for covering beakers, etc.
- |                    |     |     |
|--------------------|-----|-----|
| Size, inches ..... | 4x4 | 6x6 |
| Per dozen .....    | .27 | .55 |
5131. **Plates, Glass**, ground on one side, for covering jars, etc.
- |                    |     |     |     |     |     |       |
|--------------------|-----|-----|-----|-----|-----|-------|
| Size, inches ..... | 2x2 | 3x3 | 4x4 | 6x6 | 8x8 | 10x10 |
| Each .....         | .04 | .05 | .06 | .09 | .15 | .25   |
5133. **Plate, Porcelain**, 8½x11 cm., with 6 cavities, for color reaction. Each. .40
5134. **Plate, Porcelain**, glazed, square, 6x6 inches. .... .75
- 5134A. **Plate, Porcelain**, glazed, round, 6 inches diam. .... .75
4206. **Plate, Porcelain**, unglazed, for arsenic test (Streak Plate), 6x10 cm... .17
5135. **Plate, Porous Clay**, for quickly drying precipitates and crystals; diameter 8 inches; shape of a soup plate. .... .13
- Physical Chemistry Apparatus**, according to Ostwald, Luther, Arrhenius, Kohlrausch, McCoy and others, will be found listed on pages 427 to 436.



### PLATINUM WARE.

Our platinum ware is from the celebrated works of Baker & Co., and is warranted pure and of the most approved shapes. Dishes and crucibles are all hammered and thoroughly tested after being finished. Special apparatus made to order. Old or scrap platinum bought at the highest market price. Weights given below are approximate only.

Prices Will Be Governed by the Market Price of Platinum.



No. 5150.



No. 5150A.



No. 5150B.



No. 5150C.



No. 5150D.

- 5150. Platinum Anodes, elongated spiral form. Weight about 8 grams.
- 5150A. Platinum Anodes, flat spiral form. Weight about 10 grams.
- 5150B. Platinum Electrodes, cylindrical form, closed. Cylinder 2x1 inches. Weight about 12 grams.
- 5150C. Platinum Electrodes, cylindrical form, open. Same size and weight as No. 5150B.
- 5150D. Platinum Electrodes, conical form. Cylinder about 3x2¼ inches. Weight about 20 grams.

5151. Platinum Blow Pipe Tip, for Plattner's blow pipe. Each, Net about \$1.50.



No. 5151.



No. 5153.

- 5153A. Platinum Boat, for combustion, 1½x½x¾ in. Approx. Wt., 2.8 grams.
- 5153B. Platinum Boat, for combustion, 2 x½x¾ in. Approx. Wt., 3.6 grams.
- 5153C. Platinum Boat, for combustion, 3 x½x¾ in. Approx. Wt., 5.8 grams.
- 5153D. Platinum Boat, for combustion, 3¾x½x¾ in. Approx. Wt., 6.3 grams.



No. 5155.



No. 5157.



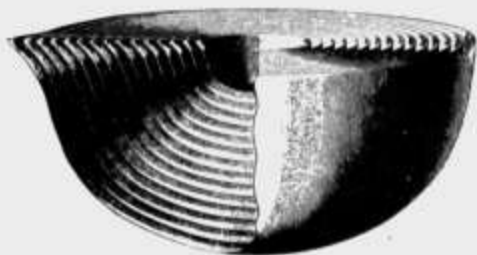
No. 5159.

- 5155. Platinum Cones. Seamless filter cones, 60°, profusely perforated.
 

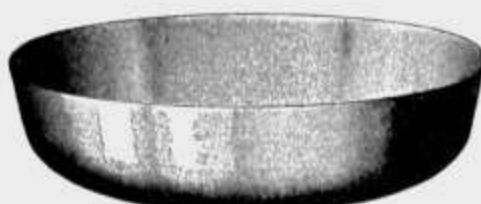
Diameter, inches	¾	1	1¼	1½
Approximate weight, grams	1	2.1	3.1	5.3
- 5157. Platinum Crucibles, with cover. Crucible and cover weigh about as many grams as they hold cubic centimeters.
 

Capacity, c.c.	8	10	15	20	25	30
Approximate weight, grams	8	10	15	20	25	30
- 5159. Platinum Crucibles, Gooch's, with perforated bottom, cover and cap for bottom.
 

Capacity, c.c.	10	15	20	25
Approximate weight, grams	13	18	22	29



No. 5161.



No. 5162.

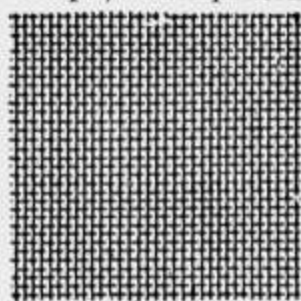


No. 5162A.

5161. **Platinum Dishes**, evaporating, round bottom, with lip.  
 Capacity, c.c. .... 15 20 25 35 50 75 100  
 Diameter, mm. .... 38 42 44 48 56 65 72  
 Approximate weight, grams..... 5 6 8 12 17 25 33
5162. **Platinum Dish**, for water analysis. Capacity 100 c.c. Approximate weight 20 grams.
- 5162A. **Platinum Dish**, for milk analysis. Capacity 45 c.c. Approximate weight 17 grams.

5163. **Platinum Foil**.  
 Size ..... Light. Medium. Heavy.  
 Thickness, in. .... .001 .002 .004  
 Approx. grams per square inch.... 0.353 0.705 1.411

Forceps, with platinum tips, see page 368.



No. 5165.



No. 5166.



No. 5167.

5165. **Platinum Gauze**.  
 45 mesh, No. 31 wire, 1,500 grams per square inch.  
 52 mesh, No. 38 wire, 0,543 grams per square inch:
5166. **Platinum Spatulas**, stock sizes, 2½ and 4 inches long, weighing approximately 5 and 8 grams.
5167. **Platinum Spoons**, for deflagration in blow pipe analysis.

Diam. of Bowl, inches	Depth, inches	Approx. Weight, grams.
¼	⅜	0.9
⅜	½	2.0
½	⅝	4.2
⅝	¾	4.6
¾	⅞	6.5

5169. **Platinum Sponges**, wired, for hydrogen ignition. Each.....Net \$ 1.00  
**Tongs**, with solid platinum tips, see page 419.

5170. **Platinum Triangles**, with flat, solid ends.  
 For crucible, c.c..... 10 15 20 30  
 Side, inches ..... 1½ 1⅝ 1⅞ 2¼  
 Approx. weight, grams. 5 8 11 12

For **Triangle Holder** for above triangles, see page 420.

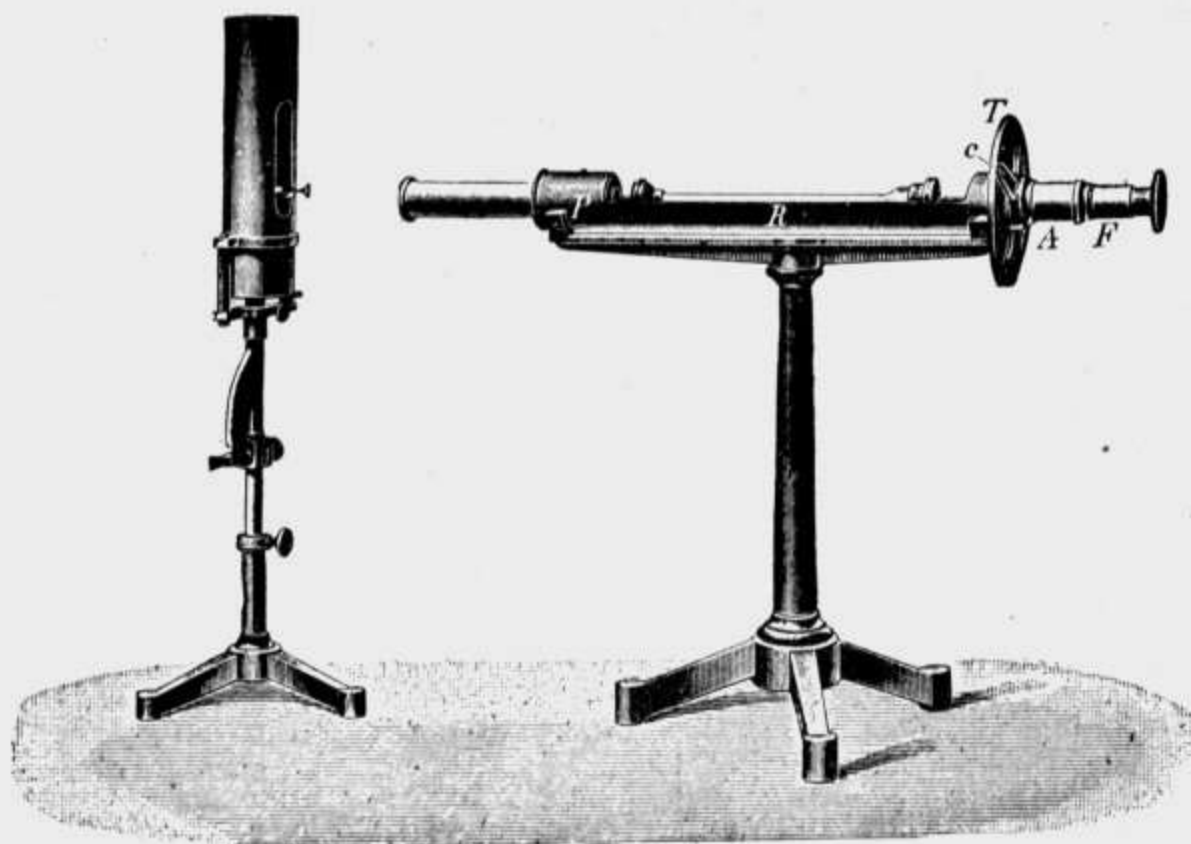


No. 5170.

5171. **Platinum Wire**.

B. & S. Gauge	Grams per foot	B. & S. Gauge	Grams per foot
18	5.37	27	0.65
20	3.41	28	0.48
22	2.08	29	0.41
23	1.61	30	0.33
24	1.33	32	0.21
25	1.08	34	0.12
26	0.85	36	0.08

**Platinum Weights and Riders**, see page 305.



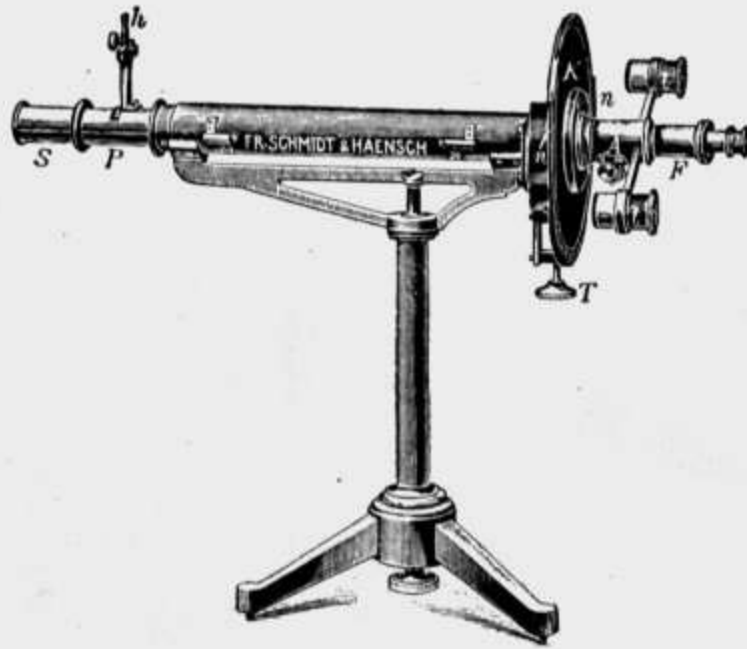
No. 5172.

5172. **Polariscope, S. & H.**, half shadow, Mitscherlich type, with Laurent polarizer, for general work and for the rapid and exact determination of albumen and sugar in urine. Provided with a vernier which reads to tenths of a degree and can be estimated to twentieths. If the instrument is to be used for general work, a tube of 200 mm. is supplied, also one of 100 mm. for dark colored solutions, but if used exclusively for urine analysis, one tube should be 189.4 mm. and the other 94.7 mm., as with this length the percentage of sugar and albumen can be read direct, as each degree is equal to 1 gram in 100 c.c. Albumen produces rotation to the left to the same degree as sugar to the right. When ordering state the length of tubes desired.

Instrument complete with patent tubes and gas lamp for homogeneous light .....Duty free \$ 53.40

- 5172A. **Polariscope, S. & H.**, half shadow, Mitscherlich type, similar to No. 5172, simple form for demonstration work with one 200 mm. tube .....Duty free 33.00

- 5172B. **Polariscope, S. & H.**, with wedge compensation and Jellet-Cornu polarizer, with dust protector and illuminating mirror for scale, for direct reading of sugar in urine. Complete with one each patent tubes of 50, 100 and 200 mm. length in mahogany case. ....Duty free 87.30



No. 5172C.

- 5172C. **Polariscope, S. & H., Lippich's, half shadow.** A reliable instrument for chemical laboratories, mounted on pillar with tripod base; for tubes up to 220 mm. The circle is graduated to 0.25 degree and is read by means of verniers to 0.01 degree. Complete in case with absorption vessel and Lippich's two part polarizer, one each 100, 200 and 220 mm. patent observation tubes, and sodium gas light. ....Duty free \$ 144.00
- 5172D. **Polariscope, same as No. 5172C, but with additional scale for reading direct percentages of cane or beet sugar.....Duty free 159.00**
- 5172E. **Polariscope, same as No. 5172C, but for tubes up to 400 mm., including one each 100, 200, 220 and 400 mm. tubes, and sodium gas light .....Duty free 165.00**
- 5172F. **Polariscope, same as No. 5172E, but with additional scale for reading direct percentages of cane or beet sugar.....Duty free 180.00**

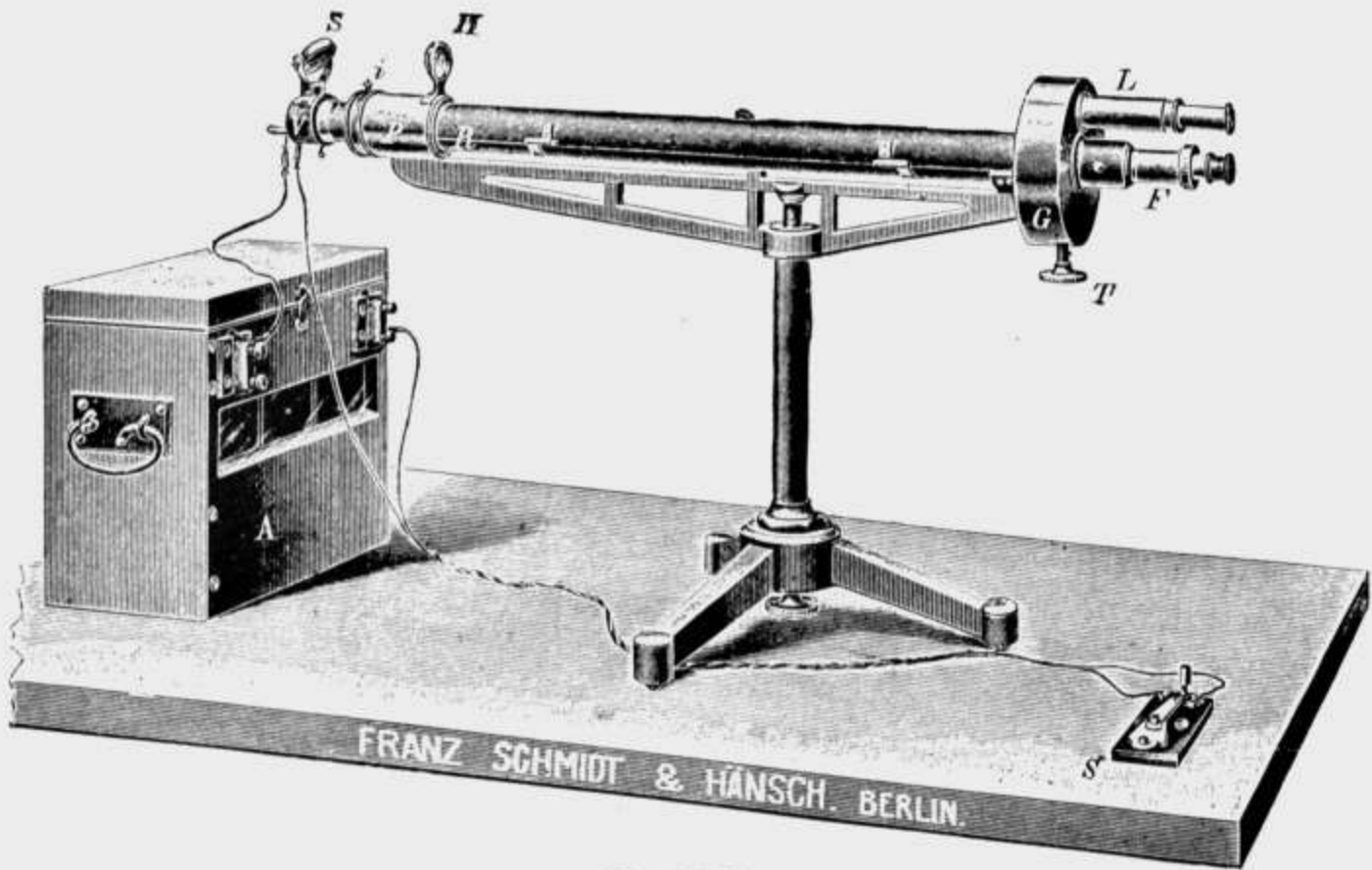


No. 5172Q.



No. 5172R.

For description of above Tubes, see page 398.

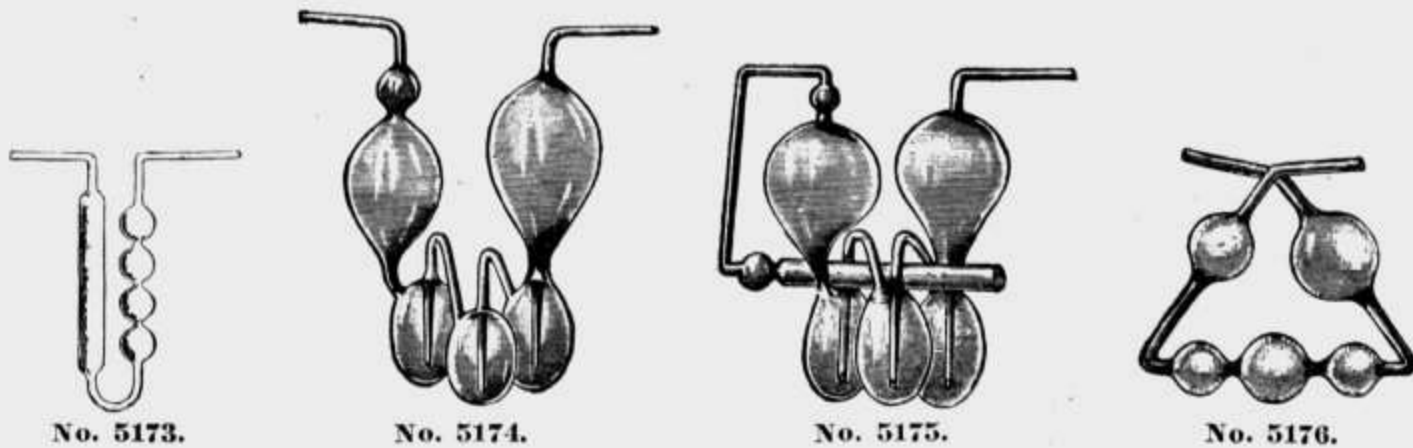


No. 5172G.

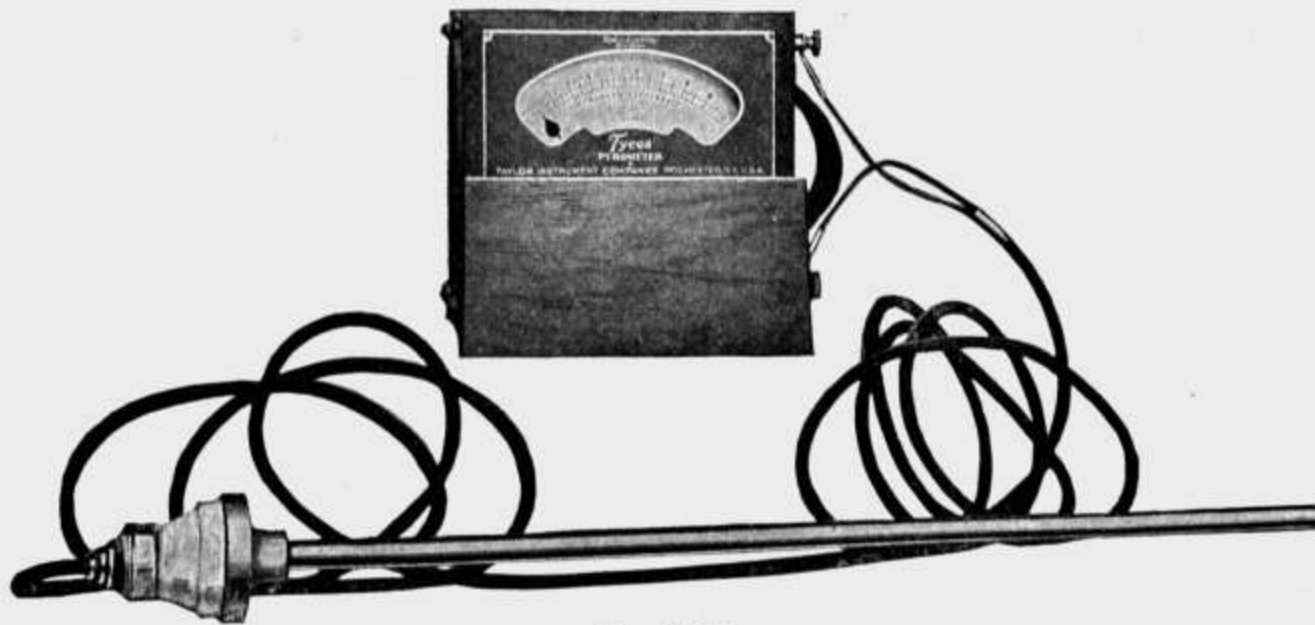
- 5172G. **Polariscope, S. & H.**, half shadow, latest construction, with single wedge compensation, dust caps for analyzer, improved reading scale suitable for sugar analysis, and one each tube 100 and 200 mm. long. . . . .Duty free \$ 142.50
- 5172H. **Polariscope**, same as No. 5172G, but for tubes up to 400 mm. in length, including one each tube 100, 200 and 400 mm. long. . . . .Duty free 157.50
- 5172K. **Polariscope, S. & H.**, same as No. 5172G, but with a triple field of vision, which increases the sensibility, and is best adapted for analytical work . . . . .Duty free 172.50

**POLARISCOPE ACCESSORIES.**

- 5172M. **Polariscope Electric Illuminating Apparatus**, to be attached to end of instrument with mirror for illuminating the scale. The lamp is for 6 volts and 0.5 amperes. . . . .Duty free 25.00
- 5172N. **Gas Sodium Light**, with platinum ring for holding the Sodium Chloride, about . . . . .Duty free 10.50
- 5172P. **Gas Sodium Light**, Landolt's, with large platinum ring for holding the Sodium Chloride. With adjustable stand, about. . . . .Duty free 18.00
- 5172Q. **Observation Tubes, Patent**, with one end enlarged so as to trap any air that may remain in tube after filling. With brass screw cap ends. (See illustration on page 397.)  
 Length, mm. . . . . 50 94.7 100 189.4 200 220 400  
 Each . . . . .Duty free 2.70 2.70 2.70 2.70 2.70 2.70 3.00
- 5172R. **Observation Tubes**, with brass screw cap ends. (See illustration on page 397.)  
 Length, mm. . . . . 50 94.7 100 189.4 200 220 400  
 Each . . . . .Duty free 2.40 2.40 2.40 2.40 2.40 2.40 2.70
- 5172S. **Cover Glasses, S. & H.**, of good mirror glass, optically inactive, 15.5 mm. diameter. Per dozen. . . . . 1.33
- 5172T. **Cover Glasses, S. & H.**, same as Nos. 5172S, but 23 mm. diameter for large end of No. 5172Q tube. Per dozen. . . . . 1.75
- 5172V. **Rubber Washer**, 15.5 mm. diameter. . . . . .20
- 5172W. **Rubber Washer**, 23 mm. diameter. . . . . .38



No. 5173.	Potash Apparatus, Mitscherlich's . . . . .	\$ 0.43
5174.	Potash Apparatus, Mohr's, improved by Geissler.....	.75
5175.	Potash Apparatus, Mohr-Geissler, with calcium chloride tube ground on	1.22
5176.	Potash Apparatus, Liebig's . . . . .	.45
9131B.	Potash Apparatus, Winkler's . . . . .	1.25



No. 5177.

5177. **Pyrometer.** This outfit consists of a 39 inch protected thermo-couple, Temperature Indicator, and 15 feet, flexible two-conductor connecting cable, provided with quick-acting, non-reversible attachment plug and tangs.

The thermo-couple is made of carefully prepared selected metals, and is consequently very durable and constant in its indications. If desired, it will be furnished without the metal protecting sheath, when it is desired to get very quick readings.

These thermo-couples can be supplied in any length, but the standard length of 39 inches will be furnished unless otherwise specified.

For each additional foot over 39 inches \$1.00 additional is charged.

The temperature indicator is rugged and accurate, and has an open, easily read scale.

It can be furnished either in the portable form as shown, or as a wall type instrument for permanent installation. The portable form has a dust-proof, walnut case with protected front and leather carrying handle. The wall type instrument has a heavy metal case. Both types are provided with external zero adjusters.

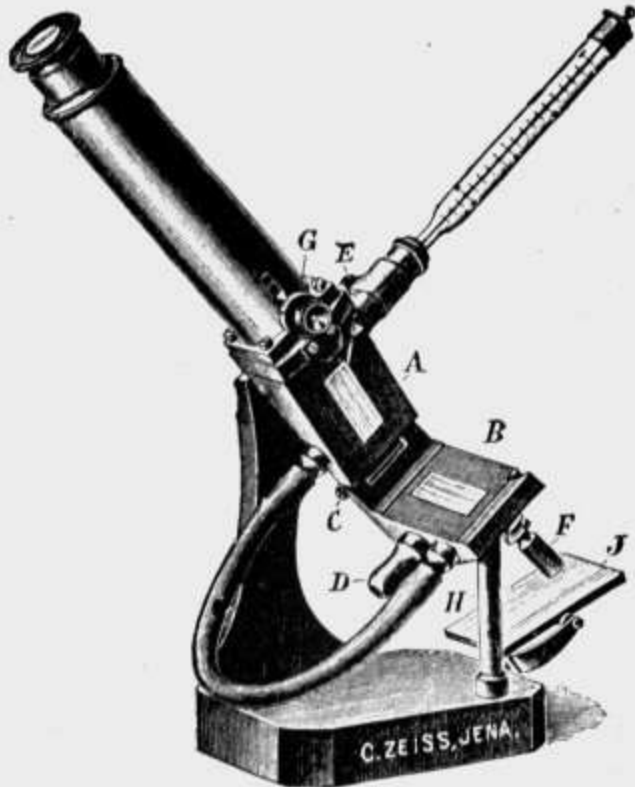
The following scale ranges are standard:

200-1000° F.	300-1800° F.	300-2200° F.
100- 500° C.	100-1000° C.	100-1200° C.

Unless otherwise specified, Fahrenheit scales will be furnished.

Complete with 39 in. thermo-couple and 15 ft. connecting leads.

.....	Duty free \$ 37.50
5177A. Extra Thermo-couples, up to 39 in. long.....	Duty free 3.75



No. 5178.

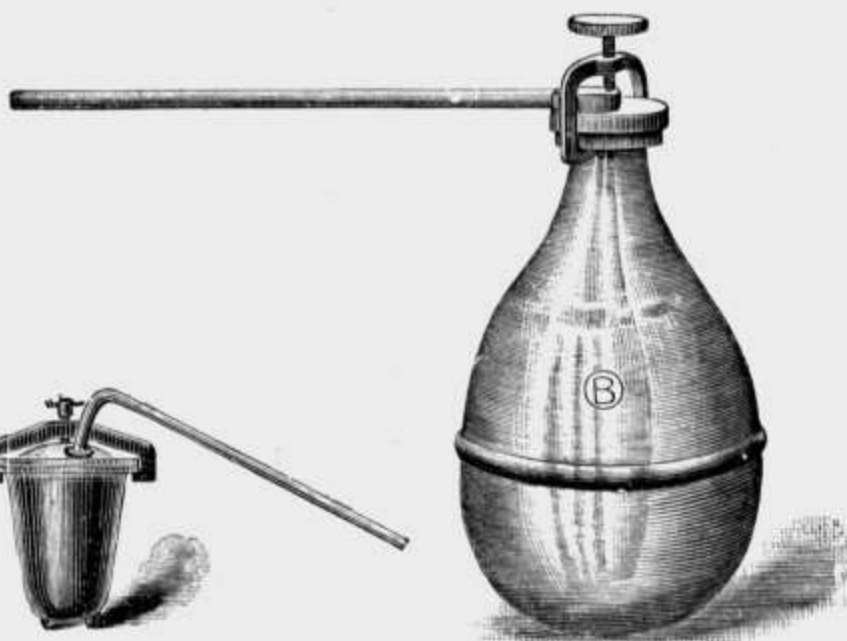


No. 5179.

5178. **Refractometer for Butter Examination.** Although primarily intended for refractometric examination of butter, may be used also for testing fats, food oils, etc. Ocular scale gives values between  $n_D=1.42$  and  $n_D=1.49$ . Furnished with micrometer screw for measuring tenth scale divisions, accurate to 1 unit of the 4th decimal. Furnished complete with bottle of standard liquid for verifying the adjustment of the ocular scale, table for transposing scale divisions in refractive indices and reverse, full directions for use and a common thermometer with thread for attaching to Refractometer graduated in  $\frac{1}{2}$  degrees from 0 to 50 degrees C.....Duty free \$ 60.00
- 5178A. **Thermometer, Special, after Wollny,** with separate scale for butter and lard. This thermometer gives the highest allowable refractometer count between 30 and 40 degrees C. Furnished with thread for attaching to instrument.....Duty free 1.90
5179. **Dipping Refractometer,** for investigating fluids of low refractive index, especially dilutions, alcoholic, volatile solutions, etc. (scope of the ocular scale from  $n_D=1.325$  to  $n_D=1.367$ ), accuracy in measurement  $\frac{1}{3}$  unit of the 4th decimal; with free standing refractometer prism of acid-proof glass, with attachable beaker for the investigation of quickly evaporating solutions and with a Table for the Conversion of the Scale Readings into Refractive Indices, in case.....Duty free 69.50
- 5179A. **Heating Trough,** for the reception of 12 glass beakers (each containing 20 cm.) for investigations in bulk, with a glass plate in the bottom of the trough and mirror below, with 24 glass beakers. .... Duty free 8.00
- 5179B. **Heating Trough,** with glass plate in the front side and mirror. Duty free 4.00
- 5179C. **Thermometer,** 15—25°C., divided in  $\frac{1}{10}^\circ$  with protecting metal case and certificate of proof.....Duty free 4.75
- 5179D. **Stem Thermometer,** 15—25°C., divided in  $\frac{1}{5}^\circ$ , about 8 cm. in length with a red line at 17.5°C.....Duty free .65
- 5179E. **Spiral Heater** .....Duty free 17.50
- 5179F. **Auxiliary Prism** for investigating fluids in very small quantities and deeply colored solutions, with unpolished surface of contact slightly countersunk .....Duty free 3.25



No. 5183.



No. 5191.



No. 5187.



No. 5189.

5181.	<b>Retort Receivers, Glass, with tubulature only.</b>					
	Capacity, ounces .....	4	8	16	32	
	Each .....	\$0.15	.21	.27	.36	
5183.	<b>Retort Receivers, Glass, with tubulature and glass stopper.</b>					
	Capacity, ounces .....	4	8	16	32	
	Each .....	.25	.33	.40	.60	
5185.	<b>Retorts, Glass, plain.</b>					
	Capacity, ounces .....	4	8	16	32	64
	Each .....	.13	.20	.25	.33	.42
5187.	<b>Retorts, Glass, with glass stopper.</b>					
	Capacity, ounces .....	4	8	16	32	64
	Each .....	.22	.25	.42	.50	.70
5188.	<b>Retorts, New Jena Glass, with tubulature and ground in stopper.</b>					
	Capacity, c.c. ....	100	250	500	1000	
	Each .....	.50	.60	.84	1.10	
5189.	<b>Retort, Iron, for distilling mercury, etc.; cover removable, fastened by screw clamp, delivery tube reaching through the cover.</b>					
	Capacity, pints .....	1/2	1	2	4	8
	Each .....	2.25	2.50	3.00	4.00	5.00
5191.	<b>Retort, Copper, for making oxygen; flask shape, with iron clamp and delivery tube.</b>					
	Capacity, pints .....	1/2	1	2	4	
	Each .....	2.25	2.50	3.00	3.35	



No. 5193.



No. 5195.

5193.	<b>Retort Adapters, Glass, for connecting retorts with receivers; straight.</b>				
	Diameter, inches, large end .....	1/2	1	1 1/2	2
	Each .....	.15	.18	.25	.40
5195.	<b>Retort Adapters, same as No. 5193; bent</b>	.17	.20	.25	.40

Retort and Crucible Combined, Skidmore's, see page 353.  
Reduction Tubes, see page 349.





No. 5201.



No. 5203.

5201. Rings, Iron, for attaching to retort stands; with improved  $\frac{5}{16}$ -inch screw.

Diameter, inches	2	3	4	5	6	7
Each	\$0.10	.13	.16	.17	.18	.20

5203. Rings, Iron, "Extension," for fastening to retort stand by means of Clamp Holders Nos. 4723 and 4725.

Diameter, inches	3	4	5	6	7
Each	.09	.10	.12	.13	.15



No. 5204.



No. 5205.

5204. Rings, Concentric, Iron, six inches in diameter, with two removable rings, with heavy screw for clamping on support for supporting water baths, sand baths, flasks, etc. \$ 0.33

5205. Rings, Concentric, Porcelain, with cover.

Number in set	5	6
Outside diameter of largest, cm.	16	20.5
Each	.85	1.25

Rubber Bags, see Gas Bags, page 373.

Rubber Bulbs, see Bulbs, page 330.



No. 5206.



No. 5211A.

5206. Rubber Caps, for test tubes.

Diameter, inches	$\frac{3}{4}$	1
Per dozen	.33	.40

5207. Rubber Finger Cots, for men, per dozen. .50

5208. Rubber Finger Cots, for women, per dozen. .50

Rubber Gloves, see Gloves, page 377.

5211. Rubber Policemen, for scraping precipitates from walls of beakers, etc., to be used on glass rod; without rods, per dozen. .55

5211A. Rubber Scraper For scraping precipitates from the walls of beakers, etc. Hard rubber handle with soft cone shaped rubber tip. .20

5212. Rubber Sheetting, white, 36 inches wide, per yard. .90

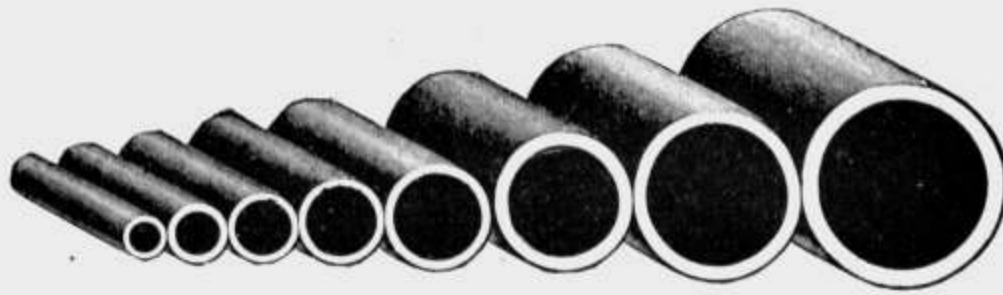
1389. Rubber Sheet (Rubber Dam), pure gum, per square foot. .33

1390. Rubber Sheet (Rubber Dam), pure gum, 36 inches wide, per linear foot. .95

5213. Rubber Stoppers, made from best quality of rubber, especially for chemical laboratory use, and will not harden from age. Each size furnished in three styles—solid, one hole or two holes. Per pound 1.75

Table Showing Approximate Number of Rubber Stoppers in One Pound.

Number	00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
Diameter large end, mm.	14	17	18	20	23	25	27	32	37	41	45	50	56	65	72	
Diameter small end, mm.	9	12	15	16	18	20	23	26	30	33	37	42	50	59	68	
Approximate Number in One Pound	Solid	120	80	60	55	42	33	28	20	15	12	11	8	6	5	4
	1 hole	130	90	65	60	45	35	30	21	16	13	11	8	6	5	4
	2 hole	138	94	70	64	47	38	32	22	17	14	12	8	6	5	4



5215.	<b>Rubber Tubing, White, best quality, hand made, medium wall.</b>						
	Inside diameter, inches.....	1/8	3/16	1/4	5/16	3/8	1/2
	Thickness of wall, inches.....	3/64	3/64	1/8	1/8	1/8	5/64
	Per foot .....	\$0.05	.07	.10	.11	.13	.22
5217.	<b>Rubber Tubing, White, best quality, hand made, heavy wall.</b>						
	Inside diameter, inches.....	3/16	1/4	5/16	3/8	1/2	
	Thickness of wall, inches.....	5/64	3/32	3/32	7/64	1/8	
	Per foot .....	.15	.16	.18	.20	.30	
5219.	<b>Rubber Tubing, Red, Antimony, best imported; medium wall.</b>						
	Inside diameter, inches.....	1/8	3/16	1/4	5/16	3/8	1/2
	Thickness of wall inches.....	3/64	3/64	1/8	1/8	5/64	3/32
	Per foot .....	.06	.09	.13	.17	.22	.30
5220.	<b>Rubber Tubing, Red, Antimony, best imported, heavy wall.</b>						
	Inside diameter, inches.....	3/16	1/4	5/16	3/8	1/2	
	Thickness of wall, inches.....	5/64	3/32	3/32	7/64	1/8	
	Per foot .....	.14	.20	.25	.38	.50	
5221.	<b>Rubber Tubing, Black, pure gum, best imported, medium wall.</b>						
	Inside diameter, inches.....	1/8	3/16	1/4	5/16	3/8	1/2
	Thickness of wall inches.....	3/64	3/64	1/8	1/8	5/64	3/32
	Per foot .....	.06	.10	.14	.18	.22	.33
5222.	<b>Rubber Tubing, Black, pure gum, best imported, heavy wall.</b>						
	Inside diameter, inches.....	3/16	1/4	5/16	3/8	1/2	
	Thickness of wall, inches.....	5/64	3/32	3/32	7/64	1/8	
	Per foot .....	.16	.22	.28	.40	.55	
5223.	<b>Rubber Tubing, Band, pure gum, for Gooch's crucibles, etc.</b>						
	Diameter, inches .....			1	1 1/4	1 1/2	
	Per foot .....			.25	.30	.40	
5225.	<b>Rubber Tubing, White, cloth insertion, heavy wall, for air pumps, vacua work, etc.</b>						
	Inside diameter, inches.....	3/16	1/4	5/16	3/8	1/2	
	Per foot .....	.10	.12	.17	.20	.25	
5226.	<b>Gas Tubing, Flexible Steel Tubing.</b>						
	The latest and best article for conveying gas to Bunsen burners, hot plates, etc.						
	It is indestructible except by acids and excess of oil; is gas tight and safe from kinking or breaking.						
	Sold only in 24 inch lengths, 1/4 inch inside diameter, rubber socket at each end.....						\$ 0.25



No. 5230.

5230.	<b>Rubber Tube and Bulb Expander.....</b>	<b>.55</b>
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No. 5237.

5237. **Sand Baths.** Best Russia sheet iron, shallow form.

Diameter, inches	3	4	5	6
Each	\$0.08	.10	.11	.15

5239. **Sand Baths.** Best Russia sheet iron, hemispherical form.

Diameter, inches	3	4	5	6
Each	.10	.14	.15	.22

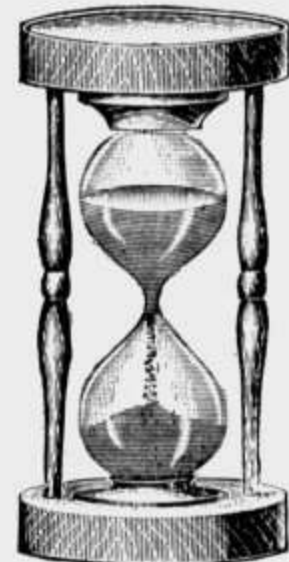


No. 5239.



No. 5241.

5241. **Sand Bath, Hot Plate.** Russia sheet iron tray, 8x10 inches, on legs... \$ 2.00  
For Hot Plates, for use with gas and electricity, see page 378.



No. 5243.

5243. **Sand Glasses,** in wooden frames.

For minutes	1	2	3	5	10
Each	.35	.35	.45	.60	.80



No. 5245.

5245. **Scoops, Horn,** flat and wide, for ordinary use; square ends.

Length, cm.	10	12	14
Each	.18	.20	.25



No. 5247.

5247. **Scoop, Agateware,** 3x5½ inches... .18



Nos. 5249-5251.

5249. **Sieves,** brass gauze, seamless brass frame, with pan bottom, 5 inches diameter.

Mesh	10	20	40	60	80	100	200
Each	1.10	1.10	1.20	1.35	1.45	1.55	3.35

5251. **Sieves,** same as No. 5249; 8 inches diameter.

Mesh	10	20	40	60	80	100	200
Each	1.55	1.65	1.75	1.90	2.00	2.35	5.20

5253. **Sieves,** same as No. 5249, in sets of five, one sieve fitting on top of another with one cover and bottom; set consists of 20, 40, 60, 80 and 100 mesh. Per set

6.65

5255. **Sieves,** set same as No. 5253; 8 inch in diameter

10.00

5257. **Covers,** for above sieves.

Diameter, inches	5	8
Each	.33	.55



No. 5258.

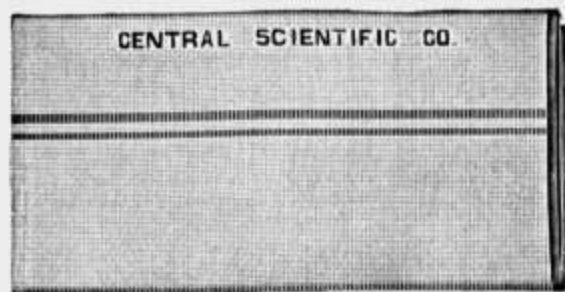


No. 9140.



No. 9142.

5258. Sieves, wooden frame, brass gauze, diameter 6 inches.  
 Mesh ..... 20    40    60    80    100    200  
 Each ..... \$0.38    .40    .45    .60    .75    1.40
9140. Sieves, as employed in the Laboratories of the Bureau of Soils, Wash-  
 ington, D. C., for mechanical analysis. Set of four sieves with bot-  
 tom pan, each about 2 inches in diameter by 1 inch high, perfect-  
 ly fitted, so that the set may be well shaken without coming apart.  
 Shaped so that there is no loss of soil, a great advantage where  
 small samples are being tested. Sieves proper readily replaceable;  
 upper two of brass, with perforations 1 mm. and 0.5 mm. in dia-  
 meter; lower two of bolting cloth, 64 and 130 mesh..... \$ 10.00
9141. Sieve, for preparing soils for analysis. Consists of a seamless brass  
 frame 5 inches in diameter, having brass bottom with circular per-  
 forations.  
 Diameter of perforations. 1/2 mm. 1 mm. 2 mm. 3 mm. 5 mm.  
 Each ..... 1.65    1.55    1.10    1.10    1.25
9142. Sieve, without bottom, but with brass ring for holding bolting cloth.  
 Same size as No. 9141. .... 1.45



No. 9142A.



No. 5263.



No. 5265.

5260. Chemists' Slide Rule, page 507.

- 9142A. Bolting Cloth, for making soil sieves, etc. Best quality silk, 40  
 inches wide. Standard weight.  
 Number ..... 5    7    9    13    18    20  
 Meshes to inch ..... 64    80    96    130    173    180  
 Per foot ..... 1.10    1.20    1.30    2.00    2.90    4.25
9143. Sieves, complete set of five as above (No. 9141), with brass cover and  
 bottom ..... 7.40
- 9143A. Cover and Bottom only of above set..... .75
9144. Sieves, set same as No. 9143 with 3 mm. and 5 mm. sieves omitted.... 5.05
- Siphons, see page 94.
5261. Spatula, Glass, 6 inch ..... .11
5263. Spatula, Horn, double end.  
 Length, inches ..... 4    6  
 Each ..... .09    .16
5265. Spatula, Steel, wooden handle.  
 Length of blade, inches..... 3    4    5    6  
 Each ..... .22    .27    .30    .42



No. 5271.



No. 5273.

5271. Spoons, Horn, superior quality, with spatula end.

Length, inches .....	4	6
Each .....	\$0.11	.17

5273. Spoon, Glass, teaspoon ..... \$ 0.29

5273A. Spoon, Glass, tablespoon ..... .45

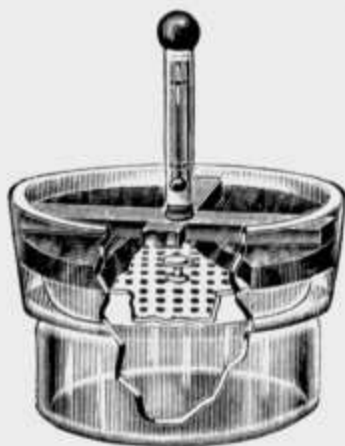


No. 5275.

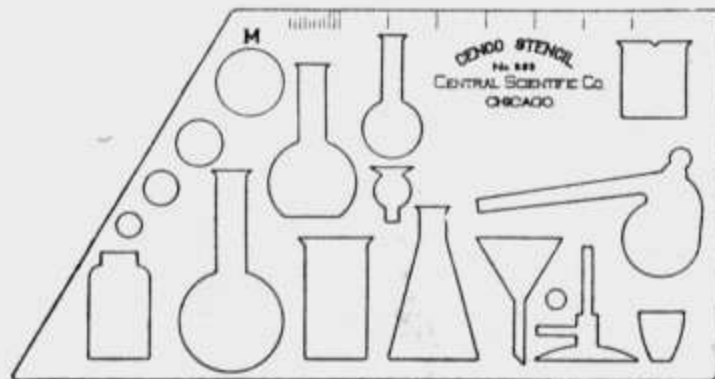
5275. Spoon, Sodium, of brass gauze, wooden handle..... .33

5276. Spoon (Capsule), Sodium, with ram-rod according to Brownlee and others ..... .27

5277. Spoons, Sodium (cartridge shells), 8x13 mm, inside. Per dozen..... .11



No. 9307.

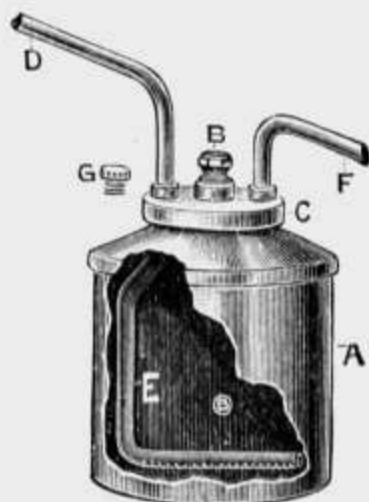


No. 532.

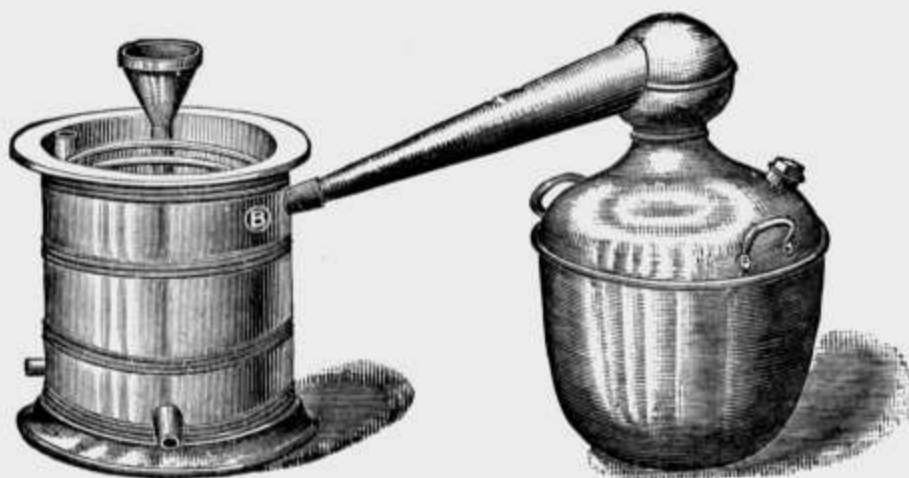
9307. **Sprouting Apparatus** (Schoenjahn's patent), for quickly determining the percentage sprouting value of barley, showing its malting quality. Equally efficient in showing sprouting value of all grains. This apparatus is simple and exceedingly practical. Complete with directions ..... 7.00

532. **Stencil, "Cenco"**. This stencil was designed to eliminate bad drawings in students' laboratory note books. It consists of a flexible plate having "cut-outs" of various articles such as flasks, beakers, Bunsen burners, funnels, etc., so that by placing the point of a pencil inside these "cut-outs" and following the curves and lines, all the articles in the illustration may be produced. The edges of the stencil itself form different angles which are of the greatest assistance when drawing bent delivery tubes. The mm. scale may be used for finding the center of any article drawn with the edge of the stencil and also for determining the length to which a line shall be drawn.

The stencil is transparent, therefore no difficulty should be experienced in drawing one piece of apparatus in the desired relative position to another. Each.....Net .10



No. 5283.



No. 5285.

5283. **Distilling Apparatus**, for destructive distillation of heavy oils and other liquids or solids requiring a high heat. The distillation may be made by live steam or by direct heat, with or without agitation by hot air blown through as desired. The still is of heavy copper with brass fittings.

Capacity, gallons	.....	1/2	1	2	5
Price	.....	\$14.00	22.25	33.35	50.00

5285. **Still**, copper retort, tin lined, with movable head, connected with pure block tin condensing worm, enclosed in zinc vessel, with proper inlets and outlets.

Capacity, gallons	....	1/2	1	2	3	5
Price	.....	\$8.00	10.50	12.50	16.00	22.00

5285A. **Retort**, only of No. 5285.

Capacity, gallons	....	1/2	1	2	3	5
Price	.....	4.80	6.50	7.90	10.30	13.85

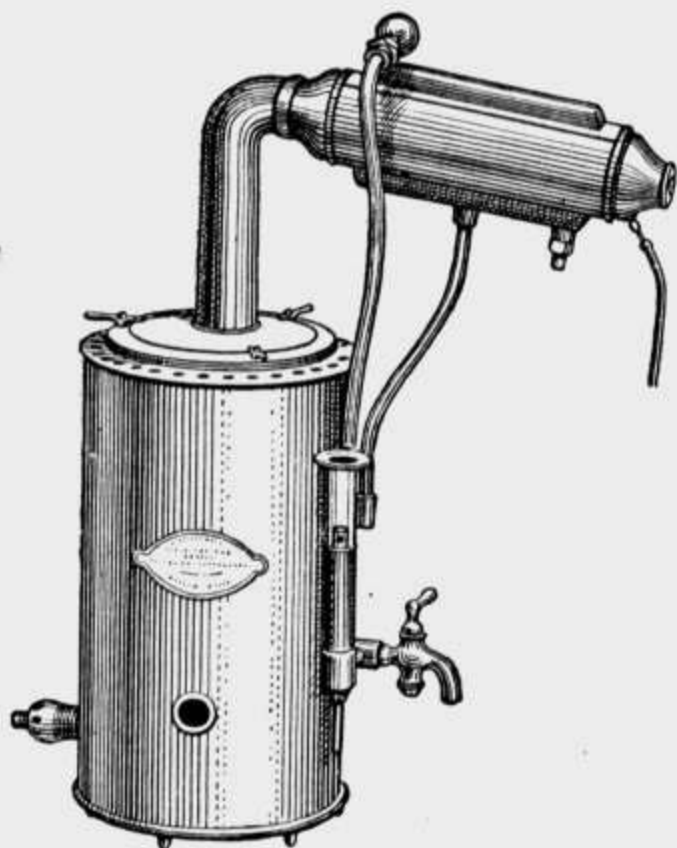
5285B. **Condensing Vessel**, only of No. 5285, complete with worm.

Capacity, gallons	....	1/2	1	2	3	5
Price	.....	3.20	4.00	4.60	5.70	8.15

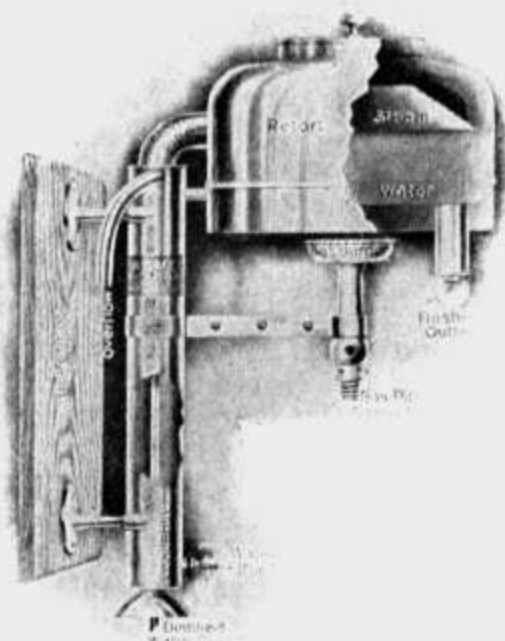


No. 5287.

5287. **Still, Ralston's New Process**. This still may be used on any stove and does not require water under pressure for its operation. The storage of the distilled water within the still avoids the reabsorption of gases which may be in the water to be distilled. Although this still is not entirely automatic in its action, it is so constructed that it cannot boil dry; it requires little care or attention. It is well made of copper and pure tin. Capacity, from 1 to 3 quarts per hour, depending on the amount of heat used. Weight, 7 lbs.; diameter, 9 inches; height, 14 inches.....Net \$ 10.00

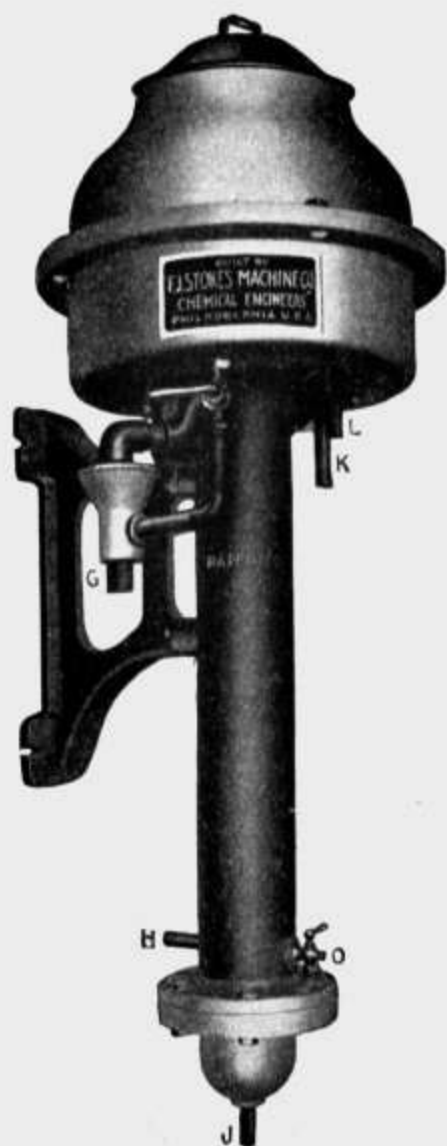


No. 5289.



No. 5292.

5289. **Barnstead Laboratory Still, for Gas.** Water from this still is of the highest degree of purity ever reached by any process of distillation, and is superior for chemical and compounding processes. It is made of heavy copper, thoroughly coated on the inside with pure tin and nickeled on the outside. The operation when once begun is automatic and continuous, and on account of the special construction produces a distillate which is Chemically Pure and free from gases and organic impurities. Capacity 1 gallon per hour.....Net \$ 45.00
- 5289A. **Barnstead Still, same as No. 5289, but electrically heated, for 110 volt current** .....Net 55.00
- 5289B. **Barnstead Still, same as No. 5289A, but for 220 volts.**.....Net 65.00
5292. **Still, Acme Automatic Water Still.** Made to hang on wall and can be placed wherever gas and water connections may most conveniently be made with pipes or rubber tubing. Occupies space 12x4 inches on the wall, projecting only 14 inches in its widest part. To operate still it is only necessary to turn on the water and light the gas under the retort. Water boils in a few moments, and distilled, pure, aerated water flows out into receptable. Fitted with removable cover to permit inspection if desired, although it is really unnecessary. Cannot get out of order, absolutely automatic, and everything so arranged as to secure maximum amount of water for the minimum consumption of gas. Made of copper and brass, tin lined and nickel plated, and of the best workmanship throughout. Capacity, one gallon per hour and one-half. Furnished with gas burner ..... 25.00



No. 5297.

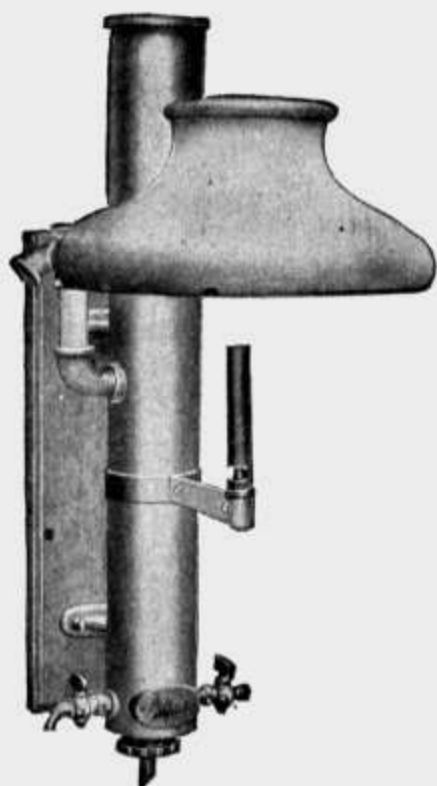
5296. **Still, Automatic,** steam heated, cast iron distilling chamber galvanized to prevent corrosion. The condensing tubes are of brass, heavily tinned. Capacity with pressure of 20 lbs. of steam, one gallon per hour ..... Net \$ 28.00

5297. **Stills,—Stokes Automatic for Steam.** The distilling chamber and condensing cylinder are of cast iron and galvanized to withstand corrosion. The condenser tubes are brass, heavily tinned inside and out. These stills may readily be flushed for cleaning by means of a valve connecting with the drain, or the copper lid may be removed and the inner chamber scrubbed. These stills are self contained and require only the two connections for steam and water, and are shipped ready to set up. The capacities are based on a steam pressure of at least 20 pounds.

Order Letter..	A	B	C	D	E
Capacity, gals. per hour.....	5	10	25	60	100
Price .... Net	\$100.00	150.00	250.00	450.00	600.00

**Peerless Automatic Water Still.** This still is built on an entirely new and different basic principle, as the boiler is so shaped that the steam is forced through the water to its center where it passes in a compact body into the condensing tube, thus reducing the amount of condensation on the side walls of the still, which is a dead loss as this water returns to the raw water and must be again made into steam. It produces twice as much water as any other still of like rated capacity, at an expense for gas of not to exceed two cents per gallon.

We call special attention to the construction of this still. Its parts are readily accessible for cleansing. Boiling vessel is of cast iron and not easily burned out or injured by rough handling. The condensing tube is of heavy tinned copper, and its ample size insures perfect condensation with a very small stream of water. This still is entirely automatic in action and when once started will operate continuously until water or gas supply is exhausted. It is finished in bright aluminum and lacquered brass and presents a handsome appearance.



Nos. 9925-28.

9925. Still, one gallon capacity.....	\$ 22.25
9928. Still, three gallon capacity.....	44.50



### NORMAL GRADUATED GLASSWARE.

Made of the best German glass, with clear graduations of extra length, standardized to meet the requirements of the German Normal-Eichungs-Commission, or the National Bureau of Standards, Washington, D. C., without control stamp. Each piece is packed in a separate carton to insure safe delivery. The following sizes are kept in stock:

**4614B. Burettes, Normal, with tip for use with pinch cock.**

Capacity, c.c. ....	10	25	50	100
Graduated to .....	1/20	1/10	1/10	1/10
Each .....	\$1.40	1.60	2.80	4.50

**4614C. Burettes, Normal, with glass stopcock, straight.**

Capacity, c.c. ....	10	25	50	100
Graduated to .....	1/20	1/10	1/10	1/10
Each .....	2.20	2.50	3.50	5.50

**4910A. Flasks, Volumetric, Normal, with glass stopper.**

Capacity, c.c. ....	50	100	250	500	1000
Each .....	.75	.80	1.10	1.40	1.60

**5002. Graduates, Cylindrical, Normal, with single graduations.**

Capacity, c.c. ....	10	100	250	500	1000
Graduated to .....	1/10	1/1	5/1	5/1	10/1
Each .....	1.10	1.50	2.10	2.50	3.20

**5121A. Pipettes, Volumetric, Normal.**

Capacity, c.c. ....	1	5	10	25	50	100
Each .....	.35	.45	.50	.70	.90	1.00

**5123A. Pipettes, Mohr's, Normal.**

Capacity, c.c. ....	1	5	10	25
Graduated to .....	1/100	1/20	1/10	1/10
Each .....	.80	1.10	1.20	1.60

### NORMAL THERMOMETERS.

(From Stock.)

With milk glass scale, made to meet the requirements of the Physikalisch-Technische Reichsanstalt.

Note: The deviations of the graduations of these thermometers from the true readings do not amount to one-half of the limit of error allowed by the Reichsanstalt.

The short thermometers are provided with Richter's arrangement of the tube, and the long thermometers with the Fuess arrangement.

**5412AA. Thermometers, Normal.**

From $-10$ to $+100^{\circ}\text{C}$ in.....	$1/5^{\circ}$	$1/10^{\circ}$
Each .....	7.00	9.00

**5414BB. Thermometer, Normal, for Junker's Calorimeter, graduated from  $-5$  to  $+50^{\circ}$  in  $1/10^{\circ}$ . Each.....** 4.50

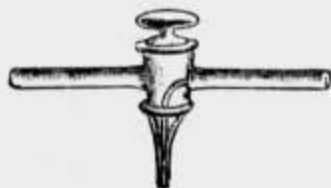
**5414DD. Thermometer, Normal, for Parr's Calorimeter, graduated from  $+65$  to  $+90^{\circ}\text{F}$ . in  $1/20^{\circ}$ . Each.....** 11.00

**5415AA. Beckmann Thermometer, for freezing point determination. Scale  $5-6^{\circ}$ , divided in  $1/100^{\circ}$ .....** 11.00

**5415BB. Beckmann Thermometer, same as above, for boiling point determination .....** 11.00



No. 5301.



No. 5303.



No. 5305.



No. 5307.



No. 5309.

5301.	Stop Cocks, Glass, straight; bore, mm.....	2	3	4	
	Each .....	\$0.80	1.00	1.25	
5303.	Stop Cock, Glass, three way; bore, 2 mm.....				\$ 1.25
5305.	Stop Cock, Glass, three way, with three tubes; bore, 2 mm.....				1.25
5307.	Stop Cock, Glass, one end bent; bore, 4 mm., heavy Bohemian glass.				.90
5309.	Stop Cock, Glass, four way, with four tubes; bore, 2 mm.....				1.33

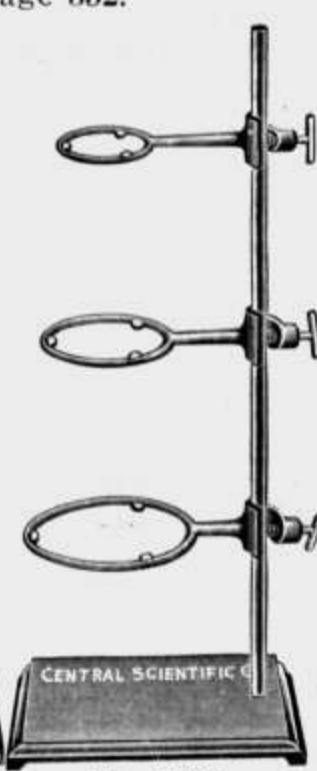
Stop Cocks, Brass, see page 118.  
 Stoves, see pages 336 and 382.  
 Suberite Mats and Rings, see page 352.



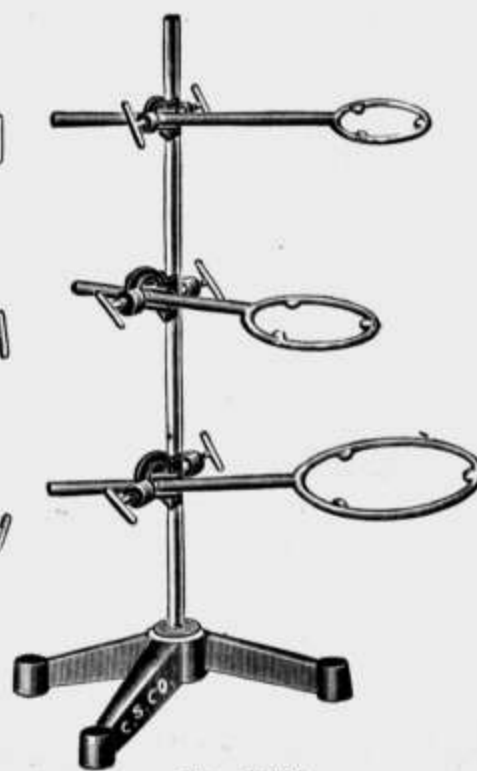
No. 5325.



No. 5327.



No. 5329.

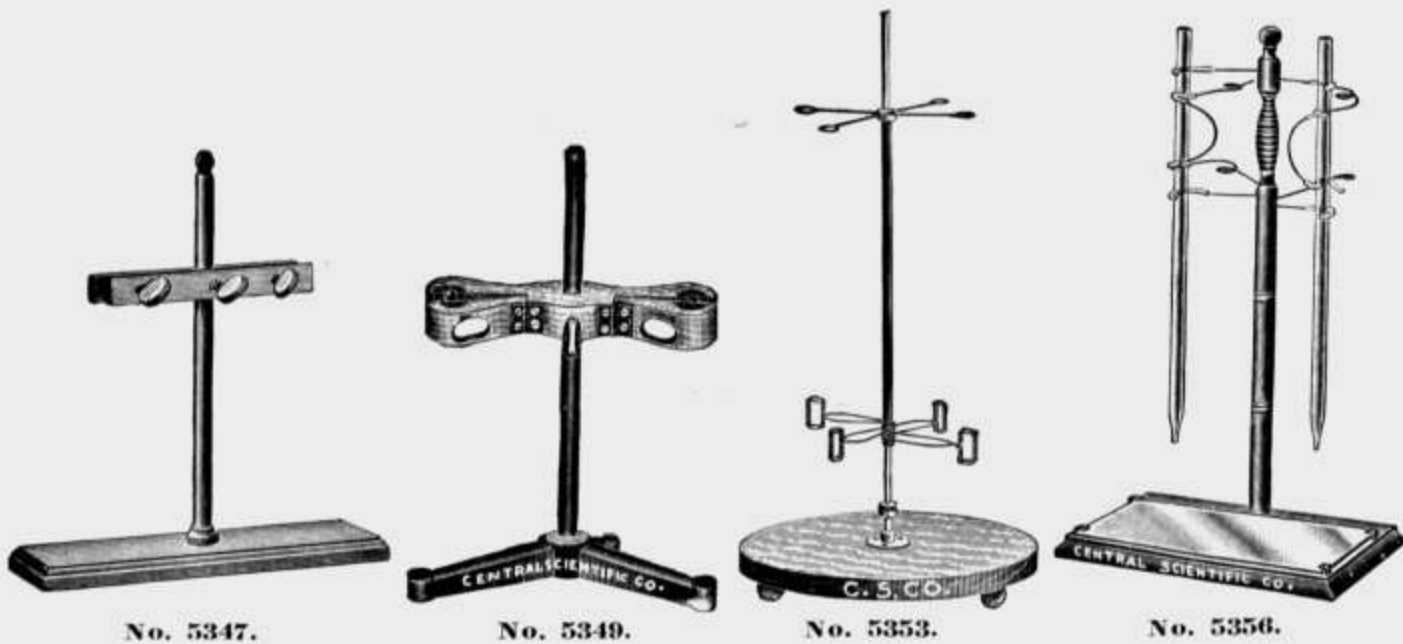


No. 5330.

5325.	Supports, iron, tripod base and coppered steel rod.				
	No. ....	1	2	3	4
	Base .....	small	medium	large	ex. large
	Rod, inches.....	18 x $\frac{5}{16}$	20 x $\frac{3}{8}$	24 x $\frac{1}{2}$	36 x $\frac{1}{2}$
	Each .....	.30	.40	.62	.85
5327.	Supports, iron, rectangular base and coppered steel rod.				
	No. ....	1	2	3	4
	Base, inches .....	4x6 $\frac{3}{4}$	5 x 8	5 $\frac{1}{2}$ x 9	6 x 11
	Rod, inches .....	18 x $\frac{5}{16}$	20 x $\frac{3}{8}$	24 x $\frac{1}{2}$	36 x $\frac{1}{2}$
	Each .....	.25	.33	.55	.85
5329.	Supports (Retort Stands), same as No. 5327, with rings.				
	No. ....	1	2	3	4
	Rings .....	3, 4 in.	3, 4, 5 in.	3, 4, 5, 6 in.	3, 4, 5, 7 in.
	Each .....	.45	.60	.85	1.25
5330.	Supports, same as No. 5325, No. 2, with No. 5203 Extension Rings, 3, 4 and 5 inches, and 3 No. 4723 clamp holders. Complete as illustrated .....				1.25
5315.	Parr Sulphur Photometer, page 507.				



5331. **Support, Platform**, of iron, 3½ inches in diameter, with heavy screw for clamping on supports or tripods. Useful for supporting burners, etc., in connection with No. 5204.  
 Concentric rings, as shown in illustration..... \$ 0.25
5341. **Support, Hardwood, Gay-Lussac's**, clamp cork lined, movable in three ways ..... 1.33
5343. **Support, Hardwood**.. Improved form of Gay-Lussac's, with extension rod 22 inches long..... 1.33
5344. **Wooden Clamp**, with ½-inch rod, same as in No. 5343, for use with clamp holders, etc., in connection with iron supports. Clamp only.. .75
5345. **Support, Hardwood, Schellbach's**. Clamp cork lined, universal movement ..... 1.33



5347. **Support, Burette**, of hardwood, for two burettes, cork lined..... 1.10
5349. **Support, Burette**, iron tripod and rod with hardwood arm, cork lined, for two burettes ..... 1.65
5353. **Support, Burette**, round hardwood base with nickel plated steel rod and revolving spring clamps for four burettes..... 3.35
- 5353A. **Support, Burette**, same as No. 5353, but with round porcelain base in place of the wooden base..... 6.25
5354. **Support, Burette**, same as No. 5353, for two burettes..... 4.00
- 5354A. **Support, Burette**, same as No. 5354, but with round porcelain base in place of the wooden base..... 4.50
5356. **Support, Burette, Chaddock's**. The rod and base are of polished hardwood. On top of the base is a rectangular piece of white glass. Clamp is of spring wire, Chaddock's patent, lined with rubber. The burette is readily placed in position or removed by simply springing back the wire. .... 2.50



No. 5357.

No. 5357A.

No. 5358.

5357. **Support, Funnel.** Made of hardwood with four beveled openings for 60° funnels. Will center over rings. Without tripod and rod..... \$ 0.45
- 5357A. **Support, Funnel,** similar to No. 5357, but intended especially for use with small rectangular base and rod (No. 5327-1). Holds 3 small 60° funnels. Without base or rod..... .40
5358. **Support, Funnel,** designed by Prof. John T. Stoddard, of Smith College. Made of aluminum to hold four two-inch funnels. Provided with strong set screw for use with No. 4743 Base and Rod. Without support ..... 1.10
- 5358A. **Support, Funnel,** same as No. 5358, to hold four 2½-inch funnels. Without support ..... 1.25
4743. **Base and Rod,** for use with above funnel holders. Base is heavy and entirely stable with excessive load in funnels..... .35



No. 5359.



No. 5361.

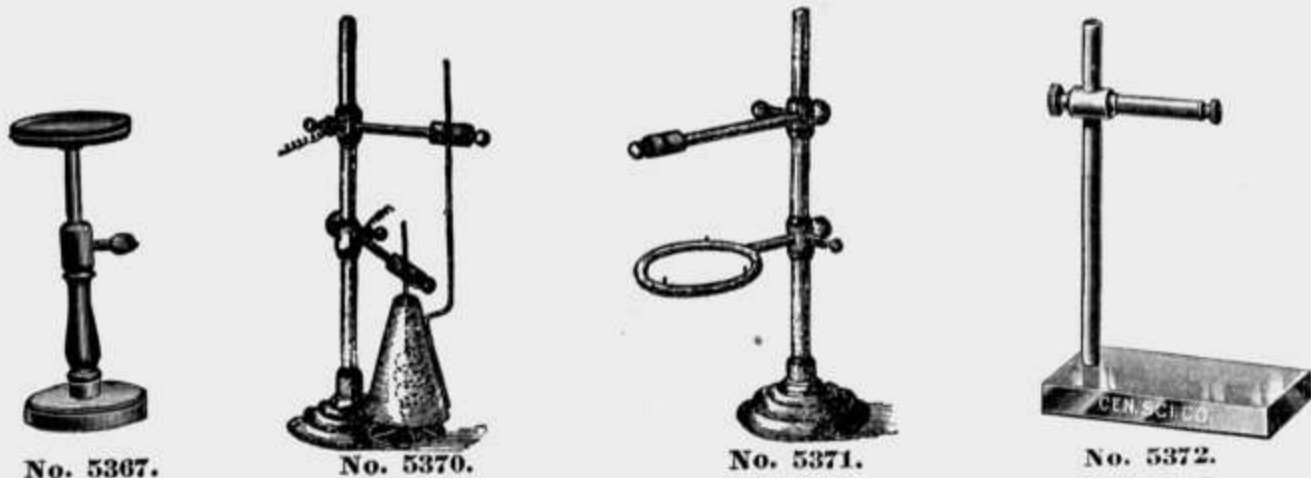


No. 5363.



No. 5365.

5359. **Support, Funnel,** of hardwood, for one funnel..... .67
5361. **Support, Funnel,** of hardwood, for two funnels..... .75
5363. **Support, Funnel,** of hardwood, for four funnels..... .80
5365. **Support, Pipette,** of hardwood, revolving, for 12 pipettes..... 2.25



- No. 5367.
  - No. 5370.
  - No. 5371.
  - No. 5372.
- |       |  |         |
|-------|--|---------|
| 5367. | Support Table, of hardwood, with leaded base. Height closed, 7 inches; height when drawn out, 10 inches.....   | \$ 1.10 |
| 5369. | Support Table, same as No. 5367. Height closed, 9 inches; height when drawn out, 15 inches.....  | 1.25    |
| 5370. | Support, Electrolytic. Glass rod mounted on base, with two clamps..  | 3.50    |
| 5371. | Support, Electrolytic. Glass rod mounted on base, with ring for dish, and clamp .....  | 3.50    |
| 5372. | Support, Electrolytic, especially designed for use in the Electrolytic Determination of Copper by Prof. W. H. Ross, of the University of Arizona. The upright rod is insulated from the base, and has an adjustable cross arm which supports a platinum anode. The base supports a platinum dish, which forms the cathode. Lead wires are connected from below through the table top, and are therefore out of the way. Support only, as illustrated, nickel plated..... | 4.00    |



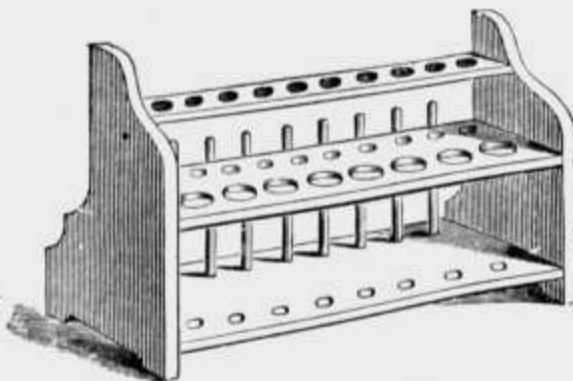
No. 5375.



No. 5377.

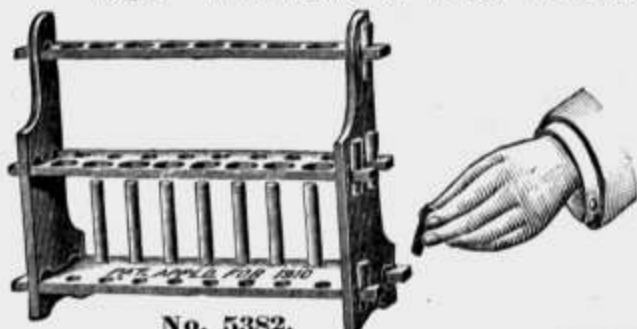


No. 5378.

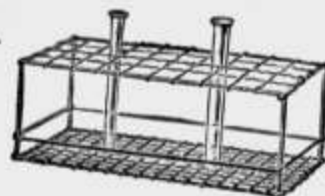


Nos. 5379-5381.

- |       |  |     |
|-------|--|-----|
| 5375. | Support, Test Tube, for 6 tubes. Heavy base with drying pins.....  | .25 |
| 5377. | Support, Test Tube, for 10 tubes. Heavy base with drying pins.....   | .33 |
| 5378. | Support, Test Tube. Designed by Prof. H. E. Griffith of Knox College. Has 10 holes for test tubes $\frac{3}{4}$ in. in diameter and 2 for test tubes 1 in. in diameter; has 12 drying pins. A valuable feature of this support is a trough at the foot of the drying pins for receiving drainage. This trough may also be used for holding tubes and stirring rods ..... | .45 |
| 5379. | Support, Test Tube, for 13 tubes. Two rows of holes with drying pins .....   | .42 |
| 5381. | Support, Test Tube, for 25 tubes. As used at the University of Chicago. Two rows of holes with drying pins.....  | .67 |

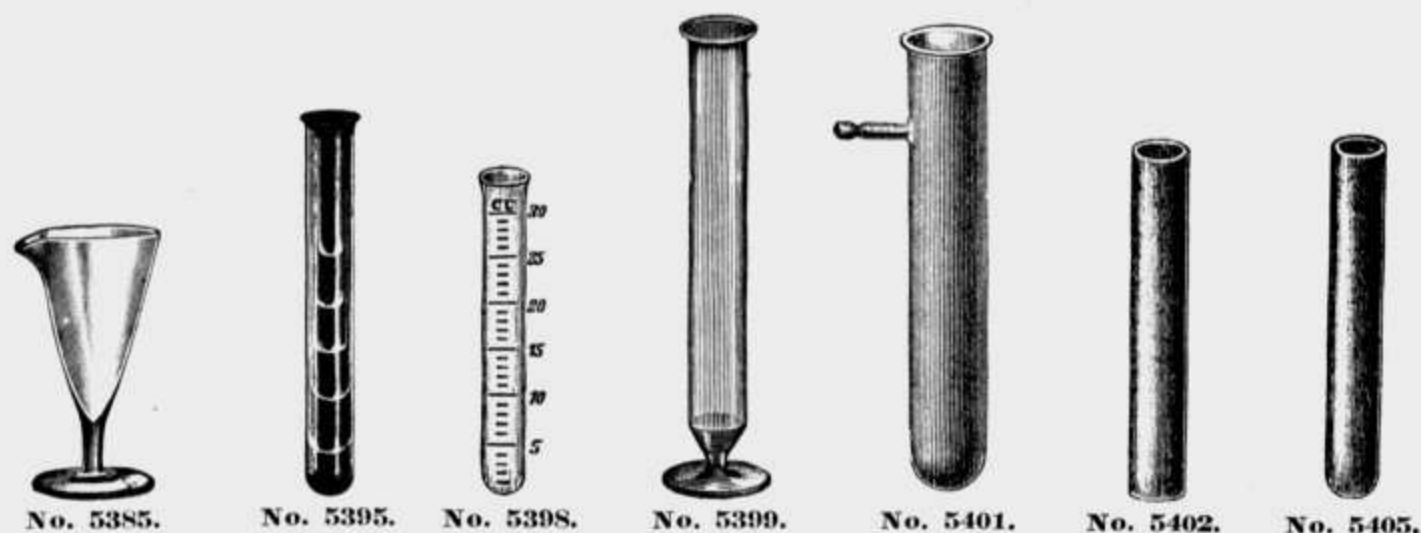


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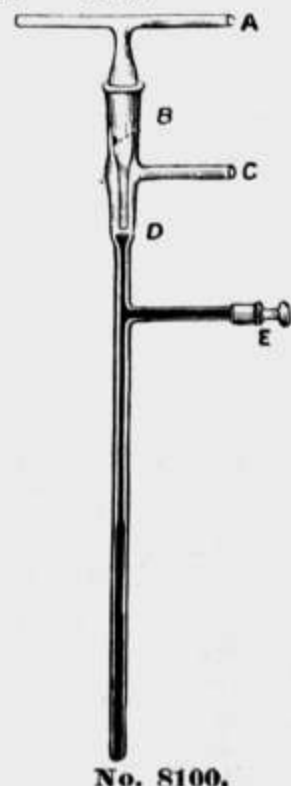


No. 5383.

- |       |   |     |
|-------|---|-----|
| 5382. | Support, Test Tube, without glued joints, shipped "knocked down" with directions for putting together; for 16 tubes, with 8 drying pins .....     | .50 |
| 5383. | Support, Test Tube, of wire. Will hold 40 tubes. Size $9\frac{1}{2}$ inches long by $4\frac{1}{2}$ inches wide by $3\frac{1}{2}$ inches high..... | .33 |



- 5385. Test Glasses, conical, with lip (urine sedimentation glass).**  
 Capacity, ounces ..... 1      2      4      6  
 Each ..... \$0.11      .17      .22      .27
- 5387. Test Glasses for the lecture table, as used at the University of Chicago. Capacity 125 c.c. Cylindrical form, with foot..... \$ 0.22**  
**Test Papers, see page 392.**
- 5395. Test Tubes, well annealed, free from lead.**  
 Size, inches ..... 3x $\frac{3}{8}$     4x $\frac{1}{2}$     5x $\frac{1}{2}$     5x $\frac{5}{8}$     6x $\frac{5}{8}$   
 Per dozen ..... .15      .20      .22      .25      .28  
 Per gross ..... 1.45    1.90    2.00    2.25    2.50  
 Size, inches ..... 6x $\frac{3}{4}$     7x $\frac{7}{8}$     8x1    10x1    12x1  
 Per dozen ..... .30      .40      .45      .80      1.25  
 Per gross ..... 2.75    3.80    5.00    9.00    12.00
- 5396. Test Tubes, assorted sizes, from 3 to 7 inch, per dozen..... .26**
- 5397. Test Tubes, New Jena Glass, thin walled.**  
 Length, mm. .... 120      160      200  
 Diameter, mm. .... 15      20      25  
 Per dozen ..... .48      .75      1.25
- 5398. Test Tube, graduated in cubic centimeters.**  
 Capacity ..... .5 c.c. in  $\frac{1}{16}$     10 c.c. in  $\frac{1}{16}$     20 c.c. in  $\frac{1}{8}$     25 c.c. in  $\frac{1}{8}$   
 Each ..... .40      .45      .55      .65
- 5399. Test Tubes, on foot; length, inches..** 4      5      6      8      10  
 Per dozen ..... .60      .75      .85      1.25    1.65
- 5401. Test Tubes, side neck; length, inches.....** 5      6      8      10  
 Per dozen ..... .60      .75      1.00    1.65
- 5402. Test Tubes (Specimen Tubes), heavy glass, flat bottom.**  
 Size, inches ..... 3x $\frac{3}{8}$     4x $\frac{1}{2}$     5x $\frac{5}{8}$     6x $\frac{3}{4}$     8x1  
 Per dozen ..... .22      .25      .30      .40      .63
- 5403. Test Tubes (Ignition Tubes), of Bohemian combustion tubing.**  
 Size, mm. .... 100x14    130x16    160x20  
 Per dozen ..... .80      .90      1.25
- 5404. Test Tubes (Ignition Tubes), of Jena combustion tubing.**  
 Size, mm. .... 140x15    160x18  
 Per dozen ..... .95      1.12
- 5405. Test Tubes (Ignition Tubes), heavy hard glass.**  
 Length, inches ..... 4      5      6  
 Per dozen ..... .45      .67      .80
- Test Tube Brushes, see page 329.**  
**Test Tube Holders, see page 345.**
- 8100. Thermo-Regulator.** This Gas Regulator secures constant temperature at any desired point from 1° Cent. to near the boiling point of mercury. Especially adapted for water baths, drying ovens, sterilizers, etc. Each..... 2.25



### THERMIT FOR LABORATORY EXPERIMENTS.

We list the necessary equipments for a series of four interesting experiments with Dr. Goldschmidt's Thermit. A compound of a metallic oxide and granulated aluminum which, when ignited, starts a chemical reaction which will produce a temperature of 3000° C. This is now used extensively in welding fractures in iron castings and rails, as the molten thermit iron has the property of melting the surface of the iron it comes in contact with, and forming a solid mass.

- 5406. Thermit, Experiment I. Welding a small piece of steel to a plate.**  
 Steel Plate,  $\frac{3}{16}$ " thick. 2 Cans Thermit.  
 2 Pouring Cups. Bottle Ignition Powder.  
 Pair Dark Glasses to protect Eyes.  
 Complete set .....Net \$ 2.50
- 5406A. Thermit, Experiment II. Burning a hole through a plate.**  
 Steel Plate, 9" square x  $\frac{3}{4}$ " thick. 4 Packages Plugging Material.  
 Tripod. Bottle Ignition Powder.  
 2 Cans Thermit. Pair Dark Glasses.  
 Tapping Spade. Large Crucible.  
 Shipping Weight, 102 lb.  
 Complete set .....Net 21.00
- 5406B. Thermit, Experiment III. Welding a large boss to a steel plate (showing the manner of welding in industrial uses).**  
 2 Steel Plates,  $\frac{3}{8}$ ". 2 Fire-brick Molds.  
 Large Crucible. Tripod.  
 Bottle Ignition Powder. 2 Welding Portions.  
 Package Luting Material. Tapping Spade.  
 2 Packages Plugging Material. Pair Dark Glasses.  
 Shipping Weight, 152 lb.  
 Complete set .....Net 22.50
- 5406C. Thermit, Experiment IV. Pipe welding. This experiment shows the following peculiar characteristics of the slag: First, its very high temperature; second, that it sets at a very high temperature; third, that in plastic condition it is highly refractory remaining in a layer distinct from the steel.**  
 4 Pieces Standard Pipe, 6" x 1". 3 Welding Portions.  
 Mold. Small Crucible.  
 Pair Tongs. 1 Set Clamps.  
 Bottle Ignition Powder. Pair Dark Glasses.  
 Shipping Weight, 86 lb.  
 Complete set .....Net 31.00
- 5406D. Thermit Combination Set, suitable for all four experiments. Shipping weight, 270 lbs. ....Net 61.00**
- 5406E. Thermit Combination Set. Experiments I-III. Shipping weight, 230 lb. ....Net 31.00**
- 5406F. Thermit, black, per pound.....Net .50**
- 5406G. Igniting Mixture (8 oz. smallest quantity sold). Per pound.....Net 1.30**

### THERMOMETERS.

Our **Chemical Thermometers** are of standard quality from the best German manufacturers, and made of Jena glass 16m, which is much superior to Thuringian glass in that the latter is liable to alter in course of time. The accuracy of the described thermometers is guaranteed. We also furnish wooden cases for these thermometers, as it avoids breakage in the laboratory.

5407. **Thermometer, Chemical**, enclosed paper scale, tube 200x7 millimeters; graduated to 110 degrees C..... \$ 0.40
5408. **Thermometers, Chemical**, enclosed hand written scale, 325 x 7 millimeters, in wood case.  
 Centigrade scale ..... —10 to 110° —10 to 210°  
 Price, each ..... .60 .80
- 5408A. **Thermometers, Chemical**, same as No. 5408, but with Fahrenheit scale ..... 17 to 220° 17 to 400°  
 Price, each ..... .60 .80
- 5408B. **Thermometers, Chemical**, same as No. 5408, with double scale; — 10 to 110° C. and 17 to 220° F..... .80
5409. **Thermometers, Chemical**, scale engraved on stem, white enameled back, 325 x 7 millimeters.  
 C. scale — 10 to..... 110° 150° 210° 360°  
 Price each ..... .90 1.00 1.10 1.33
- 5409A. **Thermometers, Chemical**, same as No. 5409, but with Fahrenheit scale ..... 17 to 220° 17 to 400° 17 to 600°  
 Price, each ..... .90 1.10 1.33
- 5409B. **Thermometers, Chemical**, same as No. 5409, with double scale; — 10 to 110° C. and 17 to 220° F..... 1.40
5410. **Thermometers, Chemical**, enclosed porcelain scale, 325x7 mm.  
 Centigrade scale —10 to 110° —10 to 210° —10 to 360°  
 Price, each..... .90 1.10 1.33
5411. **Thermometers, Chemical**, scale engraved on stem, filled with nitrogen above mercury to prevent separation of the mercury column when used at high temperatures.  
 Graduated to ..... 360°C 600°F  
 Each ..... 1.65 1.65
- 5411A. **Thermometers, Chemical**, scale engraved on stem, white back  
 Tube ..... 550 x 8 mm. 660 x 8 mm.  
 Centigrade scale ..... 100° in  $\frac{1}{5}$ ° 100° in  $\frac{1}{10}$ °  
 Price, each ..... 3.00 3.35
- 5411B. **Thermometers, Chemical**, stem scale, similar to No. 5409, with white glass back, accurately graduated and furnished with factory certificate.  
 Centigrade scale —10 to 100° —10 to 200° —10 to 320°  
 Price, each..... 2.00 2.50 3.00
- 5411C. **Thermometers, Chemical**, scale engraved on stem, the whole enclosed in a Jena glass tube; so-called "insulated thermometers," indelible, invaluable for work in acids. 110° C., 2.00; 300° C..... 2.50



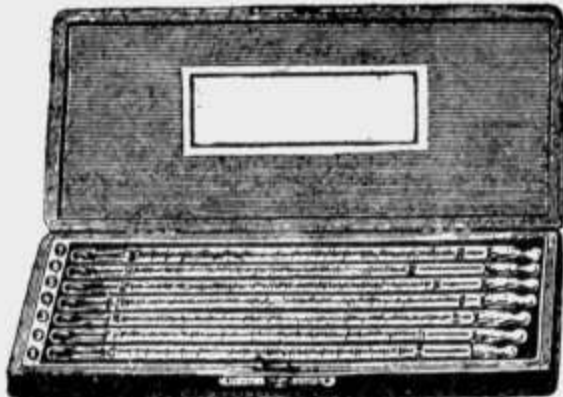


## NORMAL THERMOMETERS.

By the term "Normal Thermometer," we mean that the instrument has been made in conformity with the special regulations of Section XII. of the Physikalisch-Technische Reichsanstalt.

The deviations of the graduations of these thermometers from the true readings do not amount to one-half of the limit of error allowed by the Reichsanstalt.

5412. Thermometers, Normal, graduated on stem, with white colored back.			
Those reading above 250° C. are filled with nitrogen, and those from 400° C. filled under a pressure of 15 to 25 atmospheres.			
	From -10 to +50° C. in.....	$\frac{1}{5}^{\circ}$	$\frac{1}{10}^{\circ}$
	Duty free .....	\$3.00	4.80
5412A. Thermometers, Normal, same as No. 5412.			
	From -10 to +100° C. in.....	$\frac{1}{5}^{\circ}$	$\frac{1}{10}^{\circ}$
	Duty free .....	3.00	6.60
5412B. Thermometers, Normal, graduated on milk glass scale.			
	From -10 to +50° C. in $\frac{1}{10}^{\circ}$ divisions.....	Duty free	\$ 5.40
	From -10 to +50° C. in $\frac{1}{10}^{\circ}$ divisions, with certificate.....	Duty free	7.80
	From -10 to +100° C. in $\frac{1}{10}^{\circ}$ divisions.....	Duty free	7.20
	From +5 to +100° C. in $\frac{1}{10}^{\circ}$ divisions, with certificate.....	Duty free	9.90
	From -5 to +200° C. in $\frac{1}{5}^{\circ}$ divisions.....	Duty free	6.75
	From +5 to +200° C. in $\frac{1}{5}^{\circ}$ divisions, with certificate.....	Duty free	8.70
	From +100 to +200° C. in $\frac{1}{10}^{\circ}$ divisions, with zero point.....	Duty free	8.40
	From +100 to +300° C. in $\frac{1}{5}^{\circ}$ divisions, with zero point.....	Duty free	8.10
5412C. Thermometers, Normal, after Graeve, with milk glass scale, graduated into $\frac{1}{10}^{\circ}$ . Set of 4 of the following intervals:			
	No. 1..... -30 to +10° C.	No. 2..... 0 to +50° C.	
	No. 3..... +45 to +100° C.	No. 4..... +98 to +150° C.	
	Set in leather case.....	Duty free	16.00



No. 5412D.

5412D. Thermometers, Normal, according to Anschuetz, finest grade of thermometers for special research work in laboratory, fractional distillation, etc. Opal glass scale, very small mercury bulb. Instruments No. 2, 3, 4, 5, 6 and 7 are filled with nitrogen to guard against a distillation of mercury.			
	No. 1..... -15 to +55° C.	No. 2..... +45 to +105° C.	
	No. 3..... +95 to +160° C.	No. 4..... +140 to +220° C.	
	No. 5..... +195 to +260° C.	No. 6..... +250 to +310° C.	
	No. 7..... +295 to +360° C.		
	Set of seven, each about 6 mm. in diameter and 16 cm. long, divided in fifths of degrees. In leather case.....	Duty free	20.40
5412E. Thermometers, Normal, same as No. 5412D, but graduated in tenths of degrees and about 26 cm. long, diameter 6 mm. In leather case .....			
		Duty free	27.00
5412F. Thermometers, Normal, same as No. 5412D, but in set of five, from -15 to +260° C.....			
		Duty free	14.00
	<b>Note.</b> —Reichsanstalt Certificate for each thermometer of No. 5412D will cost additional. For set of seven.....		7.25
	<b>Note.</b> —Reichsanstalt Certificate for each thermometer of No. 5412E will cost additional. For set of seven.....		10.50
	<b>Note.</b> —For Normal Thermometer CARRIED IN STOCK, see page 408.		

5412G. Thermometers, Normal, best workmanship, after Allihn, in sets of 3; about 30 cm. long, diameter 8 mm., in fine leather case, with Test Certificate of the Physico-Technical Imperial Institute, from $-15$ to $+300^{\circ}$ C., divided into $\frac{1}{2}^{\circ}$ .	
No. 1, $-15$ to $+100^{\circ}$ C.	
No. 2, $+100$ to $+200^{\circ}$ C., with 0 point.	
No. 3, $+200$ to $+300^{\circ}$ C., with 0 and $100^{\circ}$ points indicated.	
In leather case.....	Duty free \$ 21.00
5412H. Thermometers, Normal, same as No. 5412G, but graduated into $\frac{1}{5}^{\circ}$ .	
.....	Duty free 25.00
5412K. Thermometers, Compensation Normal, after Dr. Schott, of Jena. The after-effect of heating to high temperatures is almost entirely compensated by the use of the New Jena glass 335 <sup>III</sup> in combination with 16 <sup>III</sup> . From $-10$ to $+100^{\circ}$ C., divided into $\frac{1}{10}^{\circ}$ .....	Duty free 8.40
5412L. Thermometers, same as No. 5412K, with scale from $-5$ to $+200^{\circ}$ C., divided into $\frac{1}{5}^{\circ}$ .....	Duty free 7.50

Note.—Milk Glass Scales can be furnished for the same price.

#### THERMOMETERS FOR COLD MIXTURES.

5413A. Thermometers, for low temperatures, from $-20$ to $+40^{\circ}$ C., in single degree divisions .....	Duty free 1.00
5413B. Thermometers, for thermostat, from $0$ to $60^{\circ}$ C., in $\frac{1}{10}^{\circ}$ divisions.....	Duty free 2.50
5413C. Thermometers, for thermostat, from $+5$ to $+105^{\circ}$ C., in $\frac{1}{10}^{\circ}$ divisions.....	Duty free 3.25
5413D. Thermometers, Normal Pentane, with milk glass scale, for very low temperatures, from $+30$ to $-200^{\circ}$ C.....	Duty free 7.20
5413E. Thermometers, Normal, for low temperatures, milk glass scale, from $+10$ to $-35^{\circ}$ C., in $\frac{1}{10}^{\circ}$ divisions.....	Duty free 2.50
5413F. Thermometers, filled with Toluol, with milk glass scale, from $+30$ to $-120^{\circ}$ C., graduated in $1^{\circ}$ divisions.....	Duty free 3.60

#### NORMAL THERMOMETERS FOR CALORIMETER

5414A. Thermometers, Normal, for calorimeter, after Berthelot-Mohler, with milk glass scale, with lower part of scale from $+12$ to $+24^{\circ}$ C., divided into $\frac{1}{100}^{\circ}$ .....	Duty free 11.40
5414B. Thermometers, Normal, for Junker's calorimeter, from $-5$ to $+50^{\circ}$ C., divided into $\frac{1}{10}^{\circ}$ .....	Duty free 3.00
5414C. Thermometers, Normal, for Fischer's calorimeter, from $-5$ to $+50^{\circ}$ C., divided into $\frac{1}{10}^{\circ}$ .....	Duty free 3.60
5414D. Thermometers, Normal, for Parr's calorimeter, from $+65$ to $+90^{\circ}$ F., divided into $\frac{1}{20}^{\circ}$ .....	Duty free 9.00
5414E. Thermometers, Normal, for calorimeter, from $0$ to $+10^{\circ}$ C., graduated in $\frac{1}{100}^{\circ}$ ; milk glass scale, the divisions beginning about 10 cm. from lower end of the mercury bulb. The thermometer is about 9 mm. diameter and 65 cm. long.....	Duty free 9.00

Note.—Thermometer No. 5414E can be furnished in steps of  $10^{\circ}$  C. up to  $70^{\circ}$  C. at the same price.

**BECKMANN THERMOMETERS.**

These thermometers are recommended for the exact determination of slight changes in temperature. We have listed several types, covering ranges of 1°, 5°, 10°, or 25° in any part of the scale between the freezing and boiling points.

To adjust the mercury or "set" these thermometers, the bulb is placed in water with a temperature of 1° to 2° above the limit of the temperature through which the experiment is to be conducted. When the mercury, through expansion, has filled the enlargement at the top of the tube, a sharp rap with the hand will cause the mercury column to separate. The thermometer is then cooled to the temperature of the mixture to be tested, and if the end of the mercury column is within 1° of the top, the instrument is "set."

The mercury in the enlargement may be made to join the rest of the column by heating the bulb until the mercury reaches the top, and then inverting the thermometer.

In ordering Beckmann thermometers, it is best to specify at about what temperature the instrument will be used, so that they may be tested to that range, as they may be used at any point between zero and the boiling point of water.

- 5415A. Thermometers, Beckmann, Old Form, for freezing point determination. Scale 5—6°, divided in  $\frac{1}{100}^\circ$ . Closed by metal capsule at top .....Duty free \$ 7.50
- 5415B. Thermometers, Beckmann, same as No. 5415A, for boiling point determination .....Duty free 7.50
- 5415C. Thermometers, Beckmann, same as No. 5415B. Scale 1°C., divided into  $\frac{1}{500}^\circ$  .....Duty free 12.00
- 5415D. Thermometers, Beckmann, New Form, with mercury reservoir, especially constructed for boiling point apparatus. Scale 5—6°, divided into  $\frac{1}{100}^\circ$ . Closed by metal capsule at top.....Duty free 8.10
- 5415E. Thermometers, Beckmann, same as No. 5415D, graduated to  $\frac{1}{50}^\circ$ . .....Duty free 7.50
- 5416A. Thermometers, Beckmann, New Form, small, for determination of boiling point with auxiliary scale. This scale division permits any desired interval of temperature to be conveniently and exactly set on the scale which is divided into  $\frac{1}{100}$  of a degree. Besides it can be determined at any time at what degree the thermometer was set when last used; consequently it can be seen at once if the amount of mercury in the reservoir must be changed.

The auxiliary scale division differs from the true Celsius, in that, for example, the mercury which is separated from the upper capillary end at 50° of the auxiliary scale-division, shows only the true 50° C. in the middle of the scale. By this, one is able by the separation of the mercury column in the reservoir to set the smaller thread of mercury at once to the required degree. If mercury must be let into the reservoir, that at the upper part of the reservoir must be connected with the thread by tilting the thermometer forwards; the reservoir is then warmed until the required degree is reached on the auxiliary scale division. By a sudden jerk downwards, a light knock, or by a tap, the remaining mercury will at once separate from the thread and the degree shown on the auxiliary scale division at the moment of separation will be shown by the end of the thread in the middle of the divided scale. Scale 5—6°, divided into  $\frac{1}{100}^\circ$ . Extent of auxiliary scale division —10 to +120° C., in 2° divisions.....Duty free 9.50

Note: We carry Nos. 5415A and 5415B in stock, see page 408.

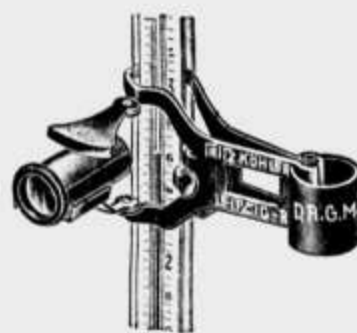


No. 5415.



No. 5416.

- 5416B. **Thermometers, Beckmann, New Form**, same as No. 5416A, for determination of freezing point.....Duty free \$ 9.50
- 5416C. **Thermometers, Beckmann**, for determination of boiling point. Graduated on very strong tube, with auxiliary scale under the reservoir. Scale same as No. 5416A. Specially recommended for the use of students in laboratories, as it is extremely durable.....Duty free 9.50
- 5416D. **Thermometers, Beckmann**, same as No. 5416C, for determination of freezing point .....Duty free 9.50
- 5416E. **Thermometers, Beckmann, Newest Differential**, with sealed in absolute thermometer; extent of the Differential Thermometer 5—6°, divided into  $\frac{1}{100}^{\circ}$ , extent of auxiliary scale division —10 to +120° in 2° divisions, extent of absolute thermometer —10 to +120°, divided into  $\frac{1}{10}^{\circ}$ .....Duty free 15.00
- 9312D. **Thermometer**, according to specifications by the U. S. Department of Agriculture, for use in Moisture Apparatus as designed by the Bureau of Plant Industry. 0 to 200° C. with certificate..... 2.25
5417. **Reading Attachment** for thermometers 6 to 20 mm. in diameter. All parts adjustable. Complete with clamps, magnifier with cross hair and reflecting mirror for use in daylight..... 4.50
- 5417A. **Incandescent Lamp** for use with No. 5417 when light is dim or room is dark. E. M. F. two volts.....Duty free 1.25
- N. B.—When desired, we will furnish 4 or 6 volt lamps at same price.  
**Tintometer, Lovibond's**, see page 347.

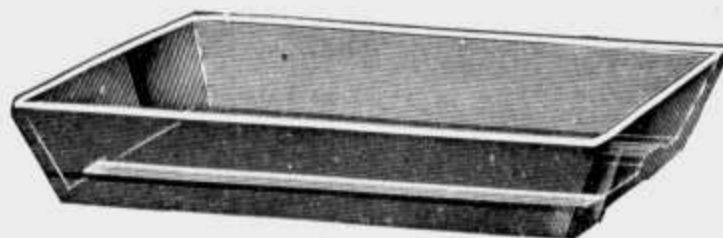


No. 5417.



No. 5418.

5418. **Tongs, Crucible, Steel.** Double bend, 9-inch..... .22
- 5418A. **Tongs, Crucible, Steel.** Double bend, 9-inch, nickel plated..... .33
- 5418B. **Tongs, Crucible, Brass.** Double bend, 9-inch..... .35
- 5418C. **Tongs, Crucible, Brass.** Double bend, 9-inch, nickel plated..... .45
5419. **Tongs, Crucible, Platinum.** Double bend, 9-inch, steel, nickel plated tongs of superior construction, with solid platinum tips.....About 10.00



No. 5423.

5421. **Tray, photographic, of metal, wire bound and coated with acid proof japan.**
- |              |      |     |      |       |       |
|--------------|------|-----|------|-------|-------|
| Size, inches | 5x8½ | 7x9 | 8x10 | 10x12 | 16x20 |
| Each         | .27  | .33 | .40  | .55   | 1.80  |
5423. **Tray, photographic, of white or amber glass.**
- |              |       |       |        |
|--------------|-------|-------|--------|
| Size, inches | 4½x5½ | 5½x8½ | 8½x10½ |
| Each         | .22   | .27   | .55    |
5425. **Tray, heavy glass, 6x8 inches, 1½ inches deep..... .18**



No. 5431.



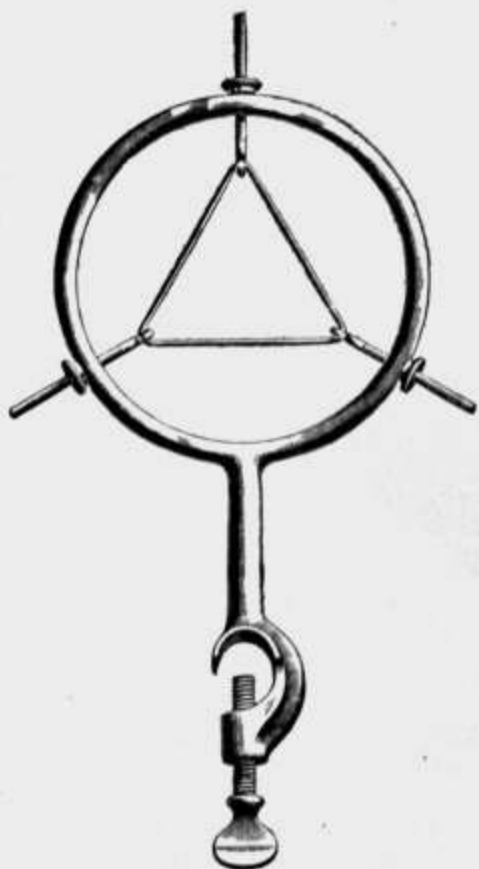
No. 5432.



No. 5433.

5431. Triangles, plain iron wire.	Number.....	1	2	3	
	Length of side, inside, inches.....	1½	2	2½	
	Per dozen .....	\$0.42	.45	.45	
5432. Triangles, iron wire, covered with pipe stems.	Number .....	1	2	3	4
	Length of side, inside, inches.....	1½	2	2½	3
	Per dozen .....	.63	.63	.67	.80
5433. Triangles, iron wire, covered with pipe stems, having a raised center, so that the crucible rests on these points.	Number .....	1	2	3	
	Length of side, inside, inches.....	2	2½	3½	
	Per dozen .....	1.00	1.00	1.00	
5434. Triangles, Nichrome wire, melting point about 3000° F., non-corrodible, cost but one-sixteenth that of platinum and last longer in service.	Number .....	1	2	3	4
	Length of side, inside, inches.....	1½	2	2½	3
	Each .....	.11	.11	.13	.13
5436. Triangles, Nichrome wire covered with <b>Fused Silica Tubes</b> , a 1912 product, superior to any triangle yet produced.	Number .....	1	2	3	4
	Length of side, inside, inches.....	1½	2	2½	3
	Each .....	Net .25	.25	.35	.40

Triangles, Platinum, see page 395.



No. 5437.

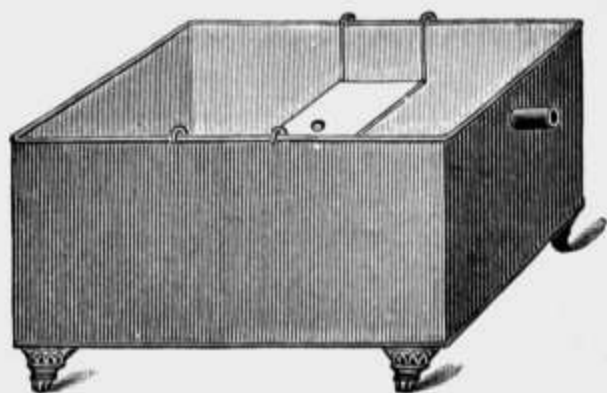


No. 5439.

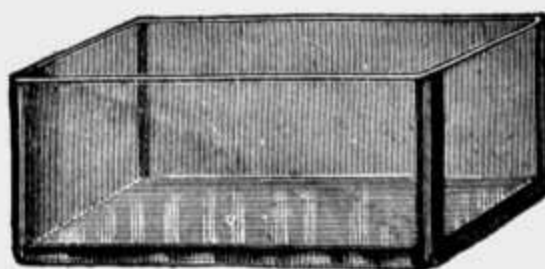


No. 5440.

5437. Triangle Holder. Will hold platinum triangles firmly in place; it prevents the wire from bending down when heated; it will accommodate any size triangle for holding crucibles up to 100 c.c. Without platinum triangle.	\$	0.83
5438. Tripod, iron, small, for spirit lamps..		.22
5439. Tripods, iron, for Bunsen burners, single ring.		
	Diameter, inches...	5 6 8 10 12
	Each .....	.22 .30 .42 .55 .75
5440. Tripods, iron, malleable, same as No. 5439, with concentric rings.		
	Diameter, inches...	5 6 8 10 12
	No. of rings.....	2 3 4 5 6
	Each .....	.28 .40 .50 .75 1.00



Nos. 5442-5446.



Nos. 5447-5450.

5442.	Troughs, Pneumatic, of japanned tin with sliding shelf and overflow; students' size, 4½x6½x10 inches.....	\$ 0.55
5444.	Troughs, Pneumatic, of heavy japanned tin with sliding shelf and overflow, 6x11x16 inches.....	1.45
5446.	Troughs, Pneumatic, heavy galvanized iron with sliding shelf and overflow, 5x9x12 inches.....	.90
5447.	Troughs, Pneumatic, Bohemian Glass, 20x10x10 cm.....	1.65
5448.	Troughs, Pneumatic, Bohemian Glass, 24x12x12 cm.....	2.25
5449.	Troughs, Pneumatic, Bohemian Glass, 30x15x15 cm.....	4.25
5450.	Troughs, Pneumatic, Bohemian Glass, 36x18x18 cm.....	6.65



No. 5451.



No. 5453.



Nos. 5455-5456.

5451.	Beehive Supports, used to support the inverted receptacle in collecting gases, OF ZINC, 3 inches in diameter.....	.33
5452.	Beehive Supports, same as No. 5451, but of glass.....	.35
5453.	Trough, Mercury, porcelain, cross shape, holding 3 kilos.....	.80
5455.	Trough, Mercury, porcelain, usual form, holding 4 kilos.....	1.15
5456.	Trough, Mercury, porcelain, usual form, holding 5 kilos.....	1.35



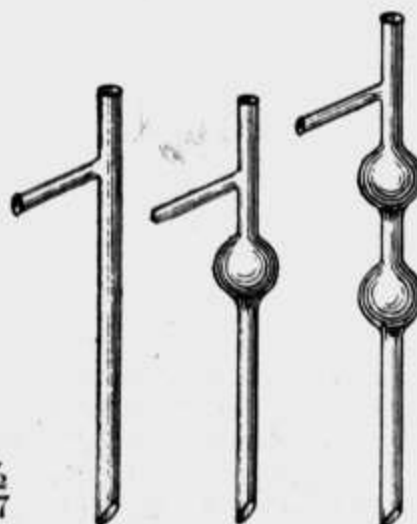
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No. 5465.

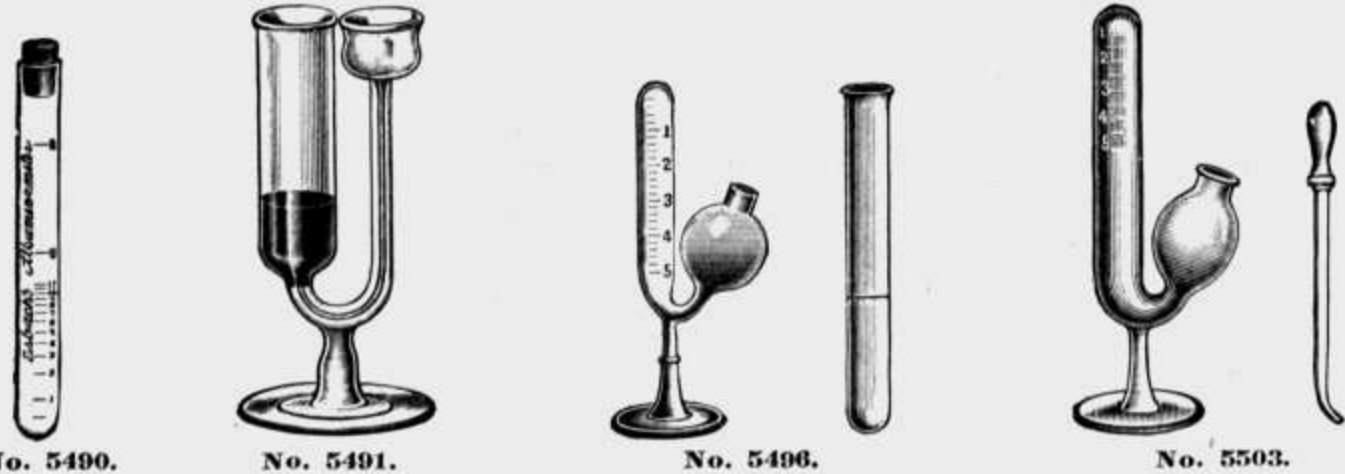


No. 5467.

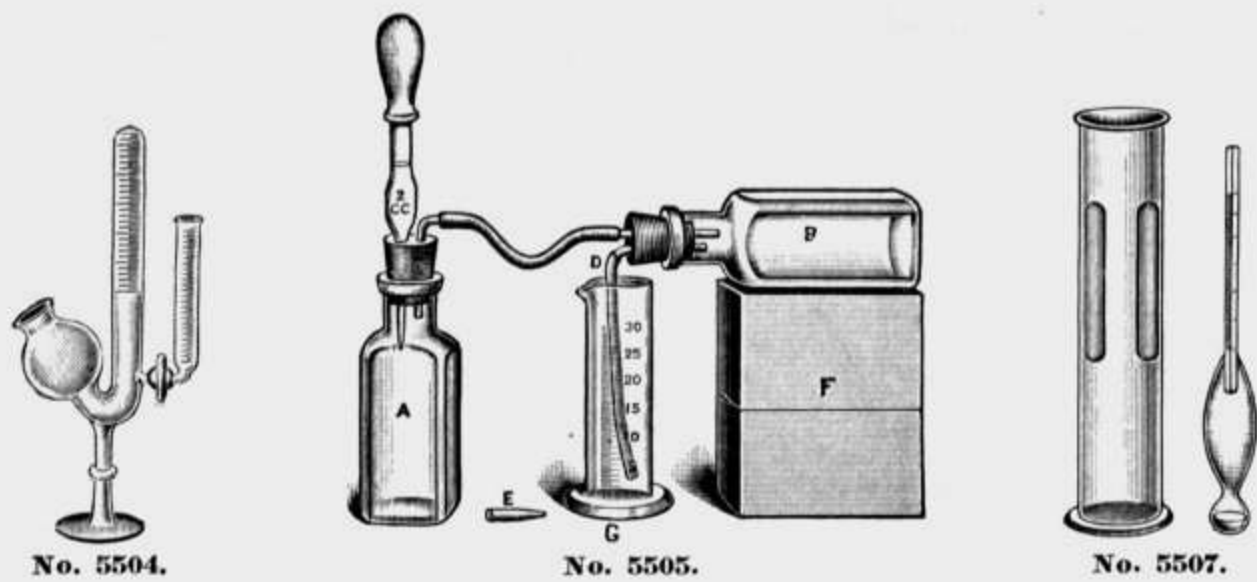


5463.	Tubes, Connecting, U shape, of glass.				
	Size, inches .....	¼	⅜	½	
	Each .....	.08	.12	.17	
5465.	Tubes, Connecting, Y shape, of glass	.08	.12	.17	No. 5477. No. 5479. No. 5481.
5467.	Tubes, Connecting, T shape, of glass	.08	.12	.17	
	Size, inches .....		⅝	¾	1½
5469.	Tubes, Connecting, Y shape, of brass.....	.27	.33	.40	
5471.	Tubes, Connecting, T shape, of brass.....	.27	.33	.40	
5473.	Tube, Connecting, Y shape, of lead, ¼ inch.....				.20
5474.	Tube, Connecting, Y shape, of hard rubber, ¼ inch.....				.10
5477.	Tube, Fractional Distillation .....				.20
5479.	Tube, Fractional Distillation, one bulb.....				.27
5481.	Tube, Fractional Distillation, two bulbs.....				.33

**URINARY ANALYSIS APPARATUS.**



- |       |   |         |
|-------|---|---------|
| 5490. | <b>Albuminometer, Esbach's</b> , for the quantitative determination of albumin in urine; graduated to read grams of albumin per liter of urine. Complete with directions .....  | \$ 0.65 |
| 5491. | <b>Horismascope (Albumoscope)</b> , for the detection of albumin in urine with nitric acid. With this instrument the nitric acid comes in contact with the urine in full strength, thus rendering the test much more delicate than ordinarily, $\frac{1}{60}$ per cent of albumen being detectible. Complete with directions for use..... | 1.25    |
| 5496. | <b>Saccharometer, Einhorn's Fermentation</b> , for the estimation of sugar in urine. Consists of a graduated fermentation tube and a graduated test tube. The percentage of sugar is read directly on the tube .....  | .75     |
| 5501. | <b>Ureometer, Doremus'</b> , for the rapid, quantitative determination of urea in urine by the hypobromate method. Consists of a graduated pipette and a fermentation tube graduated to read to $\frac{1}{10}$ per cent. Complete with directions for use.....  | 1.00    |
| 5503. | <b>Ureometer, Doremus'</b> , same as No. 5501, on glass foot.....   | 1.00    |

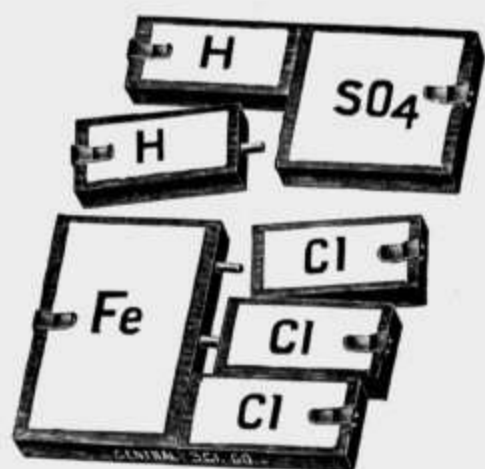


- |       |  |      |
|-------|--|------|
| 5504. | <b>Ureometer, Doremus'</b> , modified by Hinds, with glass foot.....   | 2.50 |
| 5505. | <b>Ureometer, Squibb's</b> , for approximate determination of urea in urine by displacement. Furnished with 50 c.c. bottle of reagent, vials, graduated pipette, graduated cylinder, complete with directions..                  | 3.00 |
| 5507. | <b>Urinometer, Squibb's</b> , for determination of the specific gravity of urine. Graduated from 1.000 to 1.060. Guaranteed accurate for temperatures of 77° F. In case, with cylinder and directions, without thermometer ..... | .85  |
| 5509. | <b>Urinometer, Squibb's</b> . Same as No. 5507, complete with thermometer and certificate of corrections.....  | 1.50 |
|       | <b>Fehling's Solution</b> , tablet form, sufficient to make one ounce solution .....   | .25  |

For Centrifuges, see pages 340-1.

For Fermentation Tubes, see page 362.

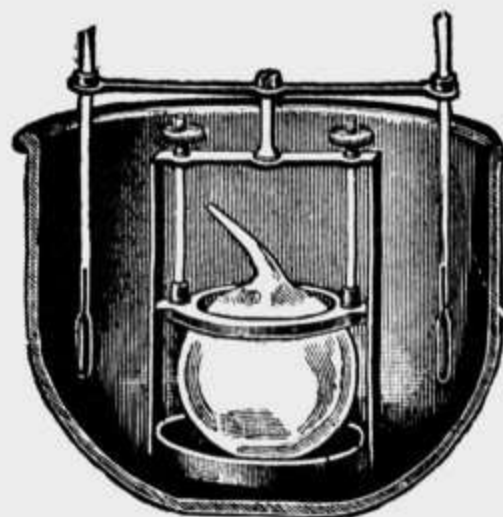
For Sedimentation Glasses, conical, ungraduated, see page 413.



No. 5555.



No. 5575.



No. 5579.

5555. **Valence Blocks**, as suggested by Prof. W. H. Nead, of Franklin Academy, Frankin, Neb. (formerly of Colorado Springs High School). The blocks representing the positive elements are provided with pins which fit into corresponding holes in the blocks which represent the negative elements or radicals. On each block is a clip for holding a card on which is printed the symbol of the element represented. With these blocks valence, the idea of bonds between the atoms in combination and equation writing are made perfectly clear. The set includes 12 blocks for univalent elements, 6 for bivalent, and 4 for trivalent, half of each being positive, and 100 printed cards with symbols of elements and radicals..... \$ 2.75
5575. **Vapor Density Apparatus**, after Victor Meyer. Complete..... 2.25
5576. **Inner Tube** only for No. 5575..... 1.00
5577. **Outer Bath** only for No. 5575..... 1.12
- 5577A. **Outer Bath** only, of copper, for No. 5575, McCoy's modification..... 5.50
5578. **Bottles**, small, glass stoppered, for No. 5575. Per dozen..... 1.75
5579. **Vapor Density Apparatus**, latest modified form, complete as illustrated with bulb support and kettle, but without thermometers..... 15.00
- Dumas Bulbs** for No. 5579, see page 315.



No. 5581.



No. 5585.

5581. **Waste Can**, galvanized, 14x14 $\frac{1}{4}$  inches; capacity, 9 $\frac{1}{4}$  gallons; with seamless cover fitting over outside..... 1.10
- Waste Jars**, see page 380.
5585. **Watch Glasses**, best imported glass, well annealed, edges ground, used for covering beakers, etc.  
 Diameter, inches.. 1 $\frac{1}{2}$     2    2 $\frac{1}{2}$     3    3 $\frac{1}{2}$     4    5    6  
 Per dozen ..... .22    .25    .50    .57    .75    .84    1.50    2.50
5587. **Watch Glasses**, counterpoised, for use on analytical balances; 2, 2 $\frac{1}{2}$  or 3 inch. Per pair..... .67
- Watch Glass Clips and Springs**, see page 345.
5589. **Watch Springs**, for burning in oxygen. Per dozen..... .22





No. 5591.



No. 5593.

5591. **Water Bath**, polished copper, tin lined, concentric copper rings and cover, handles and steam escape.

Diameter, inches .....	4	5	6	8
Number of rings.....	3	4	5	6
Each .....	\$0.95	1.15	1.35	2.25

5593. **Water Bath**, polished copper, same as No. 5591, with constant water level.

Diameter, inches .....	4	5	6	8
Number of rings.....	3	4	5	6
Each .....	1.50	1.70	1.90	2.80



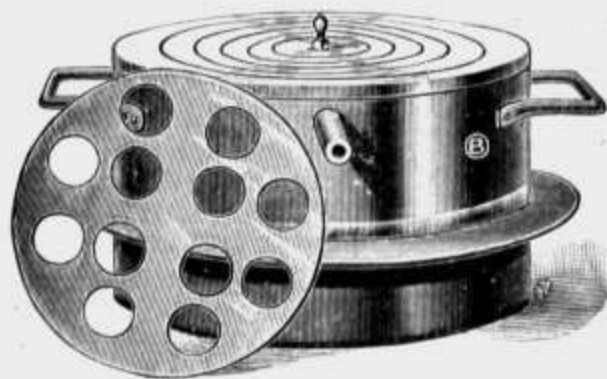
No. 5595.



No. 5596.

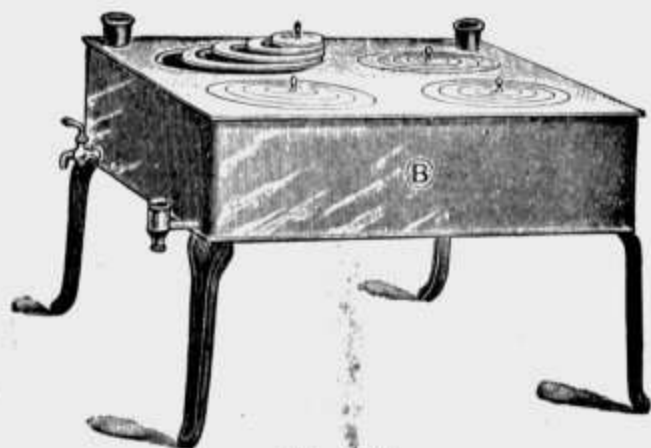
5595. **Water Bath**, polished copper, tin lined, with five concentric rings and Kekule's constant water level attachment, on detachable iron support. Diameter, 6 inches. Adopted by the University of Chicago.... \$ 3.85

5596. **Water Bath**, Victor Meyer's, funnel shape, of polished copper, tin lined, with concentric rings, cover and constant water level, with tripod 8 inches high. Diameter, 6 inches..... 3.50

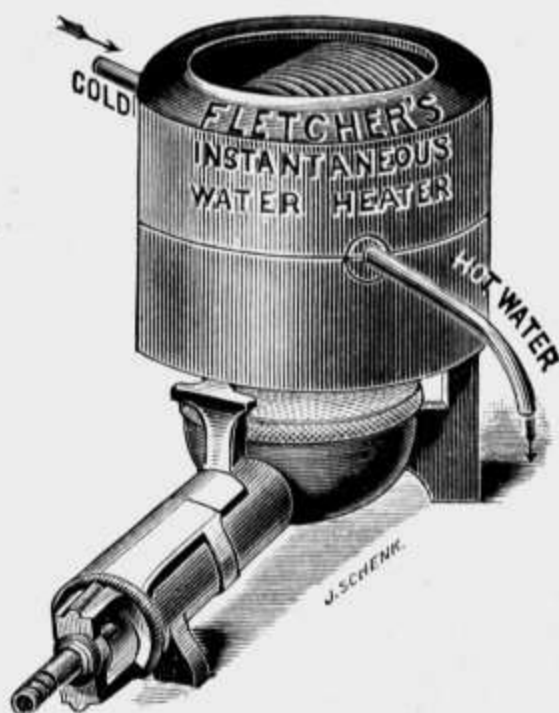


No. 5598.

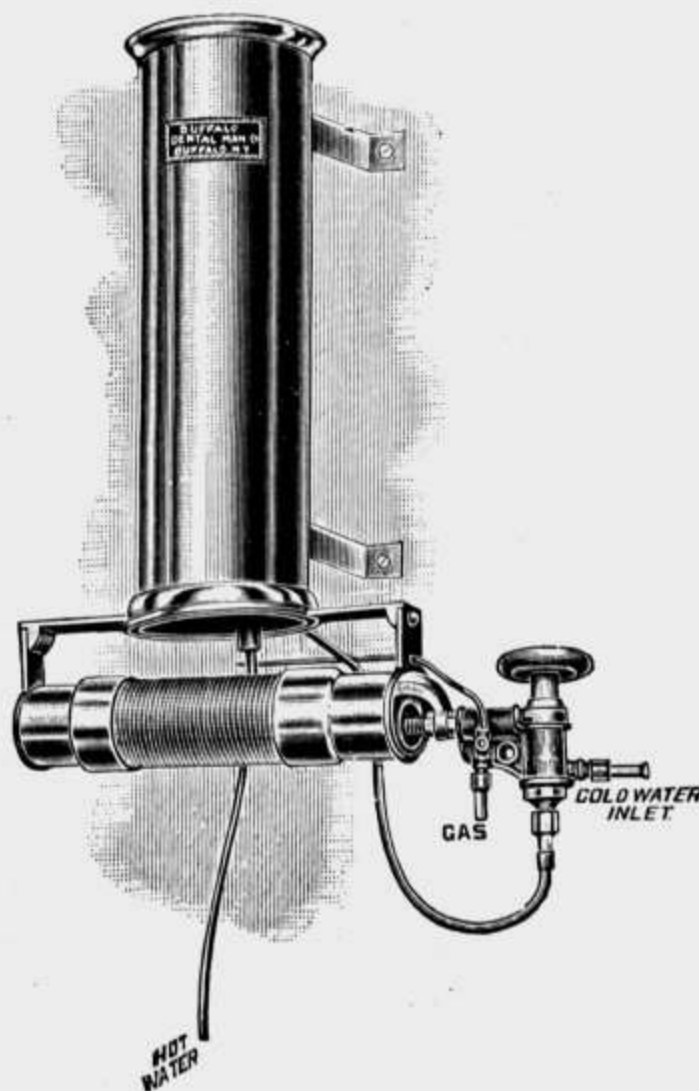
5598. **Water Bath**, of polished copper, tin lined. Diameter, 6 inches. The body is made of one piece, with concentric rings and cover, steam escape and flange to fit on tripod. Includes plate perforated for test tubes ..... 3.00



No. 5601.



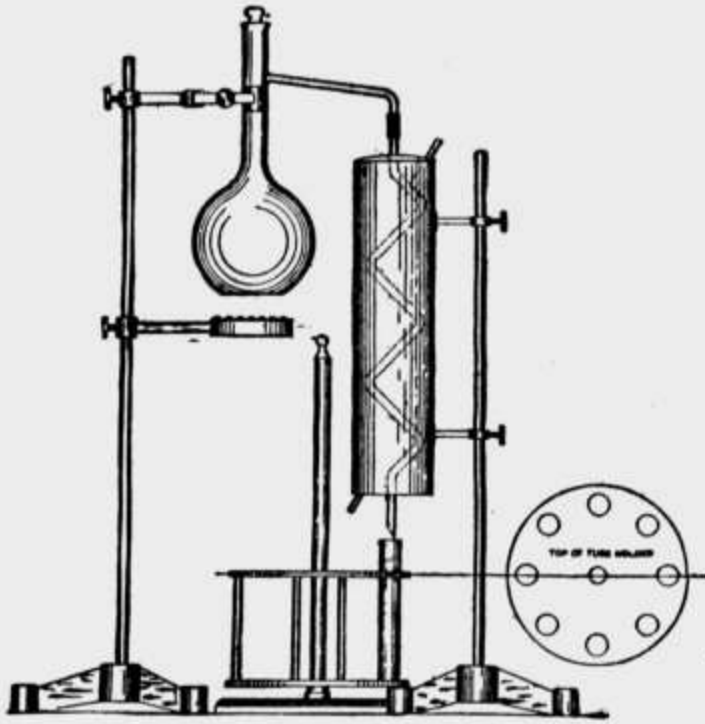
No. 5607.



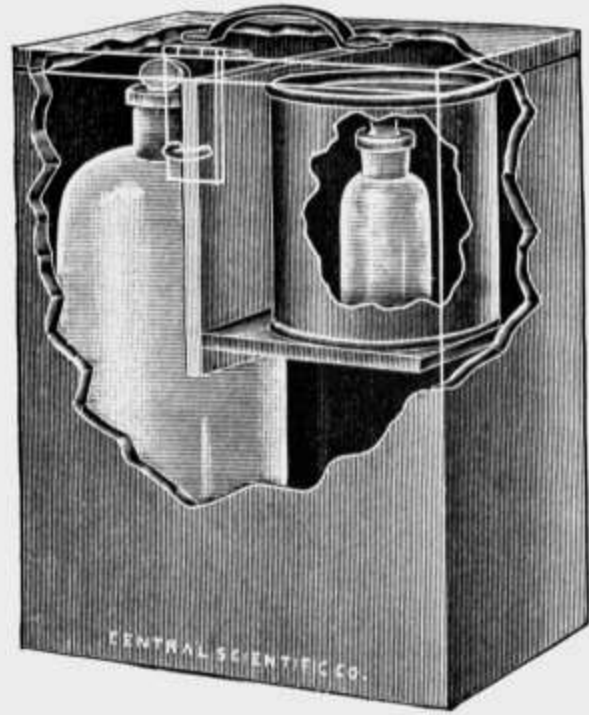
Nos. 5609-10.

- |        |  |          |
|--------|--|----------|
| 5601.  | <b>Water Bath</b> , of heavy polished copper, tin lined, 14 inches square, 5 inches deep, with four openings 5 inches in diameter, provided with rings and cover.<br>Has a stop cock to draw off the water, Kekulé's water level regulator, and an extra sheet iron bottom, and is supported by four detachable legs .....   | \$ 13.35 |
| 5602.  | <b>Water Bath</b> , like No. 5601, 23x13½x5 inches with seven openings, three of 6 inches diameter and four of 4 inches diameter, with rings and cover .....   | 19.00    |
| 5603.  | <b>Water Bath</b> , same as No. 5602, but arranged with coil for heating with steam .....  | 22.60    |
| 5605.  | <b>Water Heater, Instantaneous.</b> Gives hot water in three seconds after the gas is lighted, and in one minute will give sufficient hot water for washing hands. Illustration shows the heater on No. 4661 burner. Heater complete, without burner.....  | 4.00     |
| 5607.  | <b>Water Heater, Instantaneous</b> , same as No. 5605, with burner.....  | 6.00     |
| 5609.  | <b>Water Heater, Instantaneous</b> , specially designed for lavatory, general laboratory and domestic use; it will heat one pint of water per minute, from 50° F. to 130° F., or will boil 4 gallons per hour. A pilot light attachment keeps the water in the coil constantly warm when the water is not running and automatically lights the burner when the gas is turned on. Complete with coupled taps..... | 25.00    |
| 5609A. | <b>Water Heater</b> , same as No. 5609, but equipped with burner for gasoline gas .....  | 26.00    |
| 5610.  | <b>Water Heater</b> , same as No. 5609, but larger with twice the capacity described above. Complete with coupled taps and pilot light....   | 30.00    |
| 5610A. | <b>Water Heater</b> , same as No. 5610, but equipped with burner for gasoline gas .....  | 31.00    |

## WATER TESTING APPARATUS.



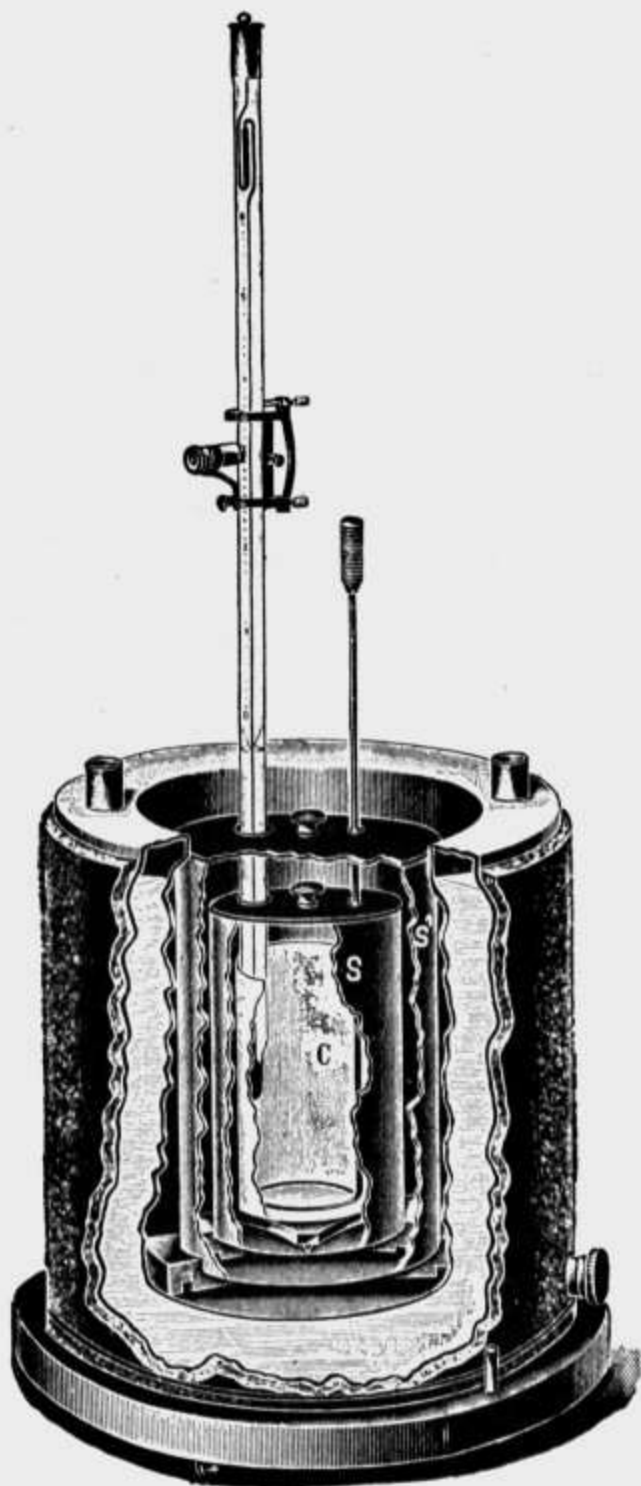
No. 5612.



No. 5615.

5612. **Water Testing Apparatus**, for the determination of ammonia in water, as used by the Department of Health of New York City, consisting of a metal condenser with block tin condenser tube and support, eight Nessler cylinders graduated at 50 and 100 c.c. in revolving support, flask, burner and support for same..... \$ 15.00
5615. **Water Sample Case**. Consists of a well made wooden case with hinges, hasp and handle; with separate compartments for one 5 pint and one 4 ounce glass stoppered bottle. Excellent for obtaining samples of drinking water for analysis by health departments. We furnished over a hundred of these sample cases to the Health Department of the State of Oklahoma. Complete with bottles and container for small bottle..... Net 3.00
5617. **Color Tube**, of brass, 24 inches long, 2½ inches in diameter, closed at end by polished plate glass, held in place by screw cap. Easily cleaned ..... 9.00
- Sedgwick-Rafter Water Apparatus**, for Microscopical Examination of water. See "The Microscopy of Drinking Water," by Geo. C. Whipple.
5619. **Sedgwick-Rafter Funnel**, graduated, with attachment and rubber stopper ..... 2.25
5620. **Sedgwick-Rafter Funnel**, plain, with attachment and rubber stopper.. 1.55
5621. **Berkshire Sand**. Per pound..... .15
5622. **Bolting Cloth Discs**. Per dozen..... .25
5623. **Support**, for funnel..... 1.50
5624. **Counting Cell** ..... 3.25
5625. **Cover Slip** ..... .25
5626. **Eye-Piece Micrometer** ..... Net 3.50
5627. **Pipettes**, 1 c.c. and 5 c.c..... .25
5628. **Graduated Flask**, 25 c.c..... .35
- Microscope**, according to selection. See Catalog N.
5630. **Hehner's Cylinders**, for the estimation of iron in water, consisting of two graduated glass tubes of same size and graduation, with stop cocks, per pair..... 4.25
5631. **Hehner's Cylinders**, same as No. 5630, with brass bases..... 6.67
- Nessler's Cylinders**, see page 380.
- Hydrotimeter**, for determination of hardness of water, see page 377.

PHYSICAL CHEMISTRY.



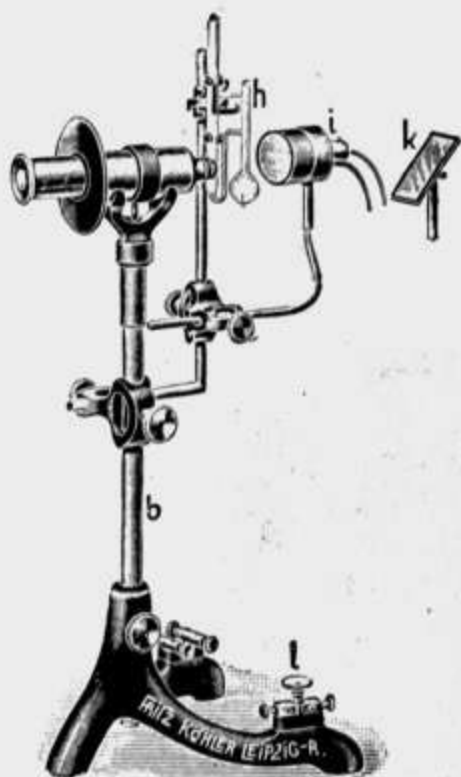
No. 5701.



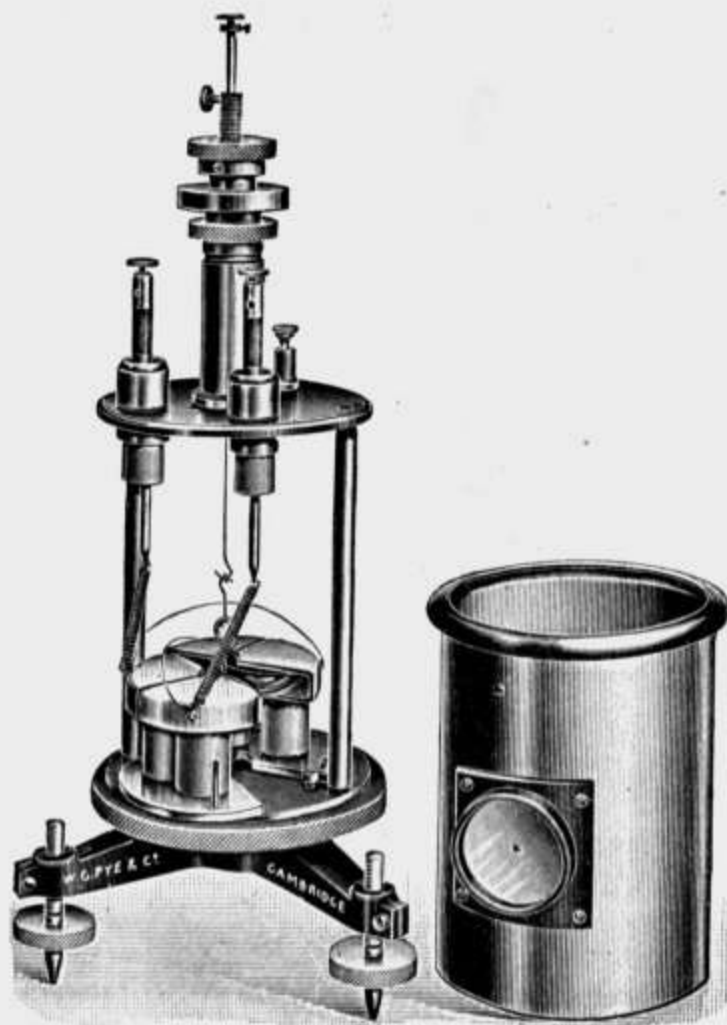
No. 5703.

5701. **Calorimeter**, after Ostwald. Consists of Calorimeter C of silver, gold lined inside, capacity 500 cubic centimeters. Enclosing this are two other cylinders insulated from each other and from C by hard rubber and each provided with hard rubber covers with holes for stirrer and thermometer. The whole is surrounded by water jacket, which in turn is covered with heavy coating of felt. Complete on hard rubber base, stirrer of nickel, but without reading attachment and thermometer.....Duty free \$ 40 00
5703. **Mixing Cell** for use with No. 5701 Calorimeter. Consists of Erlenmeyer Flask with insulating handle, supported on hard rubber rest. Inside insulating cylinders protected by heavy coating of felt. ....Duty free 9 75

**Beckmann Thermometer** for use with above, see page 418.  
**Reading Attachment** as above illustrated, see page 419.



No. 5705.



No. 5707.

5705. **Capillary Electrometer, Ostwald, new model.** Sensibility about 10 scale divisions for .001 volt. Furnished with universally adjustable mirror, incandescent lamp holder, translucent screen, one four-volt incandescent lamp, one reserve incandescent lamp and two extra capillary tubes and switch for illuminating currents (attached to tripod).

This electrometer is carefully made and completely provided for all adjustments for microscope, tubes and screen. Ocular has micrometer graduated in  $\frac{1}{10}$  millimeters.....Duty free \$ 16.00

5707. **Quadrant Electrometer, Dolezalek pattern.** This pattern is very convenient to use and has a high degree of sensibility. It has the following advantages:

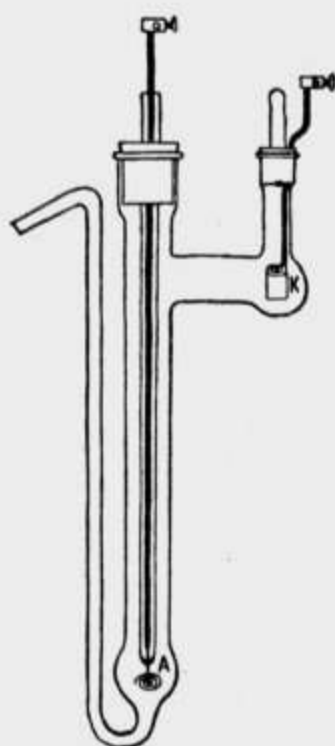
- (1) Extremely long ambroid insulation to quadrants and terminals.
- (2) Terminals conveniently placed on the top of the instrument and readily removable for cleaning.
- (3) Strong phosphor bronze suspension, giving high sensibility.
- (4) Ample adjustment in height and rotation of the vane in relation to the quadrants.
- (5) Zero adjustment without altering relative position of vane and quadrants.
- (6) Proportionate readings over a wide scale range.

The instrument is almost dead-beat and a deflection of about 250 mm. is obtained at a meter distance with a difference of potential of 1 volt between the two pairs of quadrants when the vane is charged to 100 volts. Complete with phosphor bronze suspension and plane mirror .....Duty free 50.00

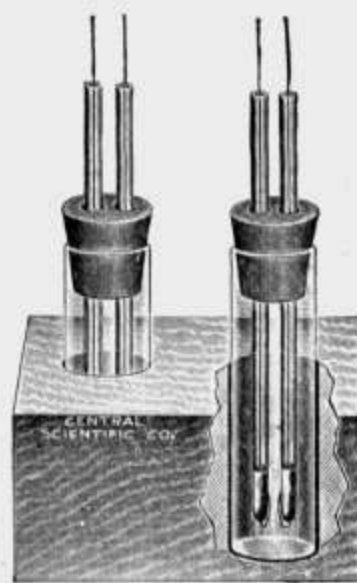
5708. **Extra System for No. 5707, including vane, plane or concave mirror, and suspension** .....Duty free 4.00



No. 5711.

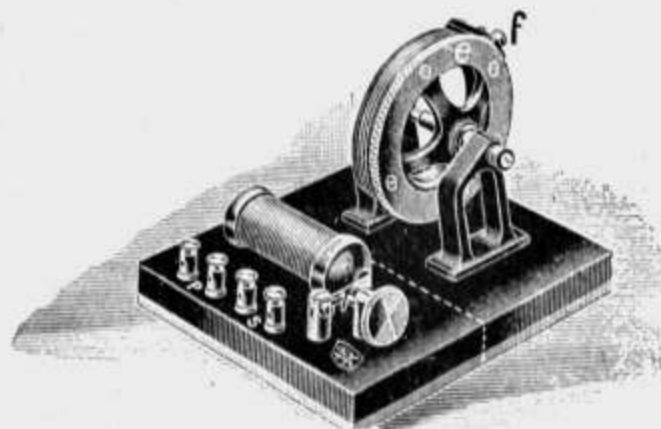


No. 5713.



No. 5717.

- |       |  |                     |      |
|-------|--|---------------------|------|
| 5709. | Capillary Electrometer Tube, oval form, with sealed-in platinum wires .....  | Duty free, about \$ | 1.00 |
| 5711. | Capillary Electrometer Tube, with connection tube (W), upright tube (R), and fused-in wire (D).....  | Duty free, about    | 1.10 |
| 5713. | Apparatus for Determining the Mobility of Ions in a Silver Salt, after Loeb and Nernst. Cathode K in the short limb consists of a piece of silver foil connected to the battery wire by a piece of silver wire. The anode A in the long arm consists of a coil of silver wire in form of flat spiral connected to battery by means of platinum wire fused in a capillary tube, which runs entire length of long limb ..... | Duty free           | 4.00 |
| 5715. | Holder for above, for supporting it in thermostat.....   | Duty free           | 2.25 |
| 5717. | Ionization Cell, after Smith and Hale. Electrodes consist of two glass rods with platinum wires fused in at bottom. Ends of platinum wires are fastened to side of cell. Battery connection secured by means of copper wires welded to the platinum and running through the glass tubes. Per pair, complete with rubber stoppers and mounted in well paraffined hardwood block.....  |                     | 4.40 |

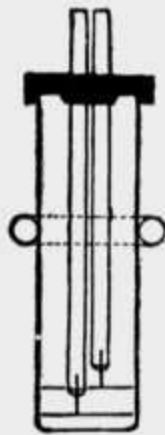


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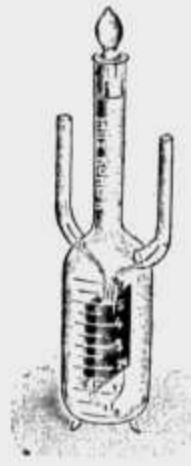
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|--------|--|-----------|-------|
| 5719.  | Inductorium for Conductivity Experiments, after Ostwald; of superior workmanship. Special device for vibrator to deaden the noise of vibration. Mounted with Kohlrausch spiral bridge on neatly finished hard rubber base. Provided with conveniently placed binding posts for electrical connections. Without receiver..... | Duty free | 10.00 |
| 1778D. | Induction Coil, small, simple form, after Walker, in sound-proof box.  |           | 6.00  |



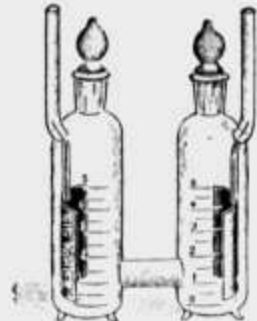
No. 5723.



No. 5725.



No. 5727.

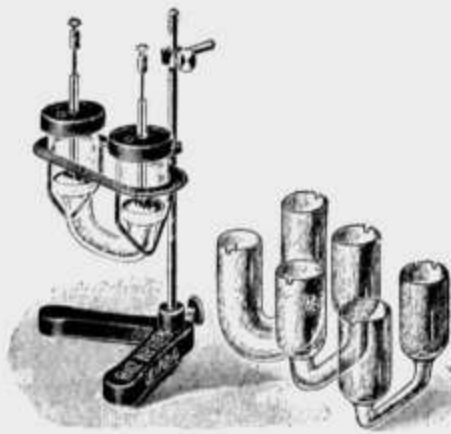


No. 5729.

- 5723. **Conductivity Cell**, after Ostwald, for poor conducting fluids. Consists of a glass cylinder of Jena glass, with hard rubber cap, through which pass two glass tubes with fused-in platinum electrodes....  
.....Duty free, about \$ 9.00
- 5724. **Reserve Glass Cylinders** for above.....Duty free .50
- 5725. **Conductivity Cell**, after Arrhenius, **for poor conducting fluids**, construction similar to No. 5723.....Duty free, about 20.00
- 5726. **Reserve Glass Cylinder** for above.....Duty free .45
- N. B.—Either of above cells may be furnished with ground-in glass cap at a charge in addition to above prices of.....Duty free 3.25
- 5727. **Conductivity Cell**, after Kohlrausch, for poor conducting fluids. Closed container with fused-in electrodes so constructed as to obviate vibrations .....Duty free, about 13.00
- 5728. **Conductivity Cell**, same as above, with thermometer. Duty free, about 14.75
- 5729. **Conductivity Cell**, after Kohlrausch, for good conducting fluids. Graduated cells with ground-in stoppers.....Duty free, about 17.50



No. 5731.



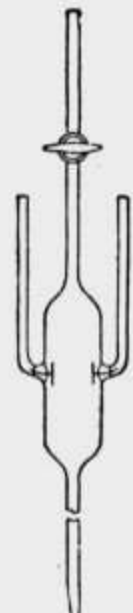
No. 5735.



No. 5737.

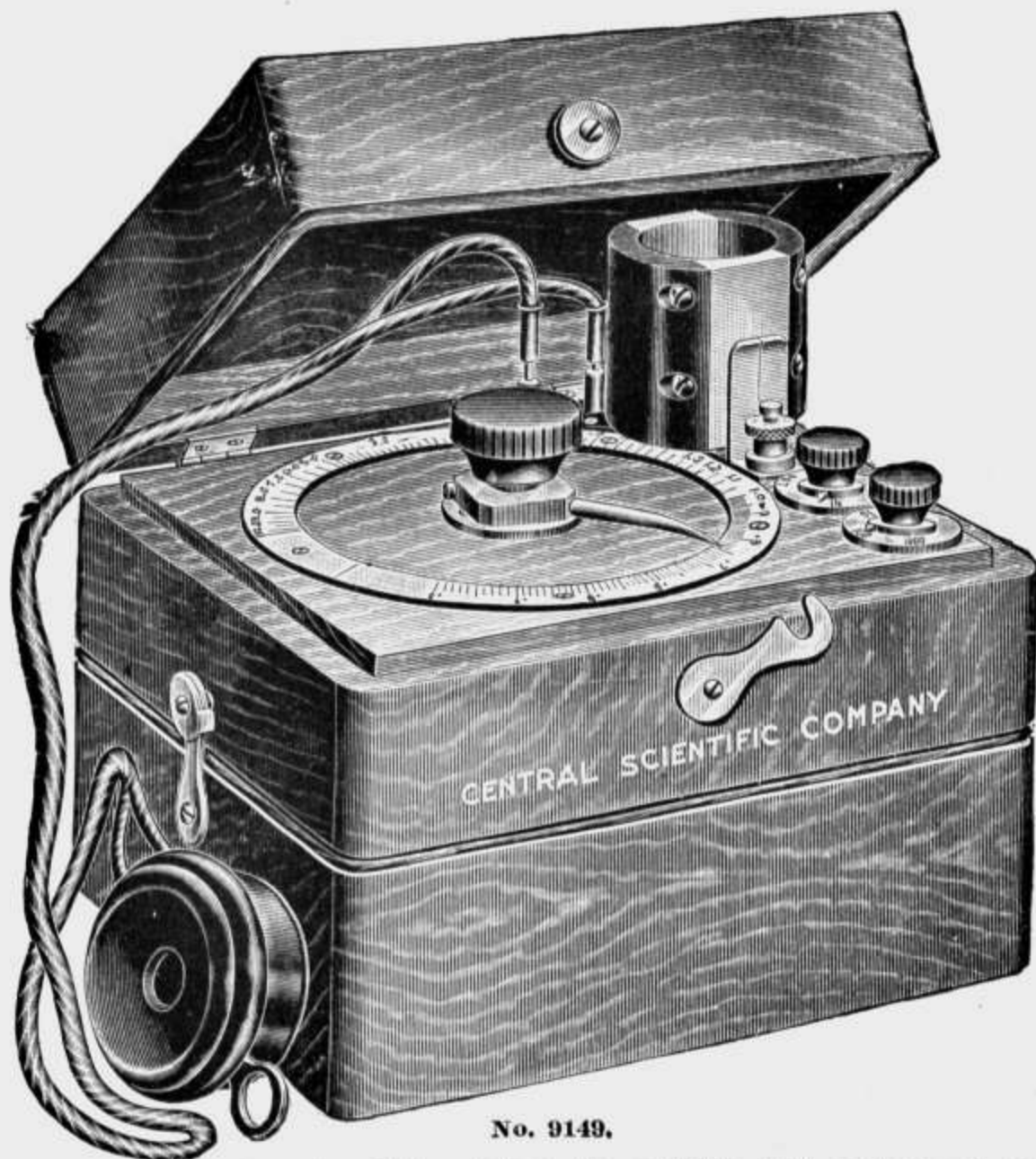


No. 5739.



No. 5741.

- 5731. **Conductivity Cell** of changeable capacity. The vertical electrodes are so supported that their distance apart may be changed.....  
..... Duty free, about 16.25
- 5733. **Conductivity Cell**, same as above, with thermometer. Duty free, about 19.50
- 5735. **Conductivity Cell**, after Kohlrausch, with five glass cells of different cross section, with electrodes but without support. Duty free, about 11.00
- 5737. **Dipping Electrode**, for immersion in fluids to be tested. For poor conductors .....Duty free, about 9.00
- 5739. **Dipping Electrode**, same as above, for good conductors.....  
..... Duty free, about 5.80
- 5741. **Pipette Electrode**, for measuring solutions affected by the air and also for measuring aqueous solutions at 100 degrees C. For poor conductors .....Duty free, about 13.00



No. 9149.

9149. **Conductivity Bridge**, for determining the soluble salt content of soils; made after designs approved by the U. S. Bureau of Soils. (See Bulletin No. 61, 1910.)

The use of this bridge depends on the fact that the electric current is conducted by the salt in solution and that the conductance of the solution or, conversely, its resistance to the passage of the current, is determined largely by its concentration. The magnitude of current that will pass is increased by an increase of salt in solution; or the resistance to the passage of the current decreases with the increase of salt. The instrument is of general utility in measuring the resistances of solutions and of soils. It is designed primarily for use as a field instrument, and finds its greatest use in determinations of "alkali" or harmful excess of soluble salts, frequently present in the soils of arid and semiarid areas. In survey work it gives a convenient method for determining in the field the percentage of alkali in a soil, so that the mapping may be carried on concurrently. It is also useful in determining the salt content of irrigation and seepage waters.

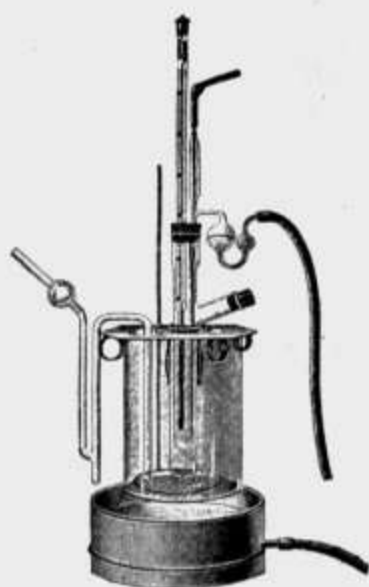
The instrument, by means of which resistances are measured, is a modified form of slide-wire Wheatstone's bridge. In operating the bridge, the cup is filled with the soil saturated with water, and placed in the clips provided for it. The resistance of the cup contents is then read, and from the resistance the amount of soluble salt present determined by reference to the tables given in the Bulletin mentioned above.

Complete as described.....Net \$ 100.00

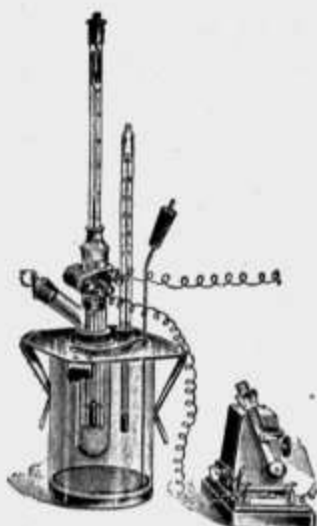
Note.—Bridges of the above type made by us have proved satisfactory to and met the requirements of the U. S. Bureau of Soils, Washington, D. C.

Bridges of this type are used by the Atchison, Topeka & Santa Fe Railway Co. for testing the alkali content of their tank water.





No. 5744.



No. 5745.

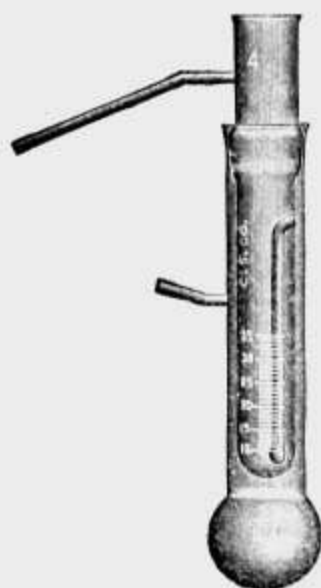


No. 5746.

## MOLECULAR WEIGHT DETERMINATION APPARATUS.

5744. Freezing Method, Beckmann's Old Form, consisting of the parts listed below .....	Duty free	\$ 11.80
5744A. Freezing Cell, with cover held in place by springs, stirrer, 4 air jackets, 4 freezing tubes, 3 filling pipettes, 1 agitating rod and rubber stopper .....	Duty free	5.00
5744B. Zinc Base Support.....	Duty free	.70
5744C. Sulphuric Acid Tube.....	Duty free	.65
5744D. Siphon .....	Duty free	.45
5744E. Stirrer. Glass rod with platinum ring.....	Duty free, about	5.00
For Thermometer for low temperature see page 417.		
5745. Freezing Method, Beckmann's New Form. Complete apparatus consists of the parts listed below.....	Duty free	48.35
5745A. Freezing Cell, with cover, stirrer, 4 air jackets, 4 freezing tubes, 3 filling pipettes, 1 agitating rod and rubber stopper.....	Duty free	9.00
5745B. Electro Magnet .....	Duty free	4.50
5745C. Metronome Interrupter, New Form.....	Duty free	6.60
5745D. Mechanical Stirring Apparatus.....	Duty free	16.25
5745E. Platinum Stirrer, with acid proof enameled iron ring.....	Duty free, about	12.00
5746. Boiling Point Apparatus, after Beckmann, for substances whose boiling point does not exceed 100° C. The complete apparatus consists of the parts listed below, except No. 5746D.....	Duty free	11.70
5746A. Boiling Tube, with inner cooler, ground-in stopper, filling cylinder, mica plate and asbestos packing.....	Duty free	4.80
5746B. Support, with two double holders.....	Duty free	4.20
5746C. Micro Burner, with mica chimney.....	Duty free	2.70
5746D. Platinum "Tetrahedra," weight about 5 grams, with equal amount of glass beads.....	Duty free, about	10.00

For Beckmann's Thermometers for above, see page 418.



No. 5747.



No. 5748.

5747. **Molecular Weight Determination Apparatus.** This is the latest improved form by Prof. McCoy. Graduated inner vessel and jacket only. Inner vessel makes ground joint connection with the jacket.. \$ 3.00
5748. **The Menzies Molecular Weight Apparatus.** (Designed by Dr. Alan Menzies of the University of Chicago.)

The apparatus serves two purposes:

- (1) To find the molecular weights of dissolved substances by measuring the lowering of vapor pressure of the solution.
- (2) To find the molecular weights of easily volatile substances by measuring their vapor densities.

The apparatus, therefore, completely fills the purpose of the Beckmann or Landsberger boiling point apparatus, and partially fulfills the function of the Victor Meyer apparatus.

(1) No molecular weight apparatus using the principle of measuring the lowering of vapor pressures of solutions in order to determine molecular weights of solutes has ever hitherto come into general use. This apparatus solves the great difficulty of removal of dissolved gases by a process of boiling out TILL CONSTANT RESULTS ARE OBTAINED. The difference of level of liquid is read first when the apparatus contains pure solvent and then a second time after the weighed quantity of solute has been added. The lowering of vapor pressure is obtained by subtracting the value of the first reading from that of the second.

(2) For vapor density measurements this apparatus gives especially RAPID as well as accurate results. The very slight modification required in the construction of the apparatus has already been effected in the form sold by us, and this modification in no wise unfits the apparatus for its first purpose.

#### SOME FEATURES OF THE APPARATUS.

- (1) **As used to determine molecular weights by measuring lowering of vapor pressure:**

The apparatus is already assembled.

No Beckmann or other thermometer is required.

A first determination takes from thirty to forty minutes, including the time required for weighing.

The reading of volume of solution is made directly on wide graduations. No thermometer has first to be removed.

The results, even in the hands of a beginner, are at least as accurate as with the boiling point methods.

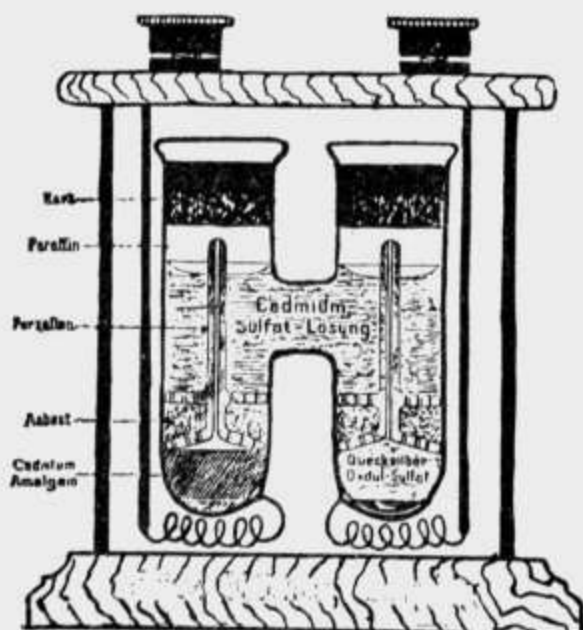
- (2) **As used for vapor density determination:**

The apparatus is already assembled, and is in working order in a few minutes.

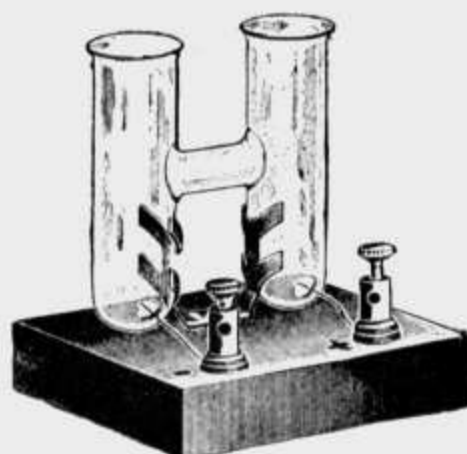
A single ring stand serves to support the complete apparatus at a convenient height above the working bench.

No barometric reading is necessary.

The vapor is measured under a partial pressure of not more than one-sixth of an atmosphere; and this low pressure tends to counteract association .....

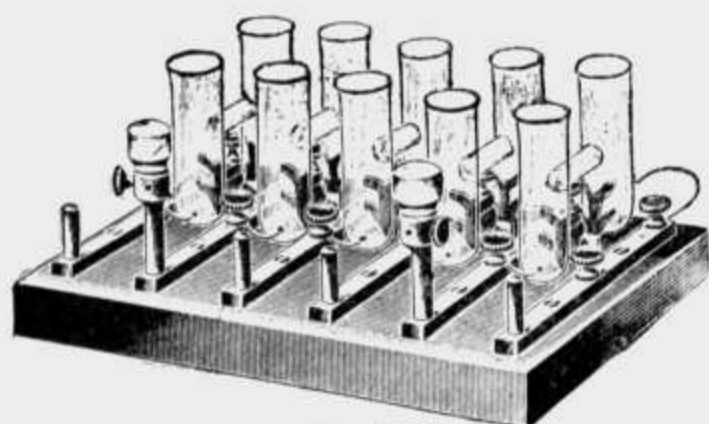


No. 5755.

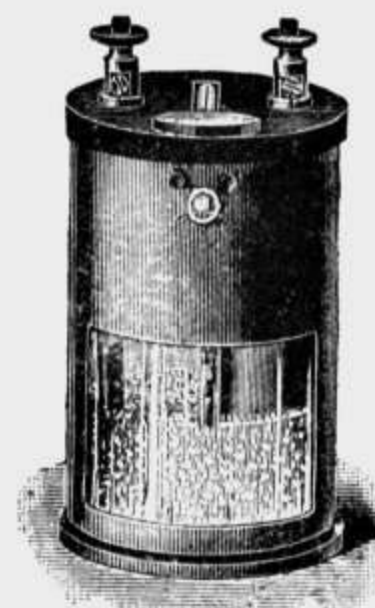


No. 2137.

- 5755. Normal Cell, Cadmium, portable. Very carefully made and only the purest chemicals used. Internal resistance about 160 ohms; without temperature coefficient.....Duty free \$ 18.00
- 5756. Normal Cell, same as No. 5755, with Reichsanstalt certificate. Duty free 19 50
- Note—Nos. 5755 and 5756 Normal Cells should deliver current only for short intervals, and then only through a resistance of at least 50,000 ohms.
- 2136. Standard Cell, Glass Part with Platinum Wires only, for schools desiring to make their own standard cells. This is the standard H form and may be used to make any of the ordinary forms of standards. Each ..... Net 2.10
- 2137. Standard Cell, same as No. 2136, on stand as illustrated..... Net 3.00

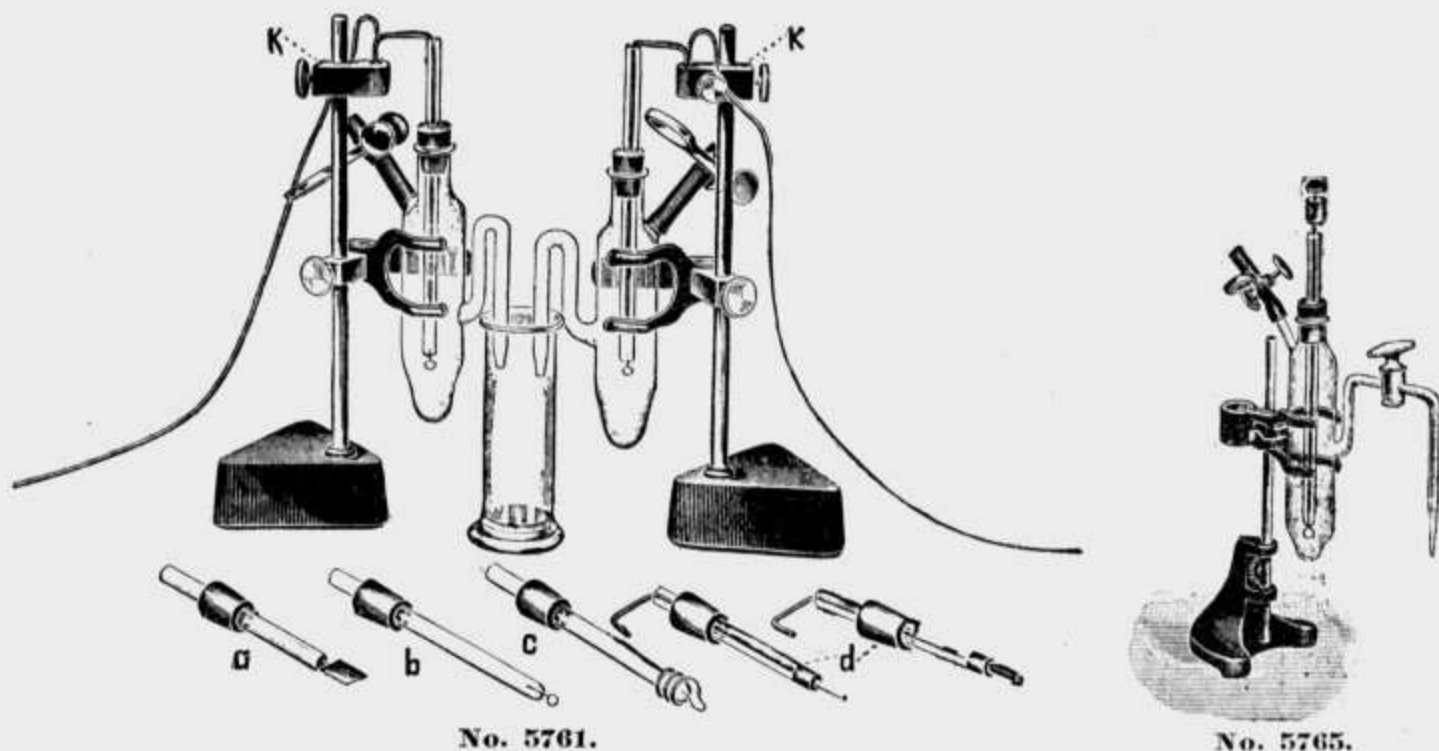


No. 5759.



No. 2140.

- 5759. Battery of five Normal Cells. Five H cells mounted on supports and base provided with bars, traveling plugs and binding posts for convenient combination in series and parallel .....Duty free 10.50
- 2140. Clark Standard Cell. Mounted in brass case, with certified thermometer. Furnished with certificate of accuracy from the German Reichsanstalt .....Duty free 12.50



- No. 5761.**
5761. **Half Elements.** Cells mounted on movable stands provided with adjustable clamp, insulated binding posts and adjustable mercury well, K, as shown in illustration, for connecting electrodes to circuit. With electrodes A to D, inclusive.....Duty free \$ 10.75
5763. **Half Elements,** with cylinder and stands, but without electrodes of any kind .....Duty free 4.80
- 5763A. **Platinum Electrodes,** a pair. Complete with rubber stoppers.....Duty free, about 2.75
- 5763B. **Platinum Electrodes,** a pair made of fused in platinum wire, the ends of which are turned into a ring. Complete with rubber stoppers .....Duty free, about 1.35
- 5763C. **Silver Electrodes,** set of three. Electrodes are silver spirals connected with fused in platinum wires. Complete with rubber stoppers .....Duty free, about 3.00

5763D. **Electrodes,** one zinc and one copper electrode, complete with rubber stoppers. Duty free, about .75

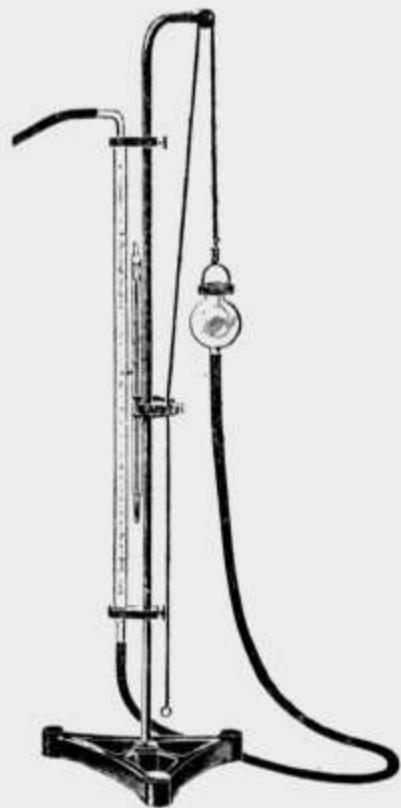
5765. **Calomel Normal Electrode.** Mounted adjustably on stand. With fused in platinum wire and copper rod terminal.....Duty free 3.25

5767. **Tensimeter,** reading accurately in oil to 0.1 mm. Glass part with manometer and scale..Duty free 4.50



No. 5767.

5773. **Gas Measuring Tube and Water Level Attachment,** complete with tripod base and stand, necessary clamps, rubber tubing, etc.....Duty free 10.00

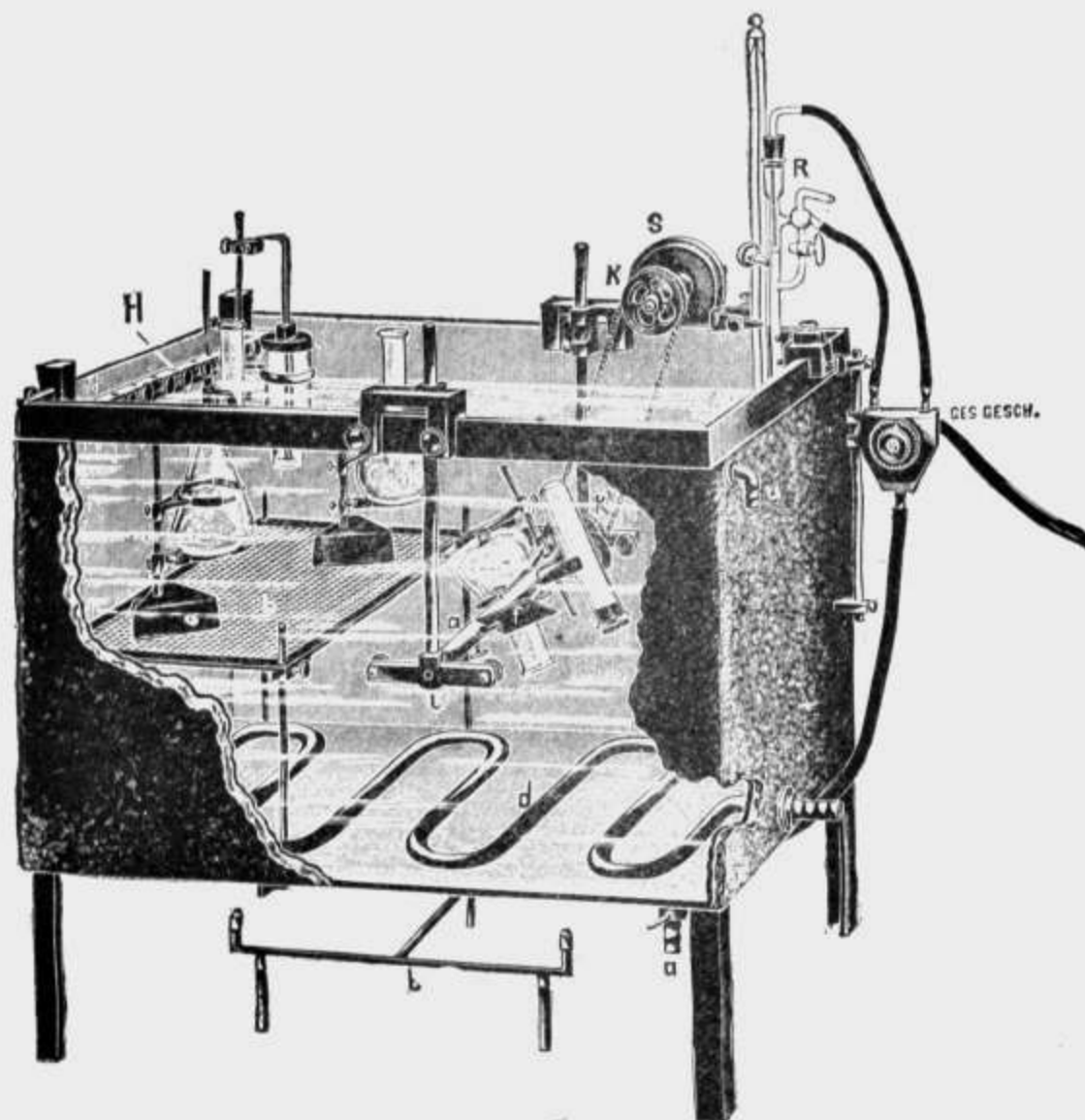


No. 5773.

5775. **Viscosity Pipette,** after Ostwald. Emptied in 80 to 100 seconds.... .90



No. 5775.



No. 5780.

5777. **Thermostat**, as used in Ostwald's Institute. Temperature control within  $0.1^{\circ}$  C. Consists of insulated rectangular box of sheet steel 55 c. m. long, 35 c. m. deep and 25 c. m. wide, capacity 58 liters up to overflow. Nickel plated inside and supplied with drainage cock and overflow tube. Furnished complete with axle and bearing, together with transmission pulley, two stirrers, one double burner and thermostat, toluol regulator with holder, two reserve regulators, adjustable nickel plated brass wire shelf, special device H for clamping conductivity cells, jars, etc. Complete chain transmission for use with belt to motor, and holder for thermometer, but without any glassware, supporting stands or holders for conductivity cells. Designed for use at room temperature and temperatures up to  $100^{\circ}$  C. Complete as above.....Duty free \$ 48 00
5778. **Thermostat**, same as above. Designed for temperature of tap water and temperature up to  $100^{\circ}$  C. Tap water is run through the copper tube d as shown in the illustration.....Duty free 55 00
5780. **Thermostat**, for use at room temperature, or with tap water, or with ice water and up to  $100^{\circ}$  C.....Duty free 58 00
5781. **Universal Holder** (shown holding flasks in illustration), nickel plated brass, spring clamp, all contact points covered with rubber, mounted on substantial foot.....Duty free 1 55
5782. **Universal Holder** (shown holding the flask on axle in illustration); same as No. 5781, without foot.....Duty free 1 25
5783. **Tube Holder** (shown holding test tube on axle in illustration), of nickel plated brass with spring clamp. For use with tubes 5-30 m. m. diameter.....Duty free 50
- For Thermometers for above, see page 417.

### RAW MATERIAL.

The following material has been selected with special reference to the physical laboratory shop. The prices are based on ordinary quantities and include cost of cutting. Special prices will be quoted on large orders.

All prices are subject to market fluctuations.

For convenience in shipping, certain items—rods, tubing, etc.—are cut in about 3-foot lengths, unless specially ordered in longer pieces.

Castings in all metals supplied at market prices.

For Tables giving Comparative Weights of Metals, see page 454.

#### ALUMINUM.

6001.	<b>Aluminum Rod</b> , full lengths, 8 to 10 feet.											
	Diam., in. ...	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	
	Lbs. per ft. ...	.032	.057	.089	.128	.174	.227	.356	.516	.697	.911	
	Price per ft. ...	\$0.06	.07	.10	.14	.20	.27	.44	.60	.75	1.00	
6002.	<b>Aluminum Sheet</b> , full sheets 12 inches wide, 5 to 6 feet long.											
	Thickness, B. & S. No.	8	12	14	16	18	20	22	24	26	28	30
	Lbs. per sq. ft. ...	1.8	1.13	.89	.71	.56	.45	.36	.28	.23	.18	.14
	Price per sq. ft. ...	2.00	1.25	1.00	.80	.60	.50	.40	.30	.25	.20	.16
6003.	<b>Aluminum Tubing</b> , seamless. Thickness of wall, B. & S. gauge, No. 20.											
	Diameter, outside, $\frac{1}{4}$ to $\frac{7}{16}$ inch, per foot. ....										\$ 0.40	
	Diameter, outside, $\frac{1}{2}$ to $\frac{11}{16}$ inch, per foot. ....										.50	
	Diameter, outside, $\frac{3}{4}$ to 1 inch, per foot. ....										.60	
	<b>Aluminum Wire</b> , see page 440.											
6008.	<b>Asbestos Cloth</b> , 36 inches wide, unaffected by acid, fire, etc.											
						Fine	Medium	Heavy				
	Per yard ...					3.10	3.35	4.55				
6011.	<b>Asbestos Paper</b> , for filtering acids, per lb. ....										.15	
6201.	<b>Asbestos Plates or Pads</b> , iron bound edges, diameter 8 inches, each..										.06	
6013.	<b>Asbestos Sheet</b> , full sheets 40x40 inches.											
	Thickness, inches .....			$\frac{3}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$				
	Per square foot. ....			.06	.10	.13	.17	.22				
	Per sheet .....			.22	.45	.90	1.25	1.65				
6014.	<b>Asbestos Sheet</b> , cut in squares, 4x4x $\frac{1}{16}$ in., per dozen. ....										.22	
6014A.	<b>Asbestos Sheet</b> , cut in squares, 6x6x $\frac{1}{16}$ in., per dozen. ....										.50	
6015.	<b>Asbestos Twine</b> , $\frac{1}{8}$ inch diameter, in pound balls, each. ....										Net 1.70	
6016.	<b>Asbestos Slate</b> , acid proof, for protecting table tops, etc. Can be cut with ordinary saw. Full sheets measure 42x48 and 42x96 inches.											
	Thickness, inches .....		$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$					
	Per sheet, 42x48 inches. ....		2.25	3.00	3.50	4.90	6.30					
	Per sheet, 42x96 inches. ....			6.00	6.80	9.60	12.20					
	For special sizes cut to order, add 2 cents per square foot.											
6016A.	<b>Asbestos Slate</b> , cut 12x12x $\frac{1}{8}$ inches, superior to asbestos pads, each. ....										.22	

#### BRASS.

6017.	<b>Brass Rod</b> , round, full lengths 12 feet.														
	Diam., inches. ....	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{2}$		
	Lbs. per ft. ....	.045	.100	.18	.28	.40	.55	.72	1.13	1.63	2.21	2.89	6.51		
	Price per ft. ....	.05	.05	.08	.12	.18	.24	.33	.50	.75	.95	1.25	2.90		
6018.	<b>Brass Rod</b> , square, full lengths 10 to 12 feet (see notice above).														
	Size, inches .....		$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$								
	Lbs. per ft. ....		.23	.51	.92	1.44	2.07								
	Price per ft. ....		.15	.30	.60	.85	1.10								
6019.	<b>Brass Sheet</b> , full sheets 12 inches wide, about 6 feet long.														
	Thickness, B. & S. No.	8	10	12	14	16	18	20	22	24	26	28	30		
	Lbs. per sq. ft. ....	5.69	4.51	3.57	2.83	2.25	1.78	1.41	1.12	.89	.70	.55	.44		
	Price per sq. ft. ...	1.95	1.65	1.33	1.10	.83	.65	.55	.45	.33	.25	.20	.17		
6020.	<b>Brass Strip</b> , full lengths 10 to 12 feet.														
	Width, inches .....	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{5}{8}$	1	1						
	Thickness, inches .....	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$						
	Lbs. per ft. ....	.085	.17	.115	.23	.29	.435	.69	.92						
	Price per ft. ....	.07	.11	.11	.15	.20	.28	.35	.60						
6021.	<b>Brass Tubing</b> , brazed, full lengths 12 feet. Price per foot:														
			Diameter, Outside, Inches												
	Wall, B. & S.	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2
	No. 12 ...										.55	.70	.85	1.00	1.15
	No. 14 ...					.25	.30	.35	.40	.50	.60	.70	.85	1.00	
	No. 16 ...				.16	.21	.25	.30	.35	.40	.50	.55	.65	.80	
	No. 18 ...		.12	.11	.13	.17	.20	.25	.30	.35	.40	.45	.50	.60	
	No. 20 ...	.10	.11	.11	.10										

**Brass Wire**,  $\frac{1}{16}$  inch and smaller, see page 440.

**Brass Balls**, see page 63.

**CARBON.**

6023.	<b>Carbon, Granulated,</b> for experimental purposes, per lb.....								\$ 0.20
6025.	<b>Carbon Rods,</b> plain, 12 inches long.								
	Diameter, inches .....	1/8	3/16	1/4	3/8	1/2	5/8		
	Each .....	.10	.10	.10	.11	.11	.12		
6027.	<b>Carbon Sheet.</b> Size of sheets, inches:								
		6x12			12x12				
	Thickness, inches .....	1/8	3/16	1/4	5/16	3/8	1/2		
	Price per sheet .....	.70	.75	1.50	1.65	1.75	1.90		

Special sizes, cut to order, quoted on application.  
**Carbons, for arc lamps,** see page 279.  
**Carbons, for batteries,** see pages 155-159.

**COPPER.**

6028.	<b>Copper Rod,</b> full lengths 10 to 12 feet.									
	Diam., inches .....	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	
	Lbs. per ft.....	.047	.106	.189	.426	.757	1.18	1.70	3.03	
	Price per ft. ....	.05	.09	.16	.35	.60	1.00	1.40	2.50	
6029.	<b>Copper Sheet,</b> plain, full sheets, 12x60 inches.									
	Thickness, B. & S. No.	14	16	18	20	22	24	26	28	30
	Lbs. per sq. ft.....	2.90	2.30	1.83	1.45	1.15	.91	.72	.57	.46
	Price per sq. ft....	2.50	2.00	1.60	1.25	1.00	.75	.60	.50	.40
6032.	<b>Copper Sheet, Foil.</b>									
	B. & S. gauge No.....						30		36	
	Per square foot.....						.55		.50	
6033.	<b>Copper Tubing,</b> 1/16 inch wall.									
	Diameter, outside, inches.....			1/4		3/8			1/2	
	Price per foot.....			.27		.27			.30	

**Copper Balls,** see page 63.  
**Copper Wire,** see page 440.

**FERROTYPE.**

6035.	<b>Ferrotypes,</b> plates 10x14 inches, each.....								.50
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**FIBER.**

6037.	<b>Fiber Rod,</b> black, full lengths about 30 inches.								
	Diameter, inches..	1/4	5/16	3/8	1/2	5/8	3/4	1	
	Price per foot....	.30	.18	.20	.30	.45	.75	2.25	
6039.	<b>Fiber Sheet,</b> black, full sheets about 24x34 inches.								
	Thickness, inches .....	1/8	3/16	1/4	5/16	3/8	1/2		
	Price per sq. ft.....	.35	.85	1.15	1.45	1.70	2.30		
6041.	<b>Fiber Tubing,</b> black, thickness of wall 1/16 inch; full lengths 2 to 3 feet.								
	Diam., inside, inches.....	1/4	3/8	1/2	5/8	3/4	1		
	Price per foot.....	.20	.22	.24	.28	.32	.40		

**IRON.**

6043.	<b>Iron Rod,</b> Norway, soft, for electro-magnets.								
	Diameter, inches .....	1/4	3/8	1/2	5/8	3/4	1		
	Lbs. per ft.....	.16	.37	.67	1.04	1.51	2.68		
	Price per ft.....	.05	.05	.08	.13	.20	.36		
6044.	<b>Iron Sheet,</b> tinned. Common tin plate, size 20x28 inches.								
	No. ....				1C	X	XX	XXX	
	Thickness, B. & S. No.....				28	26	25	24	
	Price per sheet.....				.30	.33	.37	.42	
6045.	<b>Iron Sheet,</b> Russia, .021 inch thick, per square foot.....								.22

**Iron Balls,** see page 63.  
**Iron Wire,** see No. 6131, page 442.

**LEAD.**

6047.	<b>Lead Sheet.</b>								
	Thickness, inches .....	1/64	1/32	1/16	1/8	3/16	1/4		
	Lbs. per sq. ft.....	1	2	4	8	12	16		
	Price per sq. ft.....	.27	.33	.66	1.33	2.00	2.65		
6048.	<b>Lead Tubing,</b> medium wall.								
	Diam. inside, inches.....	1/4	3/8	1/2	5/8	3/4			
	Lbs. per ft.....	.375	1.0	1.25	2.0	2.25			
	Price per ft.....	.10	.16	.20	.33	.38			

**Lead Shot,** see page 129.  
**Lead Wire,** see page 441.

**MICA.**

6050.	<b>Mica Sheet.</b>								
	Size, inches .....	2x4 1/2	4x5	4x6	5x8				
	Price per sheet.....	.07	.17	.22	.27				

**NICKEL ALLOY.**

Nickel-Chromium Ribbon, see page 442.  
 Nickel-Steel Rod, see No. 1566.

**PHOSPHOR BRONZE.**

6051. **Phosphor Bronze Sheet**, full sheets, 6 inches wide, 4 to 6 feet long.

Thickness, B. & S. No.....	22	24	26	30
Price per sq. ft.....	\$1.35	1.00	.90	.80

**Phosphor Bronze Ribbon**, for galvanometer suspensions, see page 199.

**PLATINUM.**

**Platinum Sheet and Wire**, see page 395.

**RUBBER.**

6052. **Rubber Rod**, hard, polished, full lengths 30 inches.

Diam. inches..	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
Lbs. per ft....	.015	.027	.04	.063	.08	.10	.16	.23	.29	.42
Price per ft....	.09	.12	.17	.30	.32	.38	.55	.80	1.00	1.50

6055. **Rubber Sheet**, hard, polished, full sheets 20x48 inches.

Thickness, inches .....	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$
Lbs. per sq. ft.....	.38	.76	1.14	1.52	1.90	2.28	3.04
Price per sq. ft.....	.85	1.65	2.50	3.40	4.25	5.05	6.75

**Rubber Sheet**, soft, see pages 119 and 402.

6057. **Rubber Tubing**, hard, not polished,  $\frac{1}{8}$  inch wall.

Diameter, outside, inches .....	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$
Price per ft.....	.11	.16	.22	.27

**Rubber Tubing**, soft, see page 403.

**STEEL.**

6058. **Steel Rod, Bessemer**, full lengths 4 feet.

Diameter, inches .....	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$
Lbs. per ft.....	.05	.10	.17	.27	.39	.52	.67
Price per ft.....	.05	.05	.05	.10	.10	.10	.11

6059. **Steel, Drill Rod**, high tempered, for tool making.

Diameter, inches .....	$\frac{1}{8}$ to $\frac{3}{16}$	$\frac{1}{4}$ to $\frac{7}{16}$	$\frac{1}{2}$ to $\frac{3}{4}$
Price per foot.....	.27	.55	1.00

**Steel, Magnet**, round and square, imported, best grade.

Size, inches .....	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$
6060A. Round, per foot.....	.27	.40	.75	1.00	1.50
6060B. Square, per foot.....	.40	.50	1.00	1.35	2.00

Hardening and magnetizing quoted upon application.

6062A. **Steel**, cold rolled, round, full lengths 8 to 10 feet.

Size, inches .....	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
Lbs. per ft.....	.17	.27	.39	.67	1.1	1.5	2.1	2.7
Price per ft.....	.05	.10	.10	.11	.13	.20	.27	.33

6062B. **Steel**, cold rolled, square, full lengths 8 to 10 feet.

Size, inches .....	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Lbs. per ft.....	.213	.478	.851	1.94	3.4
Price per ft.....	.06	.11	.13	.25	.38

6062C. **Steel**, cold rolled, rectangular, full lengths 6 to 8 feet.

Size, inches .....	$\frac{1}{16}$ x $\frac{1}{2}$	$\frac{1}{8}$ x $\frac{1}{2}$	$\frac{1}{4}$ x1	$\frac{1}{2}$ x $\frac{3}{4}$	$\frac{3}{4}$ x1
Lbs. per ft.....	.106	.212	.85	1.28	2.55
Price per ft.....	.05	.08	.13	.17	.30

**Steel Balls**, see page 64.  
**Steel Wire**, see page 442.  
**Steel Ribbon**, for suspension, see page 199.

**TIN.**

**Tin, Sheet**, see **Iron Sheet**, tinned.

6064. **Tin, Sheet**, pure block tin, B. & S. gauge No. 22, 12 inches wide, per square foot ..... \$ 1.10

6065. **Tin**, pure block tubing.

Diameter, inside, inches.....	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$
Ounces per ft.....	4	5	6	8	8	12
Price per ft.....	.25	.30	.38	.50	.50	.75

**Tin Foil**, see page 150.

**ZINC.**

6067. **Zinc, Sheet**, thin, B. & S. gauge No. 32, per square foot.... .11

6068. **Zinc, Sheet.**

Thickness, inches .....	$\frac{3}{32}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$
Lbs. per sq. ft.....	1.15	2.30	4.60	6.90	9.20	11.50
Price per sq. ft.....	.23	.46	.92	1.38	1.84	2.30

**Zinc Wire**, see page 442.



**WIRE.**

**6101. Aluminum Wire, bare.**

B. & S. gauge No...	14	16	18	20	22	24	26	27	28	30	36
Decimal part of an inch .....	.064	.051	.040	.032	.025	.020	.016	.014	.013	.010	.005
Per 1 oz. spool...	.....	.....	.....	.....	.....	.....	.....	.....	.50	.66	.85
Per 4 oz. spool...	.....	.....	.....	.....	.....	.80	1.10	1.15	1.25	1.60	.....
Per 1 lb. spool...	.85	.85	1.00	1.00	1.20	2.30	.....	.....	.....	.....	.....

**6103. Annunciator Wire, copper wire, double cotton covered and paraffined.**

B. & S. gauge No.....	16	18	20	22
Feet per pound.....	106	157	230	350
Price per pound.....	.50	.55	.60	.65

**6105. Brass Spring Wire, on 4 ounce spools.**

Washburn & Moen												
gauge No...	16	18	20	22	24	26	27	28	30	32	34	36
Decimal part of an inch..	.063	.047	.035	.028	.023	.018	.017	.016	.014	.013	.010	.009
Feet per spool.	20	33	68	108	170	270	340	430	550	862	2270	3520
Price per spool	.20	.20	.20	.22	.27	.30	.33	.33	.35	.40	.55	.90

**6106. Copper Wire, soft, bare, on 4 ounce spools.**

Washburn & Moen												
gauge No...	16	18	20	22	24	26	27	28	30	32	34	36
Decimal part of an inch..	.063	.047	.035	.028	.023	.018	.017	.016	.014	.013	.010	.009
Feet per spool.	20	32	66	102	160	260	325	410	510	810	2050	3175
Price per spool	.20	.20	.20	.22	.27	.30	.33	.33	.35	.40	.55	.90

**6107. Copper Magnet Wire.**

B. & S. Gauge		10	12	14	16	18	20	22	24	26	27	28	30	32	34	36	40
Decimal Equiv. in Inches		.102	.081	.064	.051	.040	.032	.025	.020	.016	.014	.013	.010	.008	.006	.005	.003
Bare	Per 1 oz. Spool									.10	.10	.11	.11	.11	.12	.13	.22
	Per 4 oz. Spool									.20	.21	.22	.22	.23	.24	.26	.44
	Per 8 oz. Spool									.34	.35	.36	.36	.38	.39	.43	
	Per 1 lb. Spool	.55	.55	.55	.55	.55	.56	.58	.60	.62	.64	.66	.68	.68	.70	.77	
D.C.C.	Per 1 oz. Spool									.17	.18	.20	.24	.27	.36	.49	1.48
	Per 4 oz. Spool				.20	.22	.25	.27	.34	.36	.40	.47	.54	.73	.99	2.97	
	Per 8 oz. Spool				.33	.35	.42	.45	.55	.60	.66	.78	.90	1.21	1.65		
	Per 1 lb. Spool	.60	.60	.60	.60	.64	.74	.84	1.00	1.10	1.20	1.42	1.64	2.20	3.00		
D.S.C.	Per 1 oz. Spool									.27	.31	.33	.42	.56	.76	.98	1.90
	Per 4 oz. Spool				.37	.40	.46	.54	.61	.66	.84	1.11	1.52	1.98	3.80		
	Per 8 oz. Spool				.58	.62	.67	.76	.91	1.02	1.10	1.41	1.87	2.53	3.29		
	Per 1 lb. Spool				1.02	1.06	1.12	1.22	1.38	1.65	1.85	2.00	2.56	3.40	4.60	5.98	

**6107A. Copper Magnet Wire, Black Enameled.** The enamel insulation is an elastic yet resistant and firmly adhering film. This insulation is exceedingly inert toward the ordinary agencies met in practice, which cause silk or cotton insulation to rapidly deteriorate and lose their value as insulating mediums. Impervious to moisture. Requires less winding space. Positive dielectric strength. More feet to the pound.

B. & S. No.....	26	28	30	36	40
Feet per oz.....	80	128	200	800	2000
Price per oz.....	.30	.35	.43	1.00	2.00
Price per lb.....	1.20	1.40	1.70	....	....

**6108. Fuse Wire.**

Amperes .....	1/2	1	2	3	5	6	10	12	15	40
Size of spools..	4 oz.	8 oz.	8 oz.	8 oz.	1 lb.	1 lb.	1 lb.	1 lb.	1 lb.	1 lb.
Feet per spool.	400	500	340	220	168	145	82	66	53	17
Price per spool.	.70	.60	.60	.60	1.10	1.00	1.00	1.00	1.00	1.00

For WIRE TABLES, see page 455.

6110. German Silver Resistance Wire, 18% alloy.

B. & S. Gauge		16	18	20	22	24	26	27	28	30	32	34	36
Decimal Equivalent in Inches		.051	.040	.032	.025	.020	.016	.014	.013	.010	.008	.006	.005
Bare	Per 1 oz. Spool						.22	.22	.23	.24	.30	.35	.42
	Per 4 oz. Spool			.36	.38	.42	.43	.44	.45	.48	.59	.70	.83
	Per 8 oz. Spool		.59	.60	.63	.67	.71	.72	.74	.79	.98	1.16	1.38
	Per 1 lb. Spool	1.02	1.07	1.09	1.14	1.21	1.28	1.31	1.34	1.44	1.77	2.10	2.50
D.C.C.	Per 1 oz. Spool						.37	.39	.42	.46	.55	.66	.95
	Per 4 oz. Spool			.52	.55	.64	.73	.78	.83	.92	1.10	1.32	1.90
	Per 8 oz. Spool		.80	.86	.92	1.05	1.21	1.29	1.37	1.53	1.83	2.20	3.17
	Per 1 lb. Spool	1.42	1.45	1.55	1.66	1.91	2.20	2.35	2.49	2.77	3.33	4.00	5.77
D.S.C.	Per 1 oz. Spool						.50	.56	.60	.77	.99	1.26	1.74
	Per 4 oz. Spool					.88	1.00	1.12	1.20	1.54	1.98	2.51	3.48
	Per 8 oz. Spool				1.29	1.46	1.71	1.86	2.00	2.56	3.30	4.18	5.80
	Per 1 lb. Spool			2.09	2.35	2.66	3.11	3.37	3.64	4.66	6.00	7.60	10.55

6111. Gutta Percha Covered Copper Wire.

B. & S. Gauge No.....	12	14	16
Price per ft.....	.05	.05	.05

Iron Wire, see No. 6131 Annealed Steel Wire.

6115. Lamp Cord, composed of fine wires insulated with rubber and braided cotton; two conductors twisted.

B. & S. No.....	16	18	20	22
Price per ft.....	.06	.06	.05	.05

6117. Flexible Two Conductor (Stage) Cable. Consists of two flexible conductors, each insulated with  $\frac{1}{32}$  inch wall of rubber, braided, and covered with an outer wall of rubber  $\frac{1}{32}$  inch thick, the whole being covered with a black cotton braid, thus forming a substantial single cable. Suitable for use with Arc Projecting Lanterns, Motors, etc.

B. & S. Gauge No.....	10	12	14
Capacity, amperes .....	32	23	16
Price, per ft.....	.15	.11	.08

6119. Lead Wire, diameter  $\frac{1}{8}$  inch, per foot..... \$ 0.05

6121. Magnesium Wire, in 1 ounce rolls, approximately 150 feet to the ounce; per ounce ..... Net .45

6123. Manganin Resistance Wire. This is an imported wire and is an alloy of manganese, nickel and copper. It is recommended by the "Physikalisch-Technische Reichsanstalt" as the best wire on the market for high grade measuring instruments. Temperature coefficient is .00001. Nos. 18 and 20 are double cotton covered. The remaining numbers are double silk covered.

B. & S. No.....	18	20	22	24	26	28	30	32	36	38
Price per lb....	3.00	3.30	4.80	5.20	6.60	7.30	9.50	.....	.....	.....
Price per oz....	.40	.50	.60	.70	.80	.90	1.00	1.25	1.65	2.15

6124. Nickel Wire, pure, bare.

B. & S. No.....	16	24	28
Price per oz.....	.22	.27	.33

6124A. Nickel-Chromium Alloy Wire, "Excello," bare, used extensively in electric heating devices. Has a resistance 55 times that of copper. Temperature coefficient for 1° C. = +0.00016; melting point 1500° C.; will not rust or corrode.

B. & S. Gauge No.....	18	20	22
Price per lb.....	4.65	5.20	5.70

6124B. Nickel-Chromium Alloy Ribbon, "Excello," same alloy as No. 6124A in ribbon  $\frac{1}{16}$  inch wide, accurately rolled, insuring uniformity of resistance. The ribbon offers greater radiating surface than wire.

Thickness, inches .....	.002	.003	.004	.005
Price per 4 oz. spool.....	5.00	3.25	2.65	2.35

For WIRE TABLES see page 455.

6124C. **Nickel-Copper Alloy Wire**, "Iala," bare, soft annealed, used in the manufacture of electrical instruments where extreme low temperature coefficient, accuracy and permanency is desired, as on shunts, etc. Resistance is 29 times that of copper and temperature coefficient for 1° C. = +0.000005.

B. & S. Gauge No.....	18	20	22
Price per lb.....	\$2.00	2.00	2.10

6124D. **Nickel-Copper Alloy Wire**, "Iala," double cotton covered, soft annealed, same alloy as No. 6124C.

B. & S. Gauge No.....	20	22	24
Price per lb.....	3.25	3.65	4.25

6124E. **Nickel-Steel Alloy Wire**, "Superior," bare, used extensively in the manufacture of lantern rheostats, etc., where a high specific resistance combined with ability to withstand high temperatures is desired. Resistance is 50 times that of copper; temperature coefficient for 1° C. = +0.00081; melting point, 1250° C.

B. & S. Gauge No.....	12	16	20
Price per lb.....	1.35	1.40	1.50

6125. **Piano Wire**, on spools.

Music Gauge No.....	00	0	1	2	3	4	5	6	7	8
Decimal parts of an inch.....	.0087	.009	.010	.011	.012	.013	.014	.015	.018	.019
Approx. feet on spool..	15	15	14	12	12	12	10	10	8	8
Price per spool.....	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06

6126. **Piano Wire**, best imported steel piano wire, in ¼ pound rolls.

Music Gauge No.....	1	2	4	5	6	7	8	9
Decimal parts of an inch.....	.010	.011	.013	.014	.015	.018	.019	.022
Price per ¼ lb. roll.....	1.65	1.00	.75	.55	.50	.45	.45	.45
Music Gauge No.....	10	12	14	18	23	26		
Decimal parts of an inch.....	.025	.028	.032	.040	.049	.061		
Price per ¼ lb. roll.....	.40	.40	.40	.40	.40	.40		

6127. **Picture Wire**, steel. No..... 0 1 2  
Per package of 25 yards..... .08 .10 .11

6129. **Platinoid Resistance Wire**, bare; temperature coefficient .000286.

B. & S. No.....	20	24	28	30
Price per oz.....	.45	.50	.55	.60

**Platinum Wire**, see page 395.

6130. **Platinum Wire, Silver Coated (Wollaston Wire)**. In making the very finest size of platinum wire filament, the wire before drawing is enclosed in a silver sheath and is then drawn through a jewel gauge (according to Wollaston) until the minimum size is attained. The silver film that still remains must be removed chemically (with nitric acid) before the wires are used. Wound on flat wooden bobbins.

Diameter of Platinum Core, mm....	0.0015	0.002	0.003	0.005
Approx. external diameter, mm....	0.15	.02	0.11	0.15
Price per meter.....	2.50	1.00	1.00	1.00

6131. **Steel Wire**, annealed, soft, on 4 ounce spools.

Washburn & Moen Gauge No. ....	16	18	20	22	24	26	27	28	30	32	34	36
Decimal parts of an inch.....	.063	.047	.035	.028	.023	.018	.017	.016	.014	.013	.010	.009
Price per Spool.....	.13	.14	.15	.16	.16	.17	.18	.19	.20	.22	.25	.30

6132. **Tinsel Wire**, not insulated, per yard..... \$ 0.11

6134. **Tinsel Wire, Conducting Cord**. One conductor. Tinsel wire covered with red or green twisted braid, per yard..... .10

6135. **Tinsel Wire, Conducting Cord**. Two conductors. One covered with blue and the other with red; the whole covered with blue and red worsted braid, per yard..... .16

6137. **Zinc Wire**, diameter ⅛ inch, per foot..... .06

For **WIRE TABLES** see page 455.

MISCELLANEOUS SUPPLIES.



No. 6204.

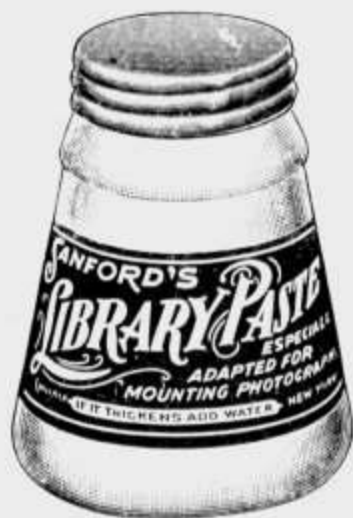


No. 6241.

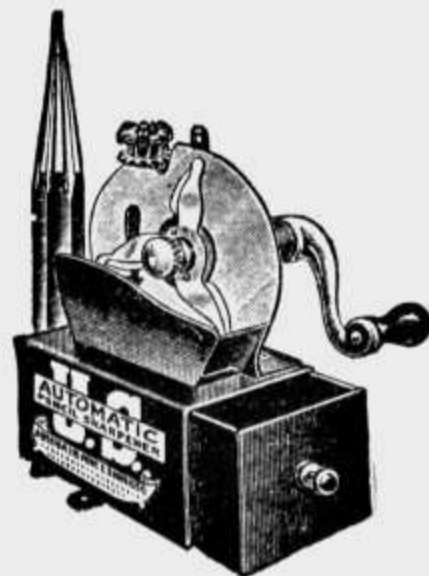
6200. **Acid Proof Finish** for chemical laboratory tables. While this preparation is not absolutely acid proof, it is a finish which has been successfully employed for years in many of the leading laboratories. Consists of two solutions with full directions for applying. The finished top will be black. Per gallon ( $\frac{1}{2}$  gallon of each solution). Net \$ 2.00
6201. **Asbestos Plates or Pads**, iron bound edges, diameter 8 inches, each.. .06
6203. **Blocks**, hardwood, sandpapered, for blocking up apparatus, etc.
- |                    |                    |                    |                    |                    |
|--------------------|--------------------|--------------------|--------------------|--------------------|
| Size, inches ..... | $\frac{1}{8}$ x4x4 | $\frac{1}{4}$ x4x4 | $\frac{1}{2}$ x4x4 | $\frac{3}{4}$ x4x4 |
| Each .....         | .07                | .08                | .09                | .10                |
| Size, inches ..... | 1x4x4              | 2x4x4              | 3x4x4              | 4x4x4              |
| Each .....         | .11                | .15                | .20                | .22                |
- Blue Print Paper**, see below.  
**Brushes**, camel hair, page 330.  
**Brushes**, lacquer, see below.
6204. **Cement, Quixo or Liquid Porcelain**, a chemically true cement, which hardens as it dries and when dry is not affected by fire or water. It adheres to anything and sets like stone. Sticks everything but is not sticky. It is glue, gum, cement, solder and liquid porcelain combined. It will join anything to everything, with the exception of India rubber, vulcanite, celluloid and blacklead. Since QUIXO is not affected by chemicals, fire or water, it will be found excellent for building aquaria, making labels and countless purposes in any science laboratory. Per 6 ounce can.....Net .25
6205. **Cheese Cloth**, best quality, per yard..... .08
6207. **Clay Pipes**, per dozen..... .16
- Candles**, see page 246.
6209. **Chamois Skins**, for cleaning instruments, etc.
- |                    |     |      |       |       |
|--------------------|-----|------|-------|-------|
| Size, inches ..... | 6x8 | 9x11 | 10x13 | 14x18 |
| Each .....         | .09 | .17  | .22   | .45   |
6211. **Chimneys**, student's lamp, per dozen..... .70
6213. **Chimneys**, Argand, straight, 2x7 inches, per dozen..... .75
6215. **Cloth**, emery.
- |                 |      |      |      |      |      |
|-----------------|------|------|------|------|------|
| Number .....    | 000  | 00   | 0    | 1    | 2    |
| Per sheet ..... | .10  | .10  | .10  | .10  | .10  |
| Per quire ..... | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 |
6217. **Cloth**, Turkey red, per yard..... .14
6219. **Cord**. Mason's chalk line,  $\frac{1}{16}$  inch, per hank of 20 feet..... .06
6221. **Cord**. Clothes line,  $\frac{1}{4}$  inch, per 100 feet..... 1.10
6223. **Cord**. Window cord, per 100 feet..... 1.20
6225. **Cord**. White cotton cord,  $\frac{1}{8}$  inch, per hank of 50 feet..... .30
6227. **Flannel**. Best woolen flannel, per yard..... .80
6229. **Flannel**. Best cotton flannel, per yard..... .20
- Fish Line**, see page 69.
6236. **Foil, Aluminum Leaf**, for Electroscopes, per book of 25 leaves, 5x5 in. .11
6237. **Foil, Dutch Metal** (imitation Gold Leaf), per book of 25 leaves, 4x4 in. .22
6238. **Foil, Gold Leaf** (pure), for Electroscopes, per book of 25 leaves, 4x4 in. .80
6239. **Foil, Silver Leaf**, per book of 25 leaves, 4x4 inches..... .20
6240. **Gas Tips**, aluminum, 6 foot, per dozen..... .50
6241. **Glue**, LePage's.
- |            |        |        |       |       |       |       |
|------------|--------|--------|-------|-------|-------|-------|
|            | Bottle |        | Can   |       |       |       |
| Size ..... | Small. | Large. | 2 oz. | 4 oz. | 8 oz. | 1 lb. |
| Each ..... | .15    | .22    | .22   | .28   | .40   | .65   |
6243. **Glue**, marine, waterproof, for projection cells, etc., per ounce bottle.. .27

MISCELLANEOUS SUPPLIES—Concluded.

6247.	<b>Library Paste</b> , Sanford's best. Style ..Large Collapsible Tube. 4 oz. Screw Cap Jar. Each .. \$0.15	.15							
6249.	<b>Lacquer</b> , colorless, for preserving polished metal surfaces, per ounce bottle.....	\$	0.35						
6251.	<b>Lacquer</b> , gold, per ounce bottle.....		.45						
6253.	<b>Lacquer Brush</b> , best camel's hair, 1/2 inch wide.		.20						
6255.	<b>Mailing Tubes</b> , heavy pasteboard, 1 1/2 x 12 inches, per dozen.....		.20						
6256.	<b>Matches</b> , Swedish Safety, in cartons of 12 boxes, per carton .....		.11						
6258.	<b>Muslin Sheeting</b> , unbleached, per yard.....		.11						
6261.	<b>Paper</b> , blue print, 30 inches wide, per 10 yd. roll		.90						
6263.	<b>Paper</b> , blue print, in light-proof packages of 24 sheets. Size, inches ... 4x5    5x7    5x8    8x10 Per package .. .20    .22    .25    .33								
6265.	<b>Paper</b> , emery, French. No.....	000	00	0	1				
	Per sheet .....	.05	.05	.05	.05				
	Per quire .....	1.00	1.00	1.00	1.00				
6266.	<b>Paper</b> , carborundum. No.....	000	00	0	1				
	Per sheet .....	.05	.05	.05	.05				
	Per quire .....	.65	.65	.65	.65				
	<b>Paper</b> , glazed, see page 225.								
6267.	<b>Paper</b> , paraffine, per quire .....								.11
	<b>Paper</b> , parchment, see page 119.								
6269.	<b>Paper</b> , sand. No.....	00	0	1	2	3			
	Per sheet .....	.05	.05	.05	.05	.05			
	Per quire .....	.30	.30	.30	.30	.30			
6270.	<b>Pencil Sharpener</b> , U. S. Automatic, automatically stops cutting and wasting the lead pencil when a perfect point is produced. The clippings fall into small drawer. Cuts like a knife and will sharpen perfectly pencils with hard or soft, small or large leads. Pencil is turned automatically. Made of steel with nothing complex to get out of order. Knives easily removed and re-sharpened when necessary. Very neat and compact. Size 4x3 1/2 x 5 in.....	Net	2.50						
6270A.	<b>Extra Knives</b> for No. 6270, set of 3...Net		.60						
6272.	<b>Rubber Bands</b> , assorted, in 1/4 pound boxes .....		1.50						
6273.	<b>Rubber Cement</b> , for cementing rubber joints, rubber, etc., per ounce bottle..		.15						
	<b>Sand Paper</b> , see above.								
6275.	<b>Sealing Wax</b> , best red, four sticks to the pound, per pound.....		.44						
	<b>Shot</b> , see page 129.								
6279.	<b>Silk</b> , best quality heavy black silk, per yard.....								1.10
6281.	<b>Silk</b> , good quality of same, per yard.....								.90
6282.	<b>Silk</b> , Oiled, per sheet 12x14 inches, in box.....								.40
	<b>Solder</b> , see page 49.								
6289.	<b>Splints</b> , 100 in package, per package.....	Net							.10
6291.	<b>Sponges</b> , for cleaning purposes, 16 to a pound, per pound.....								2.20
6293.	<b>Tags</b> , Brass, 3/4 inch diameter, numbered, per dozen.....								.40
6295.	<b>Thread</b> , white cotton, No. 70 (200 yds.), per dozen spools.....								1.00
6296.	<b>Thread</b> , black silk (50 yds.), per spool.....								.08
6297.	<b>Thread</b> , black linen (200 yds.), per spool.....								.14
6298.	<b>Towelling</b> , Crash, good quality, 17 inches wide, per yard.....								.14
	By the piece, per yard.....								.11
6298A.	<b>Twine</b> , Cotton, per ball.....								.11
6298B.	<b>Twine</b> , Linen, per ball.....								.40
6299.	<b>Wax Tapers</b> , per box.....								.11



No. 6247.



No. 6270.



No. 6300.

6300. **First Aid Cabinet.** A neat hardwood case, 8x12x3¼ inches deep, containing the following:

- 1 Gauze Bandage, 1 inch.
- 2 Gauze Bandages, 2 inch.
- 1 Cotton Bandage, 2 inch.
- 1 can Mustard (specially prepared for emetics).
- 2 packages Absorbent Cotton.
- 1 package Styptic Gauze (medicated, to stop bleeding).
- 1 package Surgical Gauze (plain, for pads and compresses).
- 1 Tourniquet (to stop arterial bleeding).
- 1 can Powdered Antiseptic Soap (for washing hands and wounds).
- 1 can Recresco Ointment (for burns, scalds, cuts, etc.).
- 1 can Kapsikar Embrocation (for use as counter-irritant, for sprains, strains, congestion, etc.).
- 1 package Court Plaster.
- 3 Safety Pins.
- 1 envelope Hooks and Eyes (to hang case on wall).

An excellent cabinet to have about the laboratory for treating cuts and burns .....Net \$ 2.50

## MINERAL COLLECTIONS.

These collections are imported from Dr. F. Krantz, the well known mineral dealer of Bonn, Germany, and are furnished in wooden cases with covers, each specimen being in a paper box with a label giving the name and locality. List of minerals in each set furnished upon request.

6502.	Mineral Collection, consisting of 100 specimens 5x6 cm.....	\$ 27.50
6504.	Mineral Collection, consisting of 100 specimens 3x4 cm.....	16.65
6506.	Mineral Collection, same as No. 6504, but in pasteboard box instead of wooden box.....	13.00
6507.	Washington School Collection. Contains the following minerals and rocks, good size, each labeled and placed in a separate tray. The whole in a neat cloth covered case with a set of unlabeled duplicates (Set No. 6508) for student.....	2.50

### MINERALS.

1. Graphite.	11. Limonite.
2. Galena.	12. Calcite.
3. Sphalerite.	13. Siderite.
4. Chalcopyrites.	14. Orthoclase.
5. Pyrites.	15. Amphibole (Hornblende).
6. Fluorite.	16. Amphibole (Asbestos).
7. Quartz Crystal.	17. Garnet.
8. Quartz, Milky.	18. Muscovite.
9. Hematite.	19. Talc.
10. Magnetite.	20. Gypsum.

### ROCKS.

1. Conglomerate.	11. Lignite.
2. Friable Sandstone.	12. Basalt.
3. Red Sandstone.	13. Granite.
4. Potter's Clay.	14. Diabase.
5. Shale.	15. Gneiss.
6. Calcareous Tufa.	16. Mica Schist.
7. Oölitic Limestone.	17. Quartzite.
8. Fossiliferous Limestone.	18. Clay Slate.
9. Compact Limestone.	19. Dolomite.
10. Peat.	20. Residual Sand.

6508.	Student's Collection, consisting of smaller duplicate unlabeled specimens of Set No. 6507 for student classification.....	.45
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## MINERALS.

Specially Selected for

### WIRELESS TELEGRAPHY COHERERS.

	Per ounce, Net
Bornite, pure .....	.20
Carborundum, crystals .....	.15
Chalcopyrites, with Iron Pyrites.....	.10
Chalcopyrites, pure .....	.15
Franklinite .....	.10
Galena, cubical .....	.10
Iron Pyrites, crystallized, radiated.....	.10
Iron Pyrites, crystallized, cubical.....	.15
Molybdenite .....	.20
Silicon, fused .....	.20
Stibnite, crystallized .....	.20
Zincite, 20 per cent.....	.15
Zincite, 70 per cent.....	.40
Zincite, 100 per cent.....	.65
Rose's Metal, M. P. 203° F.....	.35
Wood's Metal, M. P. 158° F.....	.35

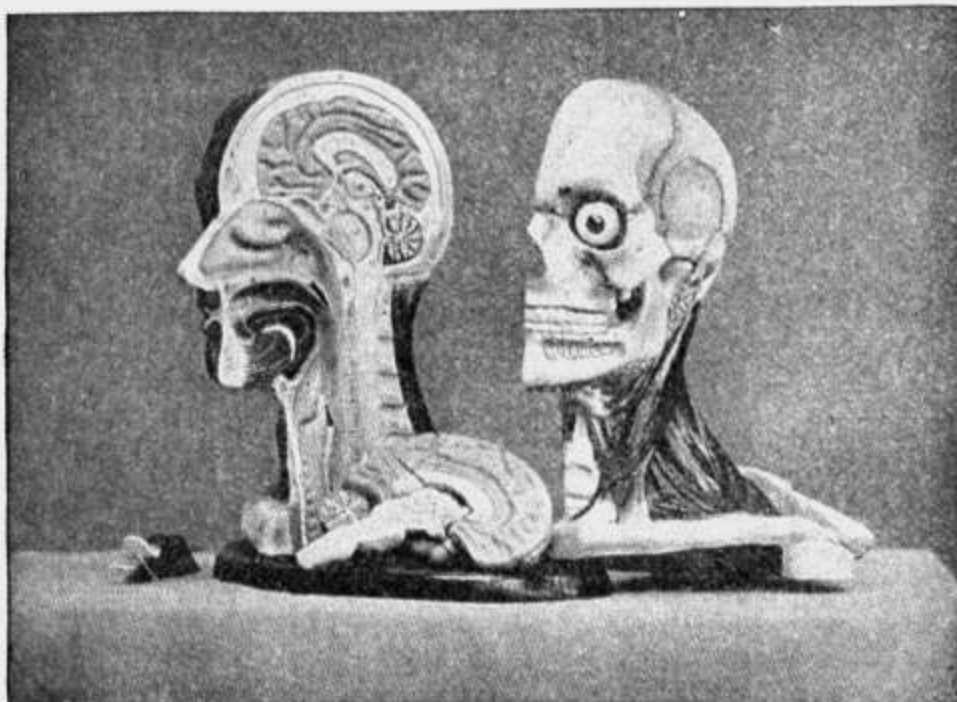
Blowpipe Minerals listed on page 322.

See also Pound List of Rocks and Minerals in Catalog R.

6601.	Numbers in the 6600 and 6700 series will be found on pages 311 and 312.	
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### ANATOMICAL MODELS.

The models listed below are made of papier-mache and are unbreakable. The anatomical accuracy of the models, as well as their durability, makes them more serviceable than any models now on the market.

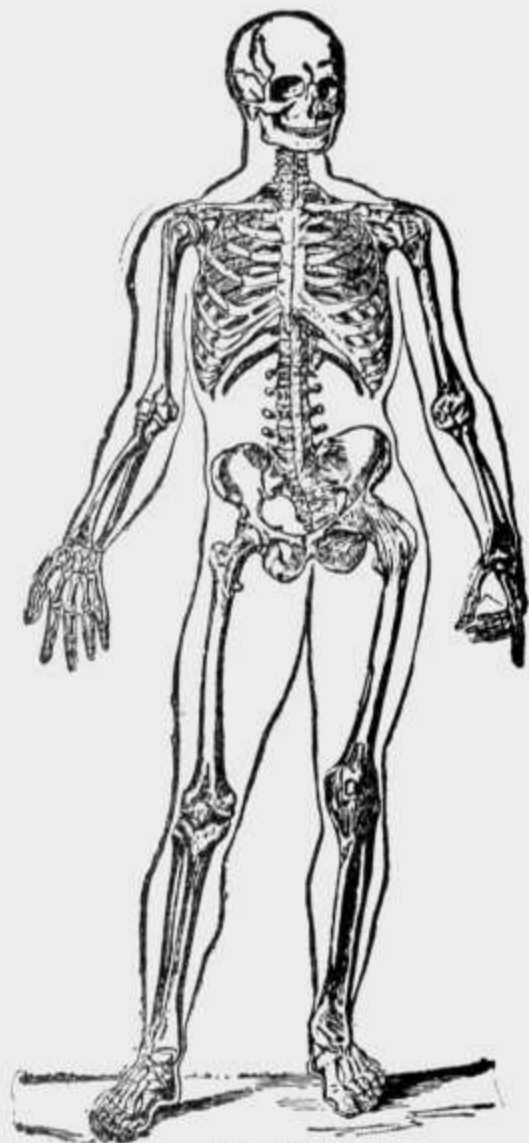
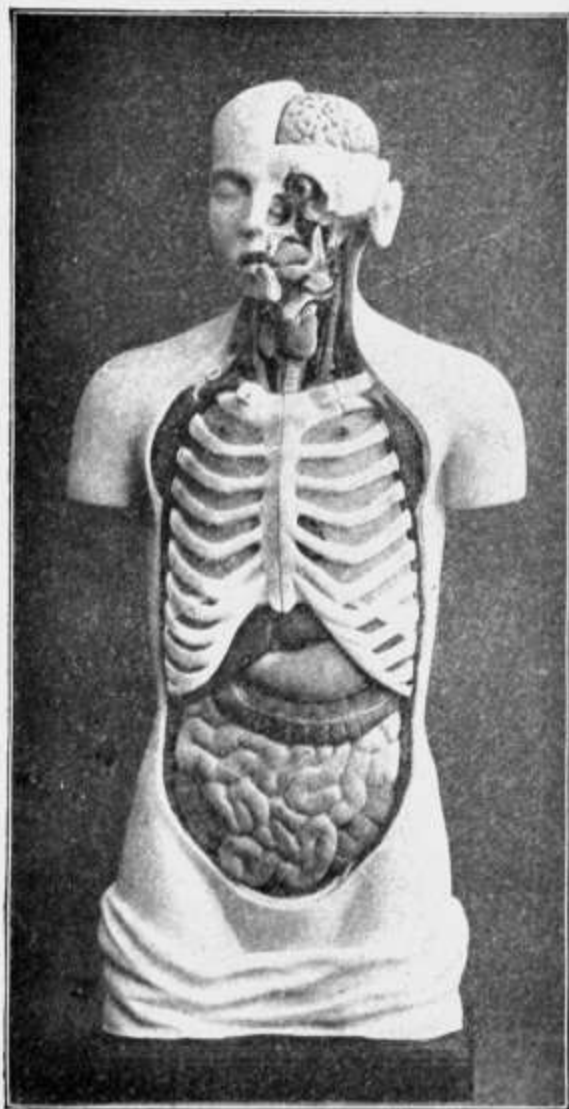


No. 8350.

		Prices Net.*
8350.	<b>Head</b> , upon stand, median sagittal section. One half shows the muscles and the median surface, the other half the bony skull; the arteries, veins and nerves of the teeth are exposed, the half of the brain may be disarticulated into 6 parts; the muscles of neck are also shown. This is an excellent model.....Duty free	\$ 20.00
8351.	<b>Head</b> , same as No. 8350, from stock.....Duty paid	27.50
8352.	<b>Half Head</b> in median sagittal section, on board, skull bones as well as the cranial cavities, cerebrum, cerebellum, spinal cord, nasal septum, larynx, tongue, palate and oesophagus are well shown.....Duty free	4.25
8353.	<b>Half Head</b> , same as No. 8352, from stock.....Duty paid	5.50
8354.	<b>Brain</b> , natural size, with nerves attached. The brain may be disarticulated into four parts.....Duty free	4.25
8355.	<b>Brain</b> , same as No. 8354, from stock.....Duty paid	5.50
8356.	<b>Brain</b> , with nerves attached, natural size, may be disarticulated into 12 parts.....Duty free	8.00
8357.	<b>Brain</b> , same as No. 8356, from stock.....Duty paid	11.00
8358.	<b>Eyeball</b> (enlarged 3 diameters), may be disarticulated into sclerotic and choroid coats, aqueous humor and lens.....Duty free	3.25
8359.	<b>Eyeball</b> , same as No. 8358, from stock.....Duty paid	4.25
8360.	<b>Eye</b> (enlarged 3 diameters), shown in anatomical position; the bones of the orbit with all muscles; the superior rectus may be removed, the model may be disarticulated into sclerotic and choroid coats, aqueous humor and lens.....Duty free	13.50
8361.	<b>Eye</b> , same as No. 8360, from stock.....Duty paid	17.00
8362.	<b>Ear</b> (enlarged 3 times), with concha; may be disarticulated into labyrinth, incus, malleus, stapes and tympanum.....Duty free	5.50
8363.	<b>Ear</b> , same as No. 8362, from stock.....Duty paid	7.75
8364.	<b>Skin</b> (enlarged 150 times), in vertical section, the 3 skin strata, the sebaceous and sweat glands, the hair follicles, arteries, veins and nerves are shown.....Duty free	3.25
8365.	<b>Skin</b> , same as No. 8364, from stock.....Duty paid	4.25
8366.	<b>Larynx</b> , natural size, with cartilages and ligaments, separable into two halves.....Duty free	2.75
8367.	<b>Larynx</b> , same as No. 8366, from stock.....Duty paid	3.75

MYER'S MECHANICAL MODEL OF THE EYE, see page 513.

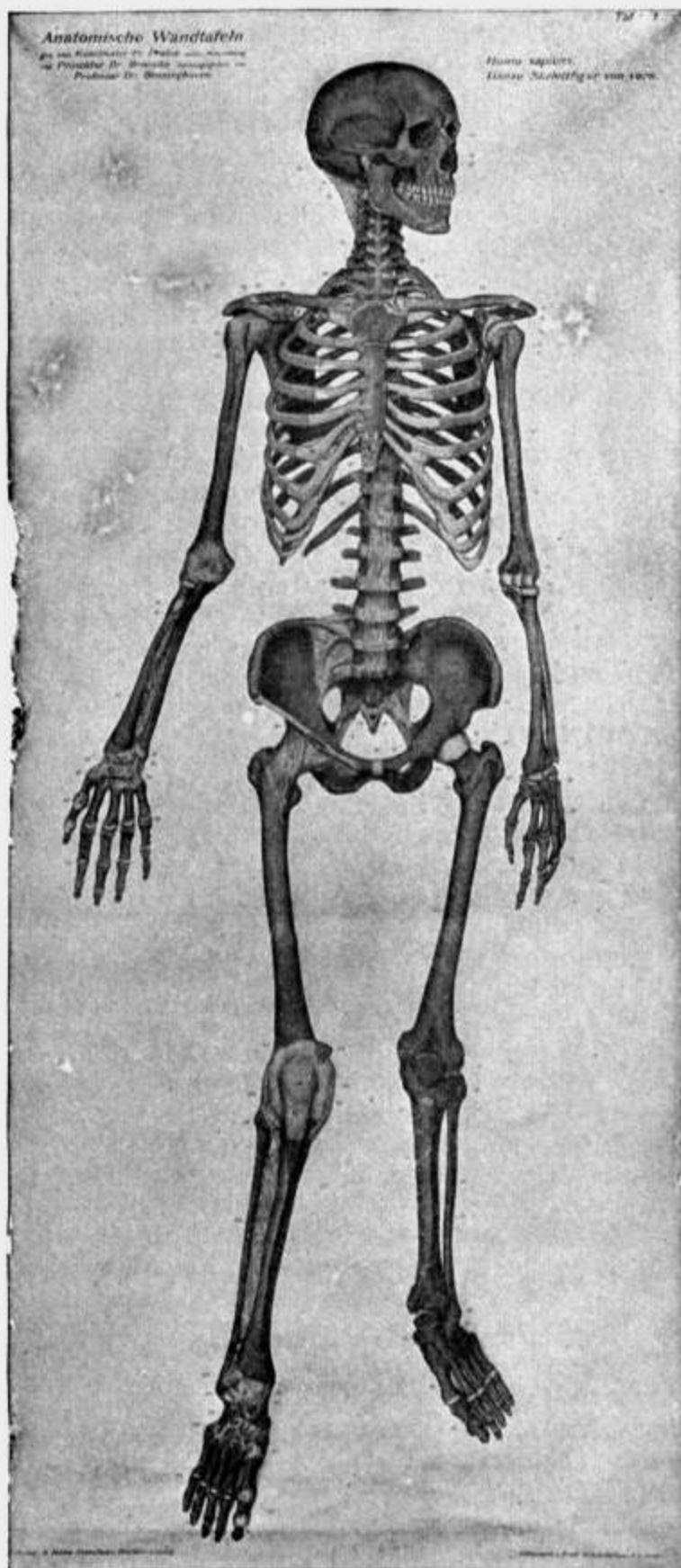




- |       |  |           |         |
|-------|--|-----------|---------|
|       | <b>No. 8373.</b>   |           |         |
| 8368. | <b>Heart</b> , natural size, made to open.....   | Duty free | \$ 2.75 |
| 8369. | <b>Heart</b> , same as No. 8368, from stock.....   | Duty paid | 3.75    |
| 8370. | <b>Lungs, with heart and larynx</b> , natural size, all three models may be taken apart. On board.....   | Duty free | 6.75    |
| 8371. | <b>Lungs</b> , same as No. 8370, from stock.....   | Duty paid | 8.25    |
| 8372. | <b>Trunk</b> , natural size, standing, all internal organs are removable.....  | Duty free | 25.50   |
| 8373. | <b>Trunk (Model 1911)</b> . This trunk of boy is an exceptionally satisfactory one and is the only one made that shows the relation of the ribs to the internal organs. The organs of the head and neck especially are very clearly shown. The trunk is entirely dissectable. This trunk is particularly recommended where lack of space or price prohibit the purchase of detail models..   | Duty free | 55.00   |
| 8374. | <b>Male figure</b> , 60cm. high, standing on base. Head and brain made to take apart, and the internal organs may be taken out for demonstration. The superficial muscles of one arm and one leg are detachable. Very fine model.....  | Duty free | 55.00   |
| 8375. | <b>Male figure</b> , life size. Exact representation of all muscles, arteries, veins and nerves. As it may be separated into about 60 parts, this model renders easy the demonstration of all important anatomical parts of the human body. It shows in a single preparation details which otherwise can only be shown in special models. It shows also the general relations of the various parts. The model is prepared from numerous anatomical dissections in Leipzig under the valuable instruction of Mr. C. Hagedorn, dissector at the Leipzig Institute, so that anatomical accuracy is combined with perfect workmanship. Testimonials of purchasers can be forwarded if desired. The structure of this model renders unnecessary the purchase of separate models. This model is recommended in all cases where funds permit and where a complete representation of the anatomy of the human subject is desirable.. | Duty free | 325.00  |
| 6801. | <b>Human Skeleton</b> . Best grade, carefully selected, finely developed, perfectly cleansed and prepared, substantially articulated, with ring for suspension at top.....   |           | 43.00   |
| 6805. | <b>Case for Skeleton</b> . Finely finished hardwood, glass door and sides, lock and key .....  |           | 22.00   |

**No. 6801.**

## NEW ANATOMICAL WALL MAPS.

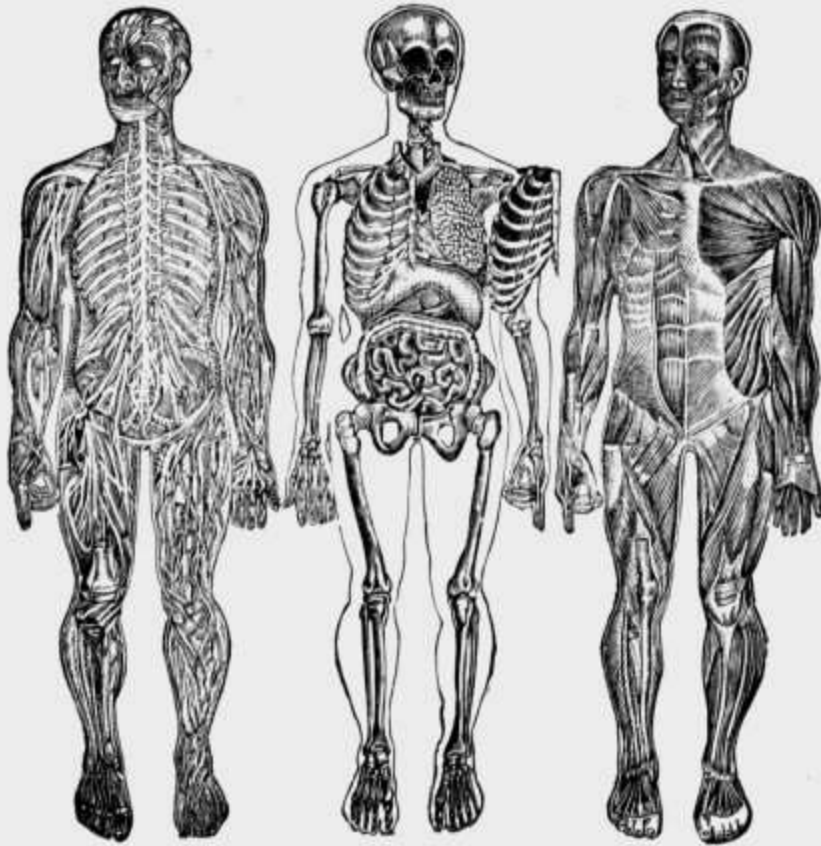


No. 8301.

Painted by **Franz Frohse** under supervision of **Prof. Dr. Broesicke** and **Prof. Dr. Benninghoven** of the University of Berlin—the co-operation of one of Germany's most able artists with two professionals of reputation. These charts combine scientific exactness and artistic workmanship with the highest degree of educational value, and are the best that are on the market in every respect. Mounted on linen and common rollers, per chart, Net \$ 4.00

- 8301. Male skeleton with ligaments, front view.
- 8302. Male skeleton with ligaments, rear view.
- 8303. Muscular system, front view.
- 8304. Muscular system, rear view.
- 8305. Heart and blood vessels.
- 8306. Pectoral and abdominal intestines in situ, I.
- 8307. Pectoral and abdominal intestines in situ, II.
- 8308. Pectoral and abdominal intestines in situ, III.
- 8309. Single viscera, illustrated.
- 8310. Brain, spinal process and nerves.
- 8311. Diagram of circulatory system.
- 8312. Ear.
- 8313. Eye.
- 8314. Skin.

**ANATOMICAL MANIKINS.**



No. 6830.

A manikin is the only complete, practical reproduction of the human body. It hangs upon your wall closed, occupying the space of a picture. Open it, and fold after fold you turn just as you would turn the pages of a large book. So you pass from the skin to the skeleton. You see in its natural colors, life size, exact position, every vein, nerve, muscle, organ and bone in the body. The name of any one of these can be learned in a second by referring to the little volume which goes with every manikin and in which the 455 parts shown are numbered. A simple, fascinating, valuable study.

The Pilz manikin is the result of years of study and work on the part of the best scientists of Germany. Physicians agree that the only perfect manikins come from Germany. The German physiologists are famous, and many of them have given their best work to a graphic illustration of their

life study—man—in the form of a manikin. It is important that you get the best manikin.

**THE PILZ MANIKIN.**  
5 Feet 5 Inches High.

A life size figure of the human body, lithographed in natural colors on indestructible heavy linen cardboard. There are thirty large folds—455 parts shown. No part is detached, so that there is no trouble putting on and taking off, and there are no small parts to lose. It shows the blood vessels, nerves, muscles, internal organs and the skeleton in their proper position and relative dimensions, as follows.

Part I. The muscles of the anterior surface of the body. On the right side the superficial muscles are partially removed in order to bring the deeper layers into view. This section shows and designates 85 different muscles.

Part II. The muscles of the posterior surface of the body. On this plate also some of the superficial muscles are partially removed, so that the deeper layers may be recognized. At the occiput a portion of the cranium is removed, showing the brain in the cavity of the skull. There are 71 muscles shown in this section.

Part III. The circulation of the blood. The course of the arterial blood is marked in red, that of the venous blood in blue. This plate shows 61 different veins.

Part IV. The nervous system. The posterior portion of the cranium is shown removed longitudinally so as to bring into view the skull contents. This plate shows 76 nerves.

Part V. The skeleton. In this plate 101 parts of the skeleton and 60 parts of the viscera are shown in actual size and colors.

- 6830. Pilz Life Size Sexless Manikin..... \$ 13 50
- 6831. Pilz Life Size Male Manikin..... 13 50

**THE MINDER MANIKIN.**  
20 Inches High.

A great many people realize their need of a manikin, yet do not feel like paying the price of a life size figure. Among these are students at colleges and schools, young people interested in physiology or in physical development, and many men who appreciate the value of having in their homes the most valuable text book made.

For these people the Minder manikin is published. This is the same as the large one, except in size, and in the quality of paper. There are the same number of parts, with the exception of the posterior muscles, which are not shown on the smaller manikin. A key, with all the parts named and numbered, is furnished. The folding plan is the same, the colors the same.

- 6832. Minder Miniature Sexless Manikin..... 2 75
- 6833. Minder Miniature Female Manikin..... 3 50

## PORTRAITS.

### "NATURE" SERIES.

We have finally completed our series of "Scientific Worthies," a list of which will be found below. These portraits differ from many that are advertised in that they are made from nearly perfect **steel engravings**, with a few necessary exceptions, which are excellent **photogravures**.

Portraits are 6x8 inches and have a large border, taking frame 10x13 inches. Portrait without frame.....Net \$ 2 50

We can also furnish above portraits in a straight grained, dark stained oak frame under glass. Same are designated as 6850A, 6870A, etc. Each.....Net 4 25

### STEEL ENGRAVINGS.

6850. Michael Faraday.	6859. J. Louis R. Agassiz.
6851. Thomas Henry Huxley.	6860. James Prescott Joule.
6852. Charles Darwin.	6861. Sir C. W. Siemens.
6853. John Tyndall.	6862. Dmitri Ivanowitsh Mendelejeff.
6854. Sir Charles Wheatstone.	6863. Louis Pasteur.
6855. Sir Wyville Thomson.	6864. William Harvey.
6856. Robert Wilhelm Bunsen.	6865. Jean Baptiste Andre Dumas.
6857. Lord Kelvin.	6866. James Clerk Maxwell.
6858. Hermann L. F. Helmholtz.	

### PHOTOGRAVURES.

6870. Sir Archibald Geikie.	6872. Lord Rayleigh.
6871. Simon Newcomb.	6873. Sir William Crookes.

### "SCIENCE" SERIES.

The following portraits of scientific men are printed in photogravure, on plate paper, 7x10. Portrait measures 3x4. Each.....Net 50

6880. John Tyndall.	6886. Gustav Wiedemann.
6881. Heinrich Hertz.	6887. Robert Bunsen.
6882. Herman von Helmholtz.	6888. Thomas Preston.
6883. August Kundt.	6889. George F. Fitzgerald.
6884. Alfred M. Mayer.	6890. Henry A. Rowland.
6885. William A. Rogers.	6891. Franz E. Melde.

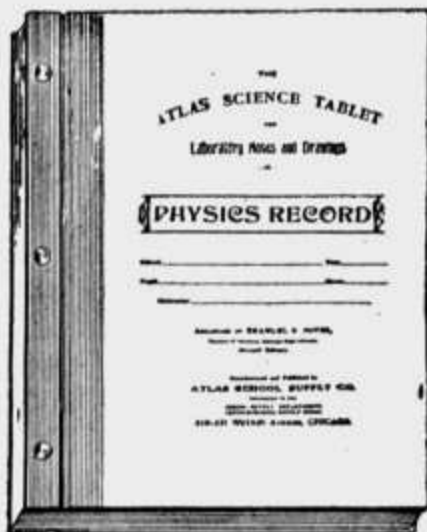
THE ATLAS SERIES OF  
**SCIENCE TABLETS**  
 FOR  
 LABORATORY NOTES AND DRAWINGS.

These tablets consist of several tablets and covers, uniform in size ( $7\frac{3}{4} \times 9\frac{3}{4}$ ) and perforated, specially arranged for laboratory use.

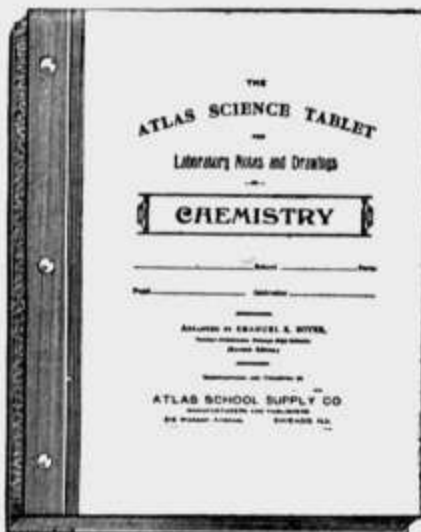
**Points of Superiority of Atlas Tablets.**

These tablets are much more convenient than drawing and note paper, either in bound form or detached sheets, for the following reasons:

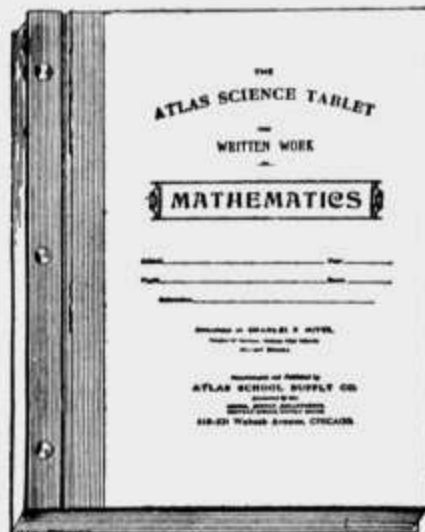
1. They render the use of the drawing boards and thumb tacks unnecessary.
2. They afford a convenient form for keeping the paper in good condition for ready use.
3. They enable the instructor to take up completed drawings and descriptions, to be inspected at his leisure, without interrupting the regular work of the pupil.
4. They render it easy to discard unsatisfactory work, which the pupil may be required to perform a second time.
5. They enable the pupil to remove sheets and thus avoid the danger of injuring work already completed.
6. The covers and fastenings afford a convenient way of collecting and temporarily binding work which has been approved and returned by the instructor.
7. Work completed and temporarily bound is easily available for classification and arrangement and for permanent binding if desirable.



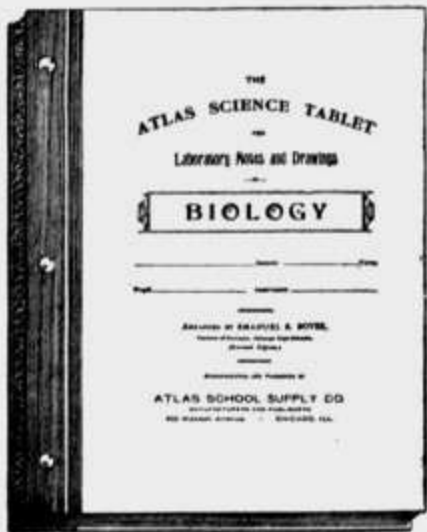
No. 6915.



No. 6916.



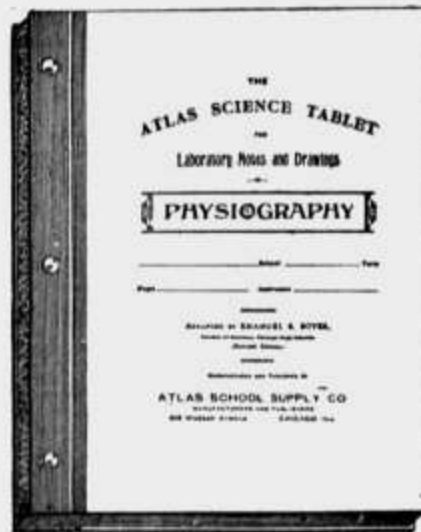
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No. 6925.



No. 6950.



No. 6940.

PRICE LIST ON NEXT PAGE.

**"ATLAS SERIES" SCIENCE TABLETS.****NET PRICE LIST.**

6911. <b>Tablet</b> , containing 75 sheets of metrically cross ruled paper (having note ruling and marginal line on opposite side). The co-ordinately ruled paper permits and facilitates making diagrams to scale. It is <b>accurately ruled</b> , being printed from an engraved plate (in non-actinic color), the heavy lines inclosing a square centimeter and the light lines a space of two millimeters square.....	\$ 17½
6912. <b>Covers</b> . Set for binding above, including front and back boards, with flexible cloth eyeletted hinge, lace fasteners, laboratory instructions and table of constants.....	07
N. B.—In ordering covers separately, specify whether for No. 6915, 6916 or 6917.	
Note.—The following tablets are uniform in make-up, consisting of a set of covers (No. 6912) and tablet (No. 6911).	
6915. <b>Physics Tablet</b> , complete.....	21
6916. <b>Chemistry Tablet</b> , complete.....	21
6917. <b>Mathematics Tablet</b> , complete.....	21
6920. <b>Drawing Tablet</b> , containing 30 sheets of specially prepared, high grade drawing paper, with perforations and marginal ruling.....	14
6921. <b>Note Tablet</b> , containing 30 sheets of extra quality ruled paper, with perforations and marginal ruling.....	10½
6922. <b>Covers</b> . Set for binding, including front and back cover boards and cloth hinge, perforated, lace fasteners; with instructions.....	07
N. B.—In ordering covers separately, specify what tablet they are for (No. 6925-6930).	
Note.—The following tablets are uniform in make-up, consisting of a set of covers (No. 6922) and one each drawing tablet (No. 6920) and note tablet (No. 6921).	
6925. <b>Biology Tablet</b> , complete.....	28
6926. <b>Botany Tablet</b> , complete.....	28
6927. <b>Zoology Tablet</b> , complete.....	28
6928. <b>Physiology Tablet</b> , complete.....	28
6929. <b>Geology Tablet</b> , complete.....	28
6930. <b>Astronomy Tablet</b> , complete.....	28
Note.—We can also supply the following <b>Special Tablets</b> , which can be substituted for Nos. 6920 or 6921, if desired.	
6935. <b>Drawing Tablet</b> , containing 30 sheets of high grade <b>ledger</b> paper for pen and ink drawing, with marginal ruling, perforated to fit covers.	14
6936. <b>Note Tablet</b> , containing 30 sheets of extra quality unruled paper, perforated to fit covers.....	10½
6940. <b>Physiography Tablet</b> , arranged by Charles Emerson Peet and Ralph E. Blount, consisting of a careful assortment of blank weather maps, astronomical observation blanks, weather observation blanks, drawing paper, ruled note paper and co-ordinate ruled paper, uniform in size with the other tablets listed above, with set of covers, complete	28
6950. <b>Herbarium</b> . This is made in two sizes, 7¾x9¾ and 11x17, uniform in design with the Atlas Science Tablets.	
The portfolio form permits the specimens to be mounted scientifically according to the genus and species to which they belong. The plan also permits adding to or removing from the collection at any time.	
<b>Hints</b> on collecting, pressing and mounting specimens are found on inside cover pages. Each sheet contains a legend for classification.	
For 50 specimens, 7¾x9¾, with index.....	28
6950A. <b>Covers</b> only, per set.....	10
6950B. <b>Mounting Sheets</b> only, per 100.....	50
6951. <b>Herbarium</b> , same as No. 6950, size 11x17, for 50 specimens, with index	52
6951A. <b>Covers</b> only, per set.....	20
6951B. <b>Mounting Sheets</b> only, per 100.....	1 00
6955. <b>Plant Analysis Blanks</b> , 7¾x9¾ inches, special printed blanks giving complete analysis for Botany work; per envelope of 20 sheets ....	07

## TABLES.

## APPROXIMATE WEIGHT IN POUNDS OF RODS ONE FOOT LONG.

Diameter.	Aluminum.	Brass.	Copper.	Iron or Steel.
$\frac{1}{16}$	.0034	.011	.012	.010
$\frac{1}{8}$	.0144	.045	.048	.041
$\frac{3}{16}$	.032	.100	.106	.092
$\frac{1}{4}$	.057	.175	.190	.166
$\frac{5}{16}$	.089	.275	.296	.260
$\frac{3}{8}$	.128	.395	.426	.372
$\frac{7}{16}$	.174	.540	.579	.508
$\frac{1}{2}$	.227	.710	.757	.664
$\frac{9}{16}$	.288	.900	.958	.842
$\frac{5}{8}$	.356	1.100	1.182	1.034
$\frac{3}{4}$	.511	1.66	1.703	1.501
$\frac{7}{8}$	.696	2.15	2.318	2.014
1	.910	2.85	3.03	2.660

## APPROXIMATE WEIGHT IN POUNDS OF ALUMINUM, BRASS, COPPER, IRON, STEEL AND ZINC PER SQUARE FOOT.

B. & S. gauge.	Size, inches.	Fraction.	Aluminum.	Brass.	Copper.	Iron or Steel.	Zinc.
1	.2893	..	4.029	12.382	13.105	10.993	10.746
2	.2576	$\frac{1}{4}$	3.588	11.027	11.671	9.790	9.337
3	.2294	$\frac{3}{16}$	3.195	9.819	10.393	8.718	8.522
4	.2043	..	2.845	8.744	9.255	7.763	7.589
5	.1819	$\frac{1}{8}$	2.534	7.787	8.242	6.914	6.658
6	.1620	$\frac{3}{16}$	2.256	6.934	7.339	6.157	6.018
7	.1443	..	2.009	6.175	6.536	5.482	5.354
8	.1285	$\frac{1}{8}$	1.789	5.499	5.821	4.882	4.773
9	.1144	..	1.594	4.898	5.184	4.348	4.251
10	.1019	..	1.418	4.361	4.615	3.871	3.756
11	.0907	$\frac{3}{32}$	1.264	3.884	4.110	3.448	3.37
12	.0808	..	1.126	3.458	3.661	3.071	3.00
13	.0719	..	1.002	3.080	3.260	2.734	2.62
14	.0641	$\frac{1}{16}$	.892	2.743	2.903	2.435	2.32
15	.0571	..	.795	2.442	2.585	2.168	2.06
16	.0508	..	.708	2.175	2.302	1.931	1.87
17	.0452	3-64	.630	1.937	2.050	1.720	1.68
18	.0403	..	.561	1.725	1.826	1.531	1.50
19	.0359	..	.500	1.536	1.626	1.364	1.35
20	.0319	$\frac{1}{32}$	.435	1.368	1.448	1.214	1.20
21	.0284	..	.396	1.218	1.289	1.081	1.05
22	.0253	..	.353	1.085	1.148	.963	.95
23	.0226	..	.314	.966	1.022	.858	.85
24	.0201	..	.280	.860	.910	.764	.75
25	.0179	..	.249	.766	.811	.716	.67
26	.0159	1-64	.222	.682	.722	.636	.60
27	.0142	..	.197	.607	.643	.568	.52
28	.0126	..	.176	.541	.573	.504	.45
29	.0112	..	.157	.482	.510	.452	.40
30	.0100	..	.140	.429	.454	.400	.37

**APPROXIMATE FEET PER POUND OF MAGNET AND RESISTANCE WIRES.**  
 Sizes larger than No. 14, see table of weight of rods on page 454.

Size B. & S.	Aluminum Wire.	Brass or G. S. Wire.	Copper Wire.			Iron or Steel Wire.
			Bare.	D. C. C.	D. S. C.	
14	268	85	80	.....	.....	88
15	334	107	102	.....	.....	108
16	417	132	128	.....	.....	139
17	526	171	162	.....	.....	178
18	667	215	204	.....	.....	226
19	847	272	264	.....	.....	279
20	1,063	343	324	298	312	353
21	1,346	431	408	370	389	446
22	1,695	549	515	461	493	565
23	2,123	684	650	584	631	714
24	2,680	869	819	745	779	909
25	3,389	1,086	1,033	903	966	1,124
26	4,291	1,388	1,302	1,118	1,202	1,428
27	5,405	1,754	1,642	1,422	1,542	2,000
28	6,849	2,222	2,071	1,759	1,917	2,273
29	8,620	2,777	2,611	2,207	2,485	2,857
30	10,869	3,448	3,294	2,534	2,909	3,623
31	.....	4,347	4,152	2,768	3,683	4,566
32	.....	5,555	5,236	3,737	4,654	5,649
33	.....	7,142	6,602	4,697	5,689	7,194
34	.....	9,090	8,328	6,168	7,111	9,090
35	.....	11,111	10,501	6,737	8,534	11,493
36	.....	14,084	13,238	7,877	10,039	14,493
37	.....	.....	16,691	9,309	10,666	.....
38	.....	.....	20,854	10,666	14,222	.....
39	.....	.....	26,302	11,907	16,516	.....
40	.....	.....	33,176	14,222	21,333	.....

**WIRE GAUGE TABLE.**  
 Showing sizes in decimal parts of an inch.

Number of Wire Gauge.	American or Brown & Sharpe.	Washburn & Moen Mfg. Co.	Music Wire.	Number of Wire Gauge.	American or Brown & Sharpe.	Washburn & Moen Mfg. Co.	Music Wire.
00	.365	.331	.0087	18	.0403	.047	.040
0	.325	.307	.0093	19	.0359	.041	.042
1	.289	.283	.0098	20	.0320	.035	.043
2	.258	.263	.0105	21	.0285	.032	.045
3	.229	.244	.0115	22	.0253	.028	.047
4	.204	.225	.0125	23	.0226	.025	.049
5	.182	.207	.0145	24	.0201	.023	.053
6	.162	.192	.0150	25	.0179	.020	.056
7	.144	.177	.0175	26	.0159	.018	.061
8	.128	.162	.0190	27	.0142	.017	.064
9	.114	.148	.0220	28	.0126	.016	.069
10	.102	.135	.0245	29	.0113	.015	.072
11	.091	.120	.0270	30	.0100	.014	.076
12	.081	.105	.0285	31	.0089	.0135	.081
13	.072	.092	.0305	32	.0080	.013	.086
14	.064	.080	.0320	34	.0063	.010	.101
15	.057	.072	.0350	36	.0050	.009	.118
16	.051	.063	.0360	38	.0040	.008	.130
17	.045	.054	.0380	40	.0031	.007	.175

**Fractional Equivalents in Decimals.**

Fractional parts of an inch.....	1/2	1/8	3/8	1/4	3/16	1/8	1/16	3/32	1/64
Decimal parts of an inch.....	.5	.438	.375	.313	.25	.188	.125	.063	.016



### PHYSICAL APPARATUS IN SETS.

Our experience has shown us that it is often desirable for a science teacher to order a complete set of Physical Apparatus for the laboratory, the amount depending on the size of his school. For the purpose of aiding the teacher in such cases, we have selected apparatus for the following sets, designed for schools of varying sizes.

The instruments are from our regular stock, and every set forms a good basis for additional apparatus, as the school grows.

The prices quoted do not include cabinets for containing the apparatus. Description thereof and price will be found on page 464.

#### PHYSICAL SET No. 1; PRICE, \$70.00.

<b>Properties of Matter.</b>		<b>Magnetism.</b>	
319. Meter Stick .....	\$ 0.28	1704. Bar Magnet .....	\$ 0.17
601. Adhesion Disc .....	.20	1729. Iron Filings .....	.11
609. Prince Rupert Drops, 1 dozen.	.25	1745. Magnetic Needle .....	.60
621. Capillary Tubes .....	.40	1761. Compass, 40 mm.....	.25
647. Inertia Apparatus .....	.80		<u>\$ 1.13</u>
	<u>\$ 1.93</u>		
<b>Mechanics.</b>		<b>Electricity.</b>	
693. Collision Balls .....	3.50	1783. Friction Rod, wax.....	.11
849. Centrifugal Hoop .....	1.25	1793. Pith Balls, 1 dozen.....	.25
843. Clamp and Drum.....	2.50	1805. Electroscopes .....	.50
1001. Equilibrium Tubes .....	.75	1811. Toepler-Holtz Electric Machine, with attachment and shocking handles and brass chains .....	19.00
1033. Bottle Imp and Jar.....	.55	1829. Leyden Jar, pint.....	1.50
1065. Siphon .....	.22	1843. Discharger .....	.66
1091. Lift Pump .....	1.35	2100-2. Simple Cell .....	.17
1093. Force Pump .....	1.50		<u>\$ 22.19</u>
1117. Hydrometer .....	.40		
1155. Barometer Tube, Cup and Pipette .....	.40		
	<u>\$ 12.42</u>		
<b>Pneumatics.</b>		<b>Sound.</b>	
1305. Air Pump .....	19.50	3004. Tuning Fork .....	.13
1357. Bell Glass, 1 gallon.....	1.20	3052. Sonometer .....	4.45
1385. Hand and Bladder Glass.....	1.00	3065. Violin Bow .....	.66
1389. Sheet Rubber, 1 square foot..	.33		<u>\$ 5.24</u>
1413. Magdeburg Hemispheres ....	3.35		
1435. Guinea and Feather Tube....	5.50		
	<u>\$ 30.88</u>		
<b>Heat.</b>		<b>Light.</b>	
1509. Air Thermometer .....	.17	3205. Concave and Convex Mirror..	.22
1553. Compound Bar .....	.55	3213. Kaleidoscope .....	.45
1555. Palm Glass .....	.35	3236. Prism, 3 inch.....	.20
1548. Conductometer .....	.28	3255. Demonstration Set Lenses....	1.00
5045. Alcohol Lamp, 4 ounce.....	.25	3487. Color Tops, 1 dozen.....	.99
5438. Tripod for same.....	.22	3465. Iceland Spar, small.....	.28
	<u>\$ 1.82</u>		<u>\$ 3.05</u>

#### SUMMARY.

Properties of Matter.....	\$ 1.93
Mechanics .....	12.42
Pneumatics .....	30.88
Heat .....	1.82
Magnetism .....	1.13
Electricity .....	22.19
Sound .....	5.24
Light .....	3.05
	<u>78.66</u>
Less 10% discount.....	7.87
<b>Total .....</b>	<b>\$ 70.79</b>

Complete Set, as above, F. O. B. Chicago, \$70.00.

**PHYSICAL SET No. 2; PRICE, \$117.00.**

This set is much more complete than Set No. 1, and includes apparatus in all branches of elementary physics. We recommend this set to be complete enough for all ordinary high schools and academies, and guarantee it to be the best set on the market for the money.

<b>Tools.</b>		<b>Magnetism.</b>		
125.	Micrometer Caliper.....	\$ 3.35	1704. Bar Magnet .....	
129.	Vernier Caliper .....	1.25	1711. Horseshoe Magnet .....	
319.	Meter Stick .....	.28	1729. Iron Filings .....	
			1733. Electro Magnet .....	
		\$ 4.88	1745. Magnetic Needle .....	
			1761. Compass, 40 mm.....	
			\$ 2.76	
<b>Properties of Matter.</b>		<b>Electricity.</b>		
601.	Adhesion Disc .....	.20	1783. Friction Rod, wax .....	
603.	Cohesion Plates .....	.45	1793. Pith Balls, 1 dozen .....	
609.	Prince Rupert Drops .....	.25	1796. Pith Images .....	
621.	Capillary Tubes .....	.40	1805. Electroscope .....	
647.	Inertia Apparatus .....	.80	1811. Toepler-Holtz Electric Ma-	
		\$ 2.10	chine with attachment and	
			shocking handles and brass	
<b>Mechanics.</b>			chains with ring and snap. 19.00	
693.	Collision Balls .....	3.50	1831. Leyden Jar, quart .....	
720.	Composition of Forces .....	1.65	1843. Discharger .....	
849.	Centrifugal Hoop .....	1.25	1859. Image Plates .....	
843.	Clamp and Drum .....	2.50	1873. Induction Cylinder .....	
913.	Gyroscope .....	1.90	1877. Hollow Globe .....	
1001.	Equilibrium Tubes .....	.75	1881. Proof Plane .....	
1023.	Liquid Pressure Gauge .....	.78	1888. Bell Chimes .....	
1033.	Bottle Imp and Jar .....	.55	2001. Geissler Tube .....	
1065.	Siphon .....	.22	2150. Plunge Battery, quart.....	
1091.	Lift Pump .....	1.35	2225. Induction Coil .....	
1093.	Force Pump .....	1.50	2309. Decomposition of Water ....	
1113.	Demonstration Hydrometer...	.20	2409. Galvanometer .....	
1117.	Hydrometer .....	.40	6107. One-half pound Magnet Wire	
1125.	Hydrometer Jar, 12x2.....	.38	for connections, No. 20DCC. .35	
1155.	Barometer Tube, Cup and			
	Pipette .....	.40		
3871.	Three Spring Balances for	1.65		
	use with No. 720.....		\$40.44	
		\$18.98		
<b>Pneumatics.</b>		<b>Sound.</b>		
1305.	Air Pump .....	19.50	877. Siren Disc .....	
1348.	Three Bursting Cubes .....	.56	3012. Tuning Fork .....	
1357.	Bell Glass, 1 gallon .....	1.20	3052. Sonometer .....	
1385.	Hand and Bladder Glass.....	1.00	3065. Violin Bow .....	
1389.	Sheet Rubber, 1 square foot..	.33	3081. Organ Pipe .....	
1403.	Mercury Shower .....	.70	3105. Chladni Plates and Clamp....	
1413.	Magdeburg Hemispheres ....	3.35		
1415.	Bacchus Illustration .....	.50	\$ 9.21	
1427.	Water Hammer .....	.60	<b>Light.</b>	
1435.	Guinea and Feather, Fountain		887. Newton's Disc .....	.55
	in Vacuo and Aurora Tube		3203. Plane Mirror for double image	
	combined .....	5.50	reflection .....	.22
		\$33.24	3206. Concave and Convex Mirrors,	
			glass, in frame .....	1.55
<b>Heat.</b>			3213. Kaleidoscope .....	.45
1509.	Air Thermometer .....	.17	3215. Incidence and Reflection ....	2.25
5407.	Chemical Thermometer .....	.40	3236. Equilateral Prism, 4 inch....	.28
1548.	Conductometer .....	.28	3255. Set Demonstration Lenses ....	1.00
1551.	Ball and Ring .....	1.00	3280. Lens, 10 cm. focus.....	.11
1553.	Compound Bar .....	.55	3281. Lens, 15 cm. focus.....	.11
1555.	Palm Glass .....	.35	3351. Blocks for supporting Meter	
1559.	Linear Expansion Apparatus.	2.65	Stick .....	.13
1589.	Calorimeter .....	.40	3352. Lens Support .....	.11
1618.	Fire Syringe .....	2.00	3353. Screen Support .....	.08
1636.	Radiometer .....	1.55	3354. Screen .....	.05
5045.	Alcohol Lamp, 8 ounces.....	.40	3355. Object and Marker.....	.08
5438.	Tripod for same .....	.22	3355B. Candle Holder .....	.08
		\$ 9.97	3466. Iceland Spar, medium .....	.40
			3487. Color Tops, 1 dozen.....	.90
			3489. Newton's Rings .....	1.50
				\$ 9.85

**SUMMARY.**

<b>Tools</b> .....	\$ 4.88
<b>Properties of Matter</b> .....	2.10
<b>Mechanics</b> .....	18.98
<b>Pneumatics</b> .....	33.24
<b>Heat</b> .....	9.97
<b>Magnetism</b> .....	2.76
<b>Electricity</b> .....	40.44
<b>Sound</b> .....	9.21
<b>Light</b> .....	9.85

131.43

Less 10% discount..... 13.14

Total .....\$118.29

Complete Set, as above, F. O. B. Chicago, \$117.00.

**PHYSICAL SET No. 3; PRICE, \$200.00.**

This set of apparatus is designed to meet the demand for a more complete collection of apparatus than Sets Nos. 1 and 2. Every department of physics as taught in the leading preparatory and high schools is comprehensively covered.

<b>Tools and Measurements.</b>		
125.	Micrometer Caliper .....	\$ 3.35
131.	Vernier Caliper (new design) .....	2.50
321.	Meter Stick, brass tipped.....	.35
369.	Wire Cutting Pliers, 5 inch.....	.60
449.	Metric Diagonal Scale .....	.10
566.	Wire Gauge .....	2.25
<b>Properties of Matter.</b>		
601.	Adhesion Disc .....	.20
603.	Cohesion Plates .....	.45
609.	Prince Rupert Drops .....	.25
619.	Capillary Tubes and Support.....	.67
643.	Osmose Apparatus .....	.27
647.	Inertia Apparatus .....	.80
651.	Elasticity of Flexure Apparatus .....	.67
656.	Wire Testing Apparatus .....	2.25
<b>Mechanics of Solids.</b>		
695.	Collision Balls with Arc.....	5.00
720.	Composition of Forces.....	1.65
727.	Lever Holder (3).....	.60
729.	Pulley, single, 2 hook.....	.18
730.	Pulley, double, 2 hook.....	.30
767.	Inclined Plane with Arc.....	3.90
771.	Hall's Carriage .....	1.00
815.	Center of Gravity Apparatus..	4.15
827.	Second Law of Motion Apparatus .....	2.75
837.	Rotator (whirling table).....	6.65
849.	Centrifugal Hoop .....	1.25
859.	Two Balls on rod, for Rotator .....	2.00
867.	Ring, Chain and Cylinder... ..	.45
913.	Gyroscope .....	1.90
3871.	Three Spring Balances, Met. and Eng., flat back.....	1.65
<b>Mechanics of Fluids.</b>		
1005.	Equilibrium Tubes .....	3.30
1023.	Liquid Pressure Gauge .....	.78
1033.	Bottle Imp and Jar .....	.55
1037.	Hydraulic Press .....	1.50
1051.	Boyle's Law Tube .....	.66
1065.	Siphon .....	.22
1069.	Tantalus Cup .....	.70
1089.	Archimedes Principle .....	1.25
1091.	Lift Pump .....	1.35
1093.	Force Pump .....	1.50
1113.	Demonstration Hydrometer ..	.20
1117.	Hydrometer for heavy liquids ..	.40
1125.	Hydrometer Jar 12x2.....	.38
1155.	Barometer Tube, Cup and Pipette .....	.40
<b>Pneumatics.</b>		
1300.	Oil Sealed Air Pump.....	27.75
1302.	Vacuum Wax .....	.33
1326.	Vacuum Gauge .....	1.40
1347.	Bell in Vacuo .....	2.75
1348.	Three Bursting Cubes .....	.56
1350.	Freezing Apparatus .....	1.40
1357.	Bell Glass, 1 gallon.....	1.20
1385.	Hand and Bladder Glass .....	1.00
1389.	Sheet Rubber, 1 square foot..	.33
1403.	Mercury Shower .....	.70
1413.	Magdeburg Hemispheres .....	3.35
1415.	Bacchus Illustration .....	.50
1417.	Spirometer (Seven-in-One)... ..	7.75
1427.	Water Hammer .....	.60
1435.	Guinea and Feather Tube, Fountain in Vacuo and Aurora Tube combined .....	5.50
<b>Heat.</b>		
1509.	Air Thermometer .....	.17
5408B.	Chemical Thermometer .....	.80
1549.	Conductometer .....	.90
1551.	Ball and Ring .....	1.00
1553.	Compound Bar .....	.55
1555.	Palm Glass .....	.35
1559.	Linear Expansion Apparatus.....	2.65
1586.	Copper Boiler (Apparatus A) ..	2.25
1593.	Calorimeter .....	2.00
1613.	Tyndall's Specific Heat Apparatus .....	1.55
1618.	Fire Syringe .....	2.00
1621.	Convection Apparatus .....	1.10
1636.	Brought forward .....	\$131.77
1661.	Radiometer .....	1.55
5045.	Sectional Model of Steam Engine .....	3.30
	Alcohol Lamp, 8 ounces.....	.40
	(Bunsen Burner substituted if desired.)	
5438.	Tripod for same .....	.22
<b>Magnetism.</b>		
1701.	Lodestone .....	.22
1704.	Bar Magnet, 6 inch.....	.17
1713.	Horseshoe Magnet, 6 inch....	.25
1729.	Iron Filings .....	.11
1733.	Electro Magnet .....	1.50
1745.	Magnetic Needle .....	.60
1761.	Compass, 40 mm.....	.25
<b>Electricity.</b>		
1783.	Friction Rod, wax .....	.11
1785.	Friction Rod, vulcanite.....	.40
1791.	Catskin .....	.55
1793.	Pith Balls, 1 dozen.....	.25
1796.	Pith Images, pair.....	.40
1801.	Electrical Pendulum .....	.55
1806.	Electroscope .....	1.25
1811.	Toepler-Holtz Electric Machine, with attachment and shocking handles and brass chains with ring and snap.....	19.00
1831.	Leyden Jar, quart .....	1.65
1843.	Discharger .....	.66
1859.	Image Plates .....	1.35
1877.	Hollow Globe .....	1.80
1881.	Proof Plane .....	.22
1888.	Bell Chimes .....	.90
1886.	Universal Support .....	.80
1891.	Volta's Hail Storm .....	2.75
1897.	Electric Flier .....	.67
1903.	Holder for Tubes, etc.....	.50
2005.	Geissler Tube, 8 inch.....	.70
2151.	Plunge Battery, 2 cell .....	5.00
2223.	Demonstration Coil .....	5.00
2246.	Electric Motor .....	1.25
2309.	Decomposition of Water.....	1.25
2403.	Galvanometer .....	4.50
6107.	One pound Magnet Wire for connections, No. 20DCC.....	.64
<b>Sound.</b>		
871.	Savart's Wheel .....	.55
879.	Siren Disc .....	1.10
3019.	Tuning Fork .....	.70
3021.	Tuning Fork on Resonant Case .....	3.00
3052.	Sonometer .....	4.45
3066.	Violoncello Bow .....	.77
3082.	Organ Pipe .....	4.45
3105.	Chladni Plates and Clamp....	1.45
3155.	Oscillograph .....	.45
<b>Wave Motion.</b>		
875.	Crova's Disc .....	.28
3170.	Spiral of Brass Wire .....	1.10
<b>Light.</b>		
887.	Newton's Disc .....	.55
3206.	Concave and Convex Mirrors..	1.55
3212.	Multiple Image Apparatus....	1.65
3215.	Incidence and Reflection App.	2.25
3226.	Sextant .....	1.65
3236.	Equilateral Prism, 4 inch....	.28
3256.	Demonstration Lenses, 2 inch.	2.50
3280.	Lens, 10 cm. focus.....	.11
3281.	Lens, 15 cm. focus.....	.11
3301.	Index of Refraction .....	.20
3351.	Blocks for supporting Meter Stick .....	.13
3352.	Lens Support .....	.11
3353.	Screen Support .....	.08
3354.	Screen .....	.05
3355.	Object and Marker.....	.08
3355B.	Candle Holder .....	.08
3466.	Iceland Spar, medium .....	.40
3489.	Newton's Rings .....	1.50
		224.07
	Less 10% discount.....	22.41
	<b>Total .....</b>	<b>\$201.66</b>
Carried forward .....		\$131.77
<b>Complete Set, F. O. B. Chicago, \$200.00.</b>		

**CHEMICALS AND APPARATUS IN SETS.**

The following Chemical Sets have been arranged by a prominent professor of chemistry according to the latest and best text books. They are up-to-date in every particular. The chemicals are all placed in bottles.

**Chemical Set. No. 1, F. O. B. Chicago, \$13.50.**

4 oz. Acid Acetic.	1/4 oz. Iodine.
1 lb. Acid Hydrochloric.	2 oz. Galena.
1 lb. Acid Nitric.	1 oz. Lead Acetate.
2 lbs. Acid Sulphuric.	1 oz. Lead Oxide (red).
1 oz. Acid Oxalic.	1/2 oz. Litmus Cubes.
1 oz. Acid Tartaric.	4 oz. Mercury.
2 oz. Ammonium Chloride.	12 in. Magnesium Ribbon.
8 oz. Ammonium Hydrate.	2 oz. Magnesium Sulphate.
1 oz. Ammonium Nitrate.	1 lb. Manganese Dioxide (powdered).
1 oz. Ammonium Sulphide.	6 in. Platinum Wire.
1 oz. Animal Charcoal.	1/2 oz. Phosphorus.
1 oz. Antimony.	1/8 oz. Potassium (metallic).
1 oz. Arsenic Trioxide.	2 oz. Potassium Bichromate.
1 oz. Alum.	1 oz. Potassium Bromide.
8 oz. Alcohol Methyl.	2 oz. Potassium Chlorate.
1 oz. Barium Chloride.	2 oz. Potassium Ferrocyanide.
1 oz. Barium Nitrate.	1 oz. Potassium Hydrate (sticks).
2 oz. Calcium Carbonate (marble).	1 oz. Potassium Nitrate.
2 oz. Calcium Fluoride.	1 oz. Strontium Nitrate.
4 oz. Calcium Sulphate.	4 oz. Sulphur Roll.
1 oz. Carbon Bisulphide.	1/4 oz. Silver Nitrate.
1 oz. Charcoal (lumps).	1/8 oz. Sodium (metallic).
2 oz. Copper Sulphate.	1 oz. Sodium Biborate.
2 oz. Ether.	2 oz. Sodium Carbonate.
8 oz. Ferrous Sulphide.	2 oz. Sodium Sulphate.
2 oz. Ferrous Sulphate.	8 oz. Zinc for making Hydrogen.
1/2 oz. Gall Nuts (powdered).	

Beakers, nest of 3 (3 to 8 oz.).

Blow Pipe, plain, 8 inch.

Bottle, W. M., 4 oz.

Bottle, W. M., 8 oz.

Corks, 1 dozen, assorted.

Crucibles, Hessian, nest, small 5s.

Deflagrating Spoon, iron, 1/2 inch.

Dish, Evaporating, 2 oz.

Dish, Lead, 3 inch.

File, Triangular, 4 inch.

Filter Paper, 1 pkg., 4 inch.

Flask, F. B., 4 oz.

Flask, F. B., 8 oz.

Funnel, glass, 2 1/2 inch.

Jar, Specie, for deflagration, qt.

Gas Generating Flask, pint.

Glass Tubing, 1/4 lb., 1/4 inch.

Graduate, conical, 60 c. c.

Lamp, Alcohol, 4 oz.

Mortar, Wedgewood, 2 3/4 inch.

Pipette, long bulb, small.

Retort, glass, plain, 4 oz.

Rubber Tubing, 6 ft., 3-16 inch.

Sand Bath, 4 inch.

Test Tubes, 1 dozen, assorted.

Test Tube Brush, sponge end.

Test Tube Holder, wood.

**Chemical Set. No. 2, F. O. B. Chicago, \$25.00.**

1/2 lb. Acetic Acid.	4 oz. Lead Monoxide.
1 lb. Hydrochloric Acid.	1/2 oz. Litmus (best cubes).
1 lb. Nitric Acid.	12 in. Magnesium Ribbon.
1 oz. Oxalic Acid.	4 oz. Magnesium Sulphate.
2 lbs. Sulphuric Acid.	1 lb. Manganese Dioxide (powdered).
1 oz. Tartaric Acid.	4 oz. Mercury.
1 oz. Ammonium Carbonate.	1/2 oz. Mercuric Chloride.
2 oz. Ammonium Chloride.	1/2 oz. Mercuric Oxide.
1/2 lb. Ammonium Hydrate.	12 in. Platinum Wire.
1 oz. Ammonium Nitrate.	1/2 oz. Phosphorus.
1 oz. Ammonium Sulphide.	1/8 oz. Potassium (metallic).
1/2 pt. Alcohol Methyl.	1/2 lb. Potassium Bichromate.
2 oz. Alum.	1 oz. Potassium Bromide.
2 oz. Animal Charcoal.	2 oz. Potassium Carbonate.
1 oz. Antimony.	1/2 lb. Potassium Chlorate.
1 oz. Arsenic Trioxide.	1 oz. Potassium Chromate.
1 oz. Barium Chloride.	1/2 oz. Potassium Cyanide.
1 oz. Barium Nitrate.	2 oz. Potassium Ferricyanide.
1 oz. Borax.	2 oz. Potassium Ferrocyanide.
1/4 lb. Calcium Carbonate (marble).	1 oz. Potassium Hydrate (sticks).
2 oz. Calcium Chloride.	1/4 oz. Potassium Iodide.
2 oz. Calcium Fluoride.	2 oz. Potassium Nitrate.
1/4 lb. Calcium Sulphate.	1/2 oz. Potassium Permanganate.
1 oz. Carbon Bisulphide.	1 oz. Potassium Sulphate.
1 oz. Cobalt Nitrate.	1/8 oz. Silver Nitrate.
4 oz. Copper Sulphate.	1/4 oz. Sodium (metallic).
2 oz. Ether.	1 oz. Sodium Acetate.
2 oz. Ferrous Sulphate.	4 oz. Sodium Carbonate.
8 oz. Ferrous Sulphide.	2 oz. Sodium Hydrate (sticks).
1/2 oz. Gall Nuts (powdered).	2 oz. Sodium Hyposulphite.
	2 oz. Sodium Sulphate.
	1 oz. Sodium Phosphate.
1/4 oz. Iodine.	1 oz. Strontium Nitrate.
2 oz. Galena.	1/2 lb. Sulphur Roll.
1 oz. Lead Acetate.	1/2 lb. Zinc for making Hydrogen.
4 oz. Lead Oxide (red).	

Continued on page 460.

## Chemical Set No. 2 Concluded.

Beakers, nest of 4 (3 to 12 oz.)	Graduate, conical, 60 c. c.
Blow Pipe, plain, 8 inch.	Hand Balance, 5 inch beam with weights, in case.
Bottles, W. M., two 8 oz.	Jar, Specie, for deflagration, ½ gallon.
Bottles, N. M., two 8 oz.	Lamp, Alcohol, 4 oz.
Corks, 1 dozen, assorted.	Mortar, Wedgewood, 3 inch.
Crucibles, Hessian, nest, large 5s.	Pipette, long bulb, large.
Deflagrating Spoon, iron, ½ inch.	Pneumatic Trough, student's.
Dish, Evaporating, 3½ oz.	Retort, glass, plain, 4 oz.
Dish, Lead, 3 inch.	Retort Stand, 3 ring.
File, Triangular, 4 inch.	Rubber Tubing, 6 feet, 3-16 inch.
Filter Paper, 1 pkg., 4 inch.	Sand Bath, 4 inch.
Flask, F. B., 4 oz.	Test Tubes, 1 dozen, assorted.
Flask, F. B., 8 oz.	Test Tubes, 1 dozen, 6x5/8.
Flask, F. B., 16 oz.	Test Tube Brush, sponge end.
Funnel, 2½ inch.	Test Tube Holder, wire.
Funnel, 3½ inch.	Thistle Tube.
Gas Bag with stopcock, 1 gallon.	U Tube, 6 inch.
Gas Generating Flask, pint.	Watch Glass, 2½ inch.
Glass Tubing, ½ lb., 3-16 to ¼.	Wire Gauze, 4x1.

## Chemical Set No. 3, F. O. B. Chicago, \$50.00.

For those desiring a complete chemical laboratory outfit we recommend the following set:

1 lb. Acid Acetic.	¼ lb. Lead Nitrate.
½ lb. Acid Boracic.	1 lb. Lead Protoxide.
2 oz. Acid Citric.	1 oz. Litmus (best cubes).
2 lbs. Acid Hydrochloric.	4 oz. Logwood.
2 lbs. Acid Nitric.	4 ft. Magnesium Ribbon.
1 lb. Acid Oxalic.	2 oz. Magnesium Chloride.
1 oz. Acid Phosphoric.	1 lb. Magnesium Sulphate.
4 lbs. Acid Sulphuric.	2 lbs. Manganese Dioxide (powdered).
½ lb. Acid Tartaric.	1 oz. Mercuric Chloride.
1 qt. Alcohol Methyl.	8 oz. Mercury.
1 lb. Alum.	2 oz. Microcosmic Salt.
½ lb. Ammonium Carbonate.	1 lb. Paraffine.
1 lb. Ammonium Chloride.	12 in. Platinum Wire.
1 lb. Ammonium Hydrate.	1 Platinum Sponge.
1 oz. Ammonium Molybdate.	1 oz. Phosphorus.
½ lb. Ammonium Nitrate.	4 oz. Plumbago.
1 oz. Ammonium Oxalate.	½ oz. Potassium (metallic).
1 lb. Ammonium Sulphate.	1 lb. Potassium Bichromate.
4 oz. Ammonium Sulphide.	2 oz. Potassium Bromide.
¼ oz. Aniline.	½ lb. Potassium Carbonate.
1 lb. Animal Charcoal.	1 lb. Potassium Chlorate.
1 oz. Antimony (metallic).	2 oz. Potassium Chromate.
2 oz. Antimony Sulphide.	1 oz. Potassium Cyanide.
1 oz. Arsenic (metallic).	1 oz. Potassium Ferricyanide.
¼ lb. Arsenic Trioxide.	¼ lb. Potassium Ferrocyanide.
1 oz. Asbestos.	2 oz. Potassium Hydrate (sticks).
2 oz. Barium Carbonate.	½ oz. Potassium Iodide.
½ lb. Barium Chloride.	1 lb. Potassium Nitrate.
½ lb. Barium Nitrate.	1 oz. Potassium Permanganate.
1 lb. Barium Sulphate.	½ lb. Potassium Sulphate.
½ oz. Bismuth.	1 oz. Potassium Sulphocyanide.
½ lb. Bone Ash.	1 oz. Potassium Bi Tartrate.
1 lb. Calcium Carbonate (marble).	¼ oz. Silver Nitrate.
1 lb. Calcium Chloride.	½ oz. Sodium (metallic).
1 lb. Calcium Fluoride.	½ oz. Sodium Acetate.
1 lb. Calcium Sulphate.	½ lb. Sodium Biborate.
2 oz. Carbon Bisulphide.	1 lb. Sodium Bicarbonate.
1 lb. Charcoal Wood (lump).	2 lbs. Sodium Carbonate.
1 oz. Cobalt Chloride.	1 lb. Sodium Hydrate (sticks).
1 oz. Cobalt Nitrate.	1 lb. Sodium Hyposulphite.
4 oz. Copper Turnings.	1 lb. Sodium Nitrate.
1 oz. Copper Nitrate.	½ lb. Sodium Phosphate.
1 lb. Copper Sulphate.	1 lb. Sodium Silicate.
¼ lb. Ether.	1 lb. Sodium Sulphate.
2 oz. Ferric Chloride.	¼ lb. Strontium Chloride.
1 lb. Ferrous Sulphate.	½ lb. Strontium Nitrate.
1 lb. Ferrous Sulphide.	2 lbs. Sulphur Roll.
1 oz. Gall Nuts (powdered).	¼ lb. Tin (metallic).
1 oz. Indigo.	1 oz. Tin Proto Chloride.
1 lb. Iron Filings.	8 oz. Turpentine.
2 oz. Galena.	1 lb. Zinc Mossy, for making Hydrogen
¼ lb. Lead Acetate.	½ lb. Zinc Carbonate.
1 lb. Lead Oxide (red).	¼ lb. Zinc Oxide.
	1 lb. Zinc Sulphate.

Continued on page 461.

**Chemical Set No. 3, Concluded.**

Beakers, nest of 5 (3 to 20 oz.).	Jar for Hydrometer, 12x2½.
Blow Pipe, plain, 8 inch.	Jar, Specie, for deflagration, two 1 quart size.
Bottles, W. M., two 8 oz.	Lamp, Alcohol, 4 oz.
Bottles, N. M., two 8 oz.	Mortar, Wedgewood, 3¾ inch.
Burette, 25 c. c. 1-10ths.	Pipette, Volumetric, 5 c. c.
Corks, 2 dozen, assorted.	Pipette, Volumetric, 10 c. c.
Cork Borers, set 1-3.	Pneumatic Trough, student's.
Cork Screw, wood handle.	Reagent Bottles, 1 set of 24.
Crucibles, Hessian, 2 nests, large 5s.	Retort, glass, plain, 16 oz.
Crucible Tongs, 9 in.	Receiver for Retort, 8 oz.
Deflagrating Spoon, brass, ½ inch.	Reduction Tube for reducing metallic oxides.
Dish, Crystallizing, 4 inch.	Retort Stand, 3 ring.
Dish, Evaporating, 2 oz.	Rubber Tubing, 6 feet, ¼ inch.
Dish, Evaporating, 6 oz.	Sand Bath, 4 inch.
Dish, Lead, 3 inch.	Spatula, steel, 4 inch.
File, Triangular, 5 inch.	Stirring Rods, 3, 5x3-16.
File, Round, 5 inch.	Test Glass, 2 oz.
Filter Paper, 1 pkg., 5 inch.	Test Tubes, 2 dozen, assorted.
Flasks, F. B., two 4 oz.	Test Tubes, 1 dozen, 6x¾.
Flask, F. B., 8 oz.	Test Tube Brush, sponge end.
Flask, F. B., 16 oz.	Test Tube Holder, wire.
Funnel, glass, 2½ inch.	Test Tube Support, 13 tubes with drying pins.
Funnel, glass, 4 inch.	Thermometer, Paper Scale, 110 degrees C.
Gas Bag, with stopcock, 1 gallon.	Thistle Tubes, Two.
Gas Generating Flask, quart.	U Tube, 6 inch.
Glass Tubing, 1 lb., 3-16-¼.	Watch Glass, 2½ inch.
Graduate, conical, 100 c. c.	Watch Springs, for burning in oxygen, ½ dozen
Hand Balance, 5 inch beam, with weights.	Wire Gauze, 4x4.
Hydrometer, for heavy liquids.	Woulff Bottle, 3 neck, pint.

**CATALOGUE R.****1912.****CHEMICALS.**

An "up-to-date" catalogue of chemicals which we will be pleased to send post free to those interested.

We purchase chemicals in large quantities from the leading manufacturers in this country and Europe and carry a full stock specially selected for school and college laboratories.

We carry a full line of Baker's Analyzed Chemicals. A complete statement of the analysis showing the exact degree of purity is on each bottle.

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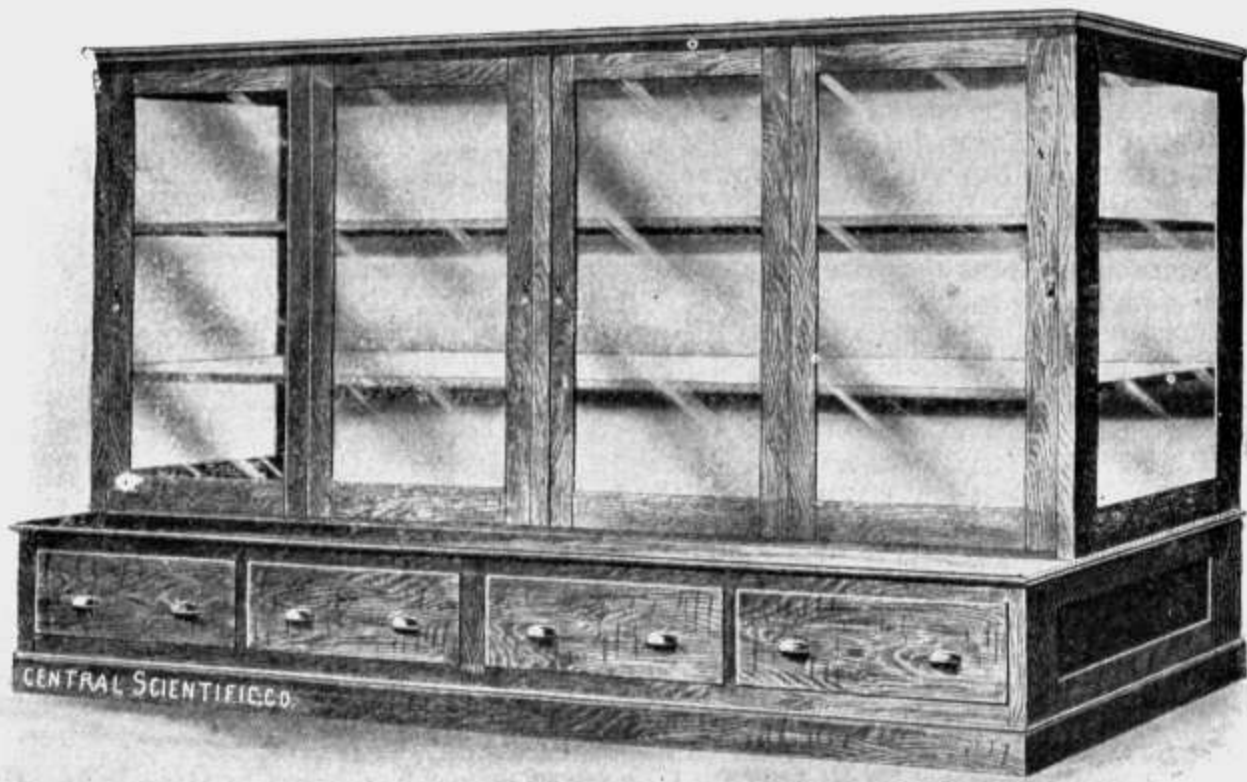
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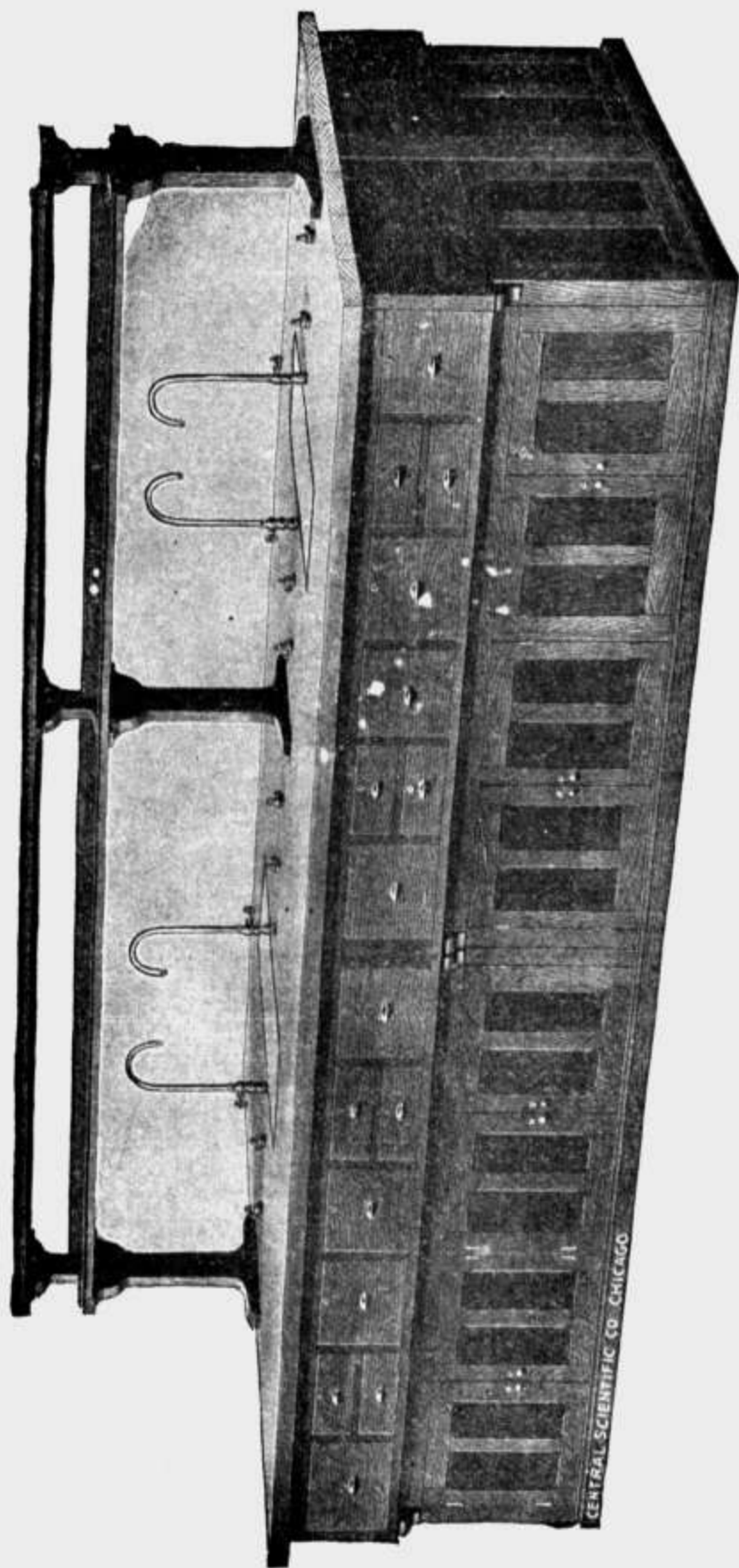
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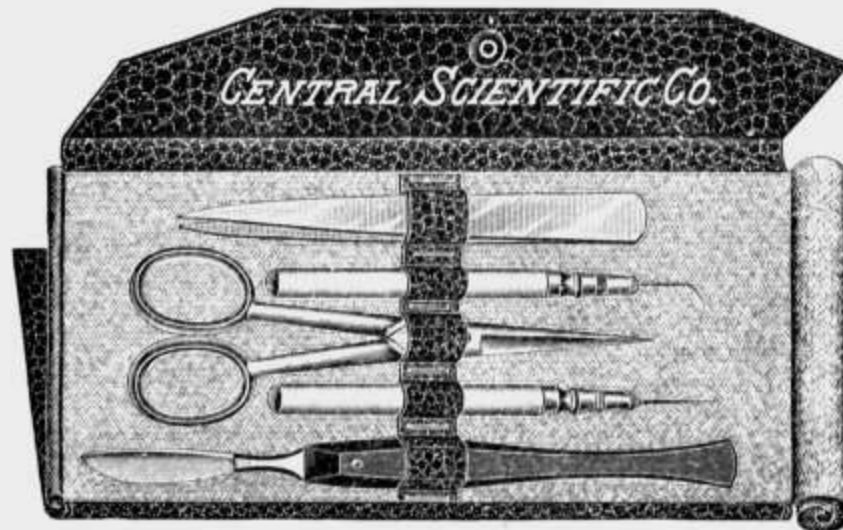
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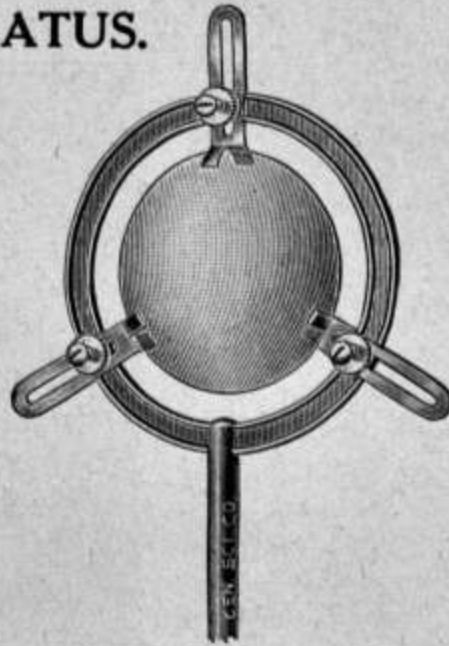
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PHYSICAL APPARATUS.



No. 30A.



No. 51A.

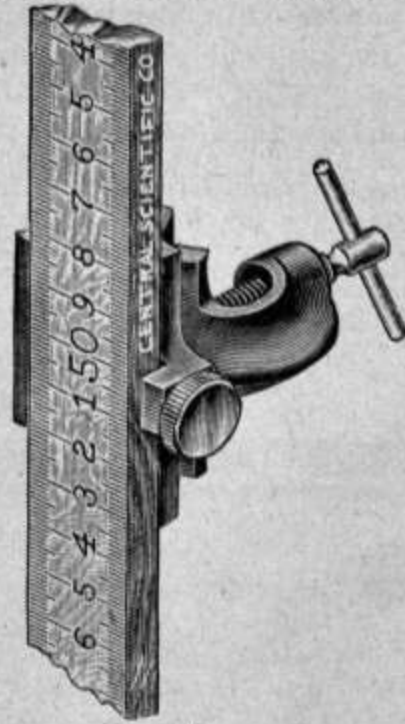
30A. **Hook Collar**, with set screw, nickel plated and of substantial construction. The many uses to which such a piece may be put will readily be seen by the teacher. Among these may be mentioned the supporting of pulleys from horizontal cross rods and the suspension of pendulums.

For rods of diameter.....	10 mm.	13 mm.	19 mm.
Each .....	\$0.40	.45	.60

51A. **Lens Holder, New Design.** For holding lenses up to 100 mm. in diameter. With this holder lenses are clamped firmly in position either in center or off center and adjustments are readily made for lenses of any diameter up to the maximum capacity mentioned. A very satisfactory feature of this new holder is the shape of the jaws, which has been so designed that concave as well as convex lenses may be used. Mounted on a nickel plated rod, 15 cm. long by 10 mm. in diameter..... \$ 0.90



No. 62A.

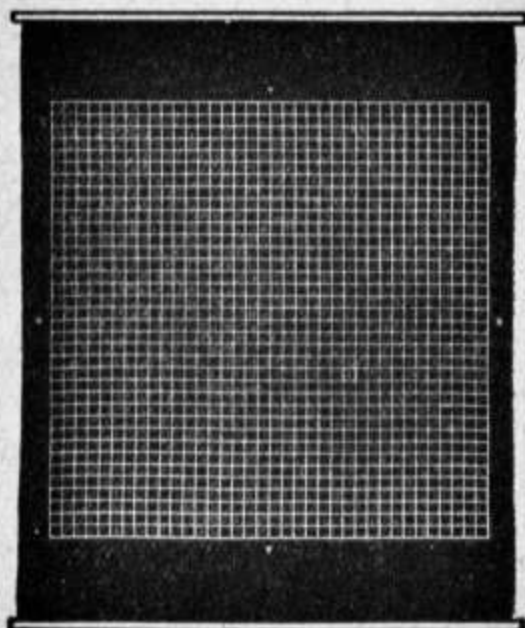


No. 75.

62A. **Extension Clamp.** For holding two rods parallel to each other. By using this clamp it is possible to fasten two rods parallel to each other without slipping the clamp over the end of the rods, as was necessary in the old form. For use with rods of from 10 to 19 mm. diameter ..... .55

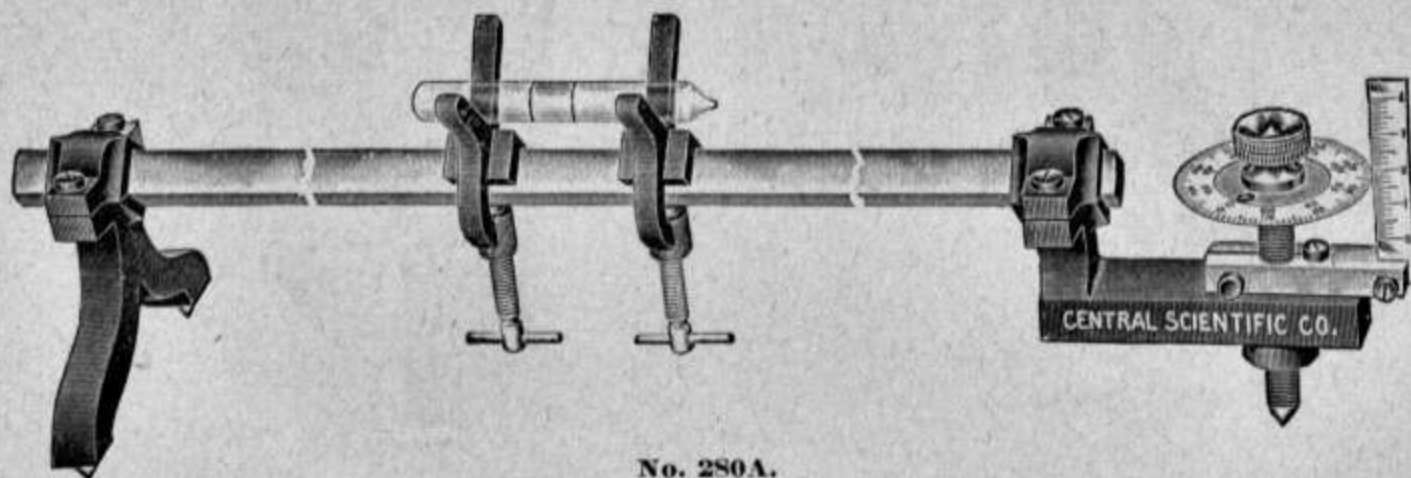
75. **Meter Stick Clamp.** A convenient device for holding the ordinary meter stick in position on a rod, with V opening for clamping it to any rod from 10 to 19 mm. in diameter. The meter stick is held firmly in place parallel to the rod by a thumb screw..... .55





No. 162A.

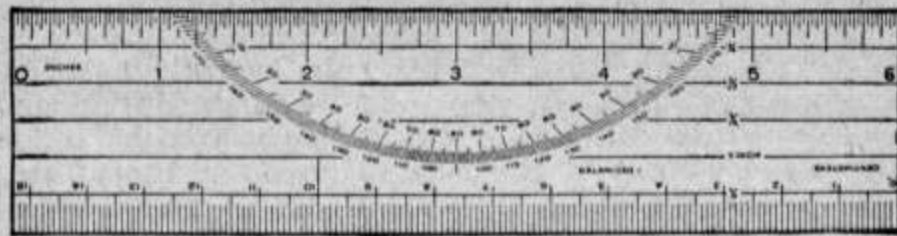
- 162A. **Cross Section Chart**, made of extra quality blackboard cloth. The cross section lines are in white, accurately spaced and permanent. Its surface takes crayon marks and permits their erasure as easily as a blackboard. Can be rolled up when not in use.
- In mathematics it is indispensable for the proper presentation of descriptive geometry (Graphs) and other mathematical diagrams. See "An Elementary Treatment of Graphs," published by Ginn & Company.
- In science it enables the instructor instantly to plot a curve visible to the entire class, without going to the trouble of first cross ruling the blackboard.
- In penmanship correct form and slant of letters can readily be shown. In drawing the possibilities of its use are numerous, including sketching profiles, symmetrical figures, drawings to scale, etc.
- Ruled surface 36 inches square.....Net \$ 3.35
- 162B. **Cross Section Chart**, similar to No. 162A, but with ruled surface 20 inches square .....Net 3.00



No. 280A.

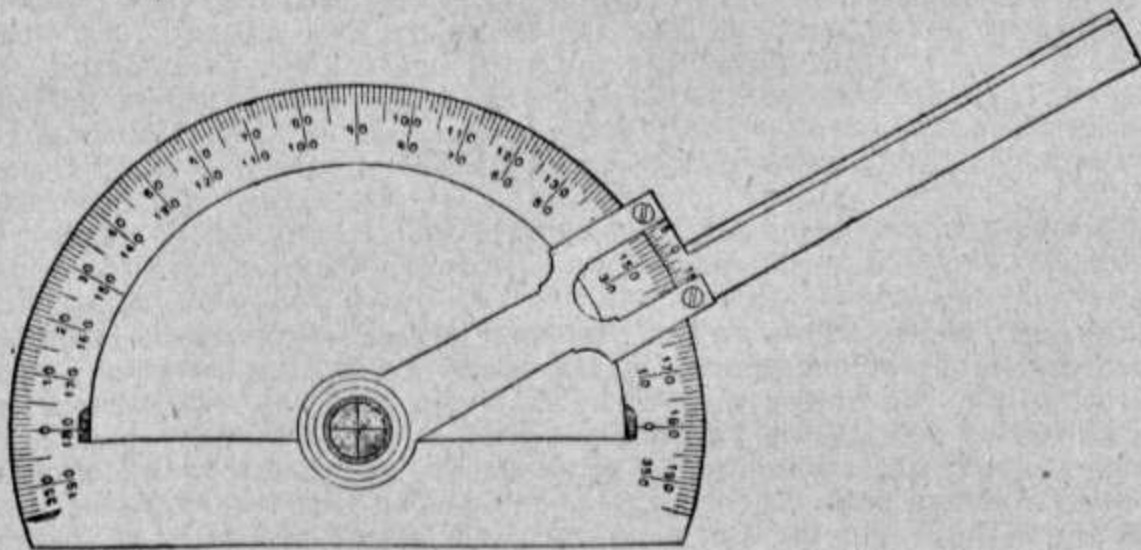
- 280A. **Level Tester**, a high grade instrument for use in calibrating and testing levels. The micrometer screw is the same one used on No. 517 Spherometer, and has a pitch of 0.5 mm. The diameter of the micrometer head is 5 cm. and it is graduated in 100 divisions. The length of the base of this level tester has been so chosen that one division on the divided head corresponds to three seconds of arc. Without level ..... 16.00

- 319A. **Half Meter Stick** of maple. One side is graduated in decimeters, centimeters, and millimeters; the other side in inches and eighths.. \$ 0.15
- 321A. **Half Meter Stick** of maple. One side is graduated in decimeters, centimeters, and millimeters; the other side in inches and eighths. The ends are tipped with brass..... .25



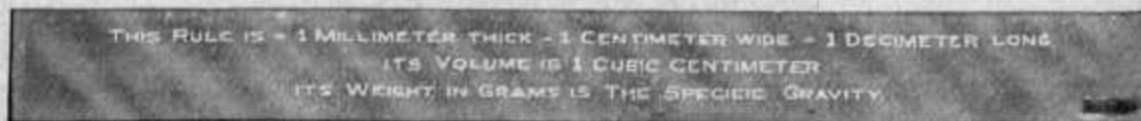
No. 412.

412. **Protractor and Rule**, made of transparent celluloid of sufficient thickness to be perfectly flexible. Lines can be drawn parallel with, or at any desired angle to each other without measuring. Length 6 inches, graduation in 32nds and mm. Each.....Net .20



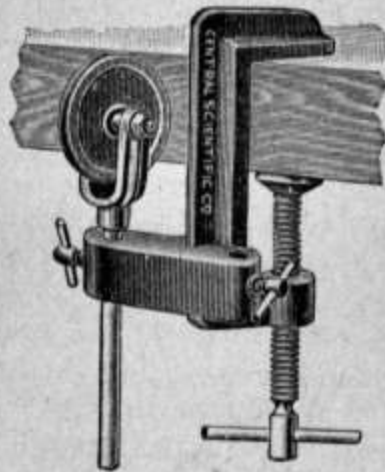
No. 426.

426. **Protractor, German Silver**, half circle, engine divided with great accuracy, 14 cm. in diameter, half degree graduations and vernier arm reading to three minutes.....Duty free 6.30
- 426A. **Protractor, German Silver**. Same as No. 426, but 20 cm. in diameter, quarter degree graduations, vernier reading to one minute .....Duty free 9.00
- 426B. **Protractor, German Silver**. Same as No. 426, but graduated for a full circle.....Duty free 10.75
- 426C. **Protractor, German Silver**. Same as No. 426A, but graduated for a full circle.....Duty free 16.00



No. 432.

432. **Rule, Steel.** "Decimeter Rule." This rule is accurately graduated in millimeters and being exactly one decimeter long, one centimeter wide, and one millimeter thick, has a volume of one cubic centimeter. The weight of the rule in grams is therefore numerically equal to the specific gravity of steel. Supplied with leather case, each .....Net \$ 0.30



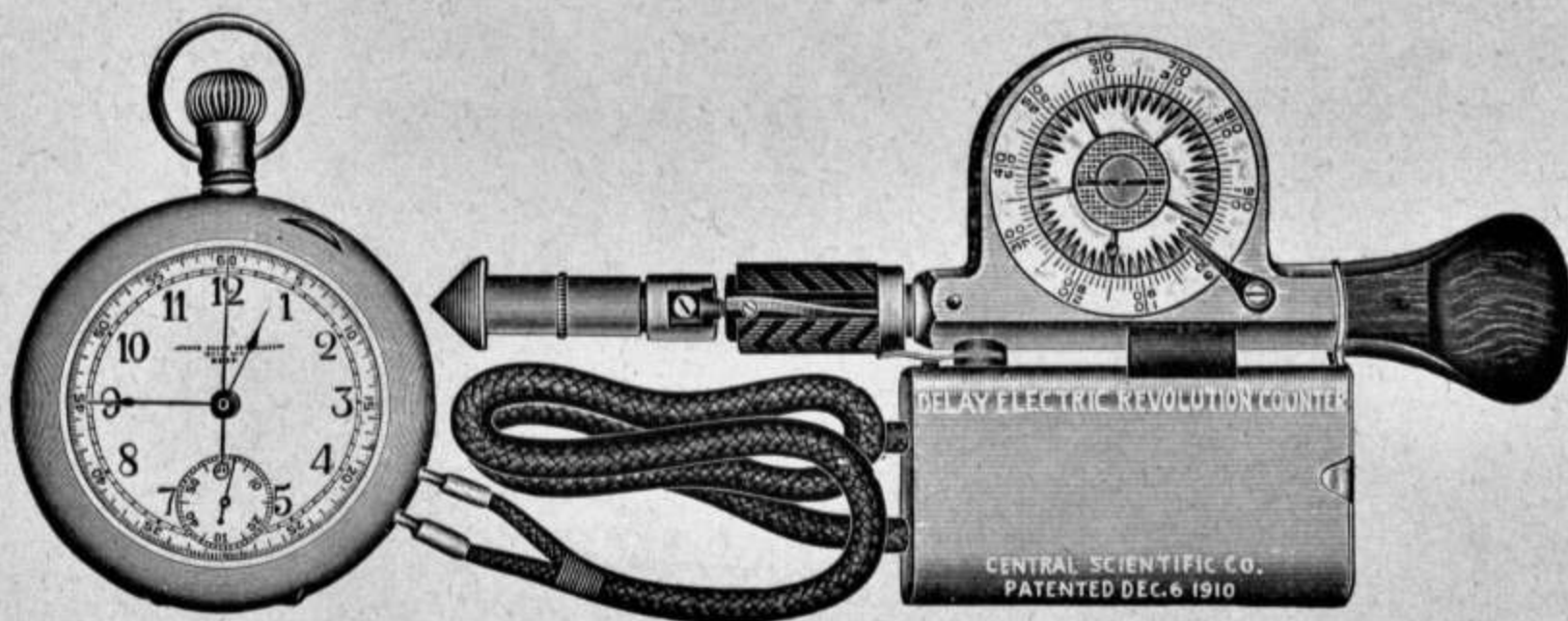
No. 744.

744. **Pulley and Clamp.** This pulley has been designed for use especially in experiments on composition of forces. As will be seen from the illustration, the pulley may be so adjusted that the string passing over it lies directly on the table top or at any distance up to  $1\frac{1}{4}$  inches above the table top. By use of the two holes in which the pulley rod can slide, the string can be placed on either side of the clamp without moving the same and can be given angles with the edge of the table from 90 degrees to nearly 0 degrees in either quadrant ..... 1.50

- 774B. **DeLay Stop-watch, Electrically Operated.** A high grade American made stop-watch, with an electro-magnet attachment by means of which the starting and stopping of the watch may be accomplished.

The watch is a seven jewel movement in a nickel case. A chronometer with stop-watch attachment is used, as this type of stop-watch is more rugged and reliable. The chronometer is a good time keeper and the electro-magnet attachment does not in any way interfere with the use of the watch as a time keeper or as an ordinary stop-watch.

This device is very useful in many laboratory experiments, such as the accurate determination of the velocity of moving bodies and the timing of various operations by automatically opening and closing the electric circuit.



No. 774C.

(Continued from page 490.)

The speed of rotating shafts can be determined by using this stop-watch in connection with a special revolution counter (see No. 774C below). Speeds of shafts up to 3000 R. P. M. can be determined without any appreciable error. Great accuracy is obtained because of the fact that both the revolution counter and stop-watch are started and stopped simultaneously and are in positive connection through an electric circuit. A small flash light battery gives sufficient power for operating this stop-watch....Net \$ 20.00

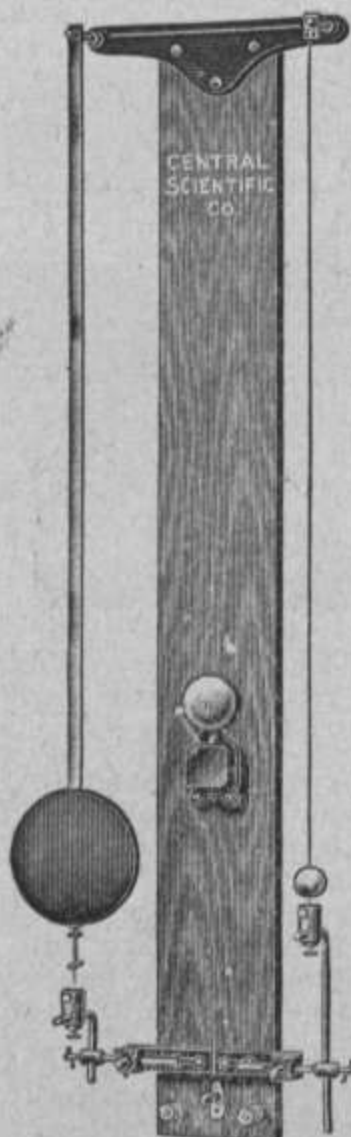
**774C. DeLay Stop-Watch and Revolution Counter.** An accurate and reliable revolution counting device. This device consists of No. 774B Electrically Operated Stop-watch and a special revolution counter, connected together in such a manner that the time taken to make any number of revolutions may be accurately determined. The starting and stopping of the watch is simultaneous with the starting and stopping of the speed counter. No error can possibly enter in. This device is easily more accurate than any other speed counter in the market.

The revolution counter is the best worm gear counter made and is equipped with a small special attachment for this work. This attachment does not interfere with the use of the counter in the ordinary manner, and it can be used for either direction of rotation. A battery of the pocket flash-light type may be used to operate the device.

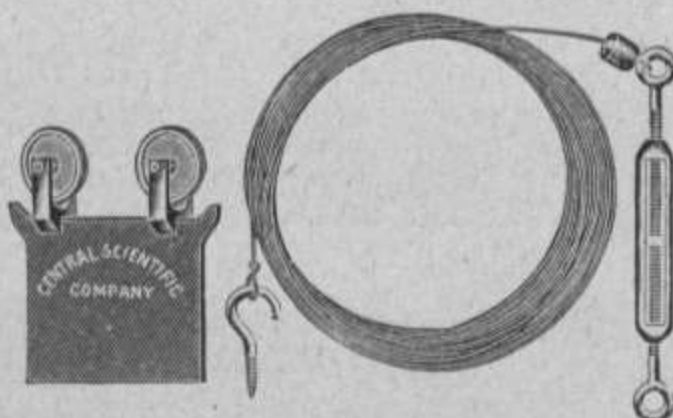
To use the device, the circuit is first closed, which places the watch under electrical control. The stem is then pressed, which releases the hand mechanically. Placing the rubber tip of the counter in the shaft center allows the free tip to revolve until it is desired to take the reading, then a slight pressure towards the shaft starts the revolution counter, and at the same time starts the stop-watch by opening the electric circuit. The stop-watch continues to run until the speed counter is removed from the shaft, when the electric circuit is again closed, stopping the second hand. Pressing the stem of the watch holds the hand mechanically so that the electric circuit may be opened. After the reading of both instruments has been taken, the indicators may be returned to zero and it is then ready for the next reading. The revolutions may be taken for any number of seconds or the time for any number of revolutions accurately determined. Where great accuracy is desired a curve may be plotted from which accurate readings may be taken for fractions of a second.

Watch and Revolution Counter complete.....Net 27.50

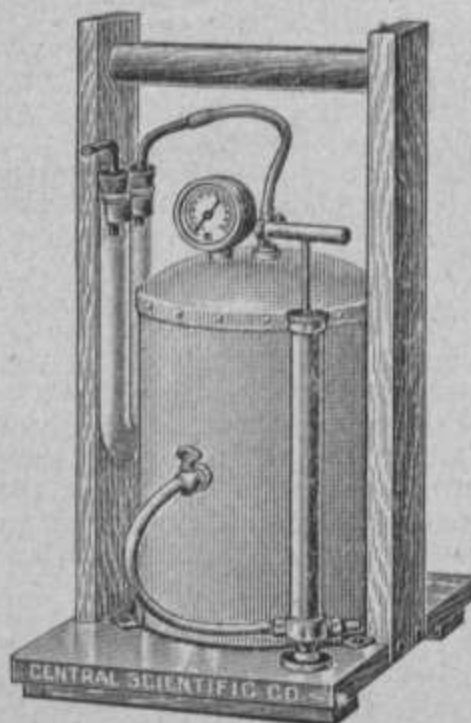
**774D. DeLay Revolution Counter only, of No. 774C, with battery and cords** ..... Nct 7.50



No. 791A.



No. 812.



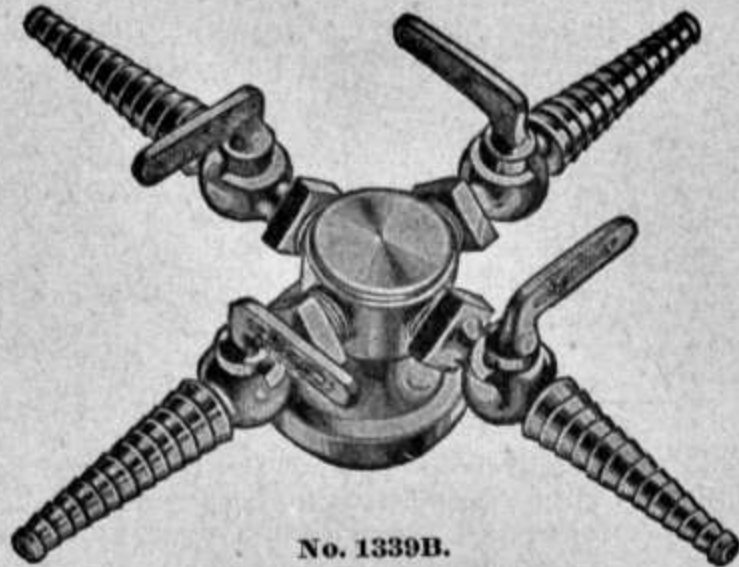
No. 1312.

- 791A. **Coincidence Pendulum**, for use in determining the value of "g" by the method of coincidences as described in Millikan's "Mechanics, Molecular Physics, and Heat," page 96. A compound pendulum and a simple pendulum are mounted on one support. Each pendulum is provided with an adjustable mercury cup and the pendulums and cups are so connected in circuit with a single stroke electric bell that the circuit is closed only when both pendulums strike the mercury cups at the same instant. By setting both pendulums in vibration and noting the interval between two coincidences which are a considerable distance apart, the period of the simple pendulum may be obtained when that of the compound pendulum is known. The length of the simple pendulum may easily be measured by use of meter stick or cathetometer and the value of "g" therefore readily determined ..... \$ 22.25
812. **Inclined Plane and Car**. In this apparatus the inclined plane consists of a wire with a hook at one end and a turn-buckle at the other end with which the wire is drawn taut. The car is of metal provided with two cone bearing pulleys. By setting the wire at different angles the car may be made to descend with varying accelerations and therefore a careful study of the laws of accelerated motion may be made. Complete as illustrated.....Net 3.40
1312. **Air Tank and Pump**. A three gallon air tank with a pressure gauge is mounted with No. 1307 Air Pump on a nicely finished hardwood base. For convenience in moving from place to place the support is provided with a handle and an air drying tube is mounted on one of the uprights as shown in the illustration. This apparatus may be used where air under pressure is needed, e. g., for driving stirrers in chemical laboratories and also in Experiment 15 of Millikan's "Mechanics, Molecular Physics, and Heat" ..... Net 15.00



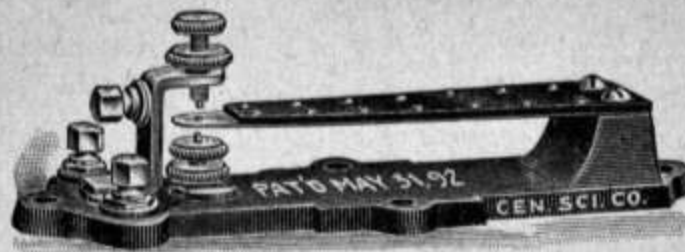
No. 1339.

1339. Gas Cock, single, of brass, nickel plated. Especially suited for laboratory use. The spout is 2½ inches long, tapering from 5/8 inch diameter at the valve to ¼ inch diameter at the end. It will take rubber tubing from ¼ inch to ½ inch inside diameter. The serrations prevent tubing from slipping off, 3/8 inch iron pipe, male thread.....Net \$



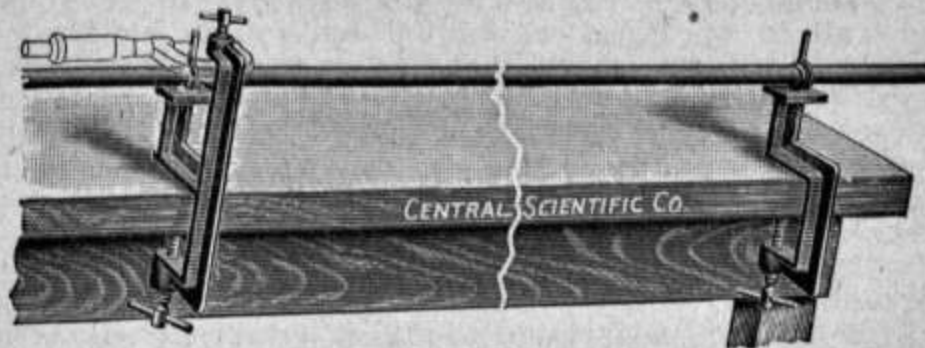
No. 1339B.

- 1339A. Gas Cock, 2-way, consisting of two No. 1339 Single Gas Cocks, with flange ..... Net 1.70
- 1339B. Gas Cock, 4-way, consisting of four No. 1339 Single Gas Cocks, with flange ..... Net 3.00



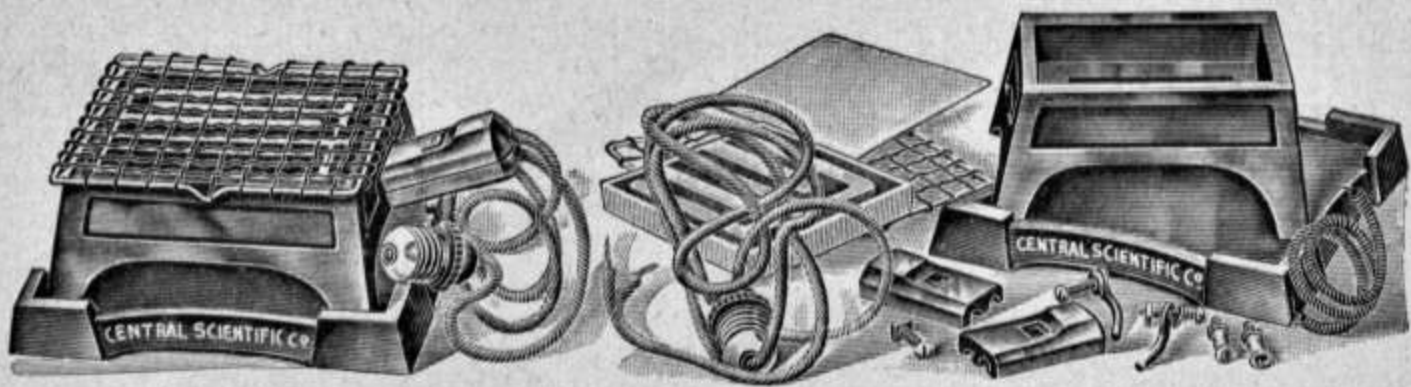
No. 1554.

1554. Thermostat, Adjustable. This thermostat can be set to make electrical contact at any desired degree of heat or cold, and will make contact on either rise or fall of temperature. Call bells or other electrical apparatus can be connected in the circuit at any desired distance from instrument. Useful as a fire alarm, and in hot-houses, incubators, and many other places where uniform temperature is required.....Net 1.25



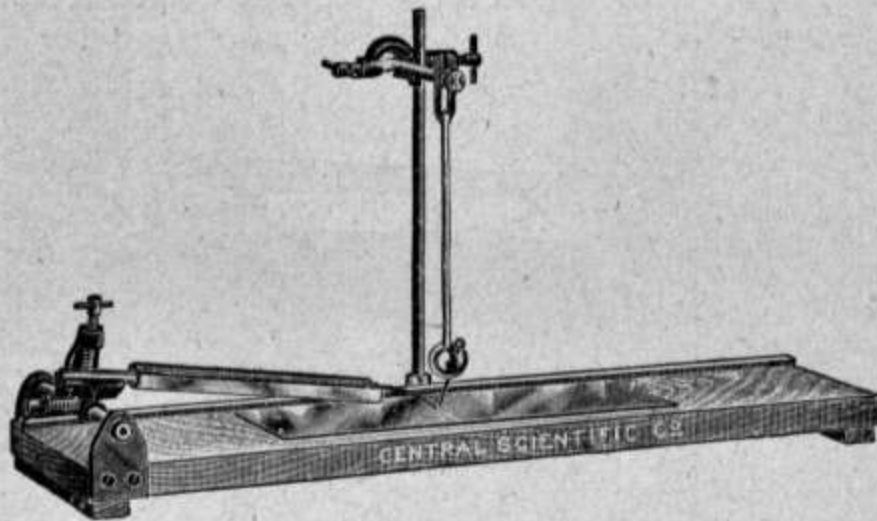
No. 1561A.

1561A. Expansion Apparatus. This new expansion apparatus consists of a brass expansion tube with two clamps for supporting it on the edge of the table. One of these clamps is fitted with a shelf and clamping screw by which any ordinary micrometer caliper may be used as a measuring device, its position being shown clearly in outline in the illustration. The tube is provided with lugs whose distance apart may be measured. The tube is held fixed in position at one of these lugs and the other makes contact with the movable head of the micrometer caliper for measurement of expansion. Complete as illustrated, without micrometer caliper.... 1.25



No. 2465.

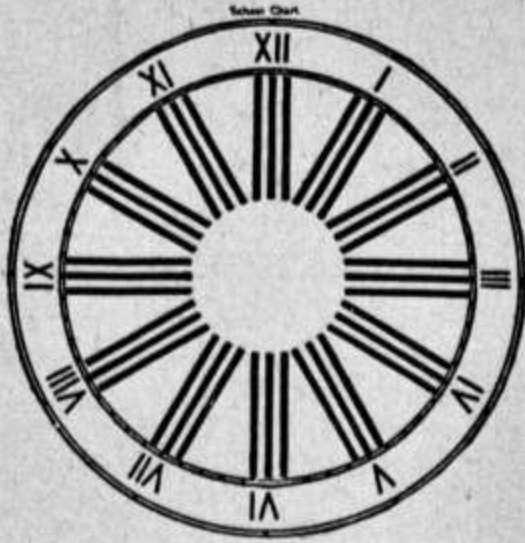
2465. **Electric Toaster and Heater Parts.** As an exercise in the construction of electric heating devices and the application of the heating effect of the electric current to practical use, we are listing all parts necessary to construct the toaster shown complete at the left of the above illustration. The parts are shown at the right and include a stand of finely glazed pottery together with a tray of the same ware, a coil of resistance wire, with a clay holder upon which it is looped, a tinned wire screen, an attachment plug with sufficient flexible wire for attaching to any ordinary socket, etc. For 110 volt current. Parts only, not assembled.....Net \$ 3.50



Nos. 3039 and 3041.

3039. **Vibrograph, New Design.** In this vibrograph we have done away with the necessity of using a smoked glass plate with its attendant dirt and annoyance. This has been made possible by the use of a **special paper** which has the property of turning dark wherever rubbed by brass, aluminum or similar metals. When a sheet of this paper is attached to a wooden slide which is substituted for the glass plate on the old form vibrograph, the two styluses leave their permanent record on the paper, so that measurements can readily be made at any time and the paper then be attached to and made a part of the pupil's permanent record of the experiment. The paper can be handled without trouble and may be written on with ordinary pen or pencil.
- The vibrograph itself consists of a wood base 6x24 inches, with support rod for carrying adjustable pendulum provided with a stylus. At one end is a clamp whose position may be varied from one side of the board to the other. The ordinary glass plate may also be used in this instrument.
- Complete with 25 sheets of paper, but without tuning fork..... \$ 3.60
- 3039A. **Coated Paper**, as used in No. 3039 Vibrograph. Size 4½x12 inches. Per package of 25 sheets.....Net .15
- 3039B. **Coated Paper**, same as No. 3039A, but in sheets 20x25 inches. Per dozen ..... Net .50
3041. **Tuning Fork.** Especially designed for the Vibrograph, of low pitch and large amplitude of vibration..... 1.35

**SNELLEN TEST TYPES**



**P N O D**  
D-60  
**L T C P E**  
D-45  
**B O L T E N**  
D-30  
**E B P O C L T N**  
D-18  
**N O C T E P D L B F**  
D-15  
**O P O E L T B N T D**

No. 3228.

3228. **Test Types, Snellen's. School Chart** on cardboard, with astigmatism diagram ..... Net \$ 0.15

3228A. **Test Chart for Vision. Allport's** improved form of the Snellen Chart for Schools. The system proposed by Dr. Allport furnishes a simple method by which the eyes of school children may be tested. Complete directions are furnished with each chart. This chart is 11x27 inches, on 6-ply bristol board with eyelet for hanging .....Net .25



No. 3424R-S.

**NEW REPLICA GRATING.**

**25,000 LINES.**

We have much satisfaction in announcing the introduction of a new grating replica by Mr. Wallace, whose replicas of Rowland gratings have met with such success and favor.

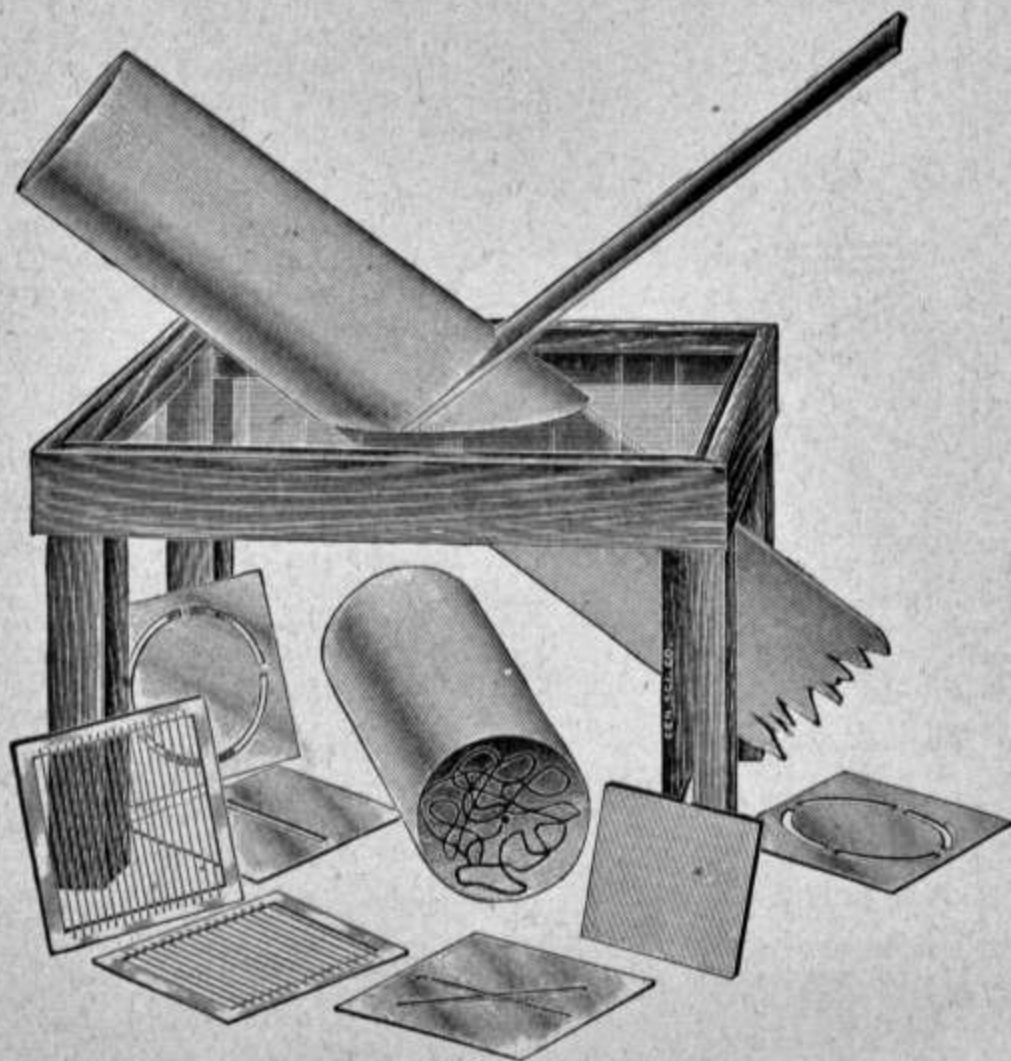
This new replica is from a Michelson grating of exceptional quality and ruled with 25,000 lines to the inch. It is unnecessary to more than briefly point out that the consequently greater angular dispersion obtained by this number of lines allows the use of the first order spectrum for the majority of work, while a crisp and clear second order is available when required.

The original ruling by Professor Albert A. Michelson of the University of Chicago is an example of that high efficiency which has resulted from the combination of a special ruling engine and an interferometer—an epoch-making advance in the production of physical apparatus of this type. The replica is made with the same care that is characteristic of Mr. Wallace's copies of Rowland's gratings. Gratings of grades A and B are enclosed in leather covered velvet lined cases.

**Net Price List.**

No.	Sized of Ruled Surface.	GRADE			
		A	B	C	D
3424R.	25x30 mm.	\$ 6.00	\$5.00	\$4.00	\$2.50
3424S.	50x30 mm.	10.00	8.00	6.00	4.00





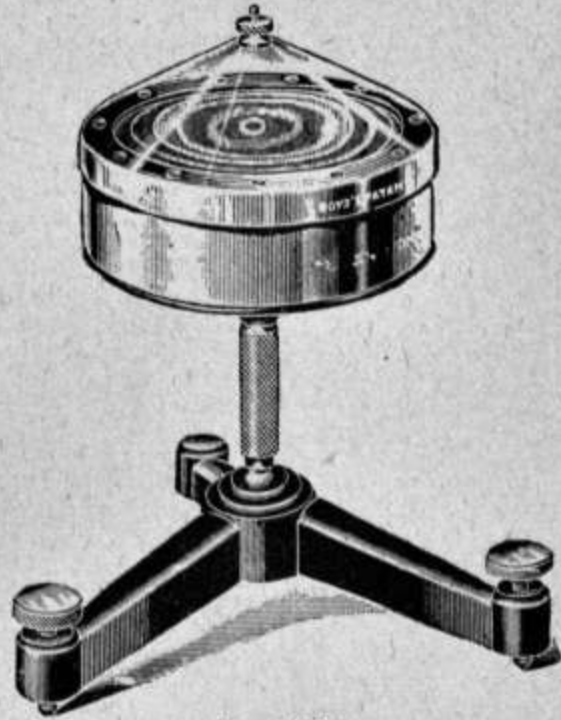
No. 3452.

3452. **Polarized Light Demonstration Apparatus.** This apparatus was designed by Professor Dinsmore Alter of the University of Alabama, to make this difficult subject easy for beginning students in the subject. All teachers find that the students learn a number of facts about polarized light and yet in most cases do not have the least conception of the real difference between polarized and ordinary light; do not visualize the action of the polarizer and the analyser; and have no idea of the reason why darkness and color can be produced by means of clear crystal which looks to the unaided eye like a piece of glass. This apparatus is designed to make the actions and the elementary theory of these actions understandable to even the youngest student of the subject. The designer has used it in a freshman class of more than a hundred students and found that it made them understand the subject much better than any other means that he has used. It consists of model of polarizer and analyser; model cylindrical wave and polarized wave to be attached beyond the polarizer; cross sections of waves of plane polarized, elliptically and circularly polarized light; plane polarized after passing through sugar solution, to show cause of color; and a table to show polarization by reflection and refraction. The designer has found no student who after examining the apparatus did not understand the subject and he has found it possible to make boys under high school age understand it after explanation. Complete as illustrated.....Net \$ 7.50



No. 3486.

3486. **Color Top, Electric**, operates with one dry cell and will spin for hours at a high speed. By using the color changing discs, beautiful illusions may be produced, which are instructive as well as amusing. It is also a perfect running electric motor, and can be used as such to run small mechanical toys with a belt from the grooved pulley on shaft. Complete with four color discs.  
.....Net \$ 1.00



No. 3491.

3491. **Rainbow Cup**. A new instrument for the study of liquid films. This instrument makes it possible to produce and observe phenomena more brilliant than has been possible before with the soap bubble. To use the instrument, some of the soap solution is poured into the cup and with a wiper is spread over the rim. This film is protected by a transparent cover of thin celluloid, the air pressure on each side of the film being equalized by a series of holes through the rim. The cup is then rotated by means of the hand to produce the colored ring patterns.

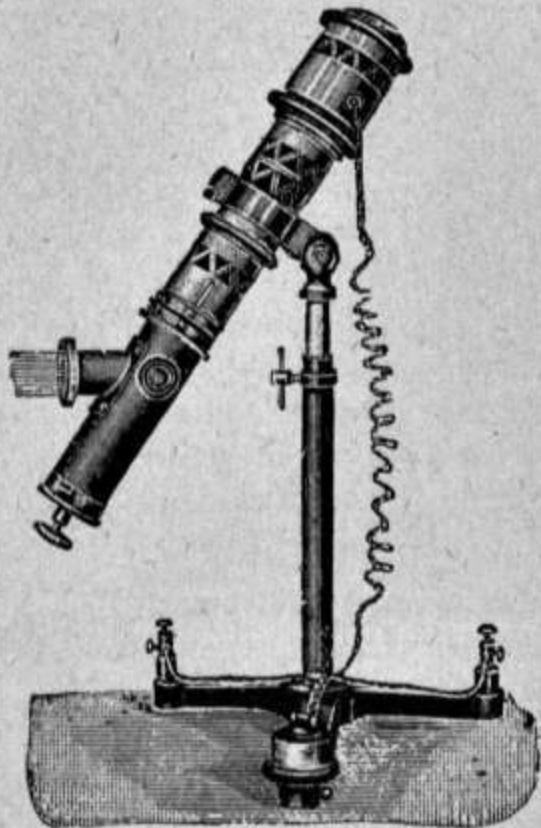
Various effects may be shown by varying the speed of rotation, by the reflection of different colored lights, by tilting the cup and in numerous other ways.

Price, including full directions.....Duty free 7.50

3492. **"Soap Bubbles, Their Colors and the Forces Which Mould Them,"** by C. V. Boys. An extended treatise on this interesting subject..Net 1.00

3496. **Holmgren Test Wools**. A set of 40 skeins of worsteds of different colors with metal tags attached. These tags are numbered in such a way that skeins from 1 to 20 are for Holmgren's first test and are of various shades of green alternating with confusion colors. The second series from 21 to 30 is composed of lighter and darker shades of rose alternating with blues, etc. The third series from 31 to 40 is made up of reds alternating with browns, sages and dark olives.

Complete set, with directions, in box. 3.00



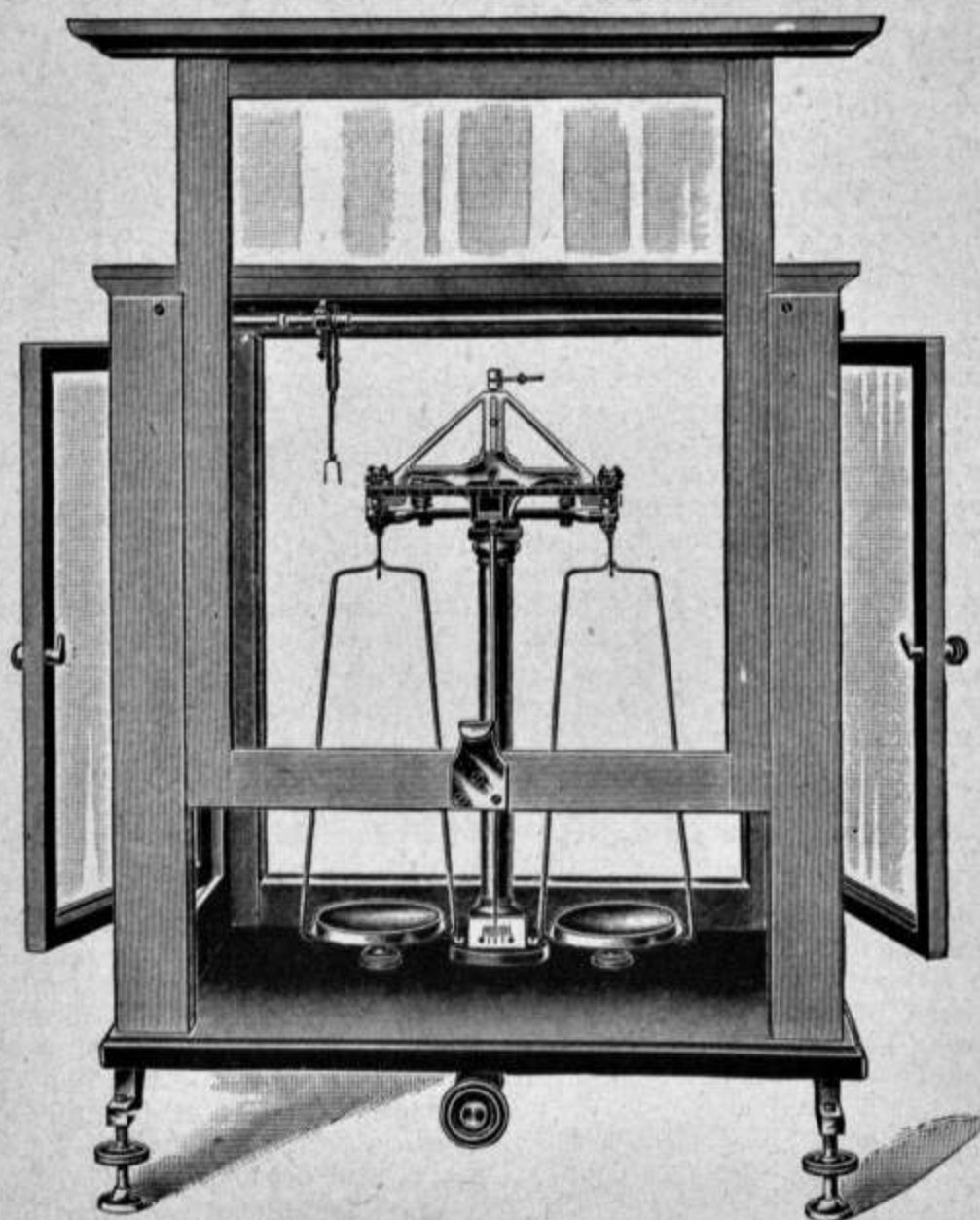
No. 3548.

3548. **Lilliputian Projection Lamp**. An electrical arc lamp especially mounted to give a strong beam of parallel rays for laboratory work. This lamp may be attached to the ordinary lighting fixtures, as it consumes only 1.5 amperes.

It will be noted that the instrument is self contained, with the rheostat (not shown in the cut) mounted upon the support. The angle of the inclination of the lamp may be varied by means of a slow motion screw. The carbons may be renewed very easily.

Complete with 10 carbons and rheostat for 110 volts Direct Current only.....Duty free 34.35

3548A. **Lilliputian Projection Lamp**, same as No. 3548 but for 220 volts Direct Current only....Duty free 39.00

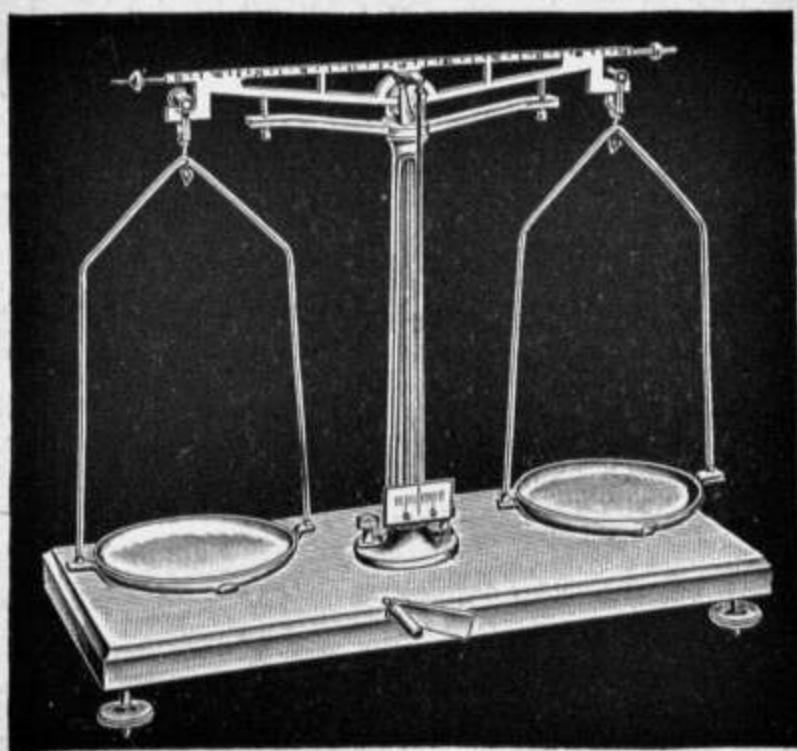


No. 3802C.

**3802B. Balance, Analytical, American University Model.** This Balance has several new patented features not found on other Balances, enabling the operator to work quickly without imparting any shock or jolt to the knife edges. The rider attachment not only lifts the rider vertically off the beam, but locks it on the lift so that it cannot possibly fall off.

Short triangular beam of rolled, cold-pressed aluminum, round brass pillar, knife edges and planes of agate and compensating hangers. Mounted on black glass plate, with polished mahogany case and counterpoised front door, but without side doors. Capacity 200 grams sensitive to 1/10 milligram.....Duty free \$ 33.50

**3802C. Balance, same as above but with side doors.....Duty free 35.00**

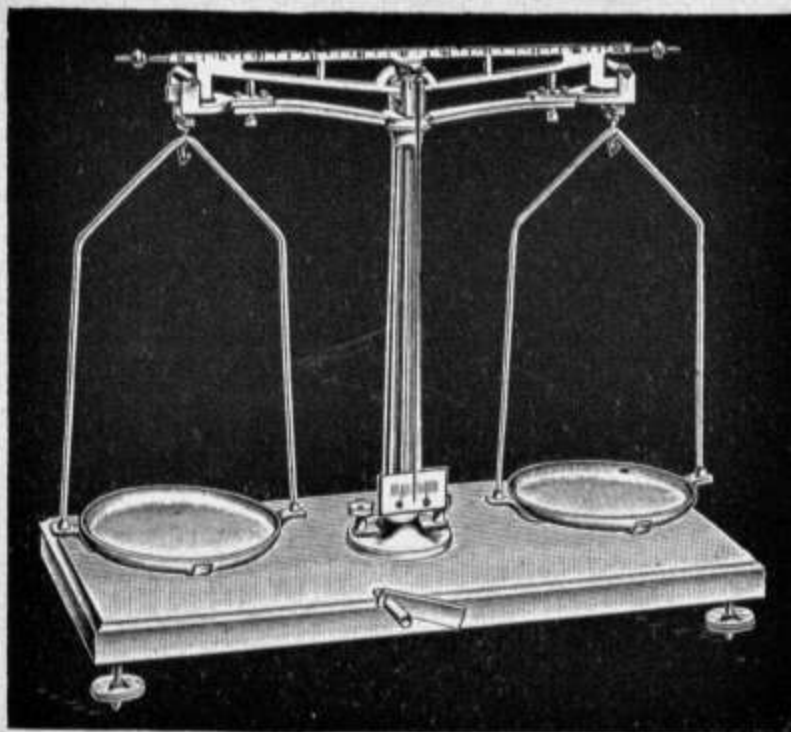


No. 3808.

3808. "Cenco" Precision Balance, made entirely of Magnalium, to resist all laboratory fumes. Light and durable, with adjustable beam support, plummet, leveling screws and agate knife edges and planes. Mounted on Magnalium board.

Capacity, grams .....	100	250
Sensitive to, milligrams .....	3	5
Furnished from stock.....	\$15.00	\$17.50

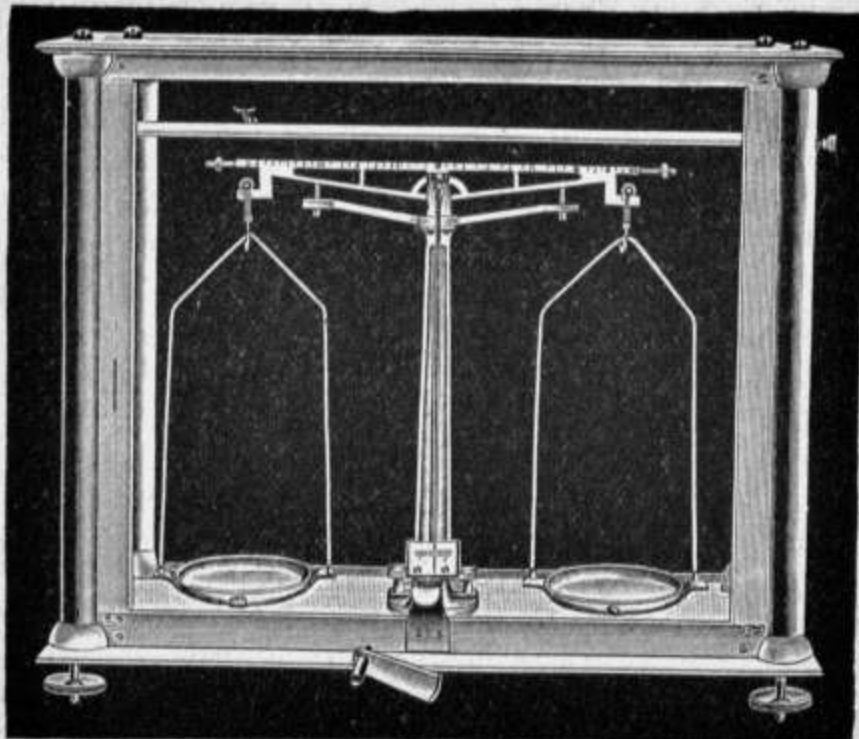
3808A. "Cenco" Precision Balance, same as No. 3808. Duty free 10.00 11.00



No. 3808B.

3808B. "Cenco" Precision Balance, same as No. 3808, but with arrest for hangers.

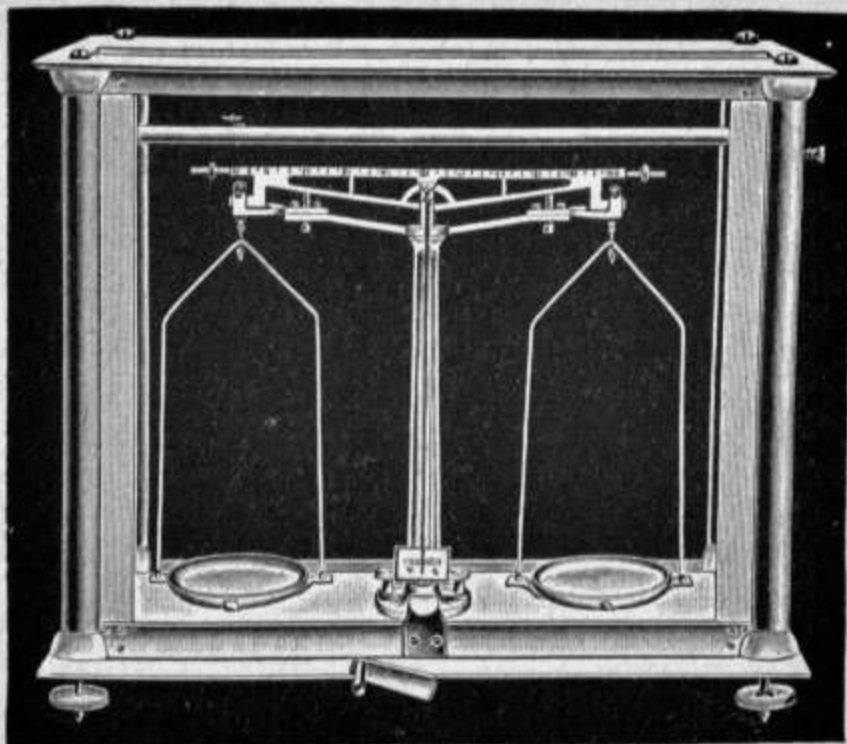
Capacity, grams .....	100	250
Sensitive to, milligrams .....	1	2
Duty free .....	11.00	12.50



No. 3809.

3809. "Cenco" Precision Balance, made entirely of Magnalium, same as No. 3808, but in Magnalium and glass case with rider attachment.

Capacity . . . . .	100	250
Sensitive to, milligrams . . . . .	3	5
Duty free . . . . .	27.00	30.00



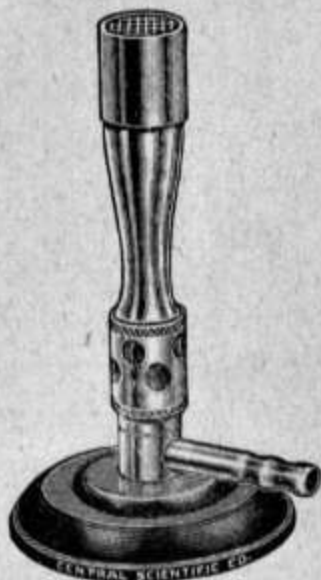
No. 3809A.

3809A. "Cenco" Precision Balance, same as No. 3808B, but in Magnalium and glass case with rider attachment.

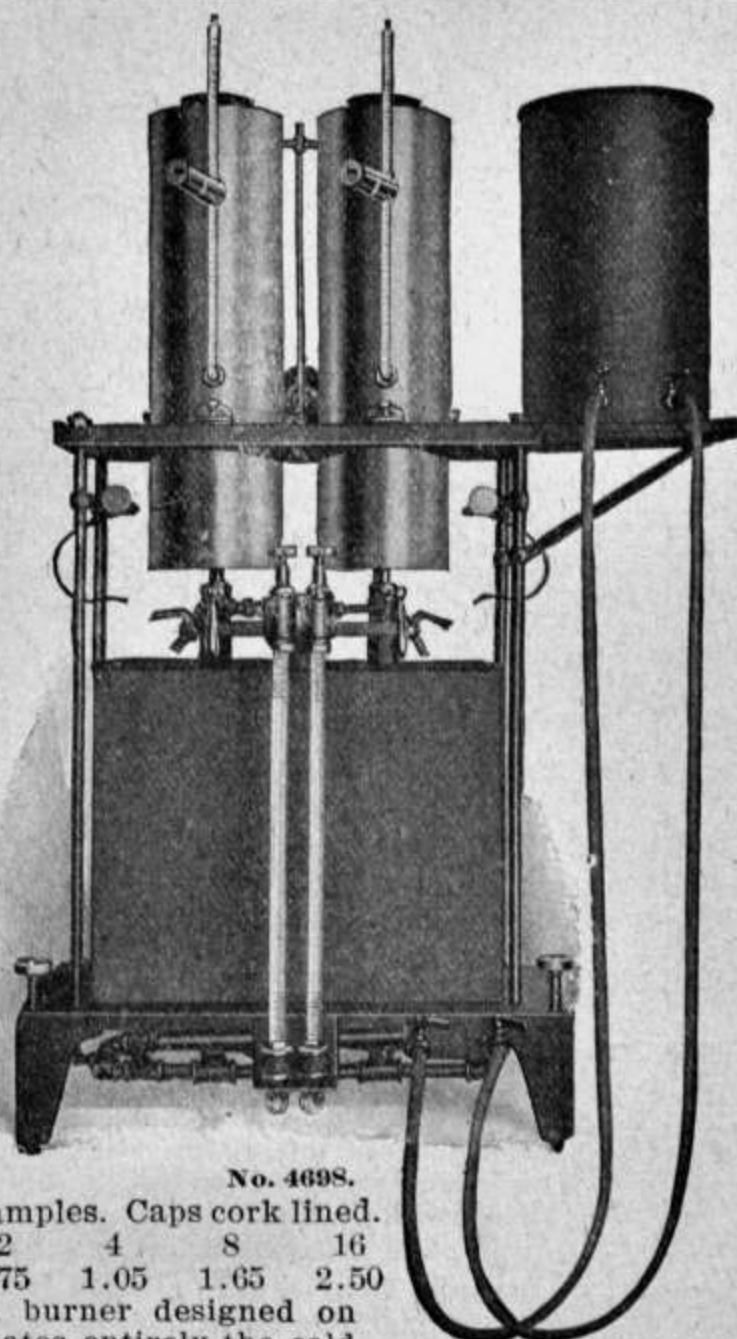
Capacity, grams . . . . .	100	200
Sensitive to, milligrams . . . . .	1	2
Duty free . . . . .	29.00	31.00



No. 4550A.



No. 4652.



No. 4698.

4550A. Bottles, metal screw capped, for samples. Caps cork lined.

Capacity, ounces	1	2	4	8	16
Per dozen	.67	.75	1.05	1.65	2.50

4652. **Meker Burners.** A very powerful burner designed on scientific principles which eliminates entirely the cold Bunsen cone, and gives a flame that is practically a homogeneous mass of burning gas with a temperature that is nearly uniform throughout. No. 0 is the students' form; Nos. 1 and 2 to be used instead of Bunsen burner; No. 3 the general laboratory type; Nos. 4 and 5 to replace the blast lamp.

Number	0	1	2	3	4	5
Height of Burner, mm.	115	115	130	155	190	250
Diameter of Flame, mm.	16	16	20	25	30	43
4652A. For Artificial Gas.....Net	\$1.30	1.40	1.60	2.00	2.50	4.00
4652B. For Natural Gas.....Net	....	1.40	1.60	2.00	2.50	4.00
4652C. For Gasoline Gas.....Net	....	1.40	1.60	2.00	2.50	4.00

4698. **Parr Gas Calorimeter.** This calorimeter measures the calorific value of any gas by burning under identical conditions the unknown gas along with a standard gas of known compositions, so that equal volumes of both under equal pressures and equal temperatures impart their heat to equal volumes of water. The heat values, therefore, are in direct proportion to the readings of the two thermometers. Thus all metering of the gas is avoided, it only being necessary to maintain exact equivalents or multiples by means of the calibrated gas holders. An automatic generator for pure hydrogen, electric motor for driving the stirring mechanism, thermometers, reading lens, and box of hydrone are included in each outfit . . . . .Net

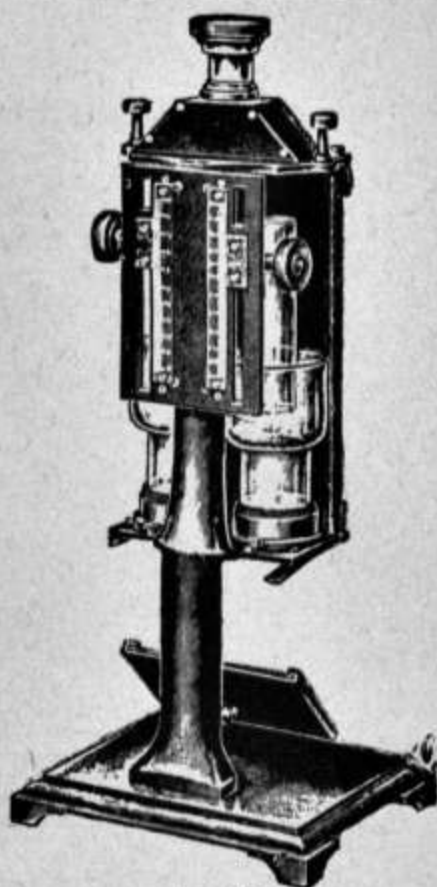
\$300.00

4698K. **Total Carbon Apparatus, Parr's.** To determine the amount of total carbon in coal, coke, etc., in connection with the Parr Coal Calorimeter. By adding acid to the residue from the calorimeter (which appears in the form of sodium carbonate) carbon dioxide is liberated and then measured under proper conditions. Complete with full directions . . . . .Net

45.00



No. 4710A.



No. 4754.

- 4710A. Chlorine Tube, 2x100 cm., for showing decomposition of water by chlorine (Newell's "Descriptive Chemistry," page 51.)..... \$ .80
4754. Colorimeter, Duboscq's. For comparison of colors in liquids. The observations are made by means of a monocular telescope which gives a circular divided field, thus eliminating the errors due to the difference of vision between the two eyes of the operator. The adjustment of colors is obtained by means of a rack and pinion which immerses the glass cylinders more or less in the liquids, the movement being registered upon a scale....Duty free 50.00
4759. Combustion Boats, fused silica (glazed) without handle. Dimensions given are inside measurements.

No. ....	0.1	0.2	0.3
Length, mm. ....	44	76	76
Width, mm. ....	12	12	16
Depth, mm. ....	8	8	10
Each, net .....	\$ .50	.75	.90



No. 4810B.

- 4810A. Crucible, Kawin's, 28 mm. diameter by 15 mm. high, of heavy pure nickel to be used in a muffle furnace for burning filter paper for silicon determinations in iron. Each.....Net .25
- 4810B. Crucible, Pennock and Martin's (Journal of American Chemical Society, December, 1903, page 1265) for the rapid and accurate determination of sulphur in coal and coke; consists of a pure nickel crucible of 40 c.c. capacity, with perforated lid for insertion of igniting wire, mounted upon an aluminum base..... 2.50

### NEW ALUNDUM REFRACTORIES.

Alundum Refractories are made in an electric furnace by fusing Bauxite, the product having the following valuable properties:

A very high melting point, 2000° Centigrade, the Crucibles having been used repeatedly without injury for melting pure platinum.

The Thermal conductivity of the bonded pieces is 2.1 times that of ordinary fire brick and 1.6 times porcelain.

The Specific heat is high, being between .195 and .198 at 20° and 100° Centigrade.

The Electrical Resistance is greater than that of porcelain, making the ware valuable for insulation work.

The Thermal Coefficient is very low (.0000071 per degree Centigrade.)

The Mechanical Strength can be varied to meet conditions; the maximum crushing strength being 7½ tons per square inch.

The Porosity can also be varied between wide limits.

The Specific Gravity is 3.91.

Each of the classes of vessels mentioned below is made embodying those combinations of the above properties which are especially needed in the work to which the pieces are suited.



No. 4757.



No. 4805.

**4757. Alundum Combustion Boats.** These Boats are adapted for general combustion and especially for the determination of carbon in iron and steel, as Alundum does not react with the iron oxides. The large area over which the sample may be spread is of advantage.

Capacity.	Width.	Height.	Each, net
87 mm.	13 mm.	8 mm.	\$0.30
93 mm.	15 mm.	10 mm.	.35

**4805. Alundum Crucibles** for general laboratory use. These crucibles will stand any temperature available in the laboratory, and this, with their high thermal conductivity, makes them valuable for coal analysis, drying materials, igniting filters, etc. They can be substituted advantageously for porcelain.

Capacity.	Diameter.	Height.	Each, net
20 c. c.	37 mm.	30 mm.	\$0.30
40 c. c.	46 mm.	40 mm.	.35

**4805A. Alundum Covers** for No. 4805 Crucibles.

To fit 20 c. c. Crucible.....	Net \$	0.30
To fit 40 c. c. Crucible.....	Net	.35





No.  
4879A.

4879A. **Alundum Extraction Thimbles** for extraction of soaps, fats, foods, rubber, etc., by both organic and inorganic solvents. They are very rapid, practically indestructible and readily cleaned by ignition.

Diameter.	Length.	Each, net
25 mm.	70 mm.	\$0.40
30 mm.	80 mm.	.45

#### ALUNDUM FILTERS.

Alundum vessels have the additional advantage of being sufficiently porous for filters and are especially adapted to routine laboratory work where suction is available because of the rapidity with which filtration can be made. They will hold the finest precipitates and are peculiarly adapted for organic work, as they can readily be cleaned over a burner. They are not affected by chemicals used in ordinary analysis.

4880E. **Alundum Conical Filters**, for rapid and complete filtration by suction. They may be used in any 60° funnel, to which they are attached by a wide band of rubber tubing. Their advantage lies in the fact that they have a large filtering area and can be thoroughly and completely washed from all soluble salts, as the entire filtering area is within the funnel. The rapidity and ease with which this type of filter can be manipulated places them in advance of other forms of laboratory filters. Price includes wire stand for support when not in use.

Diameter, inches .....	1 $\frac{3}{4}$	2 $\frac{1}{2}$
Height, inches .....	1 $\frac{1}{4}$	1 $\frac{7}{8}$
Each .....	Net .30	.35

4880F. **Alundum Filtering Crucibles**, for rapid filtration save 75% of the time usually required. Not affected by solutions of acids or alkalis and can readily be dried to constant weight. They can be used in the same manner as the Gooch Crucibles.

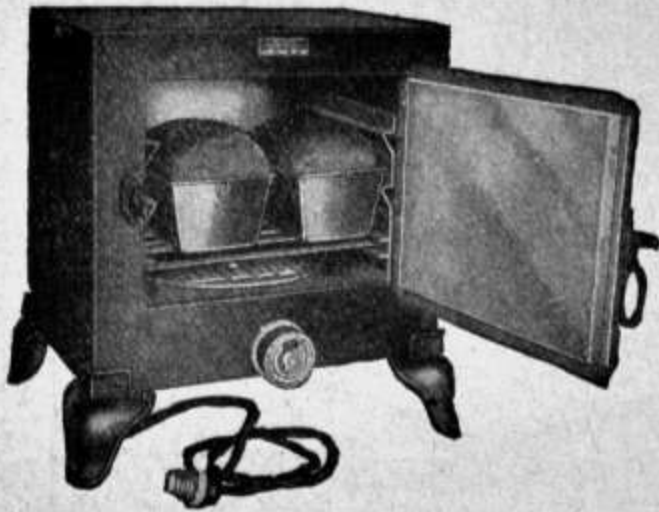
Capacity.	Diameter.	Height.	Each, net
25 c. c.	35 mm.	38 mm.	\$0.30
35 c. c.	40 mm.	43 mm.	.35

4880G. **Alundum Filtering Dish** to fit the top of any funnel for rapidly filtering large amounts of material. It is especially adapted for organic work and filters thoroughly, quickly and without previous preparation. Capacity, 400 c.c.; diameter, 140 mm.; depth, 50 mm....Net \$ 1.50

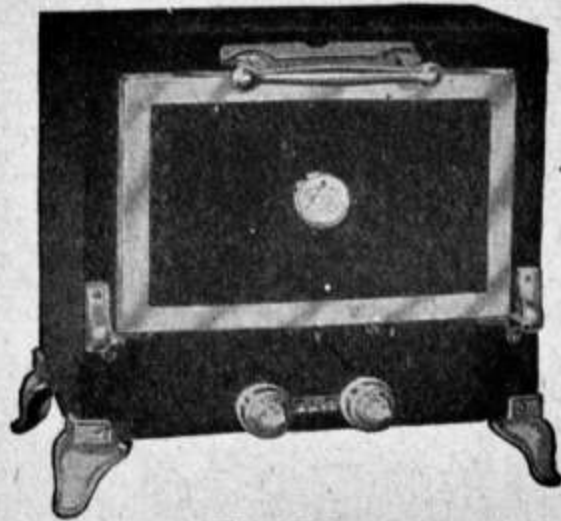
#### NICHROME WIRE GAUZE.

4976. **Nichrome Wire Gauze**, 16 mesh, will last almost indefinitely as the wire is practically rust-proof and has an extremely high melting point, about 1500°C (2800°F).

Size, inches .....	4x4	5x5	6x6	12x12
Each .....	.40	.60	.80	3.00

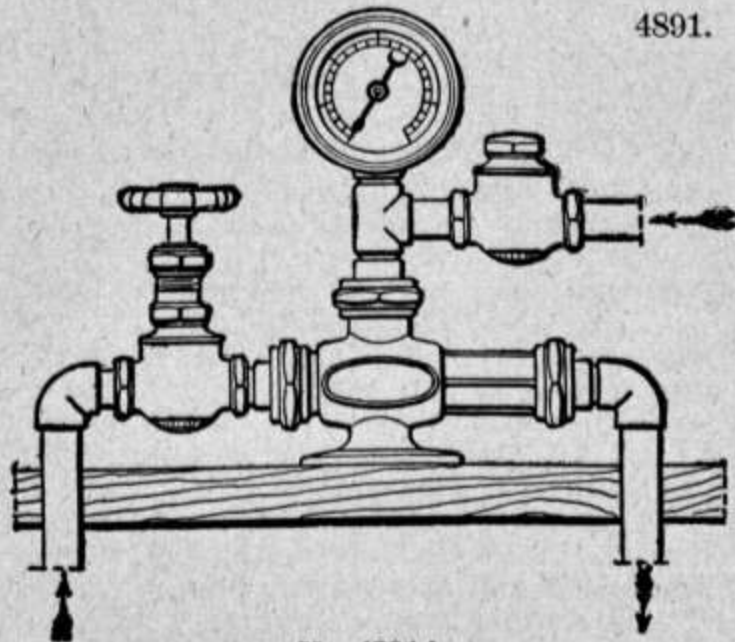


No. 4862.



No. 4863.

4862. **Electric Oven.** The walls and doors have an insulation two inches thick, and the construction of the door makes it practically heat tight. It is provided with a three point switch with a current consumption of 220, 440 and 880 watts, giving a maximum temperature of 450 degrees Fahrenheit which, when once reached, may be maintained indefinitely with the switch at low heat. Inside dimensions 10 $\frac{1}{4}$ x11x9 inches. Complete with temperature indicator, attachment plug and cord.....Net \$ 16.50
4863. **Electric Oven.** Of same general description as No. 4862, but of better construction, with nicked legs and trim, with two heating units one each at top and bottom, controlled by separate switches giving nine degrees of heat. The oven is insulated so well that it has been found on a Pyrometer test that a baking temperature was maintained for an hour after the heat had been turned off. Maximum current consumption 1750 watts. Inside measurements 18x12x12 inches. Complete with temperature indicator, attachment plug and cord.....Net 27.00
- 4863A. **Electric Oven,** same as No. 4863 but with inside measurements of 18x18x12 inches. Maximum current consumption 2100 watts....Net 35.00



No. 4891A.

4891. **Universal Water-Jet Vacuum Pump.** A very efficient pump for use in filtration, percolation, evaporation, distillation, and condensation. Has no moving parts and consequently no wear and tear; may be permanently attached to the water system; or may be used with rubber tube connections; requires no greater than ten pounds water pressure. With twenty pounds water pressure the capacity of the pump is one-third cubic foot per minute displacement of air at atmospheric pressure. In exhausting a one gallon vessel using twenty pounds water pressure, a pressure of

- one-half inch of mercury is reached in five minutes. Complete with vacuum gauge, connecting tee and two cocks.....Net 12.00
- 4891A. **Universal Steam-Jet Vacuum Pump.** Similar to No. 4891 but for use with steam pressure instead of water pressure. In exhausting a one gallon vessel with a steam pressure of fifty pounds, a pressure of six inches of mercury is reached in seven minutes. Requires for operation a volume of steam equal to the evaporation of twelve pounds of water per hour. Complete with vacuum gauge, connecting tee, stop and check valves.....Net 12.00



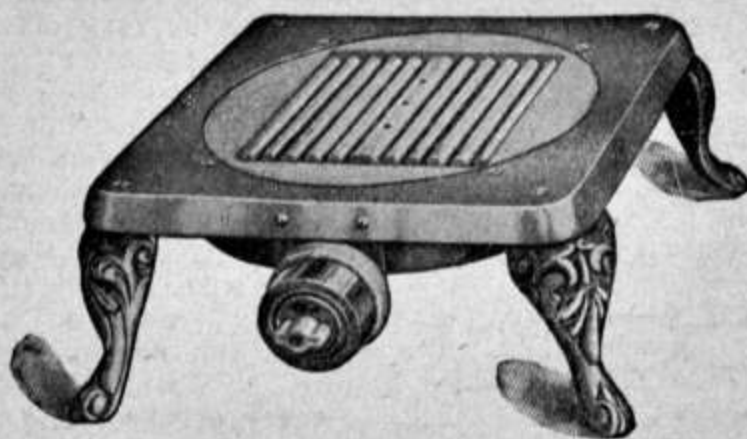
No. 5009A.



No. 4960.

4960. **Gas Lighter.** Produces by friction a flash of hot sparks which will light any kind of gas or inflammable vapor.....Net \$ .25
4961. **Extra Tips** for above, each.....Net .15
- 5009A. **Graduates, Enameled.** These graduates are of seamless enameled ware and are plainly graduated on the inside in grams, ounces, and pints.

Capacity, grams .....	100	500	1000
Smallest division grams .....	10	50	100
Capacity, ounces .....	3	16	32
Smallest division ounces .....	1	2	2
Capacity, pints .....	...	1	2
Each .....	Net \$0.55	1.00	1.35



No. 5017C.

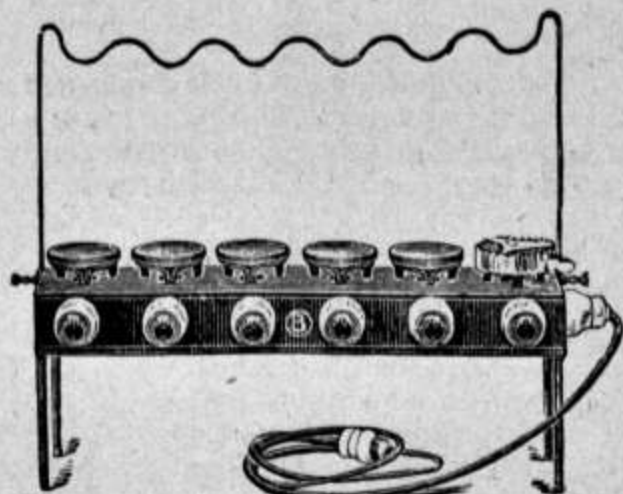
- 5017C. **Electric Hot Plate,** finished in nickel with cord and attachment plug. Heating surface 10½x10½ inches; plate 5½ inches high. A greater amount of heat may be obtained from this plate than from other forms, as the heating unit is in the open and direct radiation is obtained. Provided with switch giving three heats, consuming 220-440-880 watts ..... Net 8.50
- 5017D. **Electric Hot Plate,** same as No. 5017C, but with two burners giving a heating surface 10x21 inches. Each burner is provided with a separate switch ..... Net 17.00
- 5017E. **Electric Hot Plate,** same as No. 5017D, but with three burners, with heating surface 14x32½ inches..... Net 25.00

**POTASS. CHROMIUM SULPHATE**  
 CHROME ALUM.  
 $K_2Cr_2(SO_4)_4 + 24H_2O.$

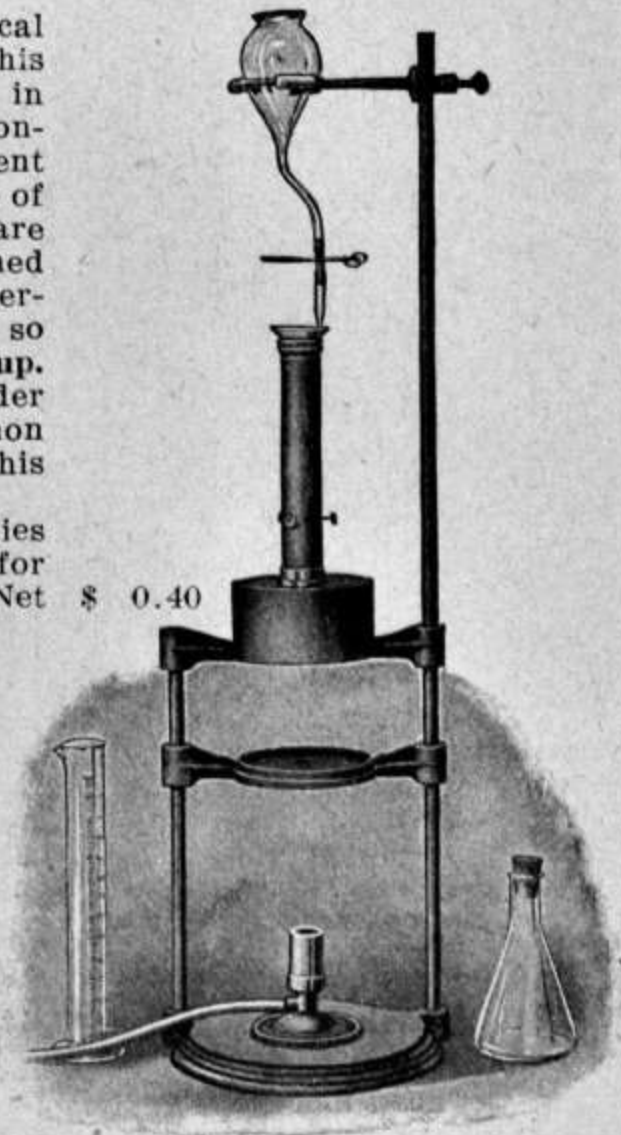
No. 5039.

5039. **New Chemical Label Book.** The most practical and usable book of labels ever issued. This book has been compiled by an instructor in chemistry of many years experience and contains labels for about four hundred different chemicals, with ample duplicates for some of the most common ones. Following these are a number of descriptive words to be attached to the regular labels. The sheets are perforated, gummed, and bound back to back so that it is impossible for the book to curl up. Legible labels, using chemical names; under each name, whenever possible, the common name of the chemical is placed; under this is the chemical symbol.

It is advisable to order not less than two copies for a set of chemicals in order to provide for duplicates and spoiled labels. Price, each..Net \$ 0.40



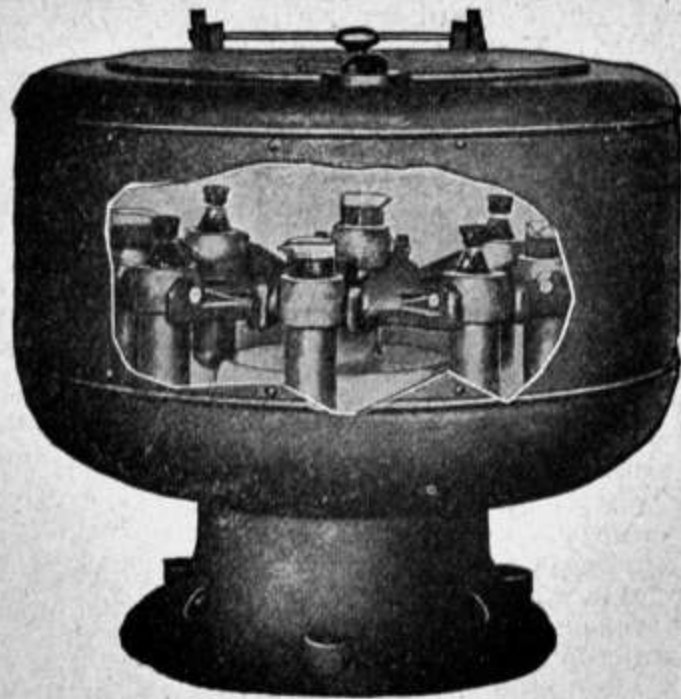
No. 5087.



No. 5315.

- |   |              |
|---|--------------|
| 5087. <b>Digesting Shelves</b> (Kjeldahl's.) Electrically heated, made of sheet iron with a support for the flasks. Each heater being a unit, any one, or all, may be used at one time as desired. 24 inches long, 5½ inches wide and 9 inches high, with six heaters.....  | Net \$ 45.00 |
| 5087A. <b>Digesting Shelves</b> (Kjeldahl's), same as No. 5087 but 40 inches long and with 10 heaters.....  | Net 65.00    |
| 5103. <b>Pencil</b> , blue, for writing on glass, porcelain, etc.....   | .17          |
| 5103A. <b>Pencil</b> , yellow, for writing on glass, porcelain, etc. . . . .  | .17          |
| 5103B. <b>Pencil</b> , red, for writing on glass, porcelain, etc.....   | .17          |
| 5260. <b>Chemists' Slide Rule</b> , 10 inches in length. This is an adaptation of the principle of the slide rule to chemical calculations. The upper scales are replaced by a series of points showing the atomic and molecular weights of the most important elements and chemical combinations. The elements and combinations to be found are marked on the body of the rule, while the determining formulas of the elements and radicals are on the face and back of the slide. On the body of the rule the marks are in two lines in different colors, and with divisions of different lengths. It is possible to perform all chemical calculations with this rule. In case with complete directions . . . . . | 7.25         |
| 5315. <b>Parr Sulphur Photometer</b> for readily indicating the percentage of sulphur in coal, coke and petroleum. The fused mass obtained from the determination by means of the Parr Coal Calorimeter is dissolved in water and the sulphur precipitated by means of barium chloride. From the depth of the liquid in the graduated tube at which the light from the flame disappears a reading is obtained directly which indicates the percentage of sulphur in the sample . . . . .  | Net 35.00    |

## CENTRIFUGES--INTERNATIONAL.



Size 1.

These are High Power Electric Centrifuges mounted in a heavy bell shaped casting which furnishes at the same time a rigid base, a protective housing and a strong bearing for the motor. Ample provision is made for oiling. The lower end of the shaft of the motor runs on a ball step immersed in oil. A speed control rheostat is supplied with each centrifuge.

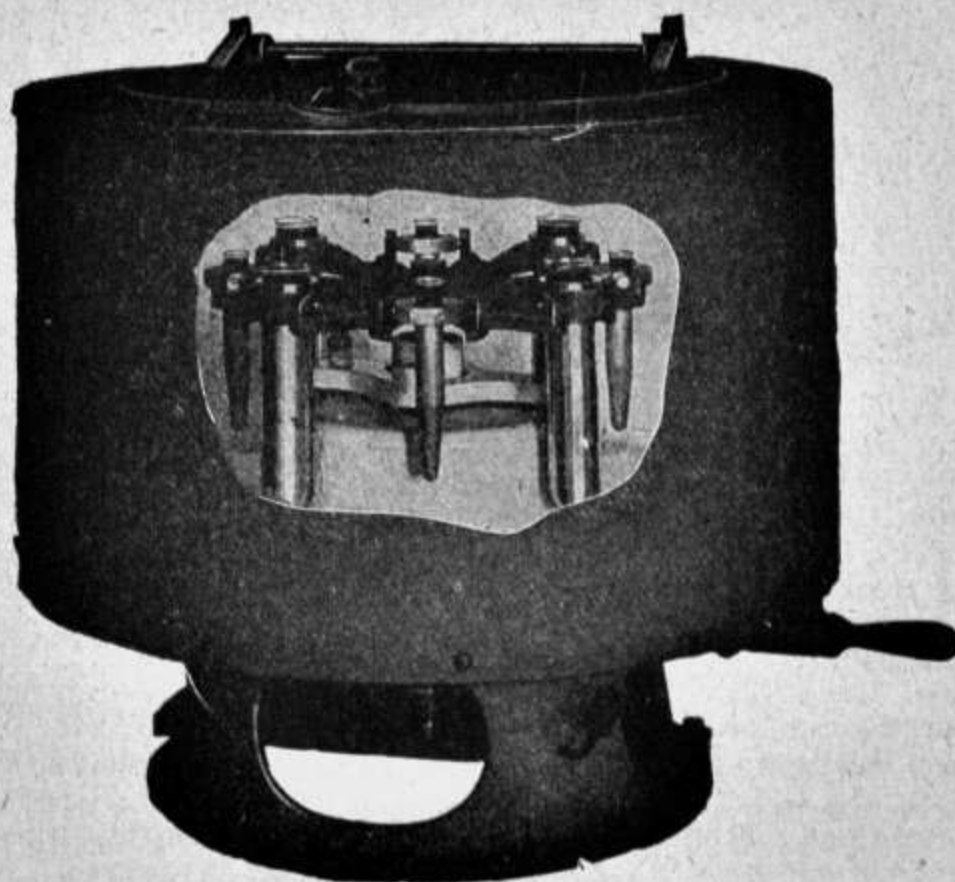
The prices of the Centrifuges listed below do not include heads or equipment. Select the ones adapted to your needs from the list below.

8501.	<b>Centrifuge</b> (Size 1, Type B), for 110 volt direct current. Height when closed 18 inches, when open 27 inches; diameter 17 inches; shipping weight about 150 pounds; maximum speed equipped with Board of Health head, about 3,000 R. P. M.; with four-tube, 15 c.c. head and tubes, about 4,000 R. P. M.; with eight-tube 50 c.c. head and tubes, about 3,000 R. P. M. With speed control, but without heads .....	Net \$ 65.00
8502.	<b>Centrifuge.</b> Same as No. 8501, but for 220 volt direct current.....	Net 68.00
8503.	<b>Centrifuge.</b> Similar to No. 8501, but for 110 volt alternating current. Height about 7 inches greater than No. 8501; speed with the four-tube 15 c.c. head and tubes, about 3,600 R. P. M.....	Net 78.00
8504.	<b>Centrifuge.</b> Same as No. 8503, but for 220 volt alternating current.....	Net 80.00

## EQUIPMENT FOR CENTRIFUGES Nos. 8501-8504.

8506.	<b>Two-Tube, 15 C.C. Head, and metal tubes.....</b>	Net 3.40
8507.	<b>Four-Tube, 15 C.C. Head and metal tubes.....</b>	Net 7.80
8508.	<b>Eight-Tube, 15 C.C. Head, and metal tubes.....</b>	Net 13.60
8509.	<b>Four-Tube, Combination Head, with two each metal tubes, 15 c.c., and 50 c.c.....</b>	Net 8.70
8510.	<b>Four-Tube, 50 C.C. Head, and metal tubes.....</b>	Net 9.60
8511.	<b>Eight-Tube Combination Head, with four each metal tubes, 15 c.c., and 50 c.c.....</b>	Net 16.40
8512.	<b>Eight-Tube, 50 C.C. Head, and metal tubes.....</b>	Net 17.20
8513.	<b>Board of Health Head, without tubes.....</b>	Net 10.00
8514.	<b>Glass Tubes, 15 c.c., plain. Per dozen, Net \$1.35; per six dozen....</b>	Net 4.75

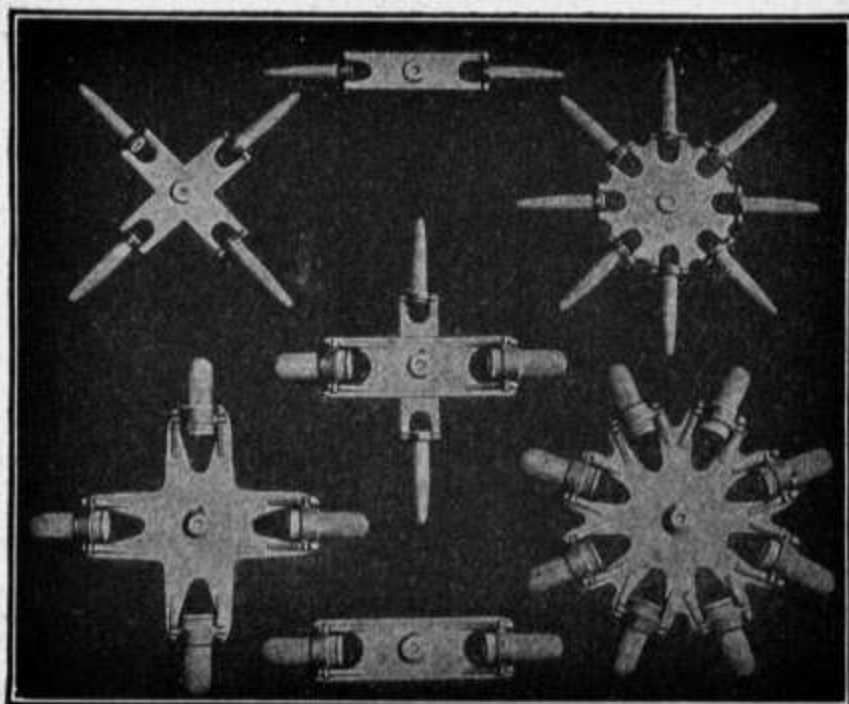
8515.	Glass Tubes, 15 c.c., graduated. Per half dozen.....	Net \$	2.00
8516.	Rubber Culture Caps, for 15 c.c. tubes. Per dozen, Net 45c; per gross . . . . .	Net	3.75
8517.	Board of Health Tubes, 2 c.c. Per hundred.....	Net	4.75
8518.	Rubber Stoppers, for Board of Health tubes. Per hundred.....	Net	1.50
8519.	Board of Health Tubes and Stoppers. Per set of 20.....	Net	1.95
8520.	Glass Tubes, Lipped, 50 c.c. Per dozen, Net \$1.50; per six dozen . . . . .	Net	5.00
8521.	Copper Lining for Size 1 Guard, extra.....	Net	10.00



Size 2.

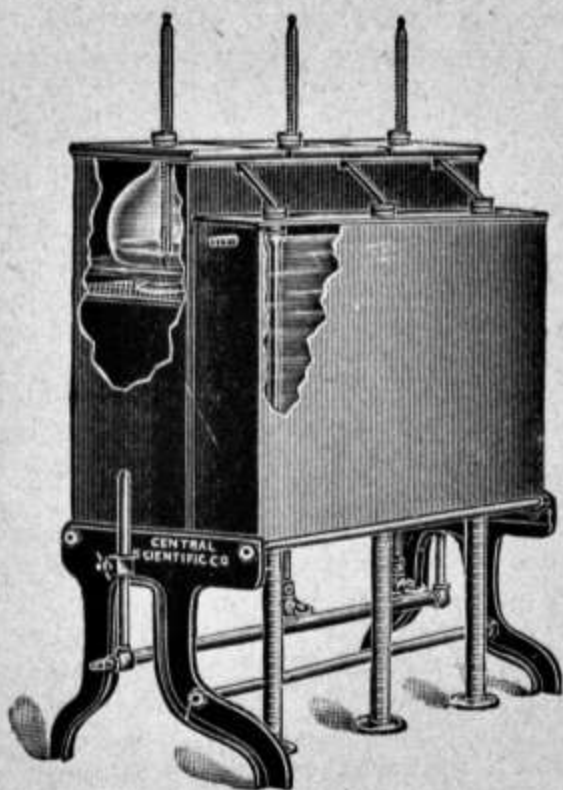
8531.	Centrifuge (Size 2, Type B), of the same general construction as Size 1, but larger, having the following dimensions: Height closed 23 in., open 35 in.; diam. 24 in.; average shipping weight about 300 pounds. The same equipment of heads and tubes may be used and in addition 100 c.c. tubes swung in the eight-tube head; also a sixteen-tube head carrying 50 c.c. tubes or Babcock test bottles. In addition a two-place head with cups of 250 c.c. capacity, or a two-place head for Squibb's separatory funnels of about 150 c.c. capacity, or a four-place head combining these two may be used. Speed with the sixteen-tube head and sixteen 50 c.c. tubes or with the eight-tube head and eight 100 c.c. tubes about 2,200 R. P. M.; with the eight-tube head and eight 50 c.c. tubes about 3,000 R. P. M.; with the eight-tube head and four 15 c.c. tubes about 3,400 R. P. M.; with the Board of Health head about 3,000 R. P. M.; and with the four-place, 250 c.c., combination head and buckets about 2,000 R. P. M.....	Net	95.00
8532.	Centrifuge. Same as No. 8531, but for 220 volt direct current....	Net	99.00
8533.	Centrifuge. Same as No. 8531, but for 110 volt alternating current . . . . .	Net	95.00
8534.	Centrifuge. Same as No. 8531, but for 220 volt alternating current . . . . .	Net	95.00

## EQUIPMENT FOR CENTRIFUGES Nos. 8531-8534.



Interchangeable Heads.

8536.	Four-Tube Head, without tubes or trunnion rings.....	Net \$	6.00
8537.	Eight-Tube Head, without tubes or trunnion rings.....	Net	10.00
8538.	Sixteen-Tube Head, without tubes or trunnion rings.....	Net	16.00
8539.	Board of Health Head, without tubes .....	Net	10.00
8540.	Two-Place Head for 150 c.c. Squibb's funnels or 250 c.c. bottles, without trunnion carriers .....	Net	5.00
8541.	Four-Place Head for 150 c.c. Squibb's funnels or 250 c.c. bottles, without trunnion carriers .....	Net	8.00
8542.	Two-Place Head for 250 c.c. conical bottom cups, without trunnion cups .....	Net	7.00
8543.	Four-Place Combination Head for 250 c.c. conical cups or bottles and 150 c.c. Squibb's funnels, without trunnion carriers.....	Net	10.00
8544.	Metal Tubes, 15 c.c., Cornell type, each.....	Net	.45
8545.	Trunnion Rings, 15 c.c., each.....	Net	.40
8546.	Metal Tubes, 50 c.c., Cornell type, each.....	Net	.55
8547.	Trunnion Rings, 50 c.c., each.....	Net	.35
8548.	Metal Tubes, 100 c.c., Cornell type, each.....	Net	.75
8549.	Trunnion Rings, 100 c.c., each.....	Net	.35
8550.	Trunnion Cups, conical bottom, 250 c.c., each.....	Net	2.50
8551.	Squibb's Trunnion Carriers, 150 c. c., each.....	Net	1.75
8552.	Trunnion Cups for 250 c.c. bottles, each.....	Net	5.00
8553.	Trunnion Cups for 7 inch Babcock bottles, each.....	Net	.50
8554.	Trunnion Ring and Cup for 9 inch Babcock bottles.....	Net	1.10
8555.	Trunnion Cups for sputum bottles, each.....	Net	.75
8514.	Glass Tubes, plain, 15 c.c. Per dozen, net 1.35; per 6 dozen.....	Net	4.75
8515.	Glass Tubes, graduated, 15 c.c. Per half dozen.....	Net	2.00
8517.	Board of Health Tubes, 2 c.c. Per hundred.....	Net	4.75
8518.	Rubber Stoppers for Board of Health tubes. Per hundred.....	Net	1.50
8519.	Board of Health Tubes and Stoppers. Per set of 20.....	Net	1.95
8520.	Glass Tubes, lipped, 50 c.c. Per dozen, net 1.50; per 6 dozen....	Net	5.00
8556.	Glass Tubes, lipped, 100 c.c. Per dozen, net 1.75; per 6 dozen....	Net	7.00
8557.	Pressed Glass Cups, 250 c.c., each.....	Net	.75
8558.	Glass Bottles, 250 c.c. Per dozen.....	Net	1.50
8559.	Squibb's Separatory Funnels, 150 c.c., each.....	Net	2.00
8560.	Copper Lining for Size 2 guard, extra.....	Net	13.00



No. 9312.



No. 9340.

**MOISTURE TESTERS.**

(See Bulletin No. 99, and Circular No. 72, Bureau of Plant Industry, United States Department of Agriculture.)

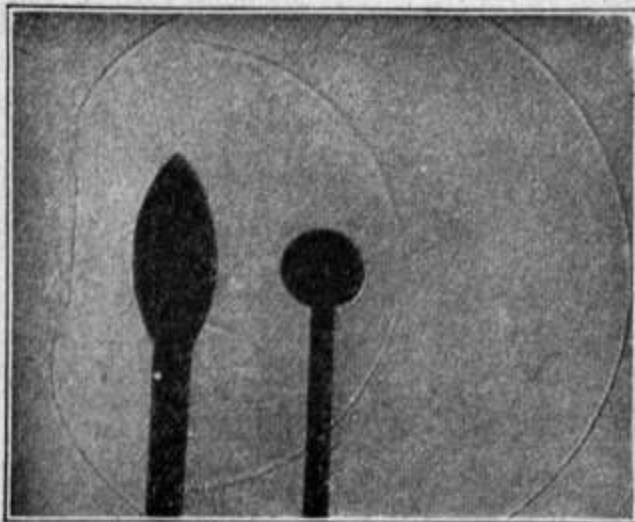
These testers were developed primarily to meet the needs of grain dealers for a rapid and exact method of determining the moisture in corn. Methods have now been worked out for making moisture tests of the more important cereal grains and some of the more important seeds. The method is entirely practicable for making moisture determinations of practically all substances which admit of a free circulation of oil during the heating. The apparatus consists of a heating chamber divided into compartments for testing a number of samples at the same time; a cold water tank of copper through which condenser tubes pass; adjustable burners; special side-neck flasks of Jena glass; and graduated cylinders. Thermometers are not included in the prices below.

9312A. Moisture Tester, six compartment, with gas burners.....	\$ 77.75
9312P. Moisture Tester, six compartment, with alcohol burners.....	85.55
9312Q. Moisture Tester, four compartment, with gas burners.....	58.90
9312R. Moisture Tester, four compartment, with alcohol burners.....	65.55
9312S. Moisture Tester, two compartment, with gas burners.....	40.00
9312T. Moisture Tester, two compartment, with alcohol burners.....	43.35
Note: If copper flasks are desired in the place of the glass flasks, add \$3.85 per compartment to the above prices.	
9312B. Flasks for moisture testers, of Jena glass, 1,000 c.c. Each.....	1.15
9312F. Flasks for moisture testers, of copper, 1,000 c.c. Each.....	5.00
9312C. Graduated Cylinders for moisture testers, 25 c.c., graduated in one-fifth c.c. Each .....	.67
9312D. Thermometers, 0 to 200 degrees centigrade. Special design for moisture testers. Each .....	2.00
9312E. Condenser Tubes, for moisture testers. Each.....	.30
9340. Grain Tester. For determining rapidly the farinaceous condition of barley and malt. Fifty kernels may be cut through in a very short time and their interior condition clearly shown. Handsomely nickel plated .....	Net 8.00

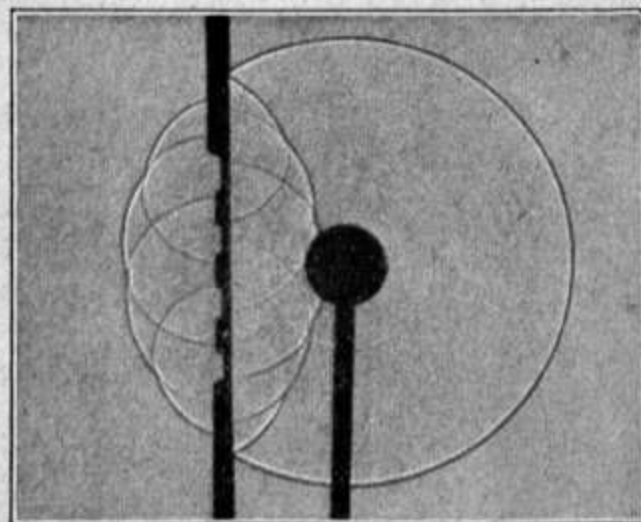
For other Grain Testers see Catalog X.



## LANTERN SLIDES OF SOUND WAVES.



No. 15.



No. 26.

The slides described below are those made by Dr. Arthur L. Foley, Professor of Physics in Indiana University, and described by him in the "Physical Review" for November, 1912.

With these slides it is unnecessary to continue longer to deal with the subject of wave motion in an abstract conventional way, which makes the subject difficult, uninteresting, and unreal to the student. The student need no longer depend entirely upon diagrams and on his imagination, for in these sound wave pictures he has actual photographs of sound waves in all stages of transmission, reflection, refraction, and diffraction. A list of the slides follows:

Fig. 0.—A cross section of sound wave and illuminator, explaining how the wave is rendered "visible" to the photographic plate.

Fig. 1.—Diagram of the complete apparatus for photographic sound waves.

Fig. 2.—Details of the illuminator, which produces light on the photographic plate thousands of times more intense than that given by a camera lens on a bright day.

Fig. 3.—Details of the sound wave spark gap.

Fig. 4.—Details of the sound lens.

Fig. 5.—Details of the sound grating.

No. 2.—Longitudinal section of a sound wave (actual photograph).

No. 3.—Sound wave just emerging from behind the sound gap terminals.

Nos. 4, 5, 6, 7, 7a, and 8 show the sound wave gradually spreading out from the origin until—in No. 8—the wave is about to pass beyond the limits of the photographic plate.

No. 10.—Here the sound wave has passed beyond the limits of the field. The hot gases from the sound spark have had time to emerge from behind the spark terminals, and are photographed.

No. 11.—Reflection of a wave at a plane surface.

No. 12.—Same as No. 11, but later, showing original and reflected waves much larger.

No. 13.—Reflection by a concave surface or mirror, showing reflected wave approaching the (real) focus, and the diffracted waves about the edges of the mirror.

No. 14.—Reflection of wave by convex mirror, focus virtual.

No. 15.—Plane wave produced by placing sound spark at the principal focus of a convex gas lens. This slide, like the other lens slides, shows the original, the reflected, and the diffracted waves.

No. 16.—Sulphur dioxide lens refracted wave convergent, focus real.

No. 17.—Carbon dioxide lens, refracted wave divergent, focus virtual.

No. 18.—Hydrogen lens, giving a refracted wave more divergent than the original wave—a diverging lens.

Nos. 19, 19a and 20.—Three stages of reflection of a wave by a parabolic mirror. Source of sound at focus, giving a plane wave after reflection. Time intervals respectively eleven, fifteen, and nineteen one-hundred-thousandths of a second.

Nos. 21, 22, 23, and 24.—Four different stages of a wave produced at one focus of an ellipse. The first shows the very beginning of the reflection; the second shows the original and reflected waves at the center of the ellipse—symmetrical with respect to the minor axis; the third shows the reflected wave circular and approaching the conjugate focus; the last shows the wave focussed at the conjugate focus.

Nos. 25, 26, 27, and 28.—Four different stages of both the transmitted and the reflected wave systems produced by a plane diffraction grating of four apertures. Time intervals respectively thirteen, sixteen, twenty-one, and twenty-four one-hundred-thousandths of a second.

The pictures completely verify Huygen's theory. Every picture shows in a beautiful way what is meant by "centers of disturbance," "wavelets," "radius of curvature," "wave," "wave fronts," "common tangents," "wave envelopes," "diffraction," "reflection grating," "transmission grating," "Huygens' construction," "pole of wave," "Stokes' law of intensity," "phase," etc.

Nos. 29 and 30.—Cylindrical grating of eight apertures, with sound source at center of curvatures, showing both the transmitted and reflected wave systems and illustrating for curved gratings what Nos. 25 to 28 do for plane gratings.

Price, Separate Slides ordered by number, each.....Net \$ 0.40  
Complete Set, 36 slides.....Net 12.50

With every order for a complete set there will be included free of charge a 20-page paper describing in detail the apparatus, the experiment, and the photographs.

**No. 8345. MYERS' MECHANICAL MODEL OF THE EYE.**

Patented Oct. 29, 1912.

This model of the eye, the invention of Jesse J. Myers, Assistant Professor of Physiology, Michigan Agricultural College, demonstrates the mechanics of normal accommodation, and also shows the cause and effect of far and near sight. All this is accomplished in so simple a manner that the model can be used successfully in the grades of the public schools as well as in colleges. It is also useful to oculists and opticians when they wish to explain to their patients their condition and the correction proposed.

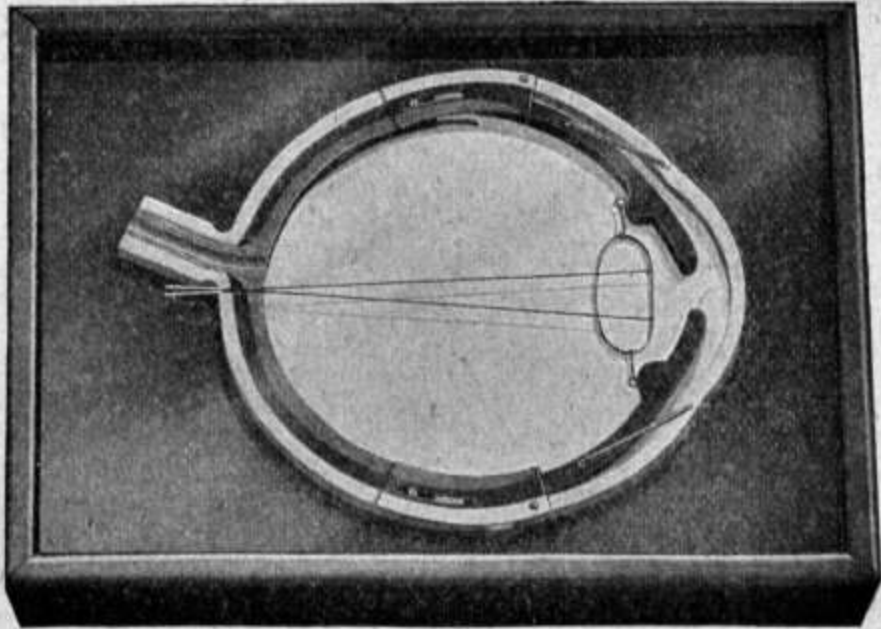


Fig. 1.

The model illustrated in Fig. 1 is enclosed in a finely finished case, 19½x15½x3 inches, provided with a glass front. Beneath this glass is a heavy bottom, which serves as a base to which are attached the parts of the model. As shown in Fig. 2, the eye is represented in longitudinal section by four pieces, a, b, b¹, c.

The piece a which represents the anterior part of the sclerotic coat, is fastened to the base, the other three parts are movable. The pieces, b, b¹, which represent the anterior portion of the choroid coat, are so arranged mechanically that they are capable of motion in a curved line, so that they can be brought forward and together, also backward and apart. An elastic hoop, representing the crystalline lens, is suspended between these two pieces. When these pieces approach each other, the tension of the hoop is lessened and it assumes a more rounded form. Two coil springs, d and d¹, representing the ciliary muscles contracting, aid in this movement to round out the lens. The effects of relaxing these muscles is shown by moving the pieces b and b¹ apart, thus increasing the tension and making the hoop less rounded. Thus simple accommodation is demonstrated.

The piece c represents the posterior part of the eye ball. Its three layers are represented each by a different color. This piece is capable of a backward and forward motion, thus elongating the eye ball to represent the condition of near sight and shortening it to represent the condition of far sight.

Two wires attached to the front side of the elastic hoop pass back across the hoop, converging and crossing each other near the back of the eye ball.

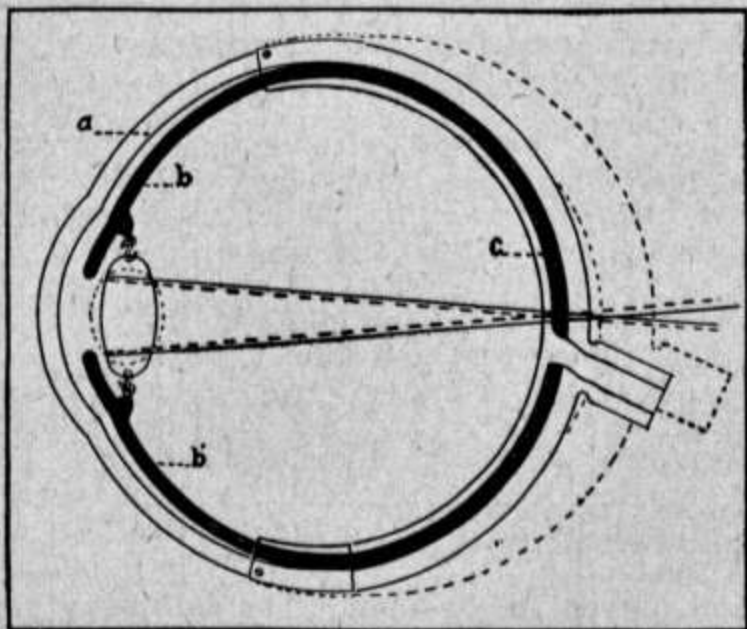


Fig. 2.

These represent two rays of light, and where they intersect the focal point. As the hoop becomes more rounded the intersection approaches the hoop. The reverse is true when the hoop becomes less rounded.

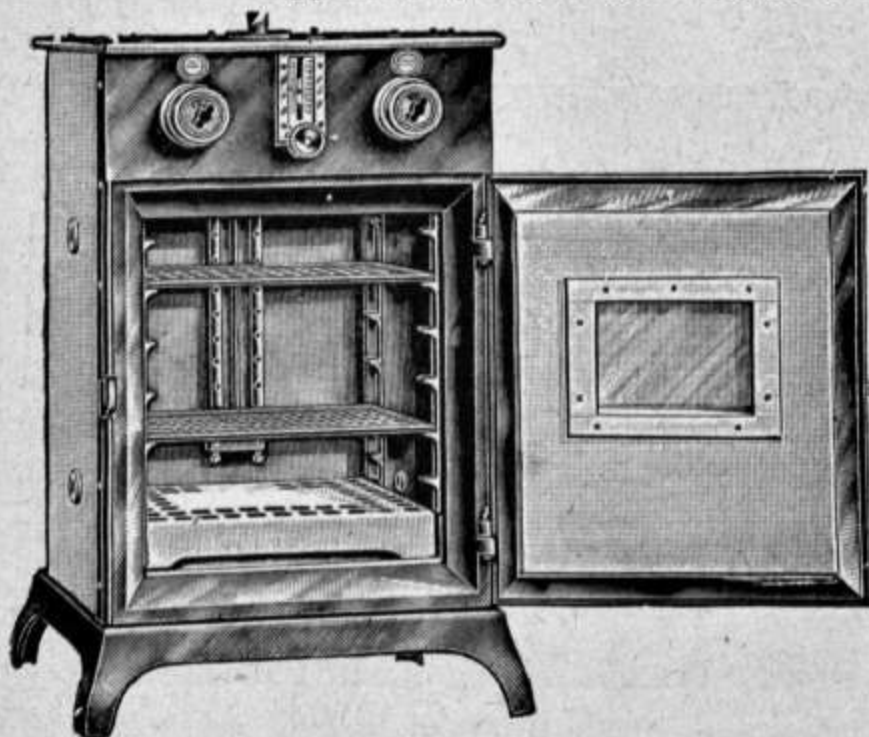
Thus there is represented in a visual way both normal and abnormal optics of the eye.

All movements of the model are controlled at the back by two knobs. One knob controls the shape of the elastic hoop, and by means of the other knob the piece c can be moved backward and forward, thus changing the length of the eye ball . . . . .

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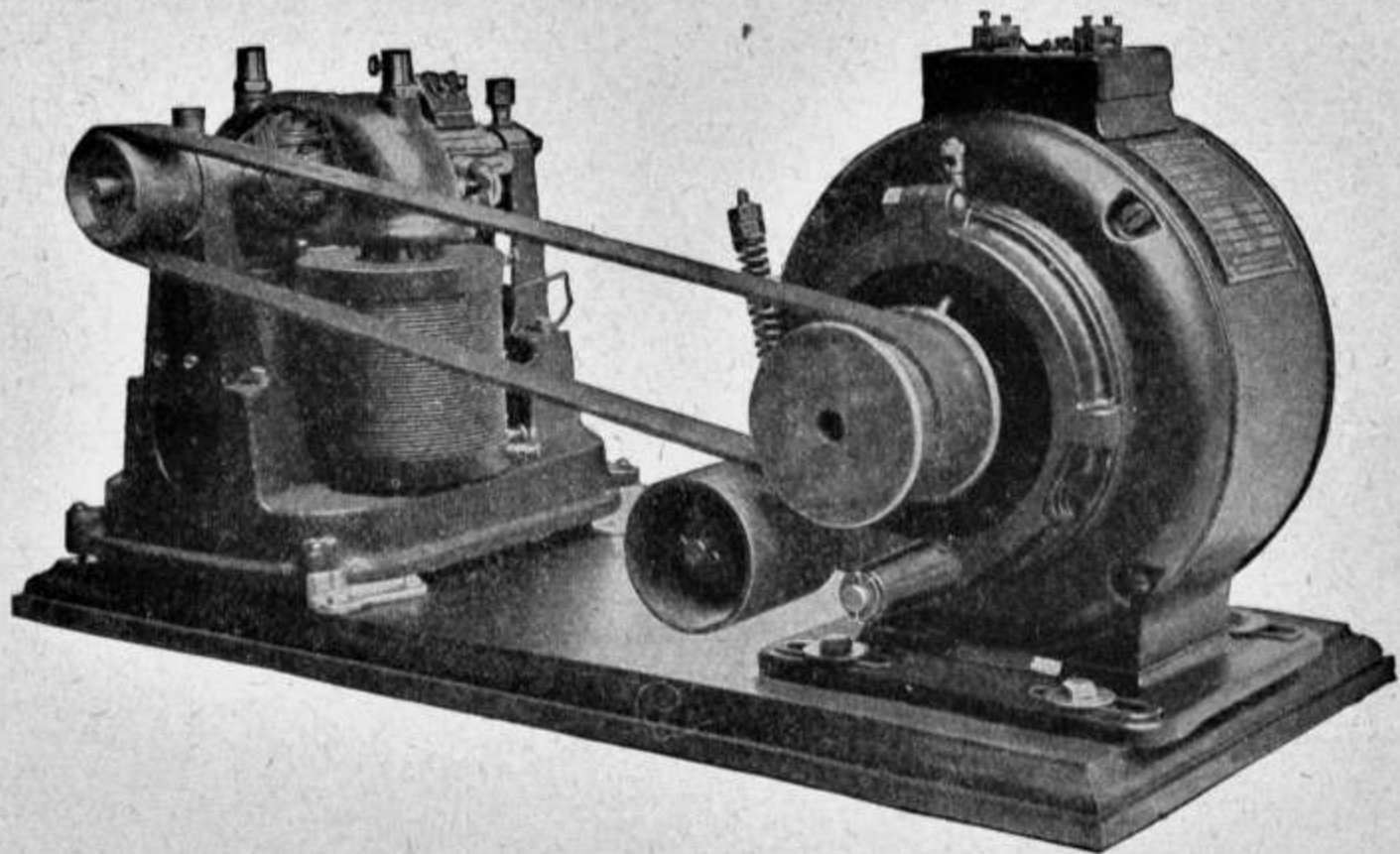
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