

GENERAL RADIO COMPANY

CATALOGUE B
RADIO LABORATORY APPARATUS

CAMBRIDGE, MASS.
U. S. A.

FOREWORD

In the instruments shown in this catalogue we make every effort to maintain the highest possible standard of design, workmanship, and material. All new designs are thoroughly tested out in practice before any instruments are sold.

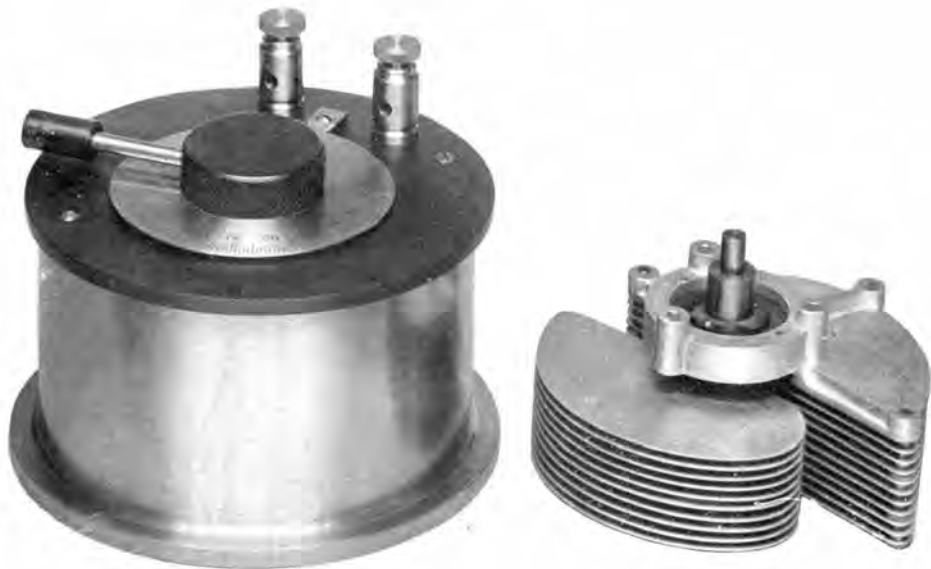
Whenever practicable we employ "Bakelite" as an insulating material, because of its superiority over hard rubber both in strength, and permanency of shape and of finish. While somewhat more expensive than hard rubber, its admirable electrical and mechanical qualities justify its use.

Most of the brass parts in our apparatus are covered with a baked lacquer, which gives a permanent and attractive finish. All binding posts, switch bases, and similar parts are securely pinned to prevent turning. Handles are either pinned on or held in place by a hardened set screw fitting a depression in the shaft. Cabinets are made of dull finished hard oak, which does not scratch or dent easily, while laminated mahogany is used for coil supports where slight changes of shape would be objectionable. Through the use of complete jigs, fixtures and gauges in the manufacture of our instruments, most of the parts are rendered readily interchangeable, a quality greatly appreciated when the purchaser wishes to make changes or repairs.

We shall be pleased to offer suggestions regarding apparatus, methods, or books for use in radio work, and hope that readers of this catalogue will feel free to call on us for information at any time.

All prices in this catalogue are strictly net. Cash should accompany orders from persons or firms not listed in the commercial directories. Unless otherwise instructed, we will use our own judgment regarding method of shipment.

General Radio Co. 11 Windsor St., Cambridge, Mass.



VARIABLE AIR CONDENSER

As shown in the cut, the plates of this condenser are curved to give approximately geometric variation of capacity, (suggested by F. A. Kolster, and by W. Duddell). This shape, allowing closer adjustment of capacity at the lower end of the scale, has proved very useful in circuits, such as those with gaseous detectors, where the ratio of inductance to capacity is large.

The plates are of hard aluminum .025" thick with a spacing of .03", the maximum radius of the rotary plates being 2". The low capacity at the zero end of the scale (about .00002 M. F.) is a valuable feature in many kinds of experimental work.

The stationary plates are cut away to decrease the capacity to the metal case.

The support of the condenser itself is a ribbed aluminum casting to which is riveted a disc of bakelite riveted in turn to an accurately machined brass bearing about 1" long. The shaft is machined from a good grade of $\frac{1}{2}$ " round steel with a flange which locates the plates and acts as a thrust bearing. The contact for the rotary plates is made thru a radially slotted bronze spring washer, giving a resistance of less than $1/200$ ohm, even after long use.

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The top of the condenser is made of 3/16" bakelite, a material which is much stronger than hard rubber and more permanent in finish.

Since the brass scale rotates opposite the line indicator, readings are always made at the same point. A round handle is used for ordinary adjustments, while the extension handle proves very useful where accurate setting is necessary.

The case is of cast brass well lacquered and provided with a screw to which a ground wire may be connected, so that the hand when brought near the condenser will not change the capacity and alter adjustments.

Diameter, 5". Height, 4". Weight, 2 $\frac{3}{4}$ lbs.

Minimum capacity, .00002 M. F.

Maximum capacity, .0007 M. F.

| | | |
|----------|---|---------|
| No. 124A | Condenser complete | \$10.00 |
| | Extra for calibration at 10 points..... | 1.50 |
| No. 124B | Condenser (same as No. 124A, but less brass case) | 8.50 |
| No. 124C | Condenser (same as No. 124B, but less bakelite top and binding posts)..... | 7.60 |
| No. 124D | Condenser (same as No. 124C, but less handle and scale) | 6.20 |

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AUDIBILITY METER

If a telephone in which signals are being received is shunted by a resistance until the signals are just audible, the ratio of the current in the telephone to the current in the shunt is an indication of the strength of the signal. For instance, if the signal is just audible when 99% of the detector current flows thru the shunt and 1% thru the 'phones, the signal is said to be 100 times as great as that necessary to produce a just audible signal.

This meter has 47 resistance coils so adjusted that the audibility is directly indicated by the numbers opposite the contact points, giving direct readings in audibility. The range is from 8000 times audibility down to 1, by steps of about 20% each.

Since there is no shunt on the 'phones at the point marked "1," the instrument may be left constantly in circuit without affecting the signal strength. One pair of binding posts is provided for connection to the detector, a second pair for the telephones. A small inductance coil is placed in the instrument to prevent the low resistance shunts from changing the conditions in the detector circuit.

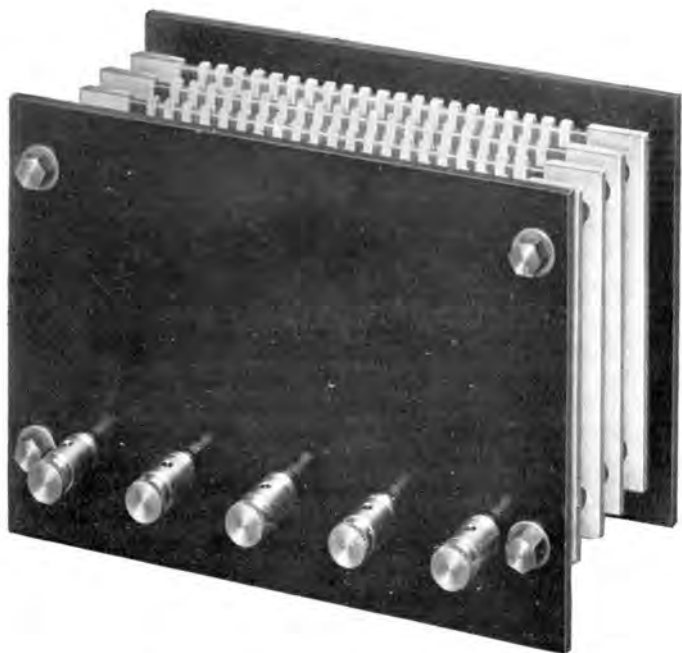
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This meter is of great value in a receiving station, since thru its use the efficiency of various detectors, receiving transformers, aerials or "hook-ups" can be compared, the increase of signal strength due to amplifiers can be determined, or the intensity of all incoming signals can be measured.

This meter will give satisfactory results on any ordinary 2000 ohm telephone, or we will adjust it to any special telephone.

Diameter, 7". Height, 3". Weight, 2½ lbs.

No. 122 Audibility Meter\$22.00



PHANTOM RESISTANCE

For many tests of transmitting apparatus, it is desirable to replace the antenna with a local circuit the constants of which are more easily and accurately determined. It also prevents interference with neighboring stations.

This resistance is made of 4 units of 4 ohms each, with separate binding posts by which 4-8-12 or 16 ohms can be obtained. With the 4 units in series, a current of 5 amperes can be continuously carried. With the units

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connected, two in series and two in parallel, giving 4 ohms, the carrying capacity is 10 amperes.

The resistance material is Advance ribbon, which has a very low temperature coefficient of resistance and a constant resistance up to very high frequencies. This ribbon is wound on asbestos-board forms, mounted vertically, an arrangement which insures a good circulation of air.

The binding posts, which are pinned to prevent loosening, are mounted on one of the bakelite end plates. The accuracy of the resistance is about $\frac{1}{2}\%$ at wave lengths of 300 meters or longer, while the inductance is about .0012 millihenrys for each section.

Special sizes will be quoted on if desired.

No. 125 Phantom Antenna Resistance\$15.00

Weight, 3 lbs; Size, 5" x 6" x 8".

We recommend our oil condensers for use in phantom antenna circuits as the resistance is very low, even at long wave lengths.

Condenser No. 108F is similar to No. 108D listed on page 6, but has a lower capacity (about .0015 M. F.) and a higher break down voltage (about 12,000 volts maximum).

No. 108F Oil Condenser\$15.00

Size, 6" x 7" x 8 $\frac{3}{4}$ "; Weight, 19 lbs.;

Capacity, .0015 M. F.

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STANDARD CONDENSERS

Our Standard Air Condensers are very valuable in laboratories, where accurate and permanent standards of capacity are needed. They are used for checking variable condensers, in alternating current bridge work, for accurate measurements of frequencies, and many other purposes.

The design of these condensers is based on suggestions made by Professor G. W. Pierce of Harvard University.

The plates are made of aluminum .050" thick, spaced .040" apart by means of very accurately machined separators. These ring shaped separators have a large area in contact with the aluminum to avoid any variation in capacity from a change in the spacing of the plates. The whole unit is held on a heavy glass top by means of eight rods passing thru the glass plate and separators. The binding posts are screwed and pinned to brass strips, which connect with the supporting rods.

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This construction gives a very rigid condenser, which should maintain its initial accuracy for any period of time.

- No. 120A Standard Air Condenser\$28.00
Capacity, .001 M. F.; Size, 8" x 8" x 4"; Weight, 6 lbs.
- No. 120B Standard Air Condenser\$33.00
Capacity, .002 M. F.; Size, 8" x 8" x 5"; Weight, 8 lbs.
- No. 120C Standard Air Condenser\$37.00
Capacity, .004 M. F.; Size, 8" x 8" x 7"; Weight, 11 lbs.



STANDARDS OF RESISTANCE

The resistance coils used in these standards are wound on a sheet of bakelite, with a double winding of manganin wire, so arranged that the currents in adjacent wires are opposite in direction and at practically the same potential.

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This construction keeps both inductance and capacity extremely low. It is desirable that resistances used at high frequencies have low inductance, in order that the inductance of the circuit shall not be materially changed as the resistance is varied. The effect of capacity in a resistance coil is to reduce the apparent resistance at high frequencies caused by the current shunted thru the capacity of the coil. The capacity of these coils is only about .000005 M. F., the effect of which is not appreciable in most high frequency measurements.

As these standards are also reliable on direct and low frequency alternating currents, they make very convenient standards for general laboratory use.

The case is of cast brass, well lacquered, and has a bakelite top. The resistance is adjusted to .1%, and every precaution is used in construction to aid in maintaining its accuracy.

Diameter, $3\frac{1}{4}$ " ; height, 2" ; weight, 1 lb.

| | | | |
|----------|----------------------|-----------|--------|
| No. 133A | Standard Resistance, | 1 ohm | \$5.00 |
| No. 133B | " " | 5 ohms | 5.00 |
| No. 133C | " " | 10 ohms | 5.00 |
| No. 133D | " " | 50 ohms | 5.00 |
| No. 133E | " " | 100 ohms | 5.50 |
| No. 133F | " " | 500 ohms | 6.50 |
| No. 133G | " " | 1000 ohms | 7.75 |

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DECADE RESISTANCE BOXES

The decade resistance box, in addition to its many uses on direct current, may, if properly designed and built, be employed in both low and high frequency alternating current tests.

In these resistance boxes, great care has been taken to make the resistance on high frequency currents the same as the direct current resistance, and to keep the inductance as low as possible.

The resistance material used in all units is manganin, which has a very low temperature coefficient of resistance (.0005% per degree C.) and contains no iron.

In the one tenth ohm units, the conductor is a thin, narrow ribbon, with very low inductance. The one, ten, and one hundred ohm units are wound on bakelite forms, with two insulated manganin wires, so arranged that the inductance is as low as possible, without increasing the distributed capacity, which with ordinary resistance coils causes serious errors at high frequencies.

The tops of these instruments are made of bakelite having a permanent, dull black finish.

The contact points are forced in, and held in place with nuts. The terminals of the resistance units are soldered directly to the projecting ends of the contact points.

The switch blades have + phosphor bronze laminations, which make good connection with the contact points.

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The insulating handle and the switch blades are securely pinned to the steel shaft, which rotates in a brass base pinned to the bakelite top.

Contact between the shaft and the switch base is made through a radially slotted bronze washer. The resistance of the complete switch is approximately .004 ohm and will not appreciably increase, even after long use.

The one tenth ohm units will carry 1 ampere, the one ohm units .25 ampere, the ten ohm units .1 ampere, and the one hundred ohm units .05 ampere—all without heating enough to change the resistance. The accuracy of the coils is better than $\frac{1}{4}\%$ on direct current and about $\frac{1}{2}\%$ at 1,500,000 cycles (200 meters wave length).

| | | | |
|----------|---------|----------------------------|---------|
| No. 102A | 10 | one tenth ohm coils..... | \$10.00 |
| No. 102B | 10 | one ohm coils..... | 10.00 |
| No. 102C | 10 | ten ohm coils..... | 10.00 |
| No. 102D | 10 | one tenth ohm coils..... | |
| | plus 10 | one ohm coils..... | 19.00 |
| No. 102E | 10 | one ohm coils..... | |
| | plus 10 | ten ohm coils..... | 19.00 |
| No. 102F | 10 | one tenth ohm coils..... | |
| | plus 10 | one ohm coils..... | |
| | plus 10 | ten ohm coils..... | 28.00 |
| No. 102G | 10 | one ohm coils..... | |
| | plus 10 | ten ohm coils..... | |
| | plus 10 | one hundred ohm coils..... | 29.00 |

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UNIVERSAL WAVEMETER

This wavemeter has a range from 150 to 11,000 meters, and is adapted to measuring the wave length of transmitters and of received signals. It consists of an air condenser, four low resistance inductance coils, a sensitive vacuum tube, a crystal detector with high resistance telephones, a high frequency buzzer with battery, and a changeover switch, all mounted in a strong oak case.

The condenser is the same as our No. 101 L, having a capacity of about .0015 M. F., and being completely shielded by copper sheet. The inductance coils are wound with stranded copper wire in substantial forms, and are connected either by means of a flexible leather-covered cable, or by a solid connector which supports the coils on the meter.

A sensitive vacuum tube is mounted beneath the top of the instrument and may be seen through a small opening near the condenser handle. The glow of the tube at resonance is clearly visible, even in bright daylight.

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A very simple crystal detector, connected either unilaterally or double, and a pair of high resistance telephones (2000 ohms) are supplied for measuring incoming signals, or currents too feeble to light the vacuum tube.

The instrument can be used to generate currents from 150 to 11,000 meters in wave length, by means of the battery and high frequency buzzer. This is very useful in a receiving station, as the receiving set may be tuned to any wave length on which signals are expected. It is also convenient for testing detectors or receiving sets at any wave length, as well as for measurements of capacity and inductance in apparatus of all kinds.

A pair of binding posts is provided for use with the thermo-galvanometer listed below, or with a sensitive hot wire meter.

The scale is divided into 100 equal divisions, and the graphs of the wave lengths are mounted in the lid of the case, where they may be easily read. Compartments are provided for containing the inductance coils, telephones, and thermo-galvanometer.

Dimensions 18" long, 9" wide, 9" high, weight 20 pounds.

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| Universal Wavemeter No. 105 C Code Word "WAFER" | Price \$105.00 |
|--|----------------|

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| Universal Wavemeter No. 105 D (with thermo-galvanometer) Code Word "WATER" | Price \$133.00 |
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DIRECT-READING WAVEMETER

This wavemeter is constructed to read from 260 to 1040 meters, resonance for transmitted signals being indicated by a sensitive hot wire meter. For use with received signals a simple crystal detector is mounted on the panel connected unilaterally, with binding posts for phones. The wave length is read directly from a scale which passes beneath a circular window with cross-hair. The inductance is mounted out of sight beneath the panel, together with the variable air condenser and the body of the hot wire meter. The entire instrument is mounted in a strong oak box which measures $8\frac{1}{2}$ by $5\frac{1}{2}$ by $5\frac{1}{2}$ inches, with a handle for carrying,—total weight $4\frac{1}{4}$ pounds.

These can be furnished in special ranges with an approximate ratio of 1 to 3,—i. e. 100 to 300 meters, etc. In their present range they are particularly adapted to use on small transmitters such as supplied to motorboats. Their extreme compactness and ruggedness are further commendable features, while the direct-reading feature makes for quick and accurate readings.

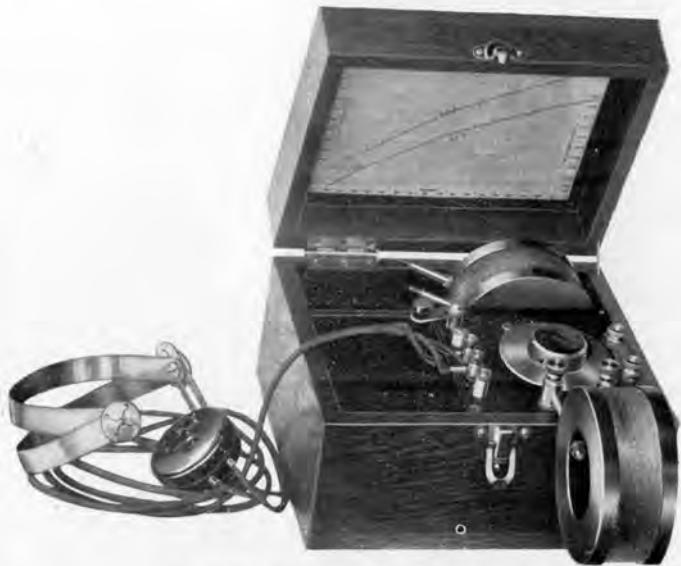
Direct-reading Wavemeter No. 145A Price \$38.00

Code Word "WORRY"

Direct-reading Wavemeter No. 145B, Range
180 to 650 meters Price \$38.00

Code Word "WOMAN"

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PORTABLE WAVEMETER

This wavemeter is constructed to read from 150 to 2600 meters, and is especially suitable for measurements about a radio station, such as measuring the capacity of the antenna, etc. The capacity of the condenser, which is of the approved "geometric variation" type, is .0007 M. F. The inductance of the coils is marked on the graph, and the coils themselves are of very low resistance, a point often neglected in small wavemeters. Two coils are ordinarily supplied, but a third inductance can be furnished to read to 12,000 meters. A simple crystal detector is supplied, with binding posts for both double and unilateral connections,—and a single high-resistance phone with headband. Binding posts are also supplied for connecting in a sensitive hot wire meter or thermogalvanometer. The two inductances and phone are contained in compartments of the case, which is of oak, while the graph of the wave lengths is fastened in the lid where it may be easily read. The meter measures 9 by 7½ by 5½ inches, and weighs seven pounds.

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|---|-------|---------|
| Wavemeter No. 132A | Price | \$29.00 |
| Code Word "WIZEN" | | |
| Wavemeter No. 132A with Extra Coil for 12,000 meters | | \$34.00 |
| Code Word "VAFOR" | | |
| Hot Wire Meter | | \$12.00 |
| Code Word "MOCHA" | | |

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VARIABLE AIR CONDENSER No. 101

This condenser is made of semicircular aluminum plates, one half being insulated from the other and arranged to rotate on a vertical axis. The steel shaft has large 45 degree angle cone bearings, accurately machined after the assembly of the moving unit. This assures perfect alignment. The bearings which support the steel shaft are of brass, positively locked in place. When completely assembled the condenser is placed in a lathe and the shaft rotated continuously at an approximate speed of 300 RPM for half an hour. This "wearing in" of the bearings makes them perfect before they leave the factory, and is insurance against future changing, sticking, or binding. Both sets of plates are .036" thick, and the clearance is .045", which, with the heavy end-castings of aluminum, make a condenser which is not apt to change its capacity with time. It is therefore well adapted for use as a variable standard of capacity, and for wavemeter work where permanence of capacity is essential. The scale is engraved on a brass disc which is fastened directly to the handle and shaft, rotating with them. The insulating discs which support the bearings of the moving unit are of thick hard rubber, which we prefer to other insulating materials because of its low dielectric hysteresis losses. The condenser is mounted in a dull-finished

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oak case with bakelite top. Care has been taken to have low resistance connections from both the moving and stationary plates to the binding posts, as well as to keep the dielectric losses as low as possible.

No. 101 L Capacity .0015 M. F. 8" x 8" x 9"
high, weight 8 lbs. Price \$19.00
Code Word "CABIN"

No. 101 M Capacity .003 M. F. 8" x 8" x 12"
high, weight 11 lbs. Price \$25.00
Code Word "CADET"

No. 101 P Capacity .005 M. F. 8" x 8" x 16"
high, weight 15 lbs. Price \$29.00
Code Word "CANAL"

Extra for Calibration Curve, \$4.00

Extra for 10" Handle for accurate adjustment \$1.50

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VARIABLE INDUCTOR

This variable inductance, commonly called a "variometer", is wound with well stranded copper wire, and has been carefully designed to give satisfactory results at high frequencies.

The coils are sections of spheres and are form wound.

The scale is engraved on a brass disc which is securely fastened to the handle and shaft.

The connections to the moving coil are made through multiple contacts, giving a low and constant resistance. A changeover switch is provided which connects the coils either in parallel or series.

The entire instrument is mounted in an oak case with a Bakelite top, and very little solid dielectric or metal in the field of the coils.

Ranges other than those listed below will be made at a slightly increased cost.

No. 107C. About .008 to .4 M. H. Price \$24.00

Carries 3 amperes continuously.

Code Word "HAPPY"

No. 107D. About .12 to 6 M. H. Price \$24.00

Carries 1 ampere continuously

Code Word "HARDY"

No. 107E. About .4 to 20 M. H. Price \$24.00

Carries $\frac{1}{2}$ ampere continuously.

Code Word "HAVEN"

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12 STEP INDUCTOR

This inductance is wound in three coils, separated from each other, and contained in an oak case with a Bakelite front. The design is such as to permit two or more of these inductances to be placed side by side, coupling being varied by moving them nearer to or farther away from each other. Thus every degree of coupling may be obtained, from very close, to nil. The further possibility of obtaining mutual coupling between three or four different circuits is of considerable importance. Dead-end switches are arranged to automatically cut out the coils not in use, thus avoiding losses in oscillating circuits.

No. 111C has about 1 M. H. inductance, with approximately 1 ohm resistance and oscillates at 1300 meters with a capacity of .0005 M. F.

No. 111D has about 10 M. H. inductance, with approximately 6 ohms resistance, and oscillates at 4000 meters with a capacity of .0005 M. F.

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No. 111E has about 75 M. H. inductance, with approximately 45 ohms resistance, and oscillates at 11,000 meters with a capacity of .0005 M. F.

No. 111F has about 150 M. H. inductance, with approximately 68 ohms resistance, and oscillates at 16,000 meters with a capacity of .0005 M. F.

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|--|---------------|
| No. 111C Variable Inductance, Code Word "ABBOT" | Price \$12.00 |
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|--|---------------|
| No. 111D Variable Inductance, Code Word "ABHOR" | Price \$12.00 |
|--|---------------|

| | |
|--|---------------|
| No. 111E Variable Inductance, Code Word "ABIDE" | Price \$14.00 |
|--|---------------|

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|--|---------------|
| No. 111F Variable Inductance, Code Word "ABYSS" | Price \$16.00 |
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FLAME-PROOF KEY

This key is designed to be used wherever there is any danger of fire or explosion due to a spark such as takes place when the key of a transmitter is operated. It is especially adapted for submarines and aeroplanes, but may be used with satisfaction in many places to which the ordinary open key is not well suited. The contacts are easily accessible, as well as the adjustments,—a valuable feature. The movement is smooth and easy,—the construction rugged. It will carry 10 amperes continuously without heating.

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|------------------------------|-------|---------|
| Flame-proof Key No. 151 | Price | \$5.00 |
| Code Word "KIMBO" | | |
| Flame-proof Key No. 151 | | |
| Carrying capacity 50 amperes | Price | \$10.00 |
| Code Word "KITTY" | | |

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DECADE BRIDGE

This bridge is made up of the same resistance units as are employed in our Decade Resistance Boxes, Type 102, in a suitable arrangement for bridge measurements. As these resistances are accurate on frequencies to 1,500,000 cycles, this bridge is adapted to measurements of inductance, capacity and resistance at high frequencies using a sine-wave generator or oscillating vacuum tube, as well as to DC measurements. In capacity and inductance measurements one arm of the bridge is arranged to compensate for the resistance of the capacity or inductance under measurement as compared to that of the standard, thus indicating the resistance as well as the capacity or inductance at the particular frequency being used.

The units have been mounted in a compact and convenient arrangement, and great care taken to eliminate losses at high frequencies.

DECADE BRIDGE, No. 160.

Price \$100 00

Code Word "BETTY."

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STANDARDS OF INDUCTANCE

These coils are wound on glass forms, and are so designed as to keep the distributed capacity low. They are mounted in oak cases for the protection of the glass forms, and are so arranged as to take fairly heavy jars without damage. Only absolutely non magnetic materials are used, and the amount of metal in the field is very slight. The continuous carrying capacity of No. 106 A and B is about 2 amperes, and of No. 106 C and D is about $\frac{3}{4}$ ampere.

| | | | |
|------------|-------------------|-------|---------|
| No. 106 A. | .05 Millihenrys | Price | \$15.00 |
| | Code Word "INLAY" | | |
| No. 106 B. | .20 Millihenrys | Price | \$15.00 |
| | Code Word "INLET" | | |
| No. 106 C. | 1.00 Millihenrys | Price | \$17.00 |
| | Code Word "INFER" | | |
| No. 106 D. | 5.00 Millihenrys | Price | \$20.00 |
| | Code word "INKLE" | | |

Other ranges will be made to order.

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SPARK INDICATOR

This instrument is a sensitive vacuum tube rotated by an electric motor. It is mounted in a dull black cylindrical case, and when the vacuum tube is connected with a high potential point on an oscillating circuit, the glowing of the tube can be seen. The rotation of the tube causes each spark to be seen as a separate band, up to about 10,000 sparks per second. The regularity of the intensity and spacing of the separate sparks can be seen, thus allowing the user to form a correct idea of the tone value and spark quality of a set.

Three different speeds are available by means of a switch in the base of the motor. A cord 8' long with a connecting plug to fit a standard socket is supplied.

No. 110 A Spark Indicator for 110 volts A.C. \$40.00
Code Word "SABLE"

No. 110 B Spark Indicator for 110 volts D.C. \$40.00
Code Word "SALAD"

No. 110 M. Vacuum tube as used in Spark Indicator \$3.25
Code Word "SALTY"

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HOT WIRE METERS

A high-grade hot wire meter should contain three definite qualities,—ruggedness of construction, quickness of action, and permanence of operating characteristics. In the meters listed below careful design and good workmanship are co-ordinated to produce an instrument which is electrically and mechanically good, and which has found a multiplicity of uses in the electrical art.

Types.

These meters are made in two sizes,—Model 127 being 3" in diameter, Model 128, 5", both sizes being made either flush mounting or front of board. In addition Model 127 is made in a portable aluminum case suitable for many purposes about a laboratory. Both sizes are also furnished in a variety of ranges,—Model 127 from $\frac{1}{4}$ ampere to 10 amperes,—Model 128 from $\frac{1}{2}$ to 20 amperes. The finish is satin black unless otherwise specified.

Construction.

All parts are interchangeable,—as well as the movements in the different cases. The expanding strip in these meters is of thin platinum. Most other materials will oxidize, which gradually changes the readings of the instrument. It is so proportioned that it works at low temperature and is of low resistance,—two very highly desirable features,—the first allowing a heavy overload without burning out, as well as keeping the case from heating up,—the second insuring minimum losses in the circuit.

Movement.

The multiplying action which is used in these meters gives an open scale with the divisions at the beginning of the scale more nearly equal to those at the other end

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than is usual in hot wire meters. The bearings which support the steel shaft are of finest sapphire, a point which needs no further comment. The support of the meters is particularly rugged,—the back of Model 127 being a solid piece 3-16" thick by 3" diameter. This makes for great strength and permanence.



Summary.

Hot wire meters Models 127 and 128 furnish very dependable instruments for measuring current values. They are not quite as quick in action as D'Arsonval instruments, nor as accurate, but have the great advantage over this type of working equally well on direct and alternating currents of any frequency. They have extremely open scales for hot wire meters and are unchanging in operating characteristics with time. There is a zero adjusting button on the front of each meter allowing instant setting of the pointer.

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Model 127 HOT WIRE METER 3 inch.

| Range | Code word | Type | Price |
|-------------------|-----------|----------------|---------|
| $\frac{1}{4}$ amp | MADAM | Front of Board | \$11.00 |
| $\frac{1}{2}$ amp | MAJOR | Front of Board | 10.00 |
| 1 amp | MANOR | Front of Board | 10.00 |
| 2 amps | MARRY | Front of Board | 10.00 |
| 3 amps | MASON | Front of Board | 10.00 |
| 5 amps | MATIN | Front of Board | 10.00 |
| 10 amps | MAXIM | Front of Board | 10.00 |
| $\frac{1}{4}$ amp | MERCY | Flush Mounting | 11.00 |
| $\frac{1}{2}$ amp | MERIT | Flush Mounting | 10.00 |
| 1 amp | MERRY | Flush Mounting | 10.00 |
| 2 amps | METAL | Flush Mounting | 10.00 |
| 3 amps | MIMIC | Flush Mounting | 10.00 |
| 5 amps | MINIM | Flush Mounting | 10.00 |
| 10 amps | MINNY | Flush Mounting | 10.00 |
| $\frac{1}{4}$ amp | MOCHA | Portable Case | 12.00 |
| $\frac{1}{2}$ amp | MOGUL | Portable Case | 11.00 |
| 1 amp | MOLAR | Portable Case | 11.00 |
| 2 amps | MONAD | Portable Case | 11.00 |
| 3 amps | MORAL | Portable Case | 11.00 |
| 5 amps | MUMMY | Portable Case | 11.00 |
| 10 amps | MUSTY | Portable Case | 11.00 |

Model 128 HOT WIRE METER 5 inch.

| | | | |
|-------------------|-------|----------------|---------|
| $\frac{1}{2}$ amp | NABOB | Front of Board | \$16.00 |
| 1 amp | NABIR | Front of Board | 16.00 |
| 2 amps | NAIVE | Front of Board | 16.00 |
| 3 amps | NAKED | Front of Board | 16.00 |
| 5 amps | NASAL | Front of Board | 16.00 |
| 10 amps | NASTY | Front of Board | 16.00 |
| 15 amps | NAVAL | Front of Board | 17.00 |
| 20 amps | NEGRO | Front of Board | 17.00 |
| $\frac{1}{2}$ amp | NOBLE | Flush Mounting | 16.00 |
| 1 amp | NOMAD | Flush Mounting | 16.00 |
| 2 amps | NOVEL | Flush Mounting | 16.00 |
| 3 amps | NATAL | Flush Mounting | 16.00 |
| 5 amps | NEWEL | Flush Mounting | 16.00 |
| 10 amps | NINNY | Flush Mounting | 16.00 |
| 15 amps | ODIUM | Flush Mounting | 17.00 |
| 20 amps | OMEGA | Flush Mounting | 17.00 |

General Radio Co. 11 Windsor St., Cambridge, Mass.



GALVANOMETERS

The galvanometers listed below have been designed to supply the demand for an instrument of great sensitivity, ruggedness, and adaptability. They may be had in four styles to cover a wide range of uses. These include Numbers 129A and B of 10 ohms resistance, particularly adapted for use with thermo couples, and Numbers 129C and D of 100 ohms resistance, which are extremely sensitive for bridge work.

— The coils are so constructed as to allow safe clearance from the stationary parts at all times, so that any chance particles, fuzz or dust cannot interfere with their proper movement. They are wound upon damping forms, properly adjusted to bring the coils to just under critical damping, as this point has been found most satisfactory for general use. This allows the pointer to swing quickly to its position, but does not permit it to swing back and forth indefinitely as it would if it were not correctly damped.

The suspension is of the strained type. This permits of much greater sensitivity in the meter than a pivot type, and requires no leveling of the instrument. This last feature is extremely desirable, as moving the galvanometer from one table to another entails no careful readjustments. Thin phosphor bronze strip has been found to be the most satisfactory material for the suspension, combining great strength and durability with freedom from "set" when the coil is deflected. This insures a stable zero. Instead of being fastened directly to the top of the coil, the suspending strip is soldered to a

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lateral U shaped spring. This acts in the character of a shock-absorber, so that even very severe bumps are perfectly neutralized without danger of snapping the delicate suspension.

Care has been exercised to produce a scale of considerable length,—over three inches,—easily read to a fine degree.

Models 129 B and D have zero center, with 50 divisions either side.

Models 129 A and C have zero left and 100 divisions. They are mounted in oak cases of rugged construction, with external adjustments for zero and for clamping the coils firmly while moving them from place to place.

No. 129A resistance 10 ohms, zero left, 1 micro-ampere moves the pointer approximately one division,—100 micro amperes full scale.
Code Word "GAMUT"

No. 129B resistance 10 ohms, zero center, 1 micro-ampere moves the pointer approximately one division,—50 micro-amperes full scale.
Code Word "GAVEL"

Our Thermo Couple No. 134 is well adapted to these models.

No. 129C resistance 100 ohms, zero left, $\frac{1}{4}$ micro-ampere moves the pointer approximately one division,—25 micro-amperes full scale.
Code Word "GENUS"

No. 129D resistance 100 ohms, zero center, $\frac{1}{4}$ micro-ampere moves the pointer approximately one division,—12 micro-amperes full scale.
Code Word "GIDDY"

Price, any model \$22.00

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THERMO COUPLES

Extensive experience has shown that a couple of copper and constantan is most satisfactory for use with a galvanometer for all ordinary purposes. To those unfamiliar with thermo couples it may be stated that fine points of unlike metals, such as copper and constantan, when welded together, generate a direct current when an oscillating or alternating current is passed through the junction. This is caused by the heat which arises from the passage of the alternating current through the fine junction. Thus a galvanometer such as No. 129A in connection with this thermo couple may be readily used to register resonance in a wavemeter circuit, and for other feeble oscillating currents. A current of only 50 milliamperes in one of these couples will cause a full scale deflection of galvanometer No. 129A. The average resistance of these couples is 1.5 ohms, but they may be supplied on special order from $\frac{1}{2}$ to 5 ohms,—the watt sensitivity remaining the same.

No. 134 Thermo couple (copper-constantan) Price \$6.00
Code Word "TABBY"



SLIDE WIRE BRIDGE No. 130

This slide wire bridge is constructed carefully and of the best materials. Its design permits of obtaining all the ordinary measurements made with a bridge, and at the same time does not make the instrument bulky or heavy. The twelve binding posts are pinned to prevent their turning, and all connections are soldered. The slide wire is of manganin, one-half meter long,—the scale is engine-engraved on boxwood, and the slider moves on a brass tube one-half inch in diameter, insuring good contact and durability. The total dimensions are 24" by 4 $\frac{1}{2}$ " by 2", and the weight is 3 $\frac{3}{4}$ pounds.

Slide wire bridge, No. 130
Code Word "SATYR"

Price \$18.00

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