

# **RADIO LABORATORY APPARATUS**

**CATALOGUE A**

**GENERAL RADIO CO.**

**11 WINDSOR STREET**

**CAMBRIDGE, MASS.**

CATALOGUE OF  
**RADIO LABORATORY APPARATUS**

MANUFACTURED BY  
**GENERAL RADIO COMPANY**

**11 Windsor Street**  
**Corner of Massachusetts Avenue**  
**CAMBRIDGE, MASSACHUSETTS**

## 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.

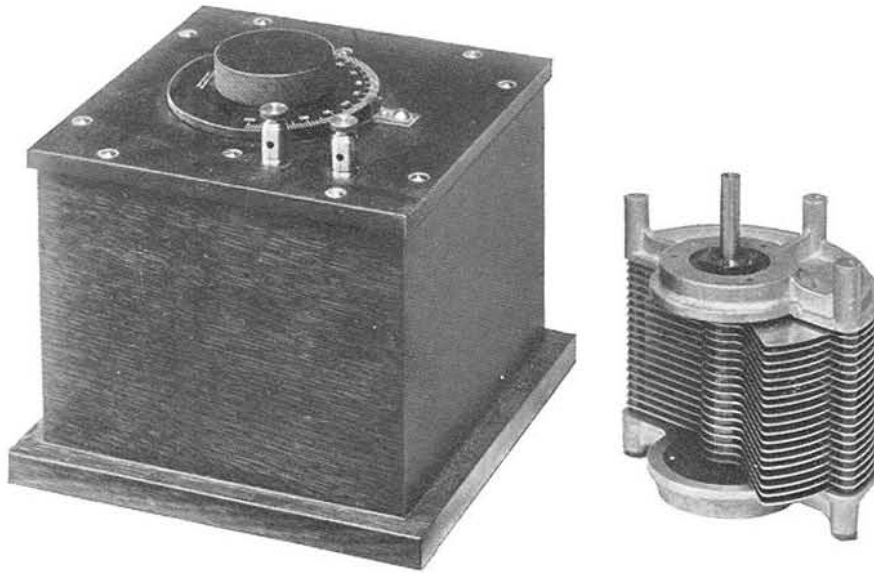
Whenever practicable we employ "Bakelite" as an insulating material, because of its superiority over hard rubber both in strength, and permanency of shape and of finish. While somewhat more expensive than hard rubber, its admirable electrical and mechanical qualities justify its use.

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.

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### VARIABLE AIR CONDENSER

This condenser is made of semicircular aluminum plates, one half the plates being arranged to rotate on a vertical axis. The steel shaft is carefully fitted to heavy brass bearings, which are positively locked in place. The rotary plates are insulated from the stationary plates by bakelite discs riveted to the ribbed aluminum end castings. The moving and stationary plates are .036" thick, and the clearance is .045", which, with the very rugged construction we use, gives a condenser which is not apt to change with time, and is well adapted for use as a variable standard of capacity, or for wave meter work, where permanence of capacity is essential.

The scale is engraved on a bakelite disc, which is fastened to the handle and shaft, rotating with them. The condenser is mounted in a dull finished oak box, having a bakelite top.

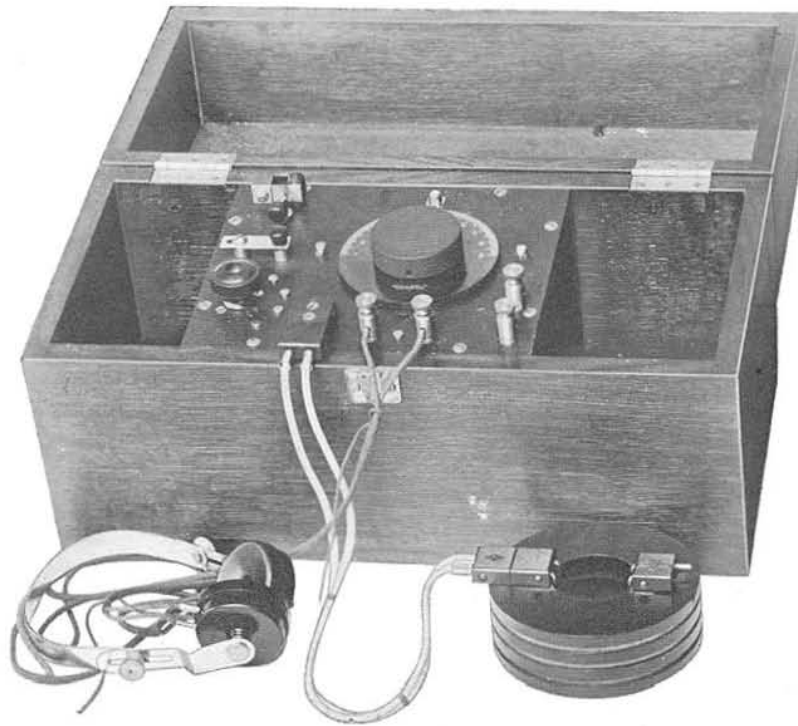
Care has been taken to keep the insulation of the condenser very high, and to have low resistance connections from the binding posts to both the stationary and moving plates.

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

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

Extra for Calibration Curve,	4.00
Extra for 10" Handle for accurate adjustment	1.50

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## UNIVERSAL WAVEMETER

This wavemeter has a range from 150 meters to 9,000 meters, and is adapted to measuring the wave length of transmitters, or of received signals. It consists of an air condenser, 6 low resistance inductance coils, a sensitive vacuum tube, a crystal detector with a telephone, a buzzer with battery, and a change over 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. The inductance coils are wound with flat, insulated copper ribbon, in laminated mahogany forms, and are connected by means of a double flexible cable to the instrument. Clips are provided in the lid for holding the coils when not in use.

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 and a pair of head telephones (2,000 ohms) are supplied for measuring incoming signals, or currents too weak to light the vacuum tube. When not in use, the telephones are kept in a compartment at the left end of the case.

The instrument can be used to generate currents from 150 to 9,000 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 in testing detectors or receiving sets, at any wave length, as the buzzer will work for hours, giving a high, clear, unvarying signal.

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

The changeover switch disconnects both ends of all instruments not in use, thus preventing any error due to their capacity. All the wiring and all the parts are mounted directly on the bakelite plate.

The scale is divided into 100 equal divisions and curves are supplied showing the wave length.

Dimensions 17" long, 9" wide 9" high, weight 20 lbs.

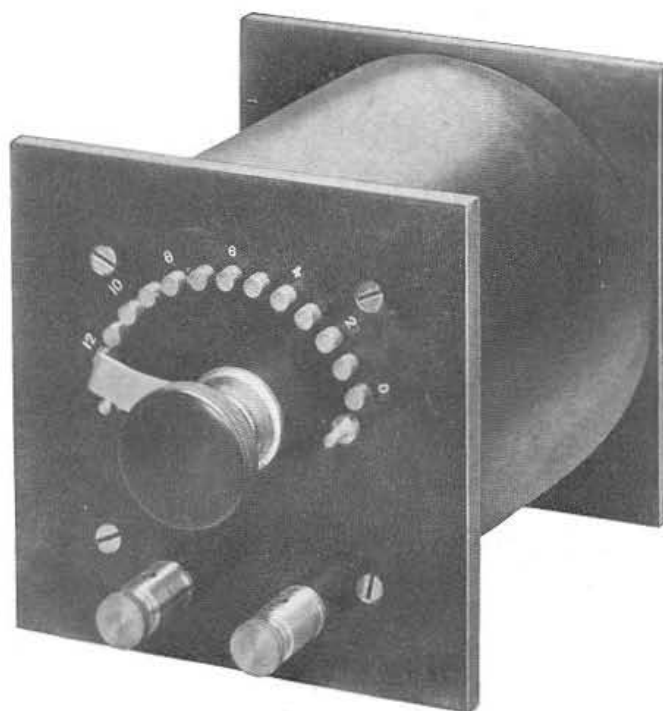
No. 105 B Wavemeter \$105 00

### **SENSITIVE HIGH FREQUENCY METER**

This consists of a platinum-tellurium thermo-junction (as described by L. W. Austin in "Bulletin of the Bureau of Standards Vol. 7 No. 2") and a microvoltmeter, mounted as a unit. Used with wavemeter No. 105 B, (which has a space for it), it allows resonance curves to be made and measures decrements. It is also the most accurate instrument for finding the resonant point in wave length measurements. It can also be used in any place where a sensitive meter for high frequency currents is desired. The scale has 50 equal divisions, and the deflections are approximately proportional to the currents squared.

No. 115 Thermo-meter \$28.00

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### VARIABLE INDUCTANCES

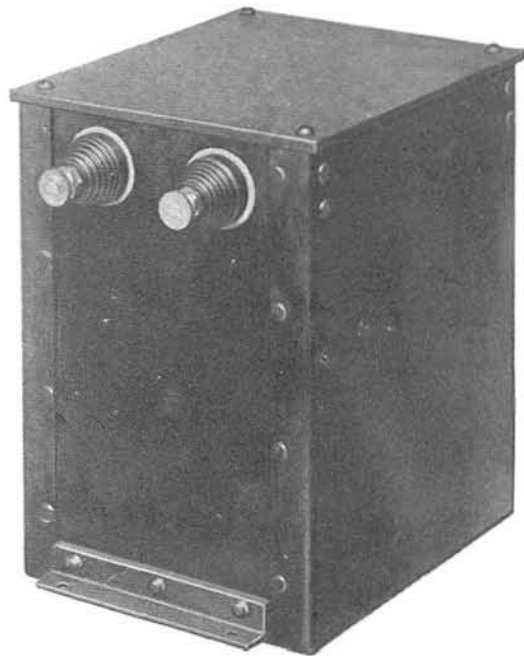
These inductances have 12 equal coils wound in grooves in a wooden form, with a tap brought out from each coil. The coil ends are of Bakelite and the form is covered with thin hard rubber.

Inductance No. 111 A has 1 Millihenry inductance, giving 2,000 meters period with a capacity of .001 microfarad, while No. 111 B has 60 Millihenrys and oscillates at about 15,000 meters with .001 M. F.

The resistance of No. 126 A is 5 ohms and 126 B is 20 ohms. The dimensions are 5" x 5" x 5". We will wind these to any specified inductance, at a slightly increased cost. These coils are very satisfactory in receiving or buzzer circuits where the current is not over .2 ampere.

No. 111 A Variable Inductance	\$12.00
No. 111 B Variable Inductance	12.00

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## OIL AND AIR CONDENSERS

This condenser is made up of aluminum plates in a galvanized iron tank filled with oil, connections being brought out to binding posts through insulating bushings.

The plates are spaced .08", making it possible to use voltages, with the oil we supply, up to about 9,000 volts. The vertical mounting of the plates lets air bubbles rise to the surface and solid particles drop to the bottom of the tank. As a spark through the oil does no harm, these condensers can not break down.

These units have a capacity of .006 M. F. with oil and .002 M. F. without. They may, of course, be used as air condensers up to about 3,000 volts.

It is a well known fact that all useful solid dielectrics show rather large losses when used in oscillating circuits, these losses increasing with the wave length, while air and some oils absorb very little energy. The effective resistance of one of these condensers of a capacity of .006 M. F. at 2,000 m. wave length is .2 ohms, while the better glass condensers of the same capacity show 2 to 3 ohms. The capacity does not change appreciably within ordinary radio frequency limits.

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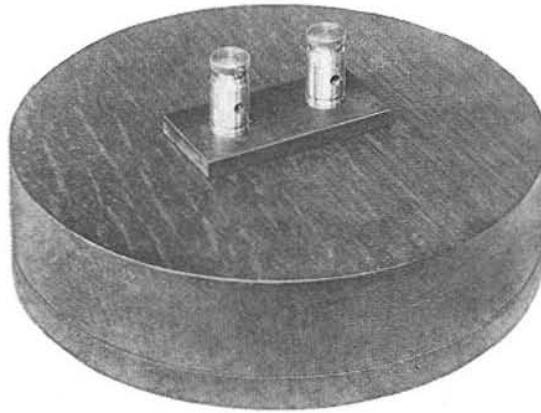
We recommend these condensers where small losses and absolute certainty of operation are desired.

The dimensions of the case are 6" x 7" x 8 $\frac{3}{4}$ " high, and the weight, with oil, is about 20 pounds.

Other capacities built to order at a small increase in price.

Oil Condenser, No. 108 D

Price, \$15.00



## STANDARDS OF INDUCTANCE

These coils are wound on well seasoned laminated mahogany forms, and are so designed as to keep the distributed capacity low. They are mounted in an oak case for the protection of the mahogany form, and so arranged that any change in the shape of the case will not affect the coil. Only absolutely non-magnetic materials are used, and the amount of metal in the field is very slight. The continuous carrying capacity of each coil is about  $\frac{3}{4}$  amp.

Number	Millihenrys	Price
106 A	.05	\$15.00
106 B	.20	15.00
106 C	1.00	17.00
106 D	5.00	20.00

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
No. 110 B	“ “ “ 110 volts D.C.	40.00
No. 110 M	Vacuum tube as used in Spark Indicator	3.25

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## AYRTON-PERRY VARIABLE INDUCTANCE

This 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 held in place by well seasoned laminated mahogany forms.

The scale is engraved on a bakelite disc, securely fastened to the handle and shaft.

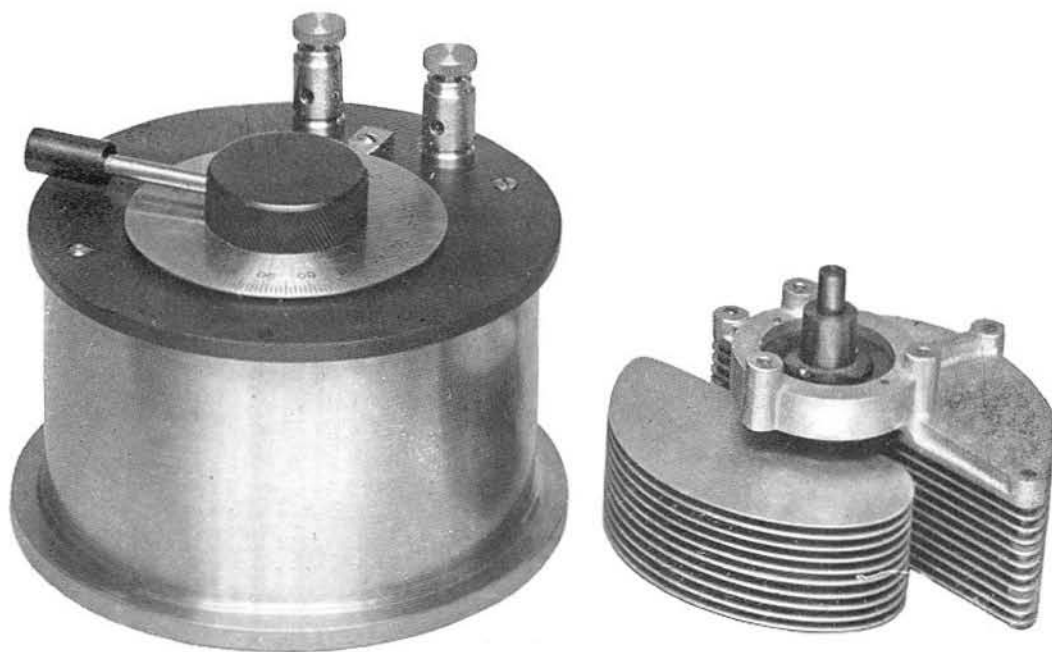
The connections to the moving coil are made through multiple contacts, giving a low and constant resistance. The connections from the two coils are brought out independently so that the coils may be used in series or parallel, or may be used as a variable mutual inductance.

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

Variometer No. 107 A Range .015 Millihenrys to .25 Millihenrys (with coils in series) \$24.00  
Will carry 4 amperes continuously.

No. 107 B Range .25 Millihenrys to 4 Millihenrys (with coils in series) \$24.00  
Will carry 1 ampere continuously

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### 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  $\frac{1}{200}$  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.

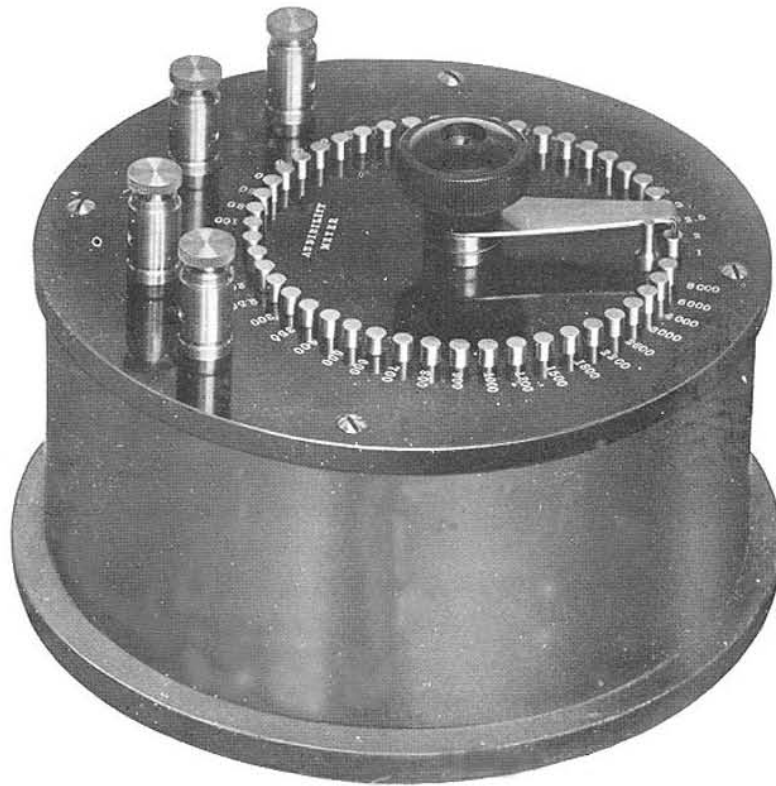
Diameter, 5", Height, 4", Weight, 2¾ lbs.

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.

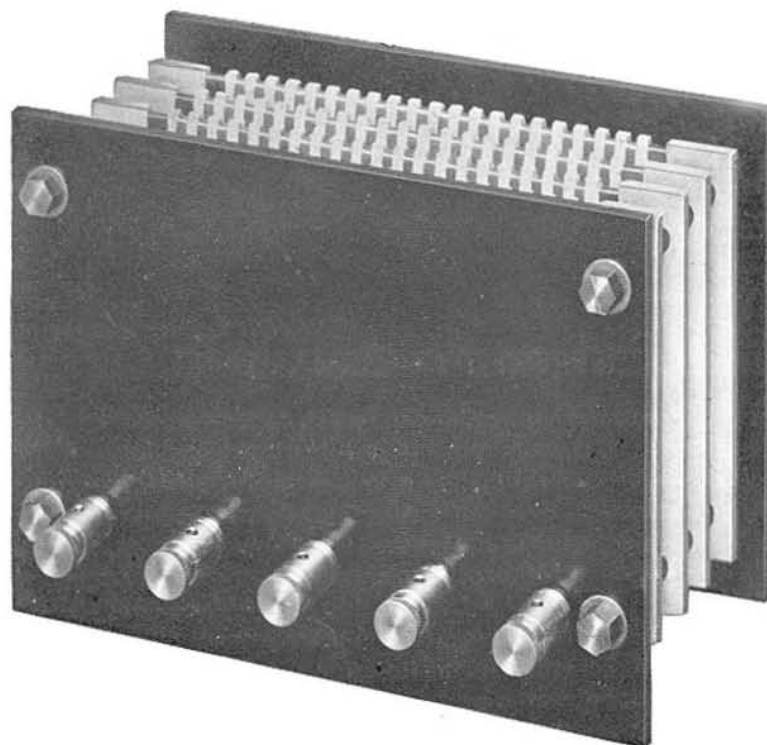
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This meter is of great value in a receiving station, since thru its use the efficiency of various detectors, receiving transformers, aeri-als or "hook-ups" can be compared, the increase of signal strength due to amplifiers can be determined, or the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

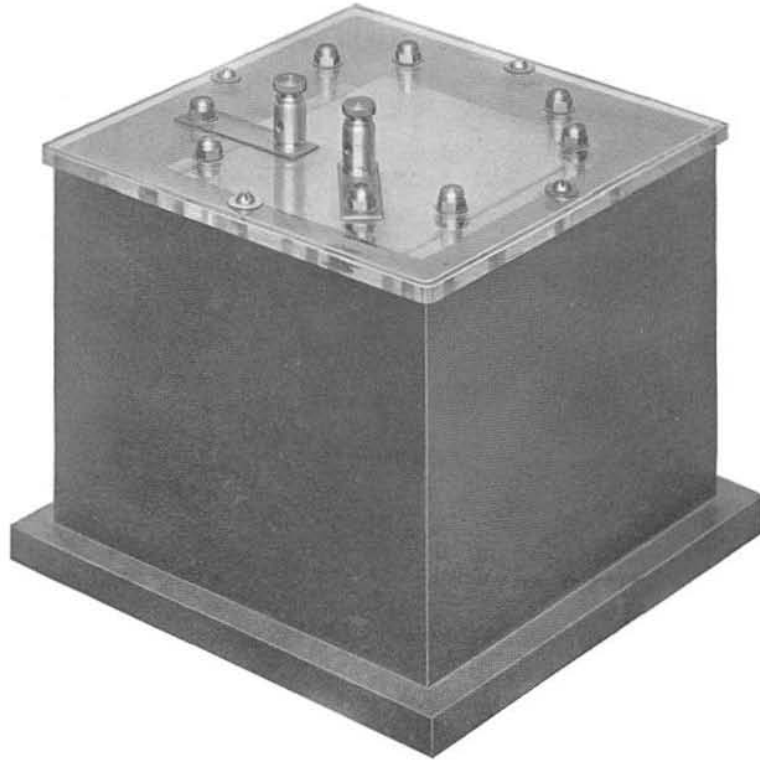
Condenser No. 108F is similar to No. 108D listed on page 6, but has a lower capacity (about .0015 M. F.) and a higher break down voltage (about 12,000 volts maximum).

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, 3¼"; 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 4 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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