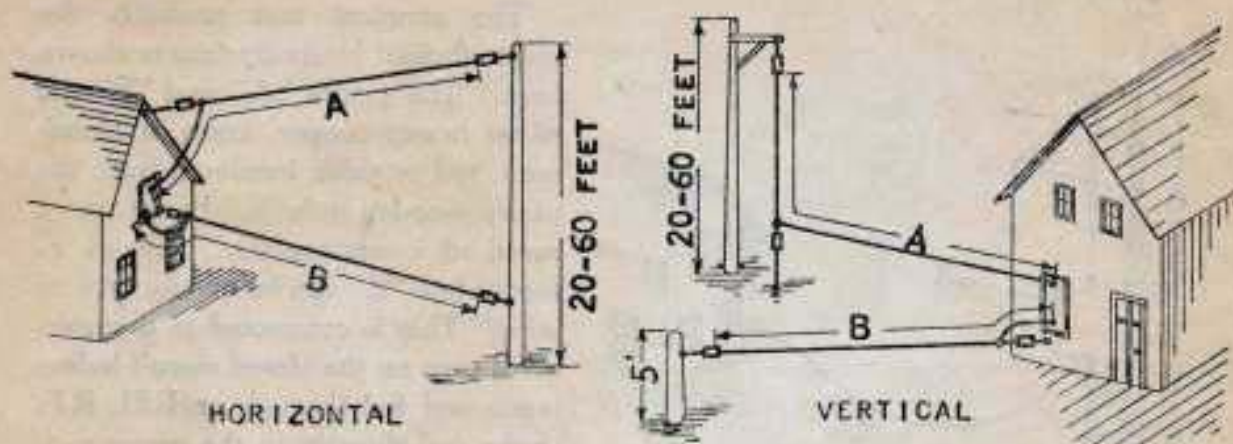


ANTENNA AND COUNTERPOISE DATA

GENERAL INFORMATION ON TUNING THE SECONDARY CIRCUIT



The antenna to be used for short wave transmission should be located in an unobstructed area free from trees, metallic structures or other foreign bodies. The above two arrangements will readily lend themselves to most locations.

Remember that in all cases the antenna "A" and counterpoise "B" are to be the same length and that this length is the total amount of wire from one end to the other including lead-in.

For correct lengths of "A" and "B" refer to the curve given on the next page. For example, if you should want to transmit on a wavelength of 40 meters operating the set slightly below the fundamental the curve indicates that the total length of each "A" and "B" is 30 feet. If you desire to operate on the 3d harmonic of the antenna, the antenna should have a fundamental to counterpoise of three times 40 meters, or 120 meters. The curve indicates 94 feet long.

Tuning the Antenna Circuit to Resonance with the Closed Circuit.

The secondary unit of the REL transmitting inductance is closely coupled to the primary or closed circuit inductance (previously this closed circuit has been tuned to the required wavelength according to instructions given with each circuit). First short circuit the antenna series variable condenser and tune the antenna inductance by moving the clip until maximum reading is indicated on the R.F. ammeter. If resonance can not be obtained remove the short circuiting piece on the antenna condenser and vary this capacity until maximum indication is had. Simply find the best combination of inductance and capacity.

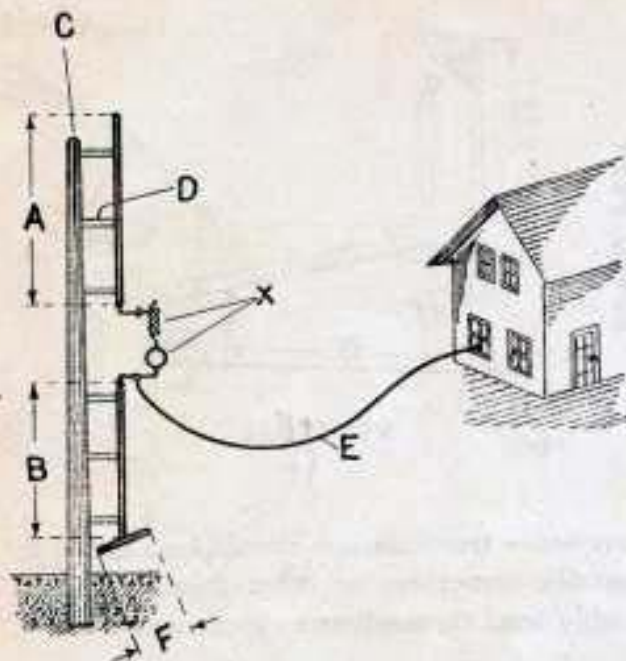
Experimentation will prove what the best coupling distance is between primary and secondary inductances. If coupling is too close the emitted signal will be broad and the circuit will be unstable.

RADIO ENGINEERING LABORATORIES

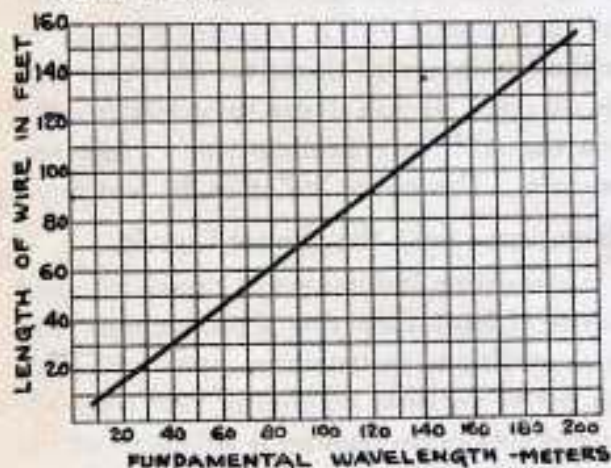
27 THAMES STREET

NEW YORK CITY, U. S. A.

ANTENNA DATA HERTZ SYSTEMS



General layout for Hertz Antenna System. (Note REL Type "L" inductance unit and R.F. ammeter at point (X).)



Curve showing antenna lengths for various wavelengths. This holds true for practical purposes where single wire systems are used and distance between aerial and counterpoise varies between 10 and 50 feet.

Curve reprint from QST, May, 1926.

The simplest and probably the most efficient Hertz System is shown here. The pieces "A" and "B" are either heavy copper, brass or aluminum, rod or tube, insulated from the heavy wooden pole "C" by means of stand-off insulators "D." The R. F. feeder line "E" can be of any type of wire. This is connected to a convenient turn on the closed circuit inductance and fed through an REL R.F. choke coil directly to the meter connection on the pole. The pole may be located at some distance from the house within limits.

The clip on the pole inductance is varied until maximum reading is had on the pole meter. Incidentally, also vary the R.F. clip on the closed circuit inductance for maximum output.

Parts "A" and "B" are of equal lengths and should correspond to table given below.

Piece "F" may be added to the lower part of "B" to help load capacities if needed. It is located about five feet above ground.

The following table is correct for operation on the fundamental of the system:

Dimensions given are in		
Feet	Feet	Meters
Length of "A" & "B"	Feet	Wave Length
14 each	3	20
30 "	5	40
*50 "	10	80

*For longer wavelengths it is advisable to use this system in horizontal designs.

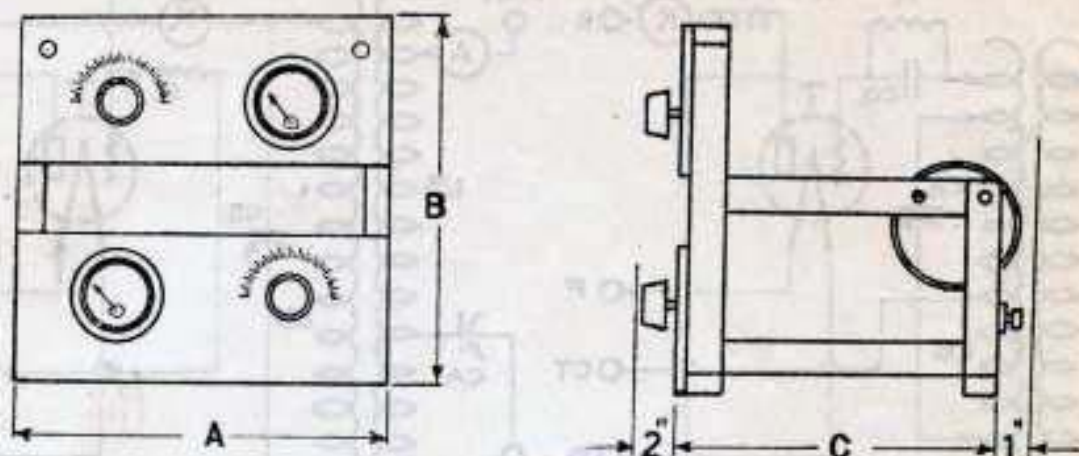
For complete data on Hertz Systems see QST, July, 1925, page 24; and July, 1926, page 8.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CAT. 157—COUPLED HARTLEY TRANSMITTING KITS



The popular loose coupled Hartley circuit is used in this kit. This is the simplest type of transmitter and will be found extremely easy to place in operation. An excellent crystal amplifier stage is obtained by using the series feed circuit with this kit.

Power supply can be had either through motor generator, rectified A.C. or "B" batteries.

TRANSMITTER SPECIFICATIONS

Cat. 157 Type	Tube Used	Watts	Dimensions—Inches			Plate Volts	Fil. Volts	Kit Price
			A	B	C			
TR-5	UX210	7.5	15	15	12½	400	7.5	\$56.00
TR-15	DE F-D-	15	15	15	12½	400	7.5	56.00
TR-50	UV203A	50	15	15	12½	1000	10	63.00
TR-65	DE F-H-	65	15	15	12½	1500	10	63.00
TR-250	UV204A	250	21	18	18	2000	11	79.00

The following parts are supplied for these kits: Frame, neatly finished in black crystalline lacquer; two black "Radion" panels, drilled and engraved; series antenna variable condenser; primary shunt variable condenser; thermocoupled R.F. antenna current meter; D.C. plate milliamperemeter; two bakelite condenser knobs; vacuum tube socket; grid condenser; plate condenser; grid leak; R.F. choke coil; rear binding post strip complete; bus-bar and flexible rubber covered wire; REL type "L" transmitting inductances with clips and two glass coupling rods.

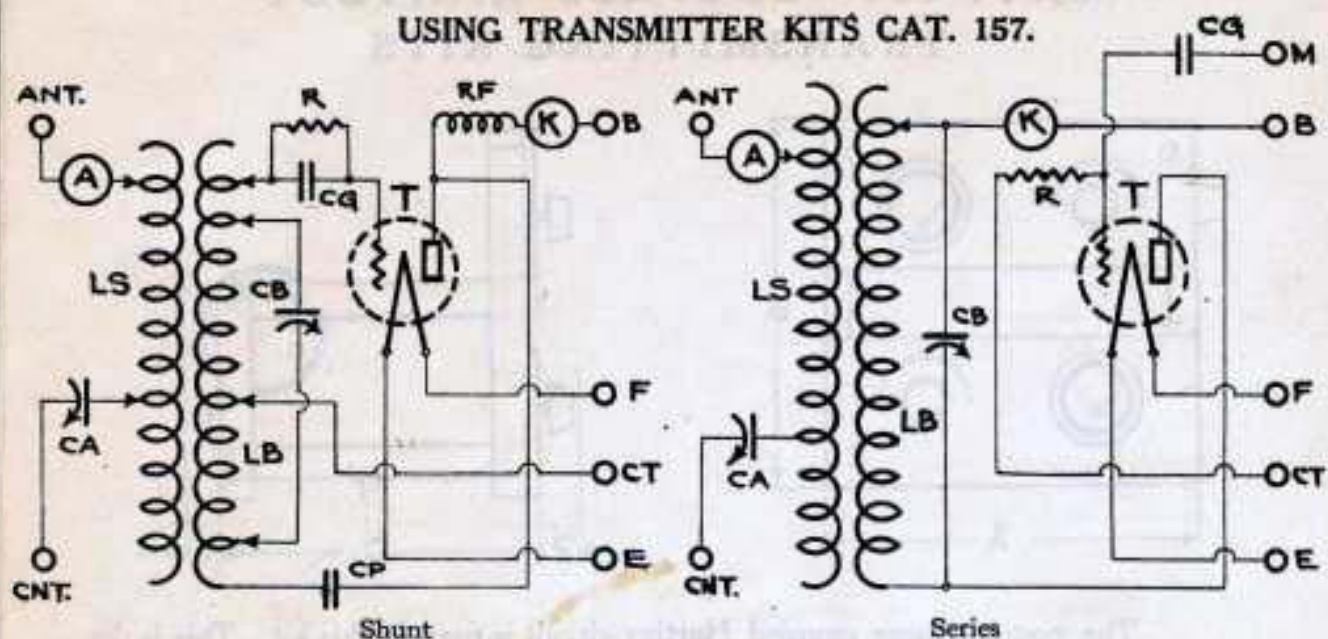
RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

COUPLED HARTLEY CIRCUIT DATA

USING TRANSMITTER KITS CAT. 157.



CIRCUIT SPECIFICATION

- | | |
|---|-----------------------------------|
| LS—REL Type "L" inductance; | LB—REL Type "L" inductance |
| (Note: For 20 meter operation use REL Type "S" inductance.) | |
| CA—Series variable condenser | CB—Shunt variable condenser |
| A—Thermo R.F. ammeter | K—D.C. milliamperemeter |
| RF—REL R.F. choke coil | CG—Grid condenser |
| CP—Plate blocking condenser | T—Transmitter tube |
| R—Grid leak | B—To positive high voltage |
| F—To filament heating transformer | E—To filament heating transformer |
| CT—To center tap on filament heating transformer | |

Note: If direct current (includes battery supply) is used on the filament connect "CT" to "F" and let positive run to "F" and negative to "E."

SHUNT FEED HARTLEY

The approximate correct positions of the clips on "LB" are shown on the REL Inductance Circular No. 125. Check wavelength with an REL Type "A" Wavemeter. If the tube is drawing too much plate current move the center tap towards the grid end and vice versa.

The antenna inductance is then connected and tuned according to instructions given on the "Antenna Data Sheet," page 3.

SERIES FEED HARTLEY

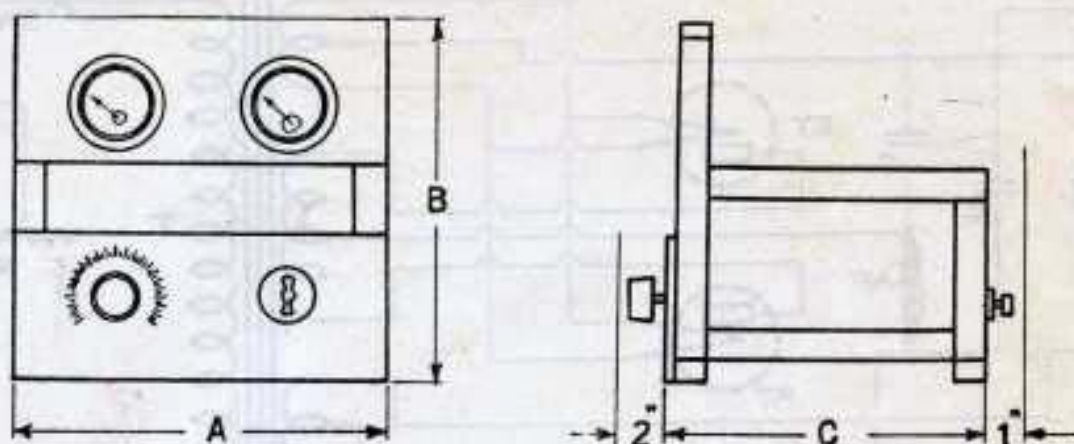
This circuit is best adapted to last stage amplifiers of crystal controlled transmitters. The connection "M" connects to the preceding inductance of another amplifier stage or else to the crystal oscillator itself. Resonance is indicated by a sharp dip in the reading of meter "K." Check all readings with an REL Type "A" Wavemeter to be positive that each amplifier stage is on the correct wavelength.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CAT. 156—RECTIFIER KITS (THERMIONIC TYPE)



When assembled these rectifier kits furnish complete power supply to the transmitter. Simply plug in to your 110 volt A.C. house line socket connection.

RECTIFIER SPECIFICATIONS

Cat. 156 Type	Tubes Required	Output Volts		Output Amps.		Kit Price
		Plate	Filament	Plate	Filament	
R-10	R C A UX 216B	400	7.5	.200	4	\$ 95.00
R-10 D	De Forest DR	400	7.5	.200	4	95.00
R-50 H	De Forest HR	1100	10	.250	5	125.00
R-250 P	De Forest PR	2200	12	.500	13	190.00

Unless otherwise specified all rectifier kits are supplied for 110 volt 60 cycle A.C. primary input. Rectifiers can be furnished to operate on various primary voltages and frequencies. Prices on application.

All rectifier kits are supplied with the following parts: Frame finished in black crystalline lacquer; (all rectifier frames have the same height dimension as the corresponding transmitter frames. This will help to give a symmetrical appearance when arranged side by side); two black "Radion" panels neatly drilled and engraved; one filament voltmeter; D.C. plate voltmeter, with resistor; one power transformer which supplies plate oscillator filament and rectifier filament; one 30 Henry choke coil; two 2 mfd. filter condensers; one primary voltage regulator; one main line snap switch; one rear binding post strip neatly engraved; two rectifier tube sockets; necessary screws and wire.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

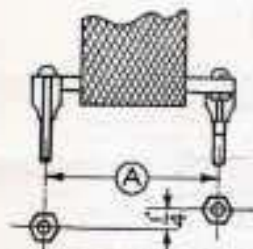
NEW YORK CITY, U. S. A.

REL PLUG-IN COILS

CAT. NO. 120



PLUG-IN COIL

BASE DIMENSIONS
(See Note)

REL Plug-in Coils are made in various sizes. They can be used wherever an inductance is required either in short wave or broadcast receivers.

The following table shows what the resultant wavelength will be when various coils are shunted by condensers of different capacities (given in microfarads). It is assumed that .00001 mfd. will represent the minimum of most condensers, although condensers of very small maximum capacity will have even small minimum capacities.

Type No.	Inductance Micro-Henrys	Wave Length Range with Various Sizes of Condensers Shunted Across Coil						Price Each
		.00001	.0001	.00025	.00035	.0005	.001	
*PL-3	2.1	9	28	47	58	70	95	\$0.90
*PL-5	8.9	29	56	78	88	100	127	0.90
*PL-8	29.3	43	85	103	117	131	177	1.00
*PL-10	24.2	51	93.5	119	132	155	212	1.05
*PL-14	30.5	61	104	146	164	203	272	1.15
*PL-24	65.	95	152	224	263	328	462	1.25
PL-30	94.3	114	183	264	327	387	517	1.30
PL-40	113.1	135	222	367	402	468	645	1.35
PL-48	229.6	168	282	437	500	590	812	1.35
PL-60	340.	195	348	508	593	690	995	1.40
PL-70	460.	228	405	594	693	814	1180	1.45

*Indicates that these sizes can be furnished with narrow mountings (N). Note: REL Plug-In Coils are made in two sizes. All types listed measure 2 3/4", while the "N" Types measure 1 7/8" (Dimension "A"). The "N" type will be found suitable for primary tickler and other purposes where a small narrow coil is required.

WHEN ORDERING COILS BE SURE TO SPECIFY TYPE NUMBERS



PLUG-IN COIL ACCESSORIES

Cat. No. 120



BASE PL-S1

SINGLE COIL BASE for one "standard" Type Coil

Type PL-S1Price \$.70

DOUBLE COIL BASE for one "standard" type Coil and one "N" type Coil

Type PL-S2Price \$.90

TRIPLE COIL BASE, for one "standard" coil in center with an "N" coil on either end. This is especially suited for capacity controlled regenerative short wave sets.

Type PL-S3\$1.10

ROTOR MOUNTING to be used in places where a variable inductance is required. Takes one "standard" type coil. For rear panel mounting 1/4" shaft projects through panel on which any type of dial can be fastened.

Type PL-R1Price \$1.75

COIL JACK with nut and lug, Type PL-J..... .10

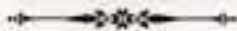
COIL PLUG with screw and nut, Type PL-P..... .10

FLEXIBLE LEADS, 8 inches long with Fahnstock clip on one end and solder lug on other,

Type PL-F10



SHOWING HOW ROTOR PL-R1 CAN BE ADAPTED TO VARIOUS ARRANGEMENTS

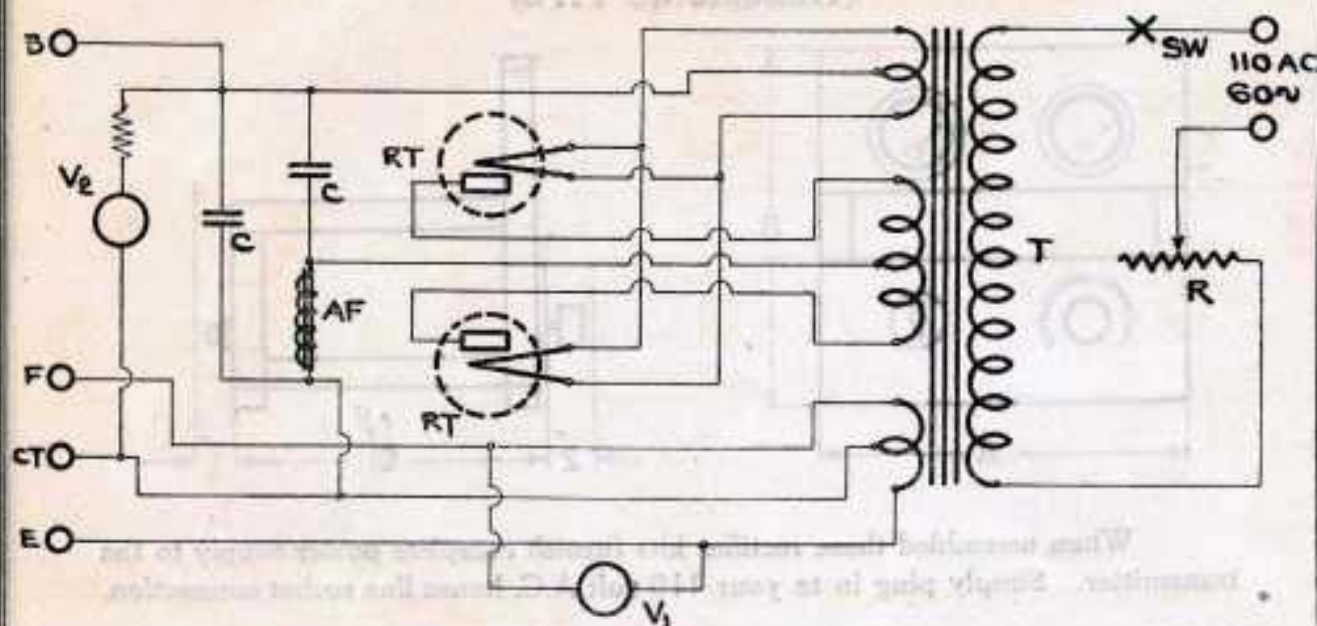


RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

THERMIONIC RECTIFIER CIRCUIT DATA USING KITS CAT. 156



CIRCUIT SPECIFICATIONS

- | | |
|---------------------|---|
| T—Power transformer | AF—30 Henry choke coil |
| SW—Line switch | V ₁ —A.C. filament voltmeter |
| R—Line rheostat | V ₂ —D.C. plate voltmeter |
| RT—Rectifier tubes | C—Filter condensers |

The apparatus in this kit is mounted in the frame as shown on detailed blueprint supplied. The resistance "R" is used to regulate the input voltage to the primary of the transformer. Voltmeters V₁ and V₂ indicated when the correct setting is obtained. This, of course, is determined by the tubes used in the transmitter.

The binding posts on the left correspond to those shown on the right side of the transmitter data sheets. Once the rectifier is set in operation there are no further adjustments necessary.

The use of alternating current provides an excellent and flexible means of supplying power for continuous wave telegraphy and telephone sets. It is especially adaptable for the amateur radio experimenter because a wide range of experimentation is open to him, at a low first cost. These units have no maintenance cost, and their life is unlimited.

Probably the best method for keying is to break the center tap line and insert the key. To reduce arcing at the key contacts place a one mfd. condenser across the key. If this is not sufficient place a 12,000 ohm resistance in series with this one mfd. condenser.

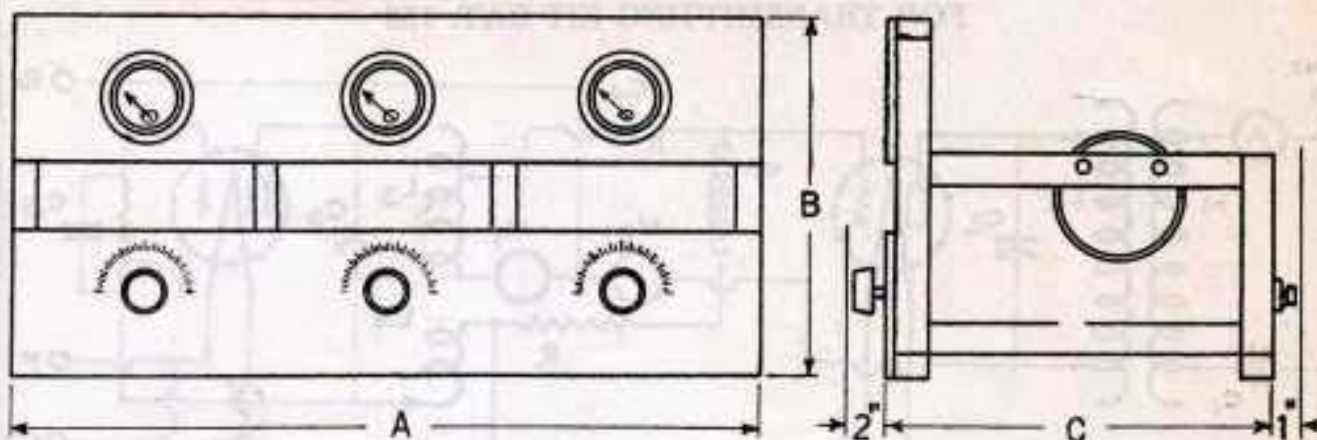
Of course, other good methods, such as breaking the grid circuit and compensated wave, can also be employed.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CAT. 155—MASTER OSCILLATOR-POWER AMPLIFIER TRANSMITTING KITS



Next to a crystal controlled transmitter the master-oscillator-power amplifier set will put out the steadiest signal. Antenna swinging has practically no effect on the emitted signal. This circuit is recommended where consistent communication is a requirement.

TRANSMITTER SPECIFICATION

Cat. 155 Type	Tubes Used	Watts	Dimensions—Inches			Plate Volts	Fil. Volts	Kit Price
			A	B	C			
TR-5	2 UX210	7.5	30	15	12½	400	7.5	\$86.00
TR-15	2 DEF-D	15	30	15	12½	400	7.5	86.00
TR-50	2 UV203A	50	30	15	12½	1000	10	96.00
TR-65	2 DE-F-H	65	30	15	12½	1500	10	96.00
TR-250	2 UV204A	250	30	18	18	2000	11	114.00

The following parts are supplied for these kits: Frame neatly finished in black crystalline lacquer; two black "Radion" panels drilled and engraved; series antenna variable condenser; oscillator inductance shunt variable condenser; amplifier inductance shunt variable condenser; thermo-coupled R.F. antenna current meter; oscillator plate current meter; amplifier plate current meter; three bakelite condenser knobs; two vacuum tube sockets; two double REL Type "L" transmitting inductances with clips and four glass coupling rods.

A very neat and efficient transmitter that you will be proud to own and operate.

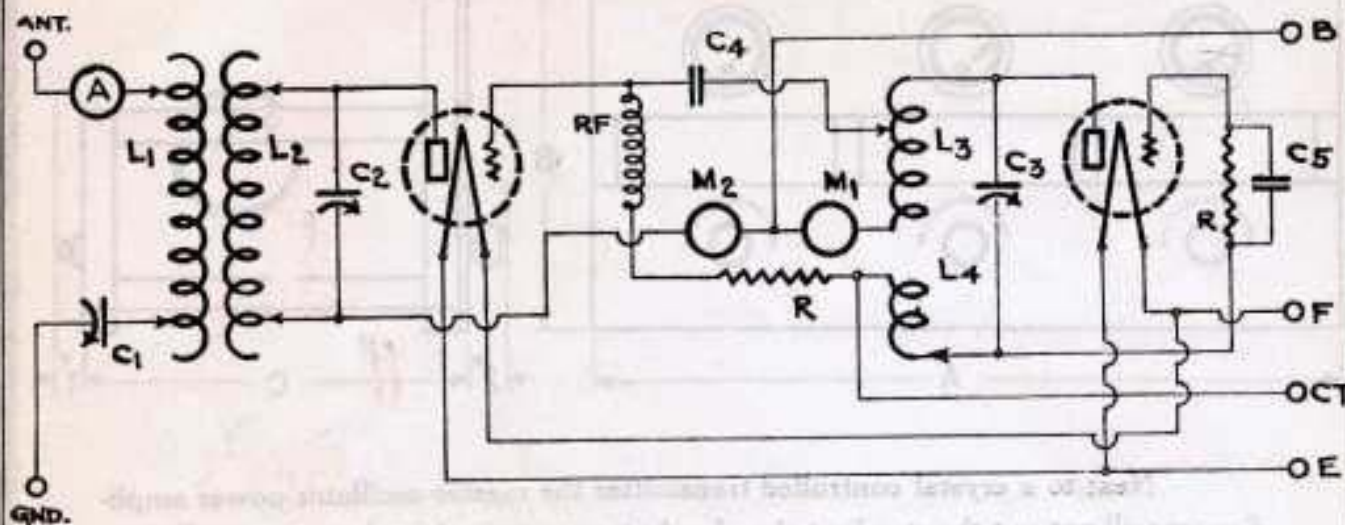
RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

MASTER OSCILLATOR-POWER AMPLIFIER CIRCUIT DATA

FOR TRANSMITTING KIT CAT. 155



CIRCUIT SPECIFICATIONS

- | | |
|--|------------------------------------|
| A—Antenna ammeter | RF—R.F. choke coil |
| C ₁ —Antenna series condenser | C ₄ —Coupling condenser |
| C ₂ —Amplifier tuning condenser | C ₃ —Grid condenser |
| C ₅ —Oscillator tuning condenser | R—Grid leak |
| L ₁ -L ₂ -L ₃ -L ₄ —REL inductance units | |

This circuit can be best adjusted in the following manner: For 40 and 80 meter operation REL Type "L" inductance are used and for 20 meters and lower use the REL Type "S."

The oscillator circuit, which is tuned by inductances L₁ and L₂ and condenser C₂, is set to the desired wavelength as indicated by an REL Type "A" Wavemeter. By varying the clip on L₁ the plate current of the oscillator tube can be regulated. This reading is given on the D.C. millampere M₁. After the oscillator is set to the correct wave length, couple L₂ to the plate end of L₁ and adjust the clips on L₁ and the condenser C₁ until ammeter "A" indicates maximum reading. It may be found necessary to short circuit C₁ and only tune the inductance L₁. This will occur when the fundamental of the antenna is the same as the designated operating wavelength of the transmitter.

L₂ is now placed in its correct position next to L₁. Care must be taken to see that the clips on L₁ and the capacity of C₁ is not changed. The amplifier circuit is tuned by L₃ and C₃. Correct position is indicated by maximum reading on "A." It will now be necessary to slightly readjust all condensers for maximum output and check wavelength at L₁.

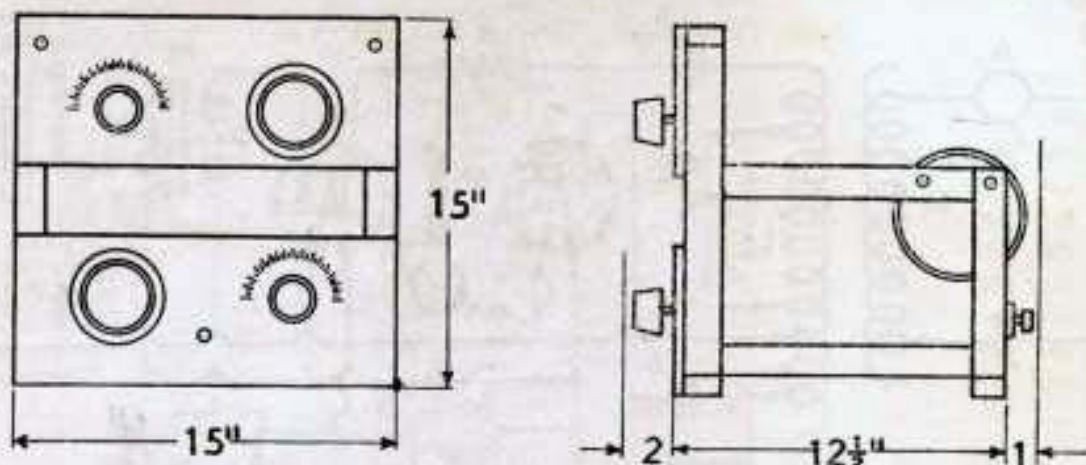
The centre tap "CT" line may be broken and the key inserted.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CAT. 136. LOW POWERED C.W. TELEPHONE TRANSMITTER KIT



Type TR-10-P

A very compact and efficient low powered telephone transmitter can be obtained with one of these kits. It is made adaptable to all tubes with either standard or UX bases. Two tubes of like characters are required. Any standard type of carbon microphone will do.

The power supply can be derived from batteries. In cases where the RCA UX-210 tubes are employed, 350 volts of "B" battery will be necessary. These batteries will last over quite a long period. The filament supply can be derived from "A" battery source giving between 6 and 7.5 volts.

Of course, motor-generator or some source of rectified AC can be used with satisfaction. In fact, many of the larger "B" eliminators which supply 300 or more volts are ideal.

Once the set is adjusted to its wavelength, there are no further adjustments necessary. Simply plug in the microphone and talk. The Coupled Hartley Oscillator is employed. This means ease in shifting from one wavelength to another.

The following parts are furnished for this kit: Frame neatly finished in black crystalline lacquer, two black "Radion" panels drilled and engraved, two variable condensers, two condenser knobs, two REL Type "L" transmitting inductances, thermo-coupled R.F. antenna meter, D.C. plate milliamperere meter, grid condenser, grid leak, plate blocking condenser, two tube sockets, REL R.F. choke coil, audio choke, modulation transformer microphone jack, rear binding post strip and necessary wire and screws.

PRICE \$68.00

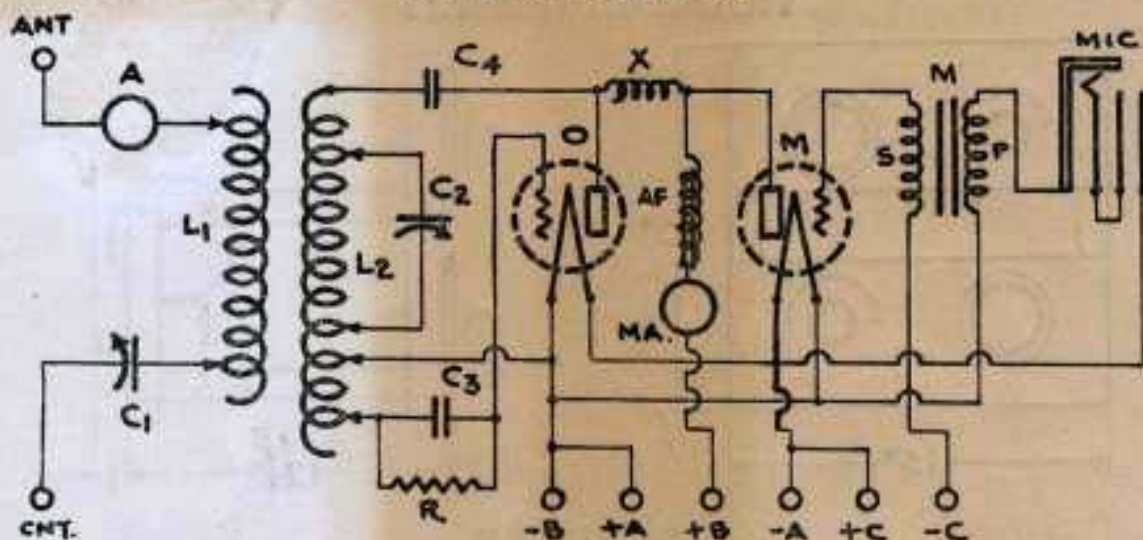
Complete Kit As Specified

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

DATA ON LOW POWERED C.W. TELEPHONE SET USING KIT CAT. 136



A—Antenna Current Meter—Thermo C

MA—D. C. Plate Milliampere Meter.

L1—Secondary—REL Type "L" Inductance Unit.

L2—Primary—REL Type "L" Inductance Unit.

C1—Antenna series variable condenser coupled R. F.

C2—Secondary shunt, wavelength cont of variable condenser.

C3—Grid Condenser.

C4—Plate Blocking Condenser.

R—Grid Resistance or Leak.

X—R.F. Choke Coil.

AF—Audio Frequency Choke Coil.

(Necessary to insure constant current for the modulator tube)

O—Oscillator tube—preferably UX-210 although any of the following can be used successfully: UX-112; UX-201 A; VT 2 or DeForest "D."

Note: Care must be taken to use the correct "A" and "B" voltages as specified for the tube used.

M—Modulator tube—must have same characteristics as oscillator tube.

MT—Modulation Transformer.

Note: The correct "C" Battery voltage will vary between 22 and 45.

Note: Where the "A" Battery does not exceed 6 volts, it may be used on the microphone as shown connected through the automatic jack.

MIC—Special Jack into which microphone is plugged.

Note: This is so connected that when the plug is withdrawn the battery circuit to the microphone is opened.

OPERATION

The set is assembled and wired according to the diagram given above. The oscillator and modulator tubes are placed in their respective sockets. The oscillatory circuit is then tuned to the desired wavelength. (For tuning the Hartley circuit see pages 3 and 6), and then the antenna circuit is tuned to resonance.

When the microphone is spoken into, plate milliampere meter needle should fluctuate in exact accordance with the voice. If the microphone is spoken into with continuous long loud syllables the pointer of the antenna meter should climb upwards. These two indicators show whether or not the set is being correctly modulated.

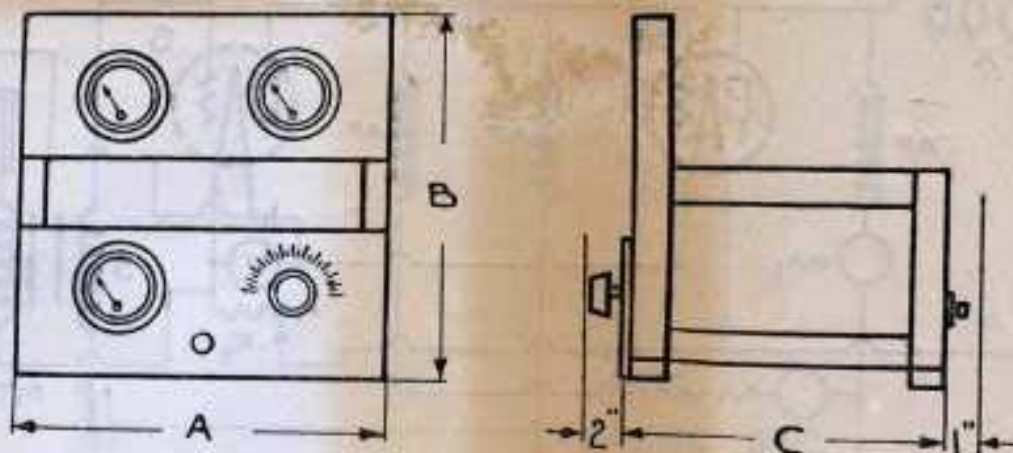
RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

MODULATOR AND SPEECH AMPLIFIER KITS

CATALOGUE No. 159



A—These combined modulator and speech amplifier kits were expressly designed or use with any of the oscillator units listed in this catalogue. The general appearance and dimensions are the same as their corresponding oscillators. This insures a neat appearance to transmitters built up of these symmetrical units.

To efficiently modulate the oscillator it is necessary to employ an extra tube as modulator. This in turn should be fed by a speech amplifier tube of smaller power. The Heising system of modulation is probably the best and is therefore employed in these kits.

SPECIFICATIONS

Cat. 159 Type No.	Mod. Tube	Speech Amp. Tube	Dimensions—Inches			Kit Price
			A	B	C	
M-5	R.C.A. UX-210	R.C.A. UX-112	15	15	12½	\$62.00
M-10D	DeForest D	DeForest D	15	15	12½	62.00
M-50	R.C.A. UV-203-A	R.C.A. UX-210	15	15	12½	72.00
M-50H	DeForest H	DeForest D	15	15	12½	72.00
M-250	R.C.A. UV-204-A	R.C.A. UV-203-A	21	18	18	80.00

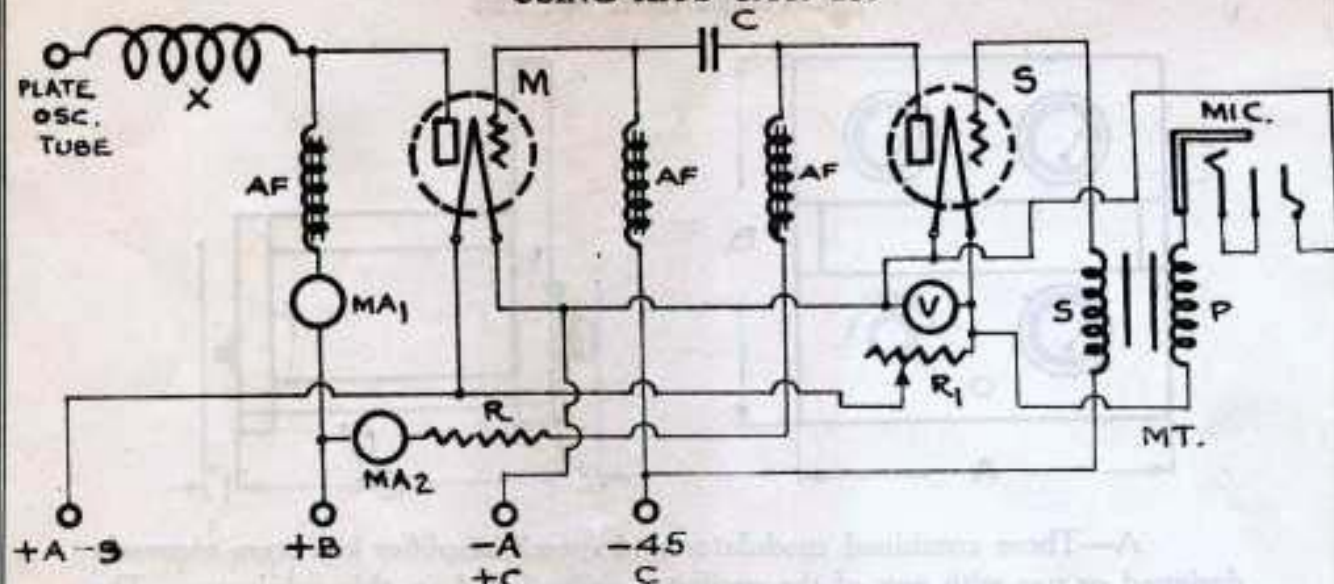
B—The following parts comprise equipment furnished with this kit: Neat and rugged frame finished in black crystalline lacquer; two black "Radion" panels, drilled and engraved; modulator tube socket; speech amplifier tube socket; three 1½ Henry audio frequency choke coils; modulator plate current milliamperemeter; speech amplifier filament volt meter; 1 mfd. coupling condenser; R.F. choke coil; modulation transformer; microphone jack.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

MODULATOR AND SPEECH AMPLIFIER DATA USING KITS CAT. 159



CIRCUIT SPECIFICATIONS

M—Modulator tube, see table on other side, for correct tube combination.

S—Speech Amplifier Tube.

X—Radio Frequency Choke Coil.

Note: This choke is absolutely necessary, if good modulation is to be obtained with the Heising system.

AF—Audio Frequency Choke Coils.

Note: The choke coil is necessary in series with the plate circuit to maintain the D. C. Supply voltage to the plate at constant value, even though the output of the set is modulated at audible frequencies.

MA1—Modulator tube plate current milliamperemeter.

MA2—Speech Amplifier plate current milliamperemeter.

R—Resistance to cut down plate voltage for speech amplifier tube.

R1—Rheostat to cut down filament voltage for speech amplifier tube.

V—Speech amplifier filament voltmeter.

Note: Under most conditions the filament supply for the oscillator and modulator tubes is too high for the speech amplifier. By means of R1 and this voltmeter it is a simple matter to obtain the correct voltage.

C—Large Coupling Condenser.

MT—Modulation Transformer.

MIC—Microphone Jack—with automatic control of microphone battery.

OPERATION

After completing this kit it remains only to be connected with the oscillator. Any of the oscillators shown in this catalogue may be used with the modulator unit. Simply connect the plate of the oscillator tube to post marked "PLATE." Care must be taken to see that the positive high voltage connection is removed from the oscillator unit as this will be fed through from the modulator side.

In radio telephone transmitting equipment the degree of modulation is of equal importance to the amount of antenna current as far as the strength of the received speech is concerned. The antenna current does not usually indicate whether the output is being modulated in a normal manner. The meter MA1 fluctuates upward when the microphone is being spoken into. It should increase to almost double if good modulation is obtained. Similarly the meter MA2 will show a very noted upward movement.

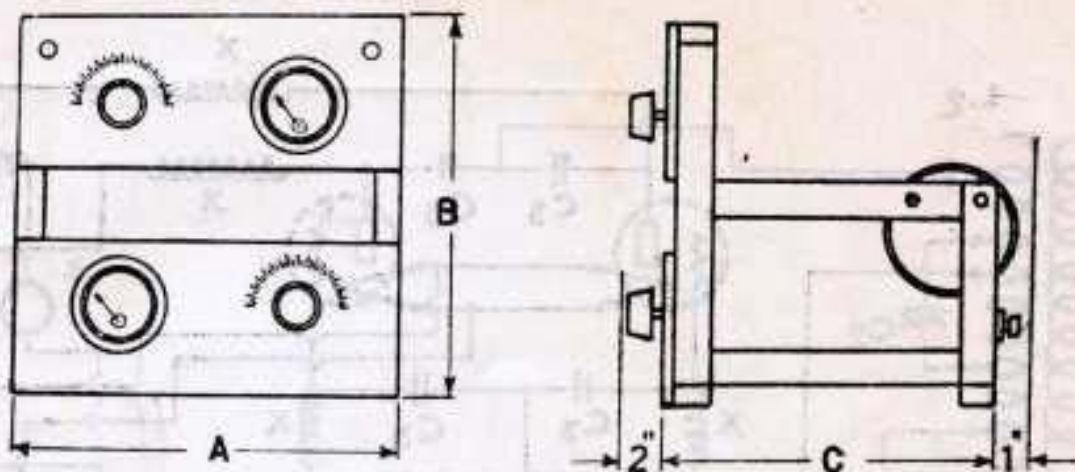
These symptoms must appear if the apparatus is functioning properly.

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CAT. 152. SELF RECTIFIED COUPLED HARTLEY TRANSMITTER KITS



By using two tubes as oscillators in the self rectified circuit a good signal tone can be produced without the additional use of extra rectifier tubes. The only other apparatus necessary is the power transformer which supplies the plates and filaments. This combination is popular with the amateurs because of its simple means of obtaining the power supply.

TRANSMITTER SPECIFICATIONS

Cat. 152 Type	Tubes Used	Watts	Dimensions—Inches			Plate Volts	Fil. Volts	Kit Price
			A	B	C			
S-5-R	RCA UX210 DE F	7.5	15	15	12½	400	7.5	\$60.50
S-15-R	RCA D	15.	15	15	12½	400	7.5	60.50
S-50-R	RCA UV203A DE F	50.	15	15	12½	1000	10.	73.00
S-65-R	RCA H	65.	15	15	12½	1500	10.	73.00
S-250-R	RCA UV204A	250.	21	18	18	2000	11.	93.50

The following parts are furnished for this kit: One neatly built frame finished with black crystalline lacquer. Two black "RADION" panels, drilled and engraved, antenna series variable condenser, primary shunt variable condenser, two condenser knobs, five R.F. Chokes, two plate blocking condensers, two grid condensers, one REL Type "L" Transmitting Inductance, two tube sockets, two grid leaks, one complete rear binding post strip, necessary mounting screws, busbar and flexible wire.

TRANSFORMER information can be obtained by referring to another section of this catalogue.

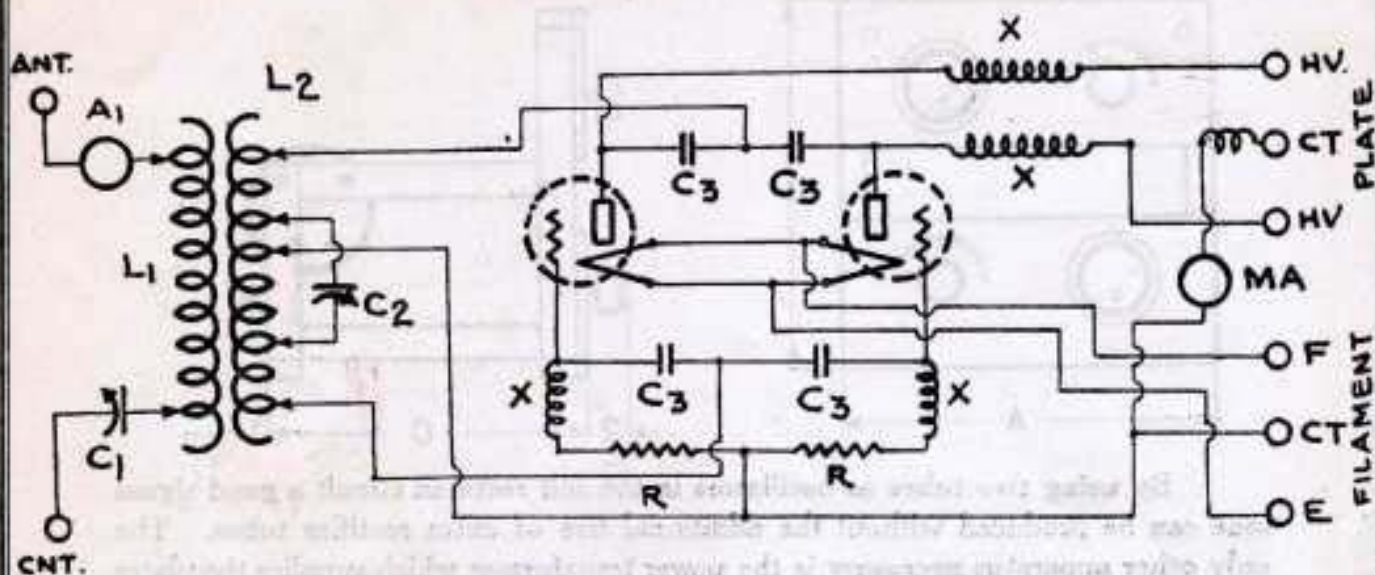
RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

SELF RECTIFIED COUPLED HARTLEY CIRCUIT

USING KITS CAT No. 152



CIRCUIT SPECIFICATIONS

- A1—Antenna Current Meter—Thermo-Coupled R.F.
 MA—D.C. Plate Milliammeter.
 L1—Secondary—REL Type "L" Inductance Unit.
 L2—Primary—REL Type "L" Inductance Unit.
 C1—Antenna Series Variable Condenser.
 C2—Secondary Shunt Variable Condenser.
 C3—Grid and Plate Condensers.
 R—Grid Resistance.
 X—R.F. Choke Coils.
 HV—Connection to high voltage winding of transformer.
 FCTE—Connection to low voltage winding of transformer.

After all connections are made and checked so as to correspond with circuit diagram shown it simply remains to tune the set to the desired wavelength. Follow tuning instructions given for the coupled Hartley kits on page 6. After the wavelength of the primary has been checked with the wavemeter, bring the secondary in resonance with this by varying the number of turns of L1 or by varying the capacity of C2. This circuit may be "keyed" in several advantageous places. The center connection to L2 may be broken and the key or relay inserted or else the key may be placed in the line which runs from the center of the two grid condensers.

The center tap connections "CT" of the plate and filament windings are connected as shown.

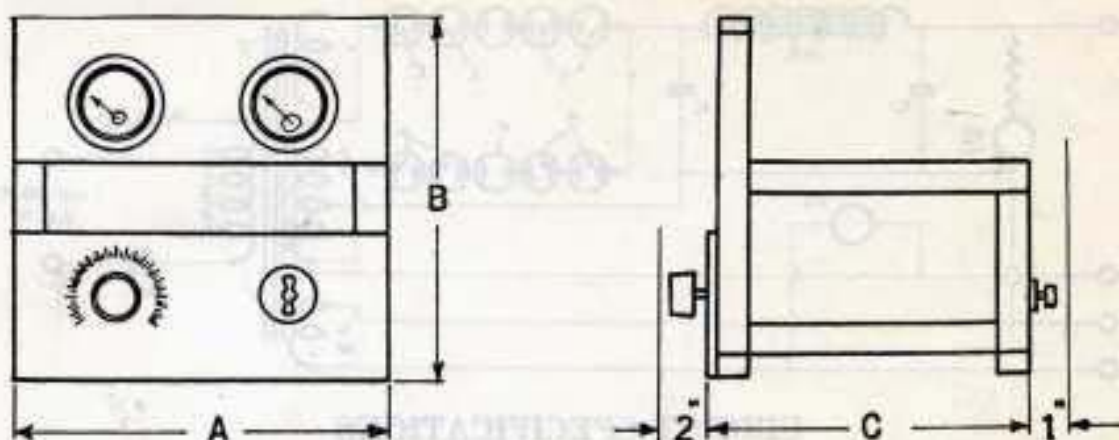
RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

RECTIFIER KITS

(ELECTROLYTIC TYPE)—Catalogue No. 158



These kits are similar to those listed as Catalogue 156, excepting that they replace the rectifier tubes with chemical jars. Although this method may seem quite mussy, it does however perform to highest satisfaction and costs less.

RECTIFIER SPECIFICATIONS

Cat. 158 Type	Output Plate	Volts Filament	Output Plate	Amperes Filament	Kit Price
R-10C	400	7.5	.200	4	\$96.00
R-50C	1100	10	.250	5	120.00
R-250C	2200	12	.500	13	180.00

Unless otherwise specified all rectifier kits are supplied for 110 volt 60 cycle A. C. Primary input. Rectifiers can be furnished to operate on various primary voltages and frequencies. Prices on application.

All electrolytic rectifier kits are supplied with the following parts: Frame finished in black crystalline lacquer: (All rectifier frames have the same height dimensions as their corresponding oscillator or modulator frames. This will enable the amateur to construct a symmetrical appearing station) two black "Radion" panels neatly drilled and engraved; A.C. filament voltmeter; D.C. plate voltmeter with resistor; Power Transformer which supplies plate and filament; 30 Henry filter choke coil; two 2 mfd. filter condensers; main line snap switch; rear binding post strip neatly engraved; necessary quantity of lead and aluminum strips with connectors; one large box of borax; connecting wire and mounting screws.

No jars are supplied with this kit due to difficulties in packing and possible breakage in shipment. Your local dealer or a 5 and 10 cent store will have these on stock. They should measure approximately two inches in diameter and five inches long. Any glass jars with about these dimensions will suffice.



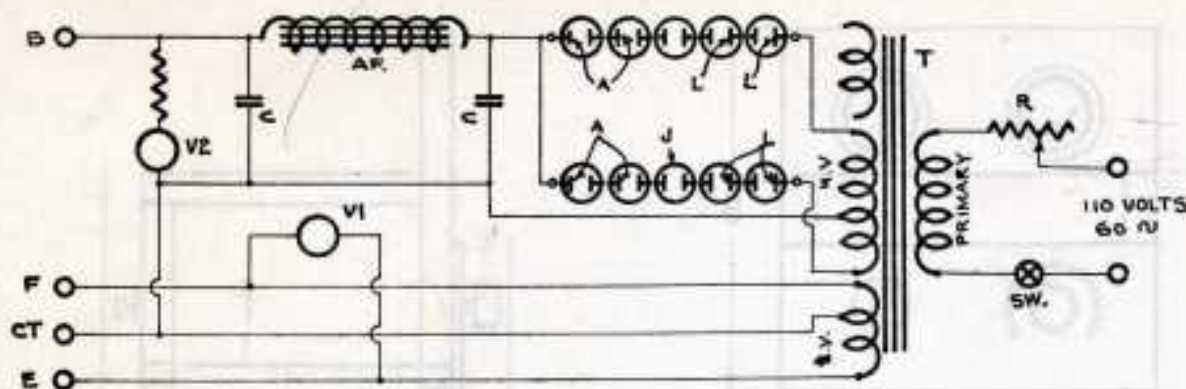
RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

ELECTROLYTIC RECTIFIER CIRCUIT DATA

USING KITS—Catalogue No. 158



CIRCUIT SPECIFICATIONS

- | | |
|---------------------|-----------------------------|
| T—Power Transformer | J—Jars, containing solution |
| SW—Line Switch | AF—30 Henry Choke Coil |
| R—Line Rheostat | V1—A.C. Filament Voltmeter |
| L—Lead Plates | V2—D.C. Plate Voltmeter |
| A—Aluminum Plates | C—Large Filter Condensers |

For general instructions see page 8.

The above diagram gives proper connections for the electrolytic rectifier. This is fundamentally constructed by immersing a strip of lead and one of aluminum in a glass jar containing approximately one pint of a saturated solution of borax and water. The lead strip is of the same size as the aluminum. About eight square inches of aluminum per ampere are necessary. A cell or jar should be provided for each seventy-five volts output.

Before using the rectifier it should be "formed" by short circuiting the output and allowing current to pass through it for from one to two hours. **CAUTION:** As during the early stages of this process, a direct short circuit is placed on the transformer, a lamp of suitable size should be placed in series with the primary. If the transformer shows a tendency to overheat a smaller lamp should be substituted for the one in use.

When a dull white deposit appears on the aluminum plates they are formed and ready for use.

For consistent, successful operation be sure that the strips are properly formed and kept clean at all times. Use only pure materials.

The filter shown here is of excellent design and one of the best. The importance of using a good filter cannot be over-emphasized at the present time, as only when one is used can a minimum of interference be obtained. Most trouble caused by interference from an amateur C.W. Transmitter has been traced to an inefficient filter system. This is caused by a sixty cycle or motor generator commutator frequency modulating the output.

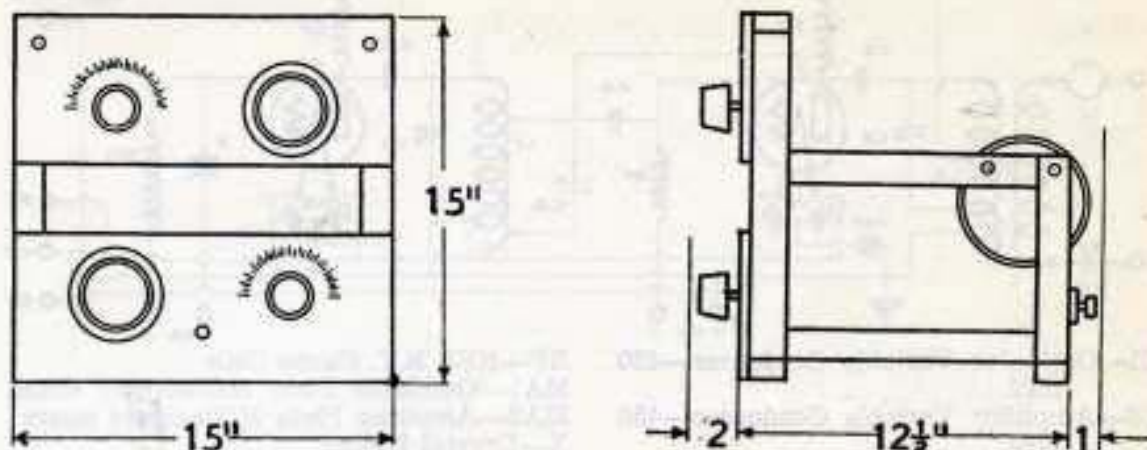


RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

QUARTZ CRYSTAL OSCILLATOR WITH ONE STAGE AMPLIFIER—Catalogue No. 144



This kit should fill the demand for a good crystal oscillator and first amplifier. It can be directly coupled to the antenna or else fed into another amplifier which uses a more powerful tube.

By combining this kit with our Catalogue No. 155 (series feed Hartley) a very efficient crystal transmitter will be the result. This last amplifier should be either a 50 or 250 watt tube (type TR-50 or TR-250). The crystal holder supplied will take care of any thickness crystal being either one inch square or round.

Crystals are not supplied.

It is advisable to use crystals of such size that their frequency will be doubled by each stage of amplification. This means that if a 160 meter crystal is used, then the first amplifier is tuned to 80 meters. This can then be fed into the antenna or into a second amplifier. This last amplifier can then be tuned to either 80 or 40 meters. The output of this goes into the antenna or still another amplifier. Care must be taken in neutralizing any amplifier which operates on the same frequency as the preceding amplifier.

The following parts are supplied for these kits: Frame finished in black crystalline lacquer; two black "Radion" panels drilled and engraved; two variable condensers with knobs; oscillator Plug-IN Inductance; four R.F. chokes; crystal holder; four filament bypass condensers; two plate blocking condensers; one grid coupling condenser; key jack; one REL Type "L" Inductance (single unit); two milliamperemeters; two tube sockets; binding post strips and connecting wire.

This kit is the basis for all crystal controlled transmitters. Its use will assure the correct results with the minimum amount of experimentation.

PRICE \$65.00

Complete Kit As Specified

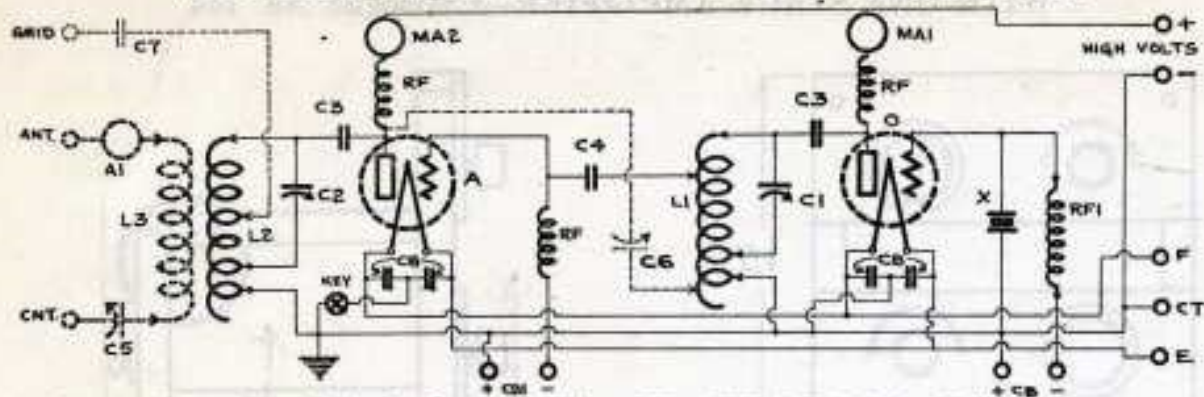


RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CIRCUIT DATA ON QUARTZ CRYSTAL OSCILLATOR WITH ONE STAGE AMPLIFIER USING KIT—Catalogue No. 144



- C1—Oscillator Variable Condenser—450 mfd.
 C2—Amplifier Variable Condenser—450 mfd.
 C3—Plate Blocking Condensers—2000 mfd.

- C4—Coupling Condensers—1000 mfd.
 C5—By pass Condensers—6000 mfd.

- RF1—Plug-IN Choke Coil with natural period equal to that of crystal

NOTE: When ordering be sure to specify frequency at which crystal oscillates so that correct choke coils can be furnished.

- L1—Special Plug-IN Inductances, tapped every 3d turn

Note: Three sizes are made. Each is designed to cover the following wavelengths used in conjunction with C1: 60 to 100 meters; 100 to 220 meters and 220 to 400 meters. Only one coil is furnished with each kit.

- L2—REL Type "L" Inductance which when used with C2 will cover all wavelengths from 30 to 120 meters.

Note: If the 320 meter coil is used in L, then it will be necessary to connect two REL Type "L" Units in series so as to tune up to about 200 meters with C2.

- A, O—Use UX 210 for both oscillator and amplifier

- HV—Use about 400 volts for plate supply on both tubes

- CB, CB1—20 to 45 volts "C" Battery (use separate battery on each tube as shown)

OPERATION

The first step is to get the oscillator going. The crystal holder plates must be free from dirt, grease and finger prints. These can be washed with carbon-tetrachloride (Pyrene liquid or Carbona). All the clips are fastened to L1 in such positions as to check with above drawing. Condenser C1 is varied slowly until a sharp dip is obtained on MA1. At this lowest reading you will have secured the operating point of the crystal and also the maximum output. Check this with the REL Wavemeter. The wavelength reading thus secured should correspond to that of the crystal.

The clip "Y" is then connected to L1 at about two turns from the plate tap. The amplifier tube "A" is then put in operation. The clips on L2 are located in approximately correct positions. C2 is then varied until a sharp dip is had on MA2. Take a wavemeter reading at L2. This will indicate the relative frequency of "A" to "O." It is preferable to have "A" at double the frequency of "O." If "A" is to operate at the same frequency as "O" then it will be necessary to neutralize "A." This must be done before any plate voltage is applied to "A."

NEUTRALIZING—Light the filaments of both tubes and apply plate voltage to "O" only. Adjust C6 until there is practically no movement of MA1 when C2 is being varied. If complete neutralization can not be had make adjustments so that a minimum will show at MA1.

(For more concise information see QST, May, 1926, page 43.)

If desired the output of L2 can be directly coupled to the antenna through the circuit A1, L3, C5 or else it may be fed through the dotted condenser C7 to the next amplifier.

RADIO ENGINEERING LABORATORIES

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NEW YORK CITY, U. S. A.

INTERNATIONAL MORSE CODE AND CONVENTIONAL SIGNALS

LIST OF ABBREVIATIONS TO BE USED IN RADIO COMMUNICATION

Abbreviation	Question	Answer or Notice
A —	N —	1 —
B —	O —	2 —
C —	P —	3 —
D —	Q —	4 —
E —	R —	5 —
F —	S —	6 —
G —	T —	7 —
H —	U —	8 —
I —	V —	9 —
J —	W —	0 —
K —	X —	
L —	Y —	
M —	Z —	

1. A dash is equal to three dots.
2. The space between parts of the same letter is equal to one dot.
3. The space between two letters is equal to three dots.
4. The space between two words is equal to five dots.

Period	.....
Semicolon	.....
Comma	.....
Colon	.....
Interrogation	.....
Exclamation point	.....
Apostrophe	.....
Hyphen	.....
Bar indicating fraction	.....
Parenthesis	.....
Inverted commas	.....
Underline	.....
Double dash	.....
Distress call	.....
Attention call to precede every transmission	.....
General inquiry call: CQ	.....
From (de)	.....
Invitation to transmit (go ahead)	.....
Question (please repeat after .....)—interrupting long messages	.....
Wait	.....
Break (bk.) (double dash)	.....
Understand	.....
Error	.....
Received (O.K.)	.....
End of each message (cross)	.....
Transmission finished (end of work) (conclusion of correspondence)	.....

Abbreviation	Question	Answer or Notice
QRA	What ship or coast station is that?	This is
QRB	What is your distance?	My distance is
QRC	What is your true bearing?	My true bearing is degrees.
QRD	Where are you bound for?	I am bound for
QRF	Where are you bound from?	I am bound from
QRG	What line do you belong to?	I belong to the Line.
QRH	What is your wave length in meters?	My wave length is meters.
QRJ	How many words have you to send?	I have words to send.
QRK	How do you receive me?	I am receiving well.
QRL	Are you receiving badly? Shall I send 20?	I am receiving badly. Please send 20 for adjustment.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are the atmospherics strong?	Atmospherics very strong.
QRO	Shall I increase power?	Increase power.
QRP	Shall I decrease power?	Decrease power.
QRQ	Shall I send faster?	Send faster.
QRS	Shall I send slower?	Send slower.
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Are you ready?	I am ready. All right now.
QRW	Are you busy?	I am busy (or: I am busy with). Please do not interfere.
QRX	Shall I stand by?	Stand by. I will call you when required.
QRY	When will be my turn?	Your turn will be No.
QRZ	Are my signals weak?	Your signals are weak.
QSA	Are my signals strong?	Your signals are strong.
QSB	Is my tone bad?	The tone is bad.
QSC	Is my spacing bad?	Your spacing is bad.
QSD	What is your time?	My time is
QSF	Is transmission to be in alternate order or in series?	Transmission will be in alternate order.
QSG		Transmission will be in series of 5 messages.
QSH		Transmission will be in series of 10 messages.
QSK	Is the last radiogram canceled?	The last radiogram is canceled.
QSL	Did you get my receipt?	Please acknowledge.
QSO	Are you in communication with any ship or station (or: with)?	I am in communication with (through).
QSP	Shall I inform that you are calling him?	Inform that I am calling him.
QSQ	Is calling me?	You are being called by
QSR	Will you forward the radiogram?	I will forward the radiogram.
QST	Have you received the general call?	General call to all stations.
QSU	Please call me when you have finished (or: at o'clock)?	Will call when I have finished.
QSY	Shall I send on a wave length of meters?	Let us change to the wave length of meters.
QSZ		Send each word twice. I have difficulty in receiving you.
QTA		Repeat the last radiogram.

When an abbreviation is followed by a mark of interrogation, it refers to the question indicated for that abbreviation.

RADIO ENGINEERING LABORATORIES

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NEW YORK CITY, U. S. A.

OPERATOR AND STATION LICENSE

It is absolutely illegal for you to test a transmitter, or operate same until you have secured both an Amateur Operator's license and a station license from the U. S. Government. (Other Countries have various laws that must be kept.) The requirements for both are simple. You must be able to copy at least ten words a minute, Continental Code, be a citizen and you must have an elementary knowledge of Radio transmitting and receiving circuits. If you do not know the code, refer to "LEARNING THE CODE BY LISTENING," QST, page 45, March, 1925. If you have been a careful reader of QST for any length of time you should know more than enough about transmitting and receiving circuits to pass the examination.

First of all, send fifteen cents (not in stamps) to Superintendent of Documents, Government Printing Office, Washington, D. C., and get a copy of Radio Communication Laws of the United States.

Carefully study those portions of the Laws relating particularly to amateur operation and read the whole thing through. Then write the Chief Radio Supervisor, Department of Commerce, Washington, D. C., asking for the address of the Supervisor to whom you should make application for blanks for the amateur station and Amateur Operators' licenses.

Until you have secured your operator's license and station call you must not attempt to operate the transmitter at all.

LIST OF INTERNATIONAL INTERMEDIATES

(Standardized by I.A.R.U.)

The letters listed below precede the regtd. country where the transmitting station is local call signals and are used to designate the

Example:—4AC-4AC-4AC-ZU-2XV-2XV-2XV. The intermediates ZU mean that a station with the call signals 4AC located in New Zealand is being called by a station with call signals 2XV located in the United States.

A—Australia	G—Great Britain	FI—Philippine Islands
AU—Alaska	H—Switzerland (Helvetia)	P—Portugal
B—Belgium	HU—Hawaii	PR—Porto Rico
BE—Bermuda	I—Italy	Q—Cuba
BZ—Brazil	IC—Indo-China	R—Argentine
C—Canada	J—Japan (provisional)	S—Scandinavia (Den-
CH—Chile	K—Germany	mark, Finland, Ice-
CR—Costa Rica	(unauthorized)	land, Norway, Sweden)
D—Denmark	L—Luxembourg	U—United States
E—Spain	M—Mexico	Y—Uruguay
F—France	N—Netherlands	Z—New Zealand
	O—South Africa	

SIGNALS DESIGNATING AUDIBILITY

R-1 Faint signals, just audible.	R-7 Good strong signals, readable through heavy QRN and QRM.
R-2 Weak signals, barely readable.	R-8 Very strong signals, several feet from the phones.
R-3 Weak signals, but readable.	R-9 Extremely strong signals.
R-4 Fair signals, easily readable.	
R-5 Moderately strong signals.	
R-6 Strong signals.	

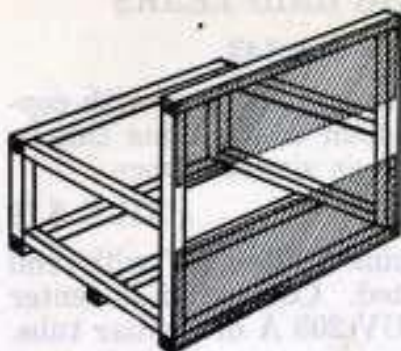
EXAMPLE

If signals are reported "R 9" it would mean—extremely strong signals.

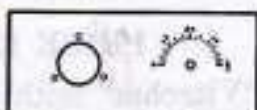
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NEW YORK CITY, U. S. A.



NEAT FRAMES WILL
HELP TO IMPROVE
SHORT WAVE STATIONS



TYPE K



TYPE L



TYPE M



TYPE N



TYPE O



TYPE P

TRANSMITTER FRAMES

Catalogue No. 137

These frames are solidly built and finished in black crystalline lacquer. Each is designed to take two panels as shown. Almost any type of circuit can be successfully housed in one or more of these frames. (Note illustration on back of catalogue cover.)

Special frames can be designed and built for larger types of transmitters used for short or long wave C. W. Telegraph or for broadcasting purposes.

FRAME SPECIFICATIONS

Cat. 137 Type No.	Dimensions Width Height	Inches Depth	Panel Sizes	Price
Q	15 15	12½	6"x15"	\$6.00
W	21 18	18	7"x21"	7.00
Z	30 15	12½	6"x30"	9.00
Y	30 18	18	7"x30"	10.00

PANELS TO MATCH FRAMES

Catalogue No. 138

The panels specified are black "Radion" 3/16 inch thick. They are drilled and neatly engraved. Condenser scales with 0 to 100 reading are engraved directly on panels.

Unless otherwise specified holes for meters are drilled 3 1/16 inch diameter. If this does not suit your requirements give dimensions of meters to be used.

Unless otherwise specified only one ½ inch hole is drilled for variable condenser shafts.

Call letters or other lettering can be engraved on panels, if desired.

PANEL SPECIFICATIONS

Cat. 138 Type No.	Size	Drilled and Engraved for	Price
K	6"x15"	1 Meter and 1 Var. Cond...	\$4.00
L	6"x15"	2 Var. Cond.....	4.20
M	6"x15"	2 Meters	3.70
N	6"x15"	1 Rheostat	3.50
O	6"x30"	3 Var. Conds.	6.00
P	6"x30"	3 Meters	5.70

Radio Engineering Laboratories is adequately equipped to drill and engrave panels of any size and thickness. Send your sketch giving location and size of holes with some idea of the engraving desired.

Estimates cheerfully submitted.



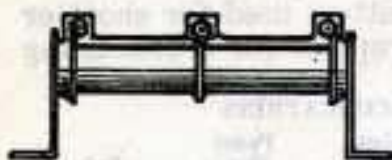
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TYPE A



TYPES B AND C



TYPES E AND F



CHOKE COIL
for
TRANSMITTERS
or
RECEIVERS

TRANSMITTING GRID LEAKS

Catalogue No. 143

TYPE A—7000 ohms graphite rod with copper plated ends, to which connections can be soldered. For UX-210 or similar tubes.

PRICE \$.70

TYPE B—5000 Ohms "Vitrohm" with end mountings, as illustrated. Connection in center for 2500 Ohms. For UV 203 A or similar tube.

PRICE \$2.10

TYPE C—5000 Ohms "Vitrohm" with end supports. Center connection for 2500 Ohms. For UV-204 A or similar tube.

PRICE \$2.90

TYPE D—20,000 Ohms "Vitrohm" with end supports. For DeForest "H" Tube.

PRICE \$6.15

TYPE E—50,000 Ohms "Vitrohm" with end supports. For DeForest "P" Tube.

PRICE \$8.60

RADIO FREQUENCY CHOKE COILS

Catalogue No. 132

The REL Choke Coils are designed for operation on any wave-lengths between 30 and 90 meters.

They may be successfully employed in short wave receiving circuits as plate R. F. Chokes. They will in many cases help to eliminate dead spots which occur on certain wavelengths due to antenna harmonics.

Many uses will be found for these efficient chokes in various transmitting circuits. Refer to QST, November 1926 issue, page 22, which shows a crystal controlled set using several REL chokes.

The Chokes are wound with triple covered paraffin wire on a bakelite tube measuring 4 inches long and $\frac{3}{4}$ inch diameter. They may be mounted in any position.

Designed to safely carry 1000 milliamperes Inductance .9 mil Henrys D.C. resistance 3.1 ohms.

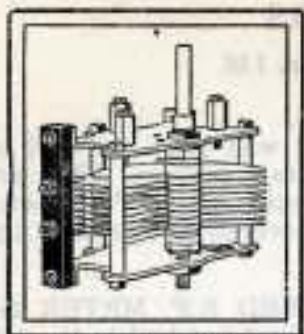
PRICE \$1.10



RADIO ENGINEERING LABORATORIES

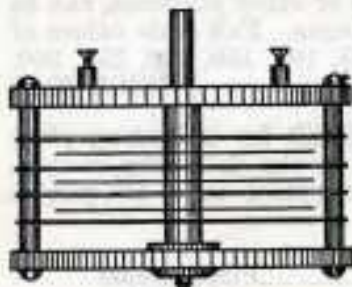
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TYPES D AND E

Heavier Construction Used
on the Other Types Listed

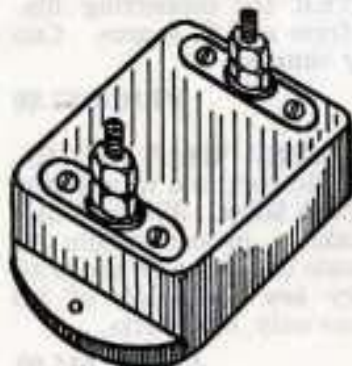


High Voltage Variable
Condenser for Neutralizing
Purposes



TYPE K

500 Volt Breakdown



TYPE M

5,000 Volt Breakdown

TRANSMITTING VARIABLE CONDENSERS

Catalogue No. 149

These Transmitting Variable Condensers are ruggedly constructed. They will maintain exact calibration through any atmospheric conditions. This assures the users of freedom from variation of wavelength and it will be found that once the transmitter has been tuned with the REL Wavemeter, you can depend on your QRH remaining constant.

Type D and E will be found suitable for all of the lower power tubes up to and including $7\frac{1}{2}$ watts. The Type F and G will do for 50 watt tubes. Type H and J will be found suitable for tubes from 250 watts to 1000 watts.

Type No.	Capacity in Mmfd.	Breakdown Voltage	Price
D	250.	700	\$4.25
E	500.	700	5.00
F	217.	3000	7.00
G	440.	3000	10.00
H	156.	5250	15.00
J	297.	7600	70.00

← HENGE →

NEUTRALIZING VARIABLE CONDENSER

Catalogue No. 153

The REL Neutralizing variable condenser is expressly designed to be used in crystal controlled or Master Oscillator circuits. It can safely be used for all powers up to 500 watts. Its construction is such as to insure maximum safety against breakdown.

CAPACITY, 75 mmfd.—breakdown voltage 5000 volts dimensions 5" by 5" with $\frac{1}{4}$ " shaft.

Catalogue No. 153

PRICE \$4.50

← HENGE →

TRANSMITTING FIXED CONDENSERS

Catalogue No. 150

This line of fixed condensers will be found suitable for transmitting circuits. There are listed below various types and sizes suitable for grid plate blocking, coupling and filter purposes.

Types "K," "L" and "M" can be supplied in other sizes. When ordering please specify capacity desired. Type "S" is completely insulated with mica.

Type No.	Capacity in Mfd.	Breakdown Voltage	Price
K	.002	500	\$0.50
L	.002	2000	2.25
M	.002	5000	9.00
N	2.	750	2.50
O	1.	1750	3.50
P	2.	2000	6.50
S	1.	3000	45.00

← HENGE →

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

METERS

Catalogue No. 146



RADIATION AMMETER
TYPE A

These meters are rugged, well built and will be found satisfactory for all general purposes. They are flush panel mount type and require a 3-1/16" diameter hole in the panel. The outside overall dimension of the flange is 3 3/4" diameter.

TYPE A—THERMO COUPLED R.F. METER for use in the antenna circuit can be furnished in the following ranges. Full scale values of .5, .8, 1, 1.5, 2, 2.5, 3, 5, 8, 10, or 15 amperes. **PRICE \$12.00**

TYPE B—D.C. MILLIAMPERE METER for measuring plate and grid currents or other purposes, can be furnished in the following ranges. Full scale values of 3, 5, 10, 15, 20, 25, 30, 50, 75, 100, 150, 200, 250, 300, 500, 800 or 1000 milliamperes. **PRICE \$7.50**

TYPE C—D.C. VOLT METER for indicating plate voltage. Can be furnished in the following ranges. (External Resistances are supplied with all meters listed.)

0-500.....	Price \$15.50
0-750.....	Price 19.00
0-1000.....	Price 22.50
0-1500.....	Price 28.50
0-2000.....	Price 34.50

TYPE D—A.C. VOLTMETER for indicating filament voltage when supplied by alternating current. Can be furnished in the following ranges:

0-10 for low power Transmitter
0-15 for 50 watt tubes
0-15 for 250 watt tubes

PRICE \$7.50

TYPE E—D.C. VOLTMETER for measuring filament voltage when supplied from a D.C. source. Can be furnished in the following ranges:

0-7.5, 0-10, 0-15

PRICE \$7.50

TYPE F—CURRENT SQUARED GALVANOMETERS for use as a resonance indicator; in a wavemeter it will be found superior to a flash lamp. Will be found exceedingly valuable for taking measurements of minute R.F. currents. Full scale deflection is had with 100 milliamperes at the very low resistance of 2.5 ohms, making the full scale loss only .025 watts.

PRICE \$15.00

When ordering meters be sure to specify type number and range.



FILAMENT VOLTMETER
TYPE D



ALTERNATING CURRENT
DIRECT CURRENT
OR ANY OTHER TYPES
ARE ALL OF SIMILAR
DESIGN PATTERNS

RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

TRANSMITTING INDUCTANCES

"The Inductance You Will Eventually Use"

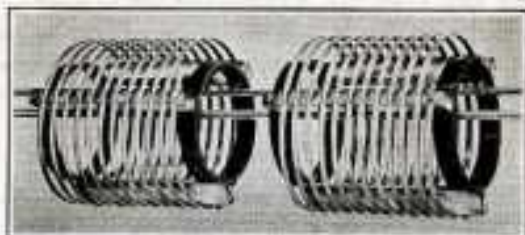


Illustration shows how two units are mounted on glass coupling rods. These rods may easily be supported on each end. Simply drill two $\frac{1}{2}$ " holes, spaced $2\frac{3}{4}$ " apart. The rods may be fitted into these.

Equally efficient for all circuits using from 1 to 5,000 watts.

REL inductance units are so designed that each type may be telescoped in the next larger type. This will prove very practical where close coupling is desired.

Single units of either type S or L.....Price \$5.50
Double units of either type S or L.....Price 11.00

(Double units comprise one primary unit and one secondary unit with two $\frac{1}{2}$ " diameter by 15" long, glass coupling rods.)

Single units of type LL.....Price 11.00

Special designs of flatwise or edgewise wound inductances for broadcasting stations. Prices on application.



Wavelength Ranges of REL Inductances When Shunted by Various Capacities

All data in the following table was made with capacity shunted across total inductance. It is to be understood that if capacity is shunted across fewer turns or if a fewer amount of turns are used, the wavelength will be reduced proportionally.

WAVELENGTH READINGS GIVEN IN METERS

Shunt Capacity In Mmfd.	One "S"	Two "S" In Series	One "L"	Two "L" In Series	One "LL"	Two "LL" In Series	Three "LL" In Series
0	23	29	38	56	56	81	
50	39	54	66	92	90	143	
80	42	60	72	102	97	155	
132	51	74	89	135	125	195	243
289	74	105	125	183	171	256	314
448	89	130	153	216	204	304	421
606	103	150	175	248	228	386	476
766	116	163	194	280	255	425	516
926			208	304	280	458	564
1085				326	298	490	603



RADIO ENGINEERING LABORATORIES

27 THAMES STREET

NEW YORK CITY, U. S. A.

CATALOGUE NO. 127

REL TRANSMITTING INDUCTANCES are considered the zenith in transmitting coil efficiency by everyone because they were designed to be used for short wave operation.

With this thought primarily in mind their construction embodies flatwise wound copper nickel plated ribbon securely mounted on moulded crystal glass spacers of the highest insulating qualities.

CLIPS—Three REL sure grip clips are furnished with each unit.

SPECIFICATIONS

TYPE S—3" diameter 6" long 11 $\frac{2}{3}$ turns.

Expressly designed for extreme short wave transmission (20 meters and less; however, can also be used on 40 meters).

TYPE L—5" diameter 6" long 11 $\frac{2}{3}$ turns.

For 40, 80 and 150 meter wave bands (corresponding to the capacity shunted across the inductance).

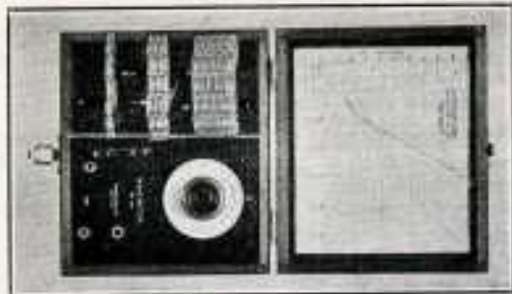
TYPE LL—8" diameter 6" long 11 $\frac{2}{3}$ turns.

Specially designed for transmitters operating above 200 meters (broadcast stations). A number of these units may be connected in series (see table below).

WAVEMETER

WAVELENGTH RANGE 17 TO 550 METERS

CATALOG NO. 125



MAY BE USED FOR

Tuning the Transmitter
 Checking the Transmitter
 Locating Antenna and Counterpoise Nodes
 Locating Coil Fields
 Calibrating an Oscillator
 Wavetrap—Absorption or Induction Method
 Calibrating a Receiver
 Measuring Capacity
 Measuring Inductance

EACH REL WAVEMETER IS INDIVIDUALLY CALIBRATED and is guaranteed to be accurate. Easy reading chart showing colored calibration curves, covering wavelength ranges. Curves readily indicate fractional meter variations.

THE WAVELENGTH RANGES OF THE COILS ARE:

Coil No. 1—Black Curve, 17 to 61 Meters
 Coil No. 2—Red Curve, 61 to 183 Meters
 Coil No. 3—Green Curve, 182 to 550 Meters

CURVE CHARTS are neatly covered with a transparent material making them selfproof.

MOUNTED IN WELL CONSTRUCTED CASE MEASURING 8 3/4" LONG, 7 1/4" WIDE AND 1" HIGH. COMPLETE WEIGHT FOUR POUNDS.

Type "A" Wavemeter.....Price \$22.00 Complete
 Additional Neon TubesPrice \$ 1.50 Each
 Additional Neon Tube BasesPrice \$.25 Each

INSTRUCTIONS FOR OPERATION OF WAVEMETER

Calibrating a Transmitter with a Neon Tube Resonance Indicator

Plug-in the coil that should cover the desired wavelength and couple this in the closed circuit of the transmitter. (It is always advisable to first tune the closed or primary circuit before the antenna is connected). If the transmitter is properly oscillating, a point will be found on the wavemeter dial where the Neon tube lights brightest. This is the resonance point which indicates that the wavemeter is tuned to the wavelength of the transmitter. This dial reading, when referred to the curve gives the correct wavelength.

Do not couple the wavemeter too closely to the transmitter. Keep it at such a point that the Neon tube will just glow. A sharper reading will thus be had.

To indicate a very feeble output it may be necessary to use a very sensitive galvanometer. This can be connected at the binding posts marked "GAL-M." The Neon tube is never removed from its socket.

Using the Wavemeter at a Receiver—At a receiver, under certain conditions, the wavemeter can be used to measure a wavelength without the use of a buzzer or other auxiliary device. This method can be applied if the receiver is provided with an oscillating tube detector or "autodyne." When the wavemeter is loosely coupled with the proper receiving circuit coil and it is being tuned to the receiver, or vice versa, a small amount of energy is withdrawn from the receiving circuits by the wavemeter. When the two circuits are in resonance there will be a small but sudden increase in the amount of energy withdrawn and a corresponding change in the current in the telephones of the receiving set. This will be indicated by two "clicks" separated somewhat, on the wavemeter dial. By moving the wavemeter further away from the receiver, these "clicks" will come closer together (if placed at too great a distance they will disappear entirely or else only one will be heard). A position will be reached where the "clicks" approach each other very closely. The dial reading directly in the middle of the two "clicks" will then give the correct resonance point and by referring to the curve will give the wavelength. This method can be used in setting a receiver at a predetermined wavelength and in calibrating a receiver.

Measurement of Inductance or Capacity—As stated previously, a wavemeter can be used with other apparatus to measure an inductance or a capacity. If a local resonant circuit containing either a known inductance and an unknown capacity, or an unknown inductance and a known capacity, is set into oscillation by convenient means, such as a buzzer, small spark coil, tube oscillator, etc., then accordingly—

$$\lambda = 59,400 \times \sqrt{LC}$$

If now the wavelength of the local circuit be measured by a wavemeter, then all but one of the quantities in the formula are known, and the unknown inductance or capacity can be found from either of the two following formulas which are derived by simple algebra from the formula above:

Where L is the inductance in millihenrys,

C is the capacity in microfarads,

λ is the wavelength in meters.

$$C = \frac{\lambda^2}{3.54 \times 10^8 \times L}$$

$$L = \frac{\lambda^2}{3.54 \times 10^8 \times C}$$

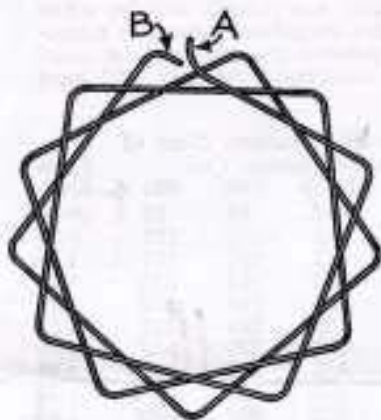
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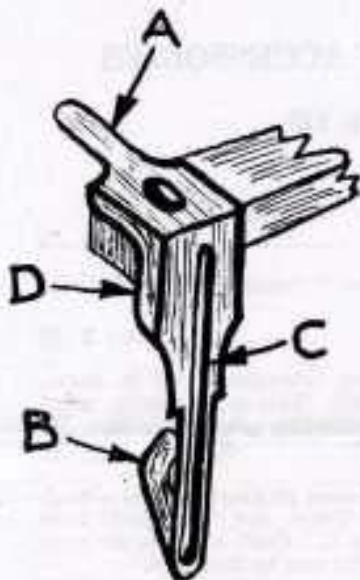
SHORT WAVE RECEIVING APPARATUS

To successfully receive signals on the short wavelength (at high frequencies) certain design principles must be more closely followed than for reception on the higher or broadcast wave bands. The Radio Engineering Laboratories have been experimenting along these lines for over three years. The results are apparatus that has proved its worth and has brought enthusiastic compliments from all parts of the world.



REL LOOSE BASKET WEAVE WINDING

Illustration shows how consecutive turns are not parallel to each other. The winding started at point A makes three complete convolutions before coming back to its original start at B. This practically gives a space wound, air dielectric coil of exceedingly distributed capacity.



ONE PIECE REL COIL PLUG

- A—Solder Lug in Which End of Coil is Soldered.
- B—Spring Contact Arm.
- C—Reinforcement Rib.
- D—Angle Corner Brass.

COILS

The Bureau of Standard's recent test on various forms of inductances for receiving sets, has proven that the loose basket weave wound coil is slightly superior over other types. REL coils have always been wound in this fashion.

They are efficient. They have a low distributed capacity due to the form of winding; they have extremely low dielectric loss, because no forms of any sort are used to support the coils; they are absolutely moistureproof, being wound with triple cotton covered paraffined wire; they are mechanically rugged because of the heavy gauge wire used; they will not soil, being wound with brown colored wire.

PLUG-IN METHOD

Short Wave Receivers must have interchangeable coils. It is desired that each coil cover only a small waveband (for example, 30 to 50 meters only). A number of coils must be used to cover all wavelengths from 10 to 200 meters. Reception on short waves is critical, that is why, with the use of numerous coils, the signals can be spread. Incidentally the tuning variable condensers must be of low maximum capacity, so as to efficiently operate in conjunction with these coils.

REL plug-in coils are equipped with the most efficient coil plug. This is one piece phosphor bronze, with positive spring tension, which insure contact on four edges. A one-piece plug is essential in eliminating loose connections, which create noises. Bad contacts or loose connections must be abolished otherwise unstable results will be had.

REL plug-in coils are quickly and easily interchanged with the minimum amount of time and effort.

VARIABLE CONDENSERS

Most short wave circuits usually require two variable condensers. One is shunted across the secondary coil and controls the wave length. This one should, in most cases, have a maximum capacity not to exceed 100 mmfd. A condenser having straight line capacity or straight line wavelength characteristics will do.

The other condenser, which is used to control regeneration, can be most any type having a maximum capacity of around 250 mmfd. If the receiver is to be used for modulated C.W. or telephone reception, do not use a straight line frequency condenser, as this will give a very abrupt control of oscillation as its maximum is being reached. That is to say, the set will go into oscillation with a sudden hard thump.

It is advantageous to use wide spaced condensers. First they will not greatly be affected by dust settling in between the plates, which would somewhat alter the capacity and thereby give an erratic or "jumpy" control of wavelength. Second, the reception of "swing signal" would not be so pronounced and could be more readily followed.

The condensers furnished with the REL No. 138 short wave receiving kit have widely separated plates.

Pigtail or spring connections on the rotary plates are usually noisy. A bad contact of this description will be more pronounced on the very short wavelengths (around 20 meters). Harsh, grinding noises will be picked up in the head phones.

GENERAL OPERATING HINTS

The short receiver antenna need not be of any special design. The average one-wire broadcast aerial will be found satisfactory. However, a long antenna will have many harmonics on the short wavelengths. This will cause very erratic movement of the oscillation control variable condenser. For example, suppose the wavelength condenser is increased ten degrees and to bring the set into oscillation it becomes necessary to move the oscillation condenser 20 degrees, then if the wavelength is increased another ten degrees, it is found necessary to bring the oscillation down 40 degrees. There is evidently very bad "chasing" of the oscillation control. The best remedy is to place a very small capacity in series with the antenna (about .0001 mfd.). This will sufficiently detune the antenna circuit and thereby give smooth control.

Various parts in a short wave receiver should be well separated. Grid and plate connections should be short and direct. All battery leads may be cabled together. Correctly designed Radio Frequency Choke coils are desirable in all long battery leads. They should be placed at the set's binding post connection strip.

The following pages illustrate several REL short wave receiving arrangements.



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NEW YORK CITY, U. S. A.

SHORT WAVE RECEIVING KIT



Neither time or expense has been spared to make this the most efficient Short Wave Receiver ever placed before the public. In short waves all of the apparatus should be designed expressly for the use to which it is put, and in this Receiver each and every piece was selected and the entire design perfected by short wave experts in a Laboratory whose entire business is devoted to short wave transmission and reception.

THE CIRCUIT employed is the well-known capacity controlled feed-back with separate coils for antenna, secondary and tickler.

VARIABLE CONDENSERS are expressively designed for short waves. Double spacing eliminates any chance of signal shifting due to dust and moisture.

INDICATING SCALES engraved directly on front panel in plain lines and figures.

VERNIER CONTROL is had by means of soft and hard rubber discs mounted behind the panel. Metallic friction noises are eliminated. There is positively no back lash. The control knobs are mounted on half-inch round rubber shafts extending four inches from front of panel. This is the only positive means of eliminating body capacity without sacrificing efficiency on short wave reception.

REL LOOSE BASKET WEAVE PLUG-IN COILS are used. These have a world-wide reputation and need no introduction. Eight coils are supplied which cover all wave lengths from 12 to 200 meters. They are easily interchanged by means of the REL PLUGS.

COIL BASE AND TUBE SOCKETS are of unique design, affording easy mounting and insuring utmost efficiency. Any type of UX base tube can be used.

AUDIO FREQUENCY TRANSFORMER of correct characteristics is supplied.

OTHER PARTS which go to make up this kit were selected with a view towards the best in short waves.

DIMENSIONS: Front, 14" x 7"—Baseboard Depth 8 3/4".

Full size Blueprint is supplied with each kit which plainly shows how to assemble and wire the set. As the condensers with the vernier controls are already mounted on the front panel it is only necessary to fasten the socket strip, binding post strips and transformer onto the baseboard and then secure this to the panel. The wiring can be accomplished easily and quickly thus putting the set in operating order within a few hours.

Catalogue No. 130

Price \$36.00

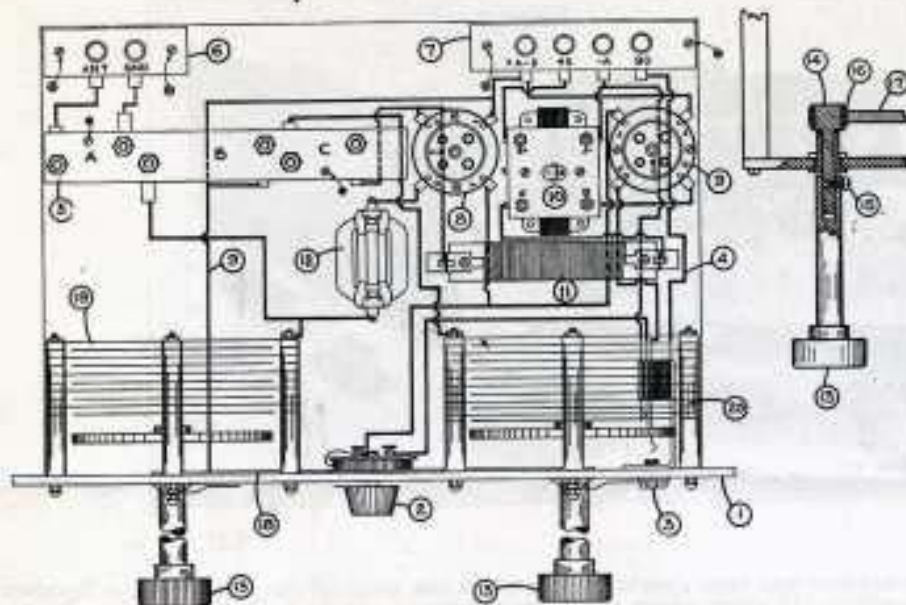


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INSTRUCTIONS FOR THE ASSEMBLY AND OPERATION OF THE NO. 130 SHORT WAVE RECEIVING KIT



**SCHEMATIC
WIRING
DIAGRAM**

Same as shown on
page 33.

GENERAL

Carefully unpack the corrugated box which contains all the parts necessary to assemble this short wave receiver. Most of the smaller parts are packed together in one box.

ASSEMBLY

The panel (1) comes completely assembled with the variable condensers and their vernier controls. It is simply necessary to mount the rheostat (2) and the jack (3). Next fasten this panel to the base board (4)—by means of the three small wood screws on the bottom of the panel. As the blueprint supplied with these instructions is of actual size, it may be used as a template for mounting the other parts on the base board.

By closely following this, the coil base (5), the antenna binding post strip (6), the battery binding post strip (7), the detector socket (8), the audio amplifier (9), the audio transformer (10), the RF choke coil (11) and the grid condenser and grid leak (12), these parts should be located on the base board. The extension handles (13) are fastened to the brass shafts (14) by means of the small set screw (15).

It will be noted that the shaft (14) has a hole drilled to take this set screw. Good consistent friction must be had at all times between the soft rubber ring (16) and the hard rubber disc (17). When this soft rubber ring (16) becomes worn, it can easily be replaced. The pieces 5, 6 and 7 are raised from the base board by means of the small bushings which are placed under the wood screws marked 9.

The antenna coil (A) plugs in at position (A), the secondary coil (B) plugs in at position (B) and the tickler coil (C) plugs in the position (C).

WIRING

It will be noted that the rotary plates of both variable condensers are connected by a strip of brass (18). Make all + A — B connections to this. This is easily accomplished through wire (19).

For ease at work it is advisable to fasten the two wires to the rheostat before the choke coil is mounted, otherwise it will be hard to get at this point. By carefully following out the schematic wiring diagram or the other layout it will be a simple matter to complete this receiver. If a soldering paste is used for flux, it will be necessary to wipe all joints with alcohol otherwise corrosion will set in. The wiring need not necessarily be run in square shape. It can be direct.

If so desired all filament and high voltage B leads may be cabled together. Make sure that the plate and grid leads are short, direct and free from other objects.

TUNING

The wavelength chart given on these sheets should be closely followed. This will immediately indicate the correct coils that are to be used in the A, B and C positions. Any type of tubes may be used. It will, however, be necessary to apply the correct plate filament voltages as required by tubes used. If everything is properly connected, the filaments will light when the phone plug is inserted in the jack (3). The rheostat is then turned so that the tubes indicate proper brilliancy.

By setting the wavelength and condenser (19) at some arbitrary position and rotating the oscillation control condenser (20) a point will be had where the set indicates oscillation. Keeping this condenser just inside of the oscillating condition and rotating the wavelength condenser (19) signals should be heard. If it is desired to receive modulated signals or voice, it will be necessary to tune condenser (20) to a point just outside of oscillation. It may be experienced that a gentler control of oscillation will be had if the rheostat is kept low and the oscillation condenser nearer to maximum.

There may be a possibility that dead spots will be had on condenser (20), that is to say a point will be reached where no oscillation is had or else a very erratic control is experienced. In cases such as this a very small variable condenser with a maximum capacity of about .0001 to .00001 mfd. should be inserted in series with the antenna.

If so desired, this No. 130 receiver can be used for broadcast reception on wavelengths up to about 650 meters. It is simply necessary to shunt the condensers 19 and 20 with other condensers having a capacity of about .0001 and using the largest set of plug-in coils.

WAVELENGTH RANGE OF PLUG-IN COILS

The following table shows the correct coils to be used to cover various wavelengths:

Wavelength Range in Meters.	Primary Coil A	Secondary Coil B	Tickler Coil C
12 to 29	7	3	5
29 to 58	5	7	7
58 to 107	7	14	12
100 to 212	12	22	18

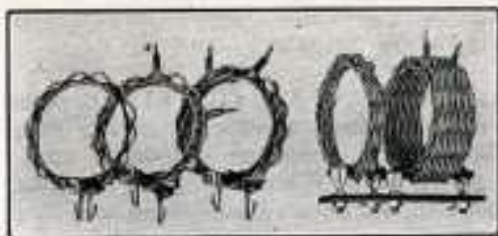
The numbers in the above columns correspond to number of turns of wire on each coil. It will be noted that the primary and tickler coils are interchangeable. They have the same width base mounting.

RADIO ENGINEERING LABORATORIES

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LOW WAVE COIL KIT



Wavelength Range of Secondary Coils When Shunted by .0001 Mfd. Condenser

Coil No. 1—12 to 40 Meters

Coil No. 2—32 to 70 Meters

Coil No. 3—58 to 120 Meters

Catalog No. 119

ELECTRICALLY EFFICIENT: REL loose basket weave coils mounted on the well-known one piece plugs. The secondaries are tapped so as to be adaptable to the Reinartz Circuit.

MECHANICALLY RUGGED: Can be roughly handled without distorting shape. Coils quickly and easily interchanged.

WAVELENGTH RANGE: 10 to 110 meters, when tuned with .0001 mfd. condensers.

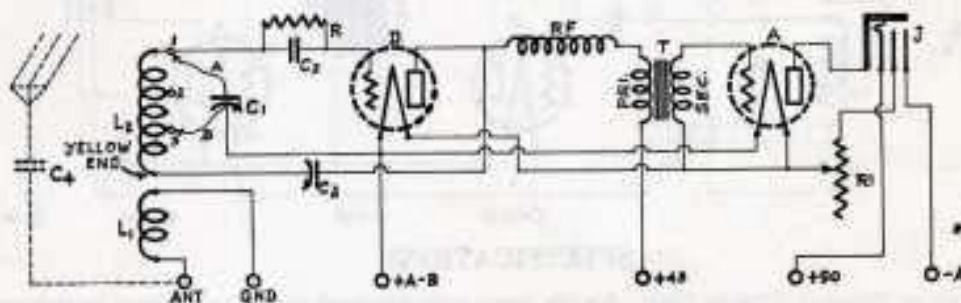
FIVE COILS (3 Secondaries, 2 Primaries) WITH BASE MOUNTING AND FLEXIBLE LEADS

PRICE \$4.50 PER SET

NOTE: If wavelengths from 110 to 200 meters are desired, use REL Plug-in Coil PL-60R—Price \$1.40. By shunting a variable condenser of .0005 mfd. across the condenser used to tune the short waves, you will be able to cover the broadcast band of 200 to 600 meters.

REINARTZ SHORT WAVE RECEIVER CIRCUIT

USING CAT. NO. 119 COIL KIT



SPECIFICATIONS

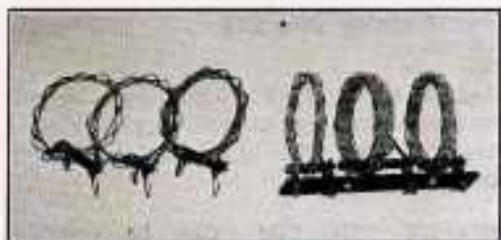
- L1—ANTENNA OR PRIMARY PLUG-IN COIL:** Can be plugged in either way. (It may be advisable to use a very small condenser in series with the antenna as indicated by C4. This will clear dead spots. Two primary coils are furnished. Use the one which is best suited for the desired wave band.)
- L2—SECONDARY PLUG-IN COIL:** Plug in so that end with the yellow tubing is towards the primary. The two flexible leads furnished are connected to C1. One of these, shown as "A," comes from the stationary plates of C1. It may be connected to either Tap "2" or else to the end of the coil at "1" (a convenient method of making Terminal "1" is to solder a short piece of stiff wire onto the coil base lug at "1," leaving the other end open so that the clip on the end of "A" may be fastened here). By thus being able to shift "A" from "2" to "1," two tuning ranges will be had on C1. This will be found advantageous in the crowded portions of the three amateur wave bands. The lead "B" is at all times connected to Tap "2."
- C1—TUNING OR WAVELENGTH CONTROL VARIABLE CONDENSER:** Should have an approximate max. capacity of 100 mmfd. preferably equipped with some sort of vernier dial.
- C2—OSCILLATION CONTROL VARIABLE CONDENSER:** With max. capacity somewhere between 100 and 250 mmfd.
- C3—GRID CONDENSER:** 250 mmfd. capacity.
- R—GRID LEAK:** 5 meg. ohms (try various sizes if it is necessary to get absolute smooth control of oscillations. Especially desired for telephone reception).
- R1—FILAMENT RHEOSTAT:** 10 to 20 ohms according to the type of tubes used.
- RF—RADIO FREQUENCY CHOKE COIL:** Absolutely essential. Use REL Type No. 132.
- D—DETECTOR TUBE:** Either 200A, 201A or 199.
- A—AMPLIFIER TUBE:** Either 201A or 199.
- T—AUDIO FREQUENCY AMPLIFYING TRANSFORMER:** If the receiver is to be mainly used for CW reception use a high ratio transformer preferably one that peaks around 1000 cycles. If the main object is voice reception then a transformer of lower ratio with flat curve characteristic is desired.
- J—HEAD PHONE JACK:** Diagram shows automatic filament control jack. Should this not be desired, ignore the two prongs furthest right and connect the upper end of R1 directly to "—A."

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SPECIAL SHORT WAVE COIL KIT



CATALOG NO. 133

THIS SPECIAL SHORT WAVE COIL KIT has been designed especially for those short wave circuits that require separate primary, secondary and tickler coils. Although our No. 119 Low Wave Coil Kit is perfectly adaptable to the Reinartz circuit it was found advisable to use this kit for the purposes mentioned.

Primary and tickler coils have the same base dimensions and are therefore interchangeable.

WAVELENGTH RANGE, 15 to 100 meters when tuned with .0001 mfd. condenser.

Wavelength Range of Secondary Coils When Shunted by .0001 Mfd. Condenser

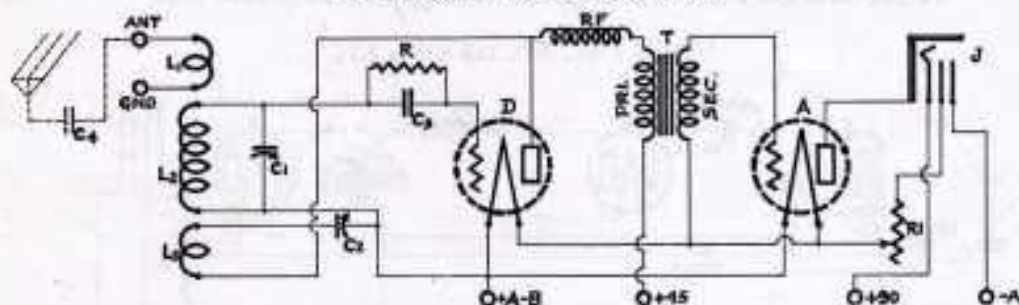
Coil No. 1—15 to 29 Meters
Coil No. 2—29 to 58 Meters
Coil No. 3—52 to 107 Meters

SIX COILS (3 Secondaries, 3 Primaries or Ticklers)
With Base Mounting

PRICE \$6.00 PER SET

SPECIAL SHORT WAVE RECEIVER CIRCUIT

USING CAT. NO. 133 COIL KIT



SPECIFICATIONS

L1—Antenna or Primary Plug-in Coil: As the same coils are used either as primary or tickler it will be found necessary to have an arrangement so that there will be no conflict between these.

If the smallest (least number of turns) primary is designated as "1" and the next as "2" and the largest as "3," then the following will result:

With the twenty meter secondary use "2" for primary and "1" for tickler; with the 40 meter secondary use "1" for primary and "2" for tickler; with the 80 meter secondary use "2" for primary and "3" for tickler. Any of the three coils can be plugged-in in any direction.

L2—Secondary Plug-in Coil:

Select the coil necessary to cover the wave band desired (see upper left hand side of this page).

L3—Tickler Plug-in Coil:

Full instruction for this coil is given under "L1."

C4—Antenna Series Condenser:

This condenser is desired to eliminate dead spots due to antenna harmonics. It can be either a small variable condenser or else a fixed condenser. The maximum capacity need not be greater than 100 mmfd, although even 10 mmfd. will be found sufficient and at times much better.

NOTE: As all the other circuit constants are the same as given on the other side of this page, they will not be repeated here.

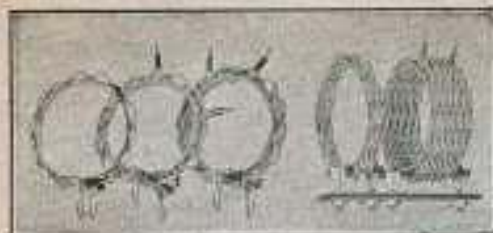
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QUALITY **REL** PRODUCTS

THE PIONEER SHORT WAVE COILS



MECHANICALLY RUGGED: Can be roughly handled without distorting shape. Coils can be interchanged quickly and easily.

REL COIL PLUGS are one piece spring bronze with four self-cleaning contact edges. No loose contacts.

Five coils with base mounting and flexible leads to cover all wavelengths from 10 to 110 meters, when tuned with variable condensers having a maximum capacity of 100 Mmfd.

Adaptable to all short wave receiving circuits.

Price \$4.50 per set

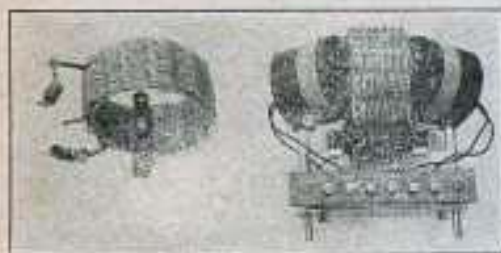
NOTE: If wavelengths from 110 to 200 meters are desired, use REL Plug-In Coil—P5-60R—Price \$1.40. By shunting a variable condenser of 500 Mmfd across the condenser used to tune the short waves, you will be able to cover the Broadcast Band of 200 to 600 meters.

LOW WAVE COIL KIT

Cat. No. 119

ELECTRICALLY EFFICIENT: Loose Basket Weave wound with triple cotton covered paraffin impregnated wire. The Secondaries are tapped so as to be adaptable to the Reinartz circuit. Moisture-proof with constant inductance characteristics. Lowest dielectric losses with maximum insulation between turns.

DISTANCE—SELECTIVITY—QUALITY



Weave Winding—Bureau of Standards tests prove this type of winding to be the most efficient.*

IMPROVED LOPEZ R. F. COIL

Of same characteristics as the Lopez Secondary. To be used as R. F. Coil with the Lopez Tuner. Shunted by a .0005 Mfd. Variable Condenser. Easily mounted in any position.

THE MOST SENSITIVE TUNED R.F. SET THAT CAN BE BUILT.

Price on the Combination.....\$10.00

IMPROVED LOPEZ TUNER KIT

Cat. No. 126

The finest and most efficient tuner. The pioneer in the field.

With two tuning ranges: 150 to 400 meters, 220 to 600 meters. Using a .0005 Mfd. Variable condenser across the secondary.

VARIABLE R. F. NEUTRALIZING CONTROL

Absolutely moistureproof. Wound with triple cotton covered paraffin impregnated wire. Loose Basket

THE EFFICIENT R.F. CHOKE



Dimensions—4 inches long, $\frac{3}{8}$ inch diameter.

Inductance .9 Mil Henrys
D. C. Resistance 3.1 Ohms.

RADIO FREQUENCY CHOKE COIL FOR RECEIVERS AND TRANSMITTERS

Cat. No. 132

Improve your set by using correctly designed REL R. F. Choke Coils. Single layer wound with No. 30 T.C.C. paraffined wire on a neatly finished black bakelite tube. Connections to screws or solder lugs.

Will safely carry 1000 milliamperes.

Can be mounted in any position by means of one screw

Price \$1.10

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