APRIL 18
1931

SHORT WAVE
PICTURE DIAGRAM

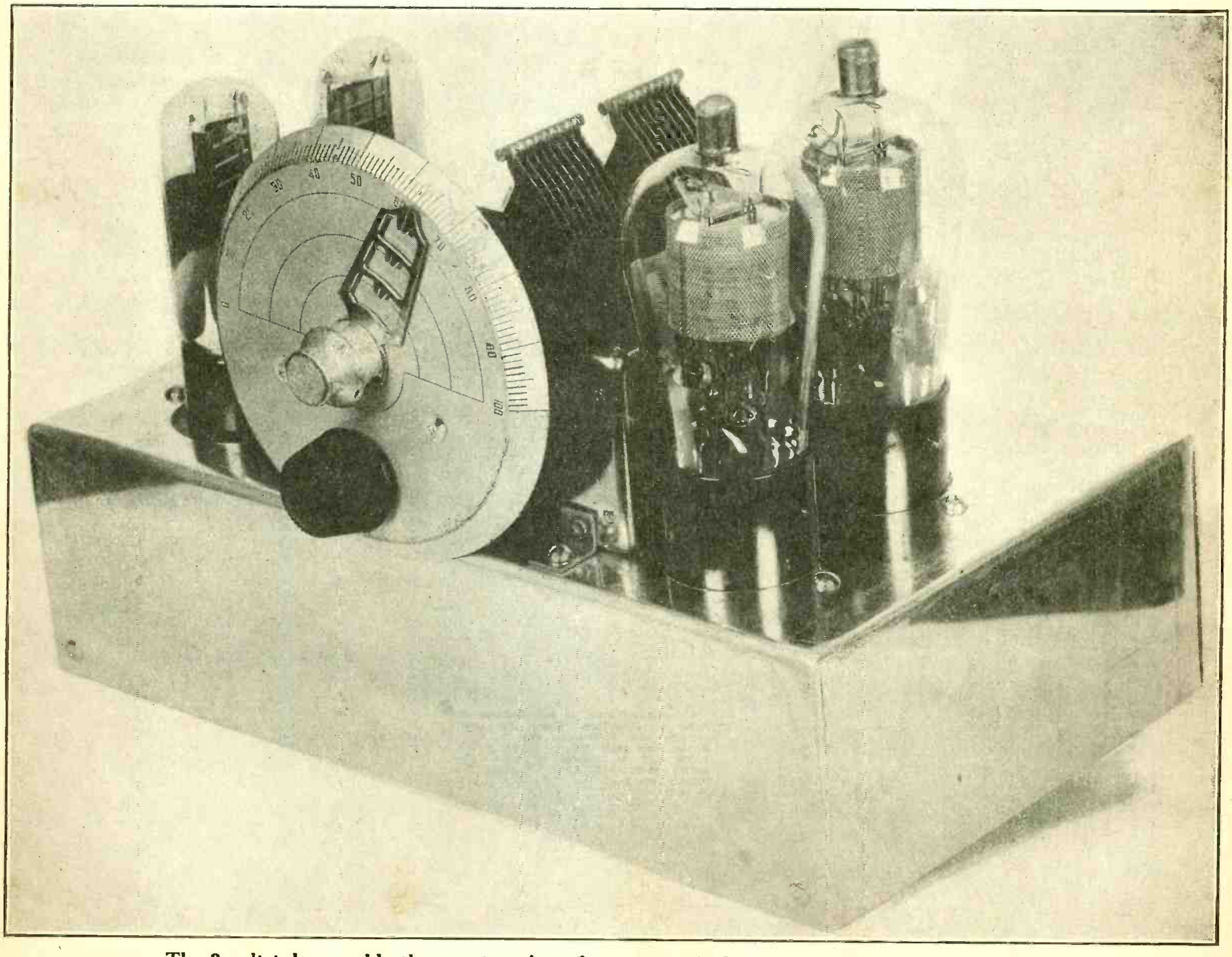
Price
15 Cents
Per Copy

FOUR
NEW
TUBES

RADIO
REG. U.S. PAT. OFF.
WORLD
The First and Only National Radio Weekly
473rd Consecutive Issue—TENTH YEAR

RADIO
TALKIES
EXPLAINED

BATTERY MODEL MIDGET



The 2 volt tubes enable the construction of an economical set that works a speaker satisfactorily. See pages 6 and 7.

Subscribers: watch the date line on your wrapper

If the expiration date line on your wrapper indicates that your subscription has expired or is about to expire, please send in renewal so that you will not miss any copies of the paper. Subscription Dept., Radio World, 145 W. 45th St., N. Y.

Vol. XIX No. 5 Whole No. 473
April 18th, 1931
[Entered as second-class matter, March 1922, at the Post Office at New York, N. Y., under act of March, 1879]
15c per Copy, $6.00 per Year

TENTH YEAR
Technical Accuracy Second to None
Latest Circuits and News

A Weekly Paper published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Telephone, BRyant 9-0558 and 9-0559

RADIO WORLD, owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.; Roland Burke Hennessy, editor; Herman Bernard, managing editor; J. E. Anderson, technical editor; L. C. Tobin, Advertising Manager.

Four New Tubes

By J. E. Anderson

[Close on the announcement of the variable mu tube, the 51 *type of some manufacturers and the* 235 *type of RCA, of somewhat different characteristics, comes the announcement of four more new tubes, as explained in the following article. The tube manufacturers are reported about to agree on one form of variable mu tube, soon to be announced.*—Editor.]

* * *

THE RCA Radiotron Company has announced four new tubes: the 236, a heater type screen grid tube for radio frequency amplification; the 237, a general purpose tube of the heater type useful as detector, amplifier and oscillator, the 238, a heater type pentode for use as power tube, and the 247, a filament type pentode for use as a power tube.

The 236, 237 and 238 have been designed for a heater voltage of 6.3 volts and a heater current of 0.3 ampere for use on 110 volt DC lines, automobiles, and 32 volt farm lighting outfits. The 247 is a power tube delivering 2.5 watts and is intended for use in receivers now using the 245 provided the circuit is suitably changed or designed especially for the 247. The principal characteristics of the four new tubes are given below.

247

Filament voltage	**2.5**
Filament current, amperes	**1.5**
Plate voltage, recommended	**250**
Screen voltage, recommended and max.	**250**
Grid voltage	**—16.5**
Plate current, milliamperes	**32**
Screen current, milliamperes	**7.5**
Plate resistance, ohms	**38,000**
Mutual conductance, micromhos	**2,500**
Load resistance, ohms	**7,000**
Power output	**2.5**
Overall length, inches	**5.625**
Diameter, inches	**2.1875**
Base, UY	
Bulb, S-17	
Socket, UY	

236

Heater voltage, DC			**6.3**
Heater current, amperes			**0.3**
Plate voltage	**90****	**135**	**135***
Screen voltage	**55****	**67.5**	**75***
Grid voltage	**—1.5****	**—1.5**	**—1.5***
Plate current	**1.8**	**3.0**	**3.5**
Screen current	**.6**	**1.0**	**1.15**
Plate resistance, megohms	**.2**	**.3**	**.25**
Amplification factor	**170**	**315**	**275**
Mutual conductance	**850**	**1.050**	**1,100**
Grid-plate capacity, mmfd.			**0.01**
Grid-cathode capacity, mmfd.			**4.**
Plate-cathode capacity, mmfd.			**9.**
Overall length, inches			**4.6875**
Diameter, inches			**1.5625**
Bulb, S-12			
Base, small UY			
Socket, UY			

The values marked with a single asterisk (*) are recommended when the tube is used in an automobile receiver and those marked with two asterisks (**) are recommended when the tube is used on a 110 *volt DC line.*

237

Heater voltage		**6.3**
Heater current, amperes		**0.3**
Plate voltage	**90****	**135***
Grid voltage	**—6****	**—9***
Plate current	**2.7**	**4.5**
Plate resistance	**11,500**	**10,000**
Amplification factor	**9**	**9**
Mutual conductance	**780**	**900**
Load resistance***	**14,000**	**12,500**
Undistorted power output, milliwatts	**30**	**75**
Grid-plate capacity, mmfd.		**2.0**
Grid-cathode capacity, mmfd.		**3.3**
Plate-cathode capacity, mmfd.		**2.3**
Overall length, inches		**4.25**
Diameter, inches		**1.5625**
Bulb, S-12		
Base, small UY		
Socket, UY		

The load resistance marked by three asterisks is the load required for maximum undistorted power output as given. One asterisk refers to values recommended for use in automobile receivers and two refer to value recommended for use in receivers designed for 110 volts DC operation.

238

Heater voltage	**6.3**
Heater current, amperes	**0.3**
Plate voltage, recommended	**135**
Screen voltage, recommended	**135**
Grid voltage	**—13.5**
Plate current, milliamperes	**8**
Screen current, milliamperes	**2.5**
Plate resistance, ohms	**110,000**
Amplification factor	**100**
Mutual conductance, micromhos	**900**
Load resistance, ohms	**15,000**
Undistorted power output, watts	**0.375**
Overall length, inches	**4.6875**
Diameter, inches	**1.5625**
Bulb, S-12	
Base, Small UY	
Socket, UY	

Uses of New Tubes

It will be noted that the three heater tubes in this series all take 0.3 ampere and 6.3 volts. Since they all take the same current it is possible to connect many of these tubes in series on a high voltage line. Suppose, for example, that a 115 volt DC line is available. It is possible, then, to connect 18 of the tubes in series since 6.3 times 18 is 113.4. Of course, no practical receiver will be built with 18 tubes but any other number of tubes less than 18 can be used on the line provided that the proper ballast resistance is used to drop the voltage, or rather to limit the current to 0.3 amperes.

In order to compute the value of the ballast resistance in any case multiply the number of tubes in the circuit by 6.3 and subtract the product from the voltage of the line and divide

(Continued on next page)

Circuit for New Tubes

Five Tube Design Has 6.3 Volt Heaters in Service

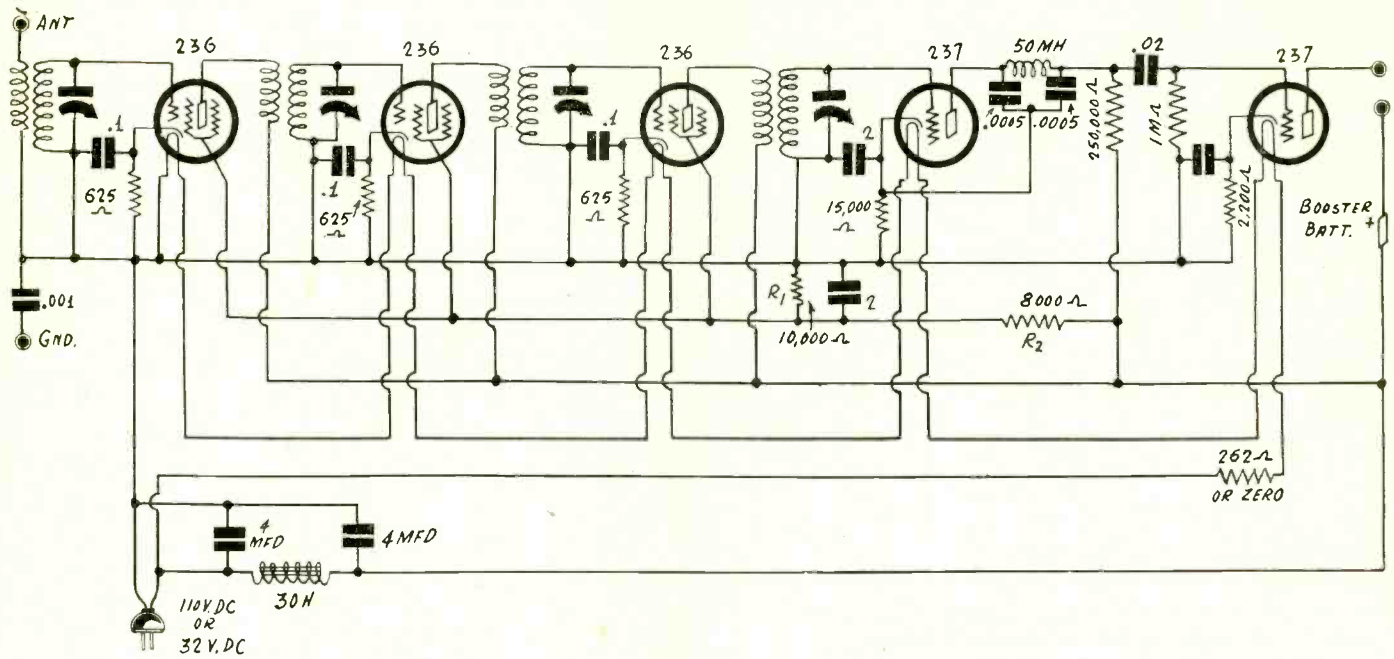


Fig. 1

The circuit of a five tube receiver with series connected heaters and utilizing the new 6.3 volt tubes.

(*Continued from preceding page*)

by .3. This voltage should be measured because even though it may be rated at 110 volts it may be considerably lower or higher. As an example, let the number of tubes in the circuit be six and assume that the voltage measures 112 volts. Six times 6.3 is 37.8 and the difference between this and the line voltage is 74.2 volts. Dividing this by 0.3 we get 247.3 ohms, which is the proper ballast in this particular case.

Tubes Must Be Similar

This method of computation holds only if all the tubes are of the same type with respect to filament requirements. That is, they may be RCA-236, RCA-237, and RCA-238.

The tubes may also be used in a similar manner on a 32-volt farm lighting outfit. As many as 5 of the tubes may be connected in series on a 32 volt battery since 5 times 6.3 is 31.5. This is so near 32 volts that it would hardly be necessary to use a ballast resistor. If more than 5 tubes are to be used it would be necessary to connect in series parallel and double the current drain. In this connection it is well to state that the resistance of each heater is 21 ohms and that when a tube is removed a 21 ohm resistance should be substituted in the series.

One of the purposes of these new tubes is use in automobile receivers, to be connected to the car battery. In such cases the heaters are connected in parallel for the required voltage for each heater is the same as the normal voltage of the battery. No ballast is required. Since the tubes are in parallel the current drawn by the receiver is equal to 0.3 times the number of tubes. Thus a six tube set would draw 1.8 amperes, which is not an excessive amount.

Sample Circuit

A sample circuit for the 6.3 volt tubes on a 110 volt DC line is shown in Fig. 1. All the essential values are given where they differ from those applicable to any other circuit. The values of the tuning coils and condensers are not given because they are the same as for any other circuit that is to cover the broadcast band. They have been given in countless receivers.

In this circuit both the heater and the plate voltages are taken from the line. The plate supply is filtered with two 4 mfd. condensers and one 30 henry choke coil. The plate voltage is less than the line voltage by the amount of drop in the choke coil, which may amount to 10 to 15 volts. The circuit is based on 90 volts on the plates and 55 volts on the screen, but if the voltages are a little higher the circuit will work so much the better. If the resistance of the choke coil is 500 ohms the drop in it will not be more than about 5 volts.

Since the plate supply is partly filtered to start with and since the two 4 mfd. condensers are very effective, it is permissible to use even less inductance in the choke. This will reduce the voltage drop still more and increase the plate and screen voltages.

The power output of the 237 tube with 90 volts on the plate and 6 volt bias is 30 milliwatts. This is not much but it is sufficient to give a good audible signal in a small loudspeaker. If a dry cell battery is connected in series with the speaker the voltage on the last tube can be boosted until the maximum power output is 75 milliwatts. This will require one 45 volt block. The grid bias should be increased to 9 volts, but this will be taken care of automatically by the bias resistor.

Use of Pentode Output

A pentode tube can be substituted in the output stage if desired and to do so it is necessary to boost the plate voltage to 135 volts as was suggested above for the 237 tubes. Connect the screen and plate returns to the same voltage, namely, 135 volts and change the bias resistor to 1,250 ohms. The grid post on this tube is the screen and the cap is the control grid. Hence it is necessary to change the input connection.

The circuit in Fig. 1 can be used on a 32-volt farm lighting supply. In this case the filter is not needed because the voltage is already steady. Hence the 30 henry choke and the two 4 mfd. condensers may be omitted. The two leads running to the plug are connected to the battery. The booster battery should be connected with its negative to the positive of the storage battery and its positive to the plate return of the last tube, as indicated in the drawing. If the last tube is a 238 pentode the screen, that is, the grid prong on the socket, should also be connected to the highest voltage tap.

In case the circuit is used on a 32 volt source, the 262 ohm ballast resistor is not needed, since the total heater voltage needed is 31.5 volts. The heater voltage is not critical and the tubes will work satisfactorily over a wide range of voltages. Hence the small excess in this case is of no importance.

The Power Pentode

The RCA-247 is essentially the same as the power pentode already described and is intended for use in the last stage of power amplifiers now using the 245 power tube. It takes 250 volts on both the plate and the screen and minus 16.5 volts on the control grid. Since it has a high amplification factor and a high power sensitivity the full output power is obtained by a relatively low signal input. Hence it is eminently suited for use after a power detector without the use of an intermediate audio frequency amplifier.

The load impedance of this tube is 7,000 ohms, which falls in the range of tubes like the 210 and 112A. Therefore output devices, either transformers or loudspeakers, wound for these tubes will fit the new pentode.

The sum of the plate and the screen current is 39.5 milliamperes. Therefore if the tube is to be self-biased, as all tubes now are in AC sets, the grid bias resistance should be 16.5/.0395, or 418 ohms.

Hook-ups for AC Pentode

Only One Stage of Audio Is Required

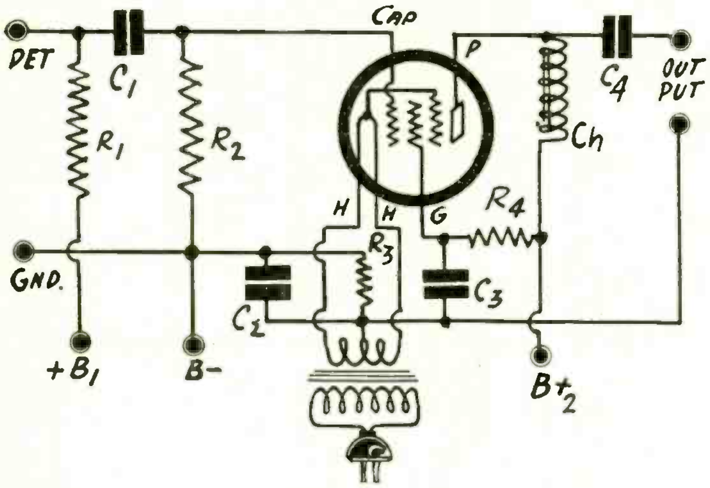


FIG. 1

The circuit of a power stage utilizing the new PZ power pentode tube. In this circuit resistance coupling is used between the power detector and the pentode tube and choke-condenser between the tube and the speaker.

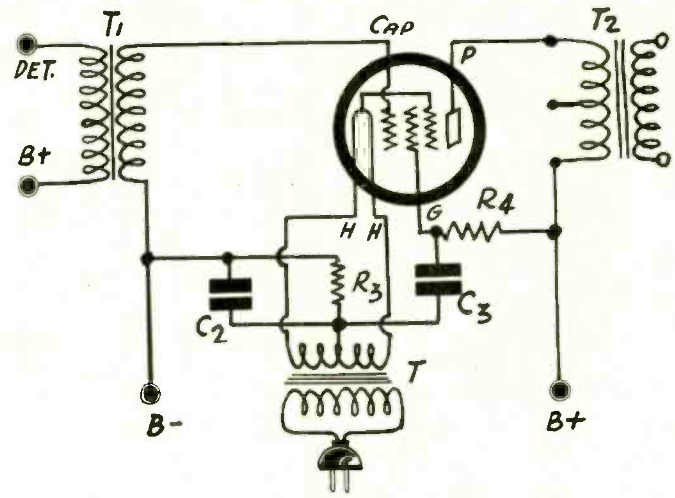


FIG. 2

A power stage circuit utilizing the pentode tube with transformer coupling both in the input and the output. This circuit should be preceded with a 227 type power detector.

[*Last week we published the first article on the new power pentode tube and gave a diagram showing how it should be connected when using batteries to supply the power. In most cases the tube will be operated on AC and therefore we herewith publish an AC operated power stage using this tube.*—EDITOR.]

SINCE the maximum peak signal voltage that should be applied to this tube is 16.5 volts, and since a power detector will easily give this output voltage, it should not be necessary to use an intermediate audio amplifier stage.

In the diagram we show resistance coupling between the detector and the power stage because this form of coupling is not only simpler and less expensive but it gives better quality than any other form of coupling. If we assume that the detector preceding this is a 224 scren grid tube, a high resistance should be used in the plate circuit, and therefore R1 should not be smaller than 250,000 ohms. It helps little to make this resistance large unless the grid leak resistance R2 also be made large, and it should not be smaller than about one megohm. This makes the effective load resistance on the detector 200,000 ohms, which is satisfactory value.

Conserving Low Notes

If the low notes are to be conserved it is necessary that Cl be not too small. A value of .01 mfd. should be regarded as the minimum but it is hardly necessary to make it any larger than .02 mfd. if the receiver is to be used exclusively for sound amplification. If it is to be used for television the condenser should not be smaller than one microfarad. The size of the stopping condenser depends on the value of the grid leak resistance. The larger this is the smaller may the stopping condenser be for a given amplification of the low notes. It is well to maintain the value of the product of C1 in farads and R2 in ohms at .02 for sound amplification and at 0.1 for television amplification.

Difficulties are encountered in amplifiers when this product is made larger, and this is true whether it is increased by making the condenser capacity large or the grid leak resistance high. If the condenser is made large, leakage through the condenser tends to make the grid of the tube following positive so that it will not amplify. If the grid leak is made large the same problem arises for then the leakage through the leak, which tends to make the grid negative, cannot keep up with the leakage through the stopping condenser and the insulation of the control grid, which tends to make the grid positive, and the control grid goes positive. This stops the tube from functioning.

Bias on Tube

The bias on the power tube should be 16.5 volts and it is obtained from the drop in R3. Normally 39.5 milliamperes will flow through this resistance and therefore the value of R3 should be 418 ohms. This is a comparatively low value and a small by-pass condenser across it will not do much good, and for that reason C_2 should not be smaller than 4 mfd. An electrolytic condenser of 8 mfd. would be desirable in this position.

The effective space charge grid voltage and the effective plate voltage should be the same for this tube and all the voltage should be 250 volts. Since there will be a voltage drop in the choke Ch a resistance R4 is put in series with the space charge grid lead. If we assume that the DC resistance of Ch is 500 ohms the value of R4 should be 2,300 ohms. In any case R4 should be 4.64 times as great as the effective DC resistance of Ch or of the load of the tube. This assumes that the returns are made to the same point as in this circuit.

It must be stated that the voltages are not critical and no harm will result if one is a little higher than the other. Hence R4 may be of 2,000 ohms, or it may even be omitted in a pinch.

The condenser C3 across this resistance should be at least 2 mfd. and it should be connected from the space charge grid to the midpoint of the filament winding serving the pentode.

Choke-Condenser Output

The output impedance of the pentode is considerably higher than that of any other output tube and it required a higher load impedance, such as that of most magnetics or inductor dynamics. The choke Ch should have an effective inductance of 30 henries or more and the condenser C4 should not be smaller than 4 mfd.

If an output transformer designed for a 112A or a 210 tube is available, this may be used in place of the choke-condenser output coupler. Better still, a push-pull output transformer designed for either of these tubes may be used to advantage provided that the entire primary is used in the plate circuit.

The 2.5 volt winding serving the tube should not be used for any other tube in the receiver. It may be on a separate transformer or on the power transformer serving the set as a whole. The winding designed for the 245 output tube or tubes is suitable, or any other 2.5 volt winding that is center-tapped.

Voltage Required

The voltage required by the plate and the space charge grid is 250 volts and that by the control grid is 16.5 volts. Hence the total voltage between B2 and ground should be 266.5 volts. This and more can be obtained from any power supply designed for a set using 245 tubes.

In Fig. 2 is the circuit of a power stage with transformer coupling using the pentode tubes. The corresponding voltages in these two circuits are the same as are the condensers and resistors having the same designations are also the same. Since the detector in this case is coupled to the amplifier by means of transformer T1 a detector of the 227 type is assumed, and this may well be of the power type so that the output voltage after it has been stepped up by T1 is sufficient to load up the pentode. The output transformer T2 is of the push-pull type with the entire primary winding in the plate circuit. This output, as was suggested above, may be used also with the circuit in Fig. 1.

Better quality will be obtained with the circuit in Fig. 1 but somewhat more volume will be obtained from that in Fig. 2.

A Sensitive 2-Vo

By Gordon

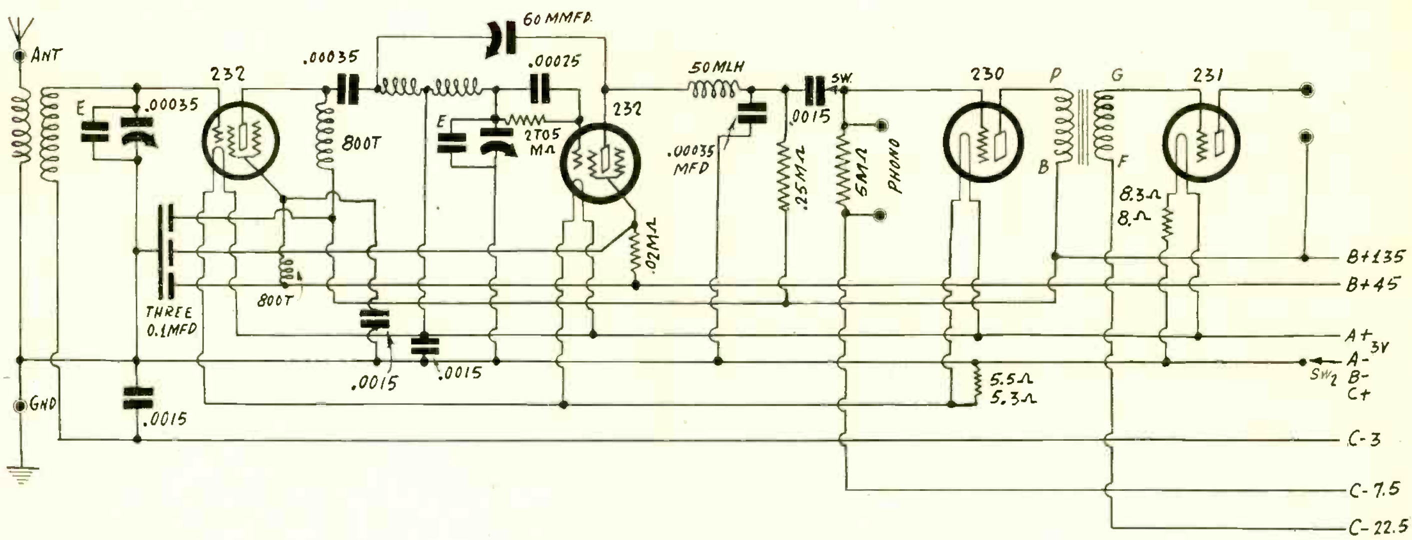


Fig. 1
The 2-volt battery midget that draws only 0.3 ampere filament current and 22 milliamperes of plate-screen current.

SIZE of chassis, 9½ inches wide by 5½ inches front to back, by 2⅝ inches high!

Device, a broadcast receiver for battery operation, to work a loudspeaker.

This is a battery midget with a vengeance.

The new 2 volt tubes are used throughout. There are two 232 screen grid tubes, one is used as radio frequency amplifier, the other as sensitized detector. The first audio tube is the general purpose valve, 230, while the output tube is a 231.

With such a set the sensitivity is abundant for everyday use, while the volume is adequate for speaker operation.

Where Parts Are Mounted

The dial, double tuning condenser, binding posts and twin assemblies are on top of the chassis, while the rest of the parts, including coils, are underneath. One coil is mounted against the inside of the front flap of the subpanel, the other coil against a side flap, so that the coils are at right angles, thus reducing the coupling to a minimum. Then it is not necessary to shield the coils.

Each coil is the same. The diameter of the bakelite tubing is 1¾ inches. The primary consists of 15 turns of any kind of wire, so long as it is insulated, while the secondary, spaced ¼ inch away, consists of 70 turns of No. 28 enamel wire. In the case of the interstage coil, the circuit requires the interconnection of primary and secondary. The requirement is that the end of the primary, in the actual wiring of the set, be connected to the beginning of the secondary. Another way of expressing the same requirement is that if the coil is regarded from one end of the form to the other, the extreme terminal of the secondary goes to the grid, the other end of the secondary is connected to the adjoining end of the primary and to ground, while the remaining terminal of the primary connects to one side of the .00035 mfd. condenser that leads indirectly to the plate of the radio frequency tube.

These data regarding the interstage coil require that the windings be put on in the same direction.

LIST OF PARTS

Coils

One antenna coil and one interstage coil
Two 800 turn radio frequency choke coils
One 50 millihenry shielded radio frequency choke coil.
One audio transformer

Condensers

Two Hammarlund equalizers, 100 mmfd. maximum capacity
One Hammarlund 60 mmfd. variable condenser
One two-gang condenser, each section .00035 mfd. capacity
One block of three 0.1 mfd condensers
Three .0015 mfd. fixed condensers
Two .00035 mfd fixed condensers

Resistors

Three 4 ohm filament resistors with mountings
One 1.3 ohm filament resistor
One 0.25 meg. Lynch pigtail resistor
One 5.0 meg. Lynch pigtail resistor

Other Parts

One aluminum subpanel, with socket holes punched.
Four UX sockets. One REL Dial
One 4 lead battery cable
Two binding post with insulators
One speaker twin jack and one Phono twin jack
Two Benjamin switches
Two knobs
One roll of hookup wire
Two grid clips

Stability Achieved

As for the antenna coupler, the polarities of connection are not important, but of course the large winding must go in the grid circuit, the small winding in the antenna circuit. It is just as well to follow the same system here as previously, so that the adjoining terminals of the windings go to ground and C minus, in regard to primary and secondary respectively. A fixed condenser should bypass the C battery here, just as one bypasses the filament in the detector stage, to eradicate the effect of the resistance of the battery or filament from the tuned circuit.

In a circuit like this it is very important to attain stability, because otherwise carriers can not be easily resolved into signals. To gain the desired end it is imperative to include a radio frequency choke coil of high inductance in the screen circuit of the radio frequency amplifying tube, and it would be necessary to have such a choke in the plate circuit of that tube, were it not for the actual presence of such a choke in the plate circuit as a coupling impedance. The coupling choke serves the dual purpose of coupling and assistance to stability. However, in the instance of the choke in the screen circuit, a bypass capacity is necessary to augment the action of the choke, so that radio frequency currents kept out of the B batteries by the choke are detoured to ground by the condenser, leaving, as it were, no avenue of escape.

New 2-Volt Tubes Are Good

The 232 tube makes a splendid radio frequency amplifier, and the manufacturers are delivering tubes of this type that are of a very high standard of excellence. In the beginning it is reported there was some trouble with the 2 volt tubes in general, but if so, this has been fully remedied, and public satisfaction, even elation, with the 2 volt tubes is general.

The front of the chassis has on it the switch, SW2, which need not be insulated, as the metal of the panel may be used as A minus, and the small variable condenser, marked 60 mmfd. in the diagram, Fig. 1., which condenser has to be insulated. For this purpose two insulating bushings are used, a 7/16 inch diameter hole being required, and the mounting nut of the condenser tightened against the bushings, which face in opposite

It Battery Midget

Watkins

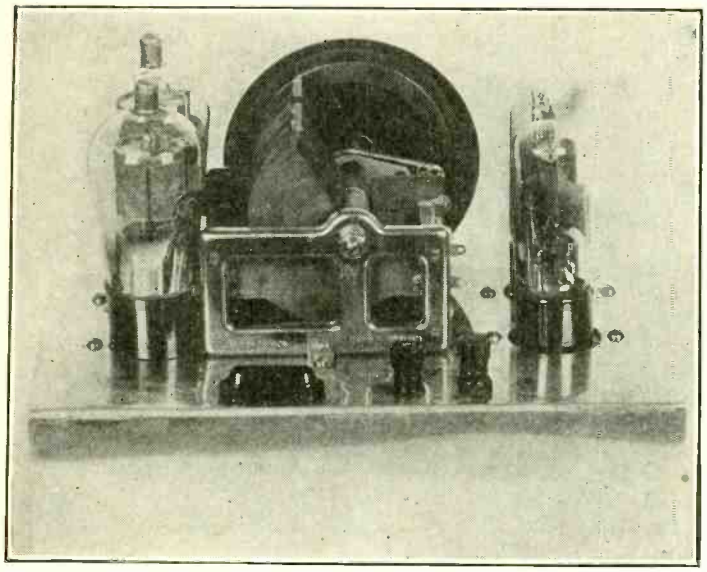


Fig. 2
Rear view of the chassis with parts mounted.

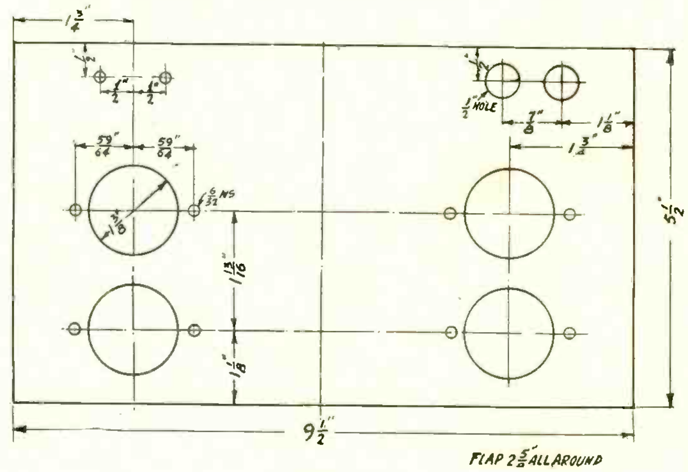


Fig. 3
Dimensions for the aluminum chassis

directions, the collar of the bushing through the chassis hole in each instance.

If provision is to be made for a phonograph pickup connection, a twin assembly is used for this purpose, but it is advisable also to cut out the possibility of any radio signal, that might interfere with phonograph rendition, so the other switch, SW1, also is included, and likewise must be insulated. This switch would be at rear, but the type of switch recommended is itself insulating, in respect to the part on which it is mounted, so that no bushings for this purpose are necessary. The same type of switch is used for SW1 and SW2 and is made by Benjamin.

Filament Resistors

The voltages should be applied as specified in the diagram. The parts should be used of the values stated, except that it is permissible to use a somewhat higher value of resistance in the detector screen circuit, say, 50,000 ohms. However, 20,000 ohms (0.02 meg.) works very well. The value is not critical within the stated limits.

Two filament resistors are shown. One is of 5.5 ohms, to drop the 3 volts of the A battery to 2 volts for the filaments, while the other is an 8.3 ohm resistor in the negative leg of the power tube to achieve the same purpose. The practical values may be attained by connecting 4 ohms and 1.3 ohms in series, to constitute 5.3 ohms, and connecting two 4 ohm resistors in series to constitute 8 ohms. The 4 ohm value is represented by the filament resistor otherwise used to drop 6 volts to 5 volts for a .25 ampere tube. The 1.3 ohm value is obtainable in wire-wound form. These are the values theoretically required, while their practical substitutes are shown below. The filament current for each of the tubes, ahead of the output, is .06 ampere (60 milliamperes), while the 231 power tube draws .12 ampere (120 milliamperes) filament current. Since the total is only .3 ampere, two No. 6 dry cells may be connected in series to constitute the 3 volts of the A battery. The normal recommended maximum drain for this type of cell, consistent with good life is 0.25 ampere, so the normal maximum is exceeded only 5 per cent., which is well within the tolerance limit.

Parts Explained

Three 45 volt B batteries are needed, and these may well be of the heavy-duty type, for long life, although even the medium sized ones, at the little current drain here required, will last several months of average use. The total plate and screen current is about 22 milliamperes.

The audio transformer coupling the first audio stage to the output tube, may be any type of the usual ratios generally sold today, which are around 1-to-3. The subpanel height was made 2⅝ inches to take care of several different types of popular brand audio transformers.

E represents Hammarland equalizers. The capacity is 100 mmfd. maximum. The two equalizers are set once, and left thus. You may select some station on a frequency around 1,000 kc and match up on that basis, which gives a more even distribution of results from an equal capacity viewpoint, although if you desire to build up the higher wavelengths at the expense of the lower ones, you may match up at around 500 meters or so.

The three 0.1 mfd. condensers are in one case. The black lead, common to all three capacities, is represented by the single bar at left in the diagram, and goes to grounded A minus. The three red leads represent the respective capacities, and it makes no difference which red lead goes to any one of the three points, screen of radio frequency tube, screen of detector or B plus 135 volts.

The 50 millihenry choke coil is copper shielded, and the shield is grounded.

Tuning Data

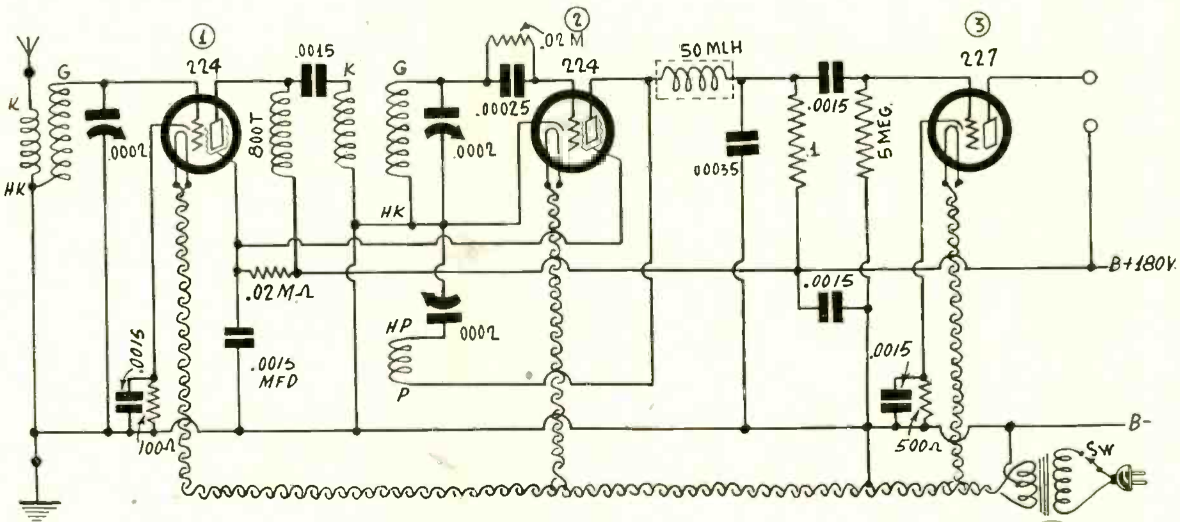
The tuning curve of the set will depend of course on the type of condenser used and on the setting of the equalizers. Assuming the use of the double condenser illustrated, with trimmers turned in only as little as required to achieve matching at around 1,000 kc, the stations would come in about as follows: 1500 at 8; 1450 at 12; 1350 at 19; 1250 at 26; 1150 at 34; 1050 at 42; 950 at 50; 850 at 61; 750 at 72; 650 at 84; 550 at 98. This line is approximately midline.

Using a little larger subpanel, a straight frequency line double condenser of .00035 mfd. capacity could be used, that would afford equal dial separation for equal differences in frequency. Then the readings would be approximately 1500 at 8; 1450 at 12; 1350 at 23; 1250 at 33; 1150 at 42; 1050 at 52; 950 at 62; 850 at 72; 750 at 71; 650 at 90; 550 at 98.

[Other illustrations on front cover]

A Short-Wave Set with Not Too Much Noise

By Roland Tookle



Two tuned circuits, with tickled detector of the leak - condenser power type, ahead of an audio stage, make a fine short-wave receiver.

ONE of the best ways to enjoy short-wave reception is to have a short-wave set, complete in itself, except that you may be able to obtain the B voltage from some external source, therefore may omit the B supply.

If there is a stage of audio built in you will be able to listen to far-distant stations with enjoyable earphone volume. And if you want to hear the station on the speaker, with the aid of the audio amplifier in your broadcast set, you can do that quite readily, by connecting the plate output post of the set to the plate spring of the detector socket in your broadcast receiver. The detector tube is removed from the receiver, and, since that tube likely is a 227, you can put it in the output stage of the short-wave set. However, this connection can be made to any type of set.

Choice of Coils

The circuit shown in Fig. 1 meets the requirements already set forth. It consists of a stage of tuned radio frequency amplification, a tickled detector with tuned input, and a stage of resistance-coupled audio frequency amplification. A filament transformer is built in, so that you have an AC job, less B supply.

Individual tuning of both stages helps mightily, and is the valuable assistant in making it possible to bring in European stations when all other conditions are right. The two tuning condensers and the feedback condenser all are Hammarlund .0002 mfd. variable capacitances.

The coils used may be of the tube base type or may be of the precision air-wound type, both models being obtainable with plug-in bases that fit sockets ordinarily used for UY tubes. The coils in the two coil sockets are identical, for interchangeability, even though one winding is not functioning when a coil is in the antenna socket. For instance, there are three windings, and the antenna coil requires two, so the tertiary is not used. This fact is well brought out in the pictorial diagram of the receiver, shown on the opposite page.

The screen grid tube in the first stage is capable of high amplification, which fact naturally raises the possibility of its oscillating, but the value of screen resistor was chosen so as to operate the tube just below the spillover point, when the voltage applied to the high end of that resistor was 150 volts. So in some few instances, where the extra 30 volts applied may bring about oscillation, determined by the plopping sound arising when the cap of the first tube is touched, a somewhat higher value of resistor may be used here, or the 135 or 150 volts may be used instead of 180 volts.

Not Too Much Noise

The diagrams call for 180 volts, because out of six receivers tested, five proved dependable and stable under the conditions as diagrammed, while the sixth oscillated a little in the radio frequency stage, cured by putting 10,000 ohms more in series with the .02 meg. resistor (20,000 ohms). The solution is simple, at all hazards, and it is advisable to use .02 meg., because if no oscillation is present in the radio frequency stage, the sensitivity is higher with that resistance value. The increase in the resistance value, although causing a greater voltage drop, does not affect the detector materially.

An attractive point about this circuit is that loud signals may be obtained without an overabundance of noise. It is the common experience of those who toy around with short-wave apparatus that noise comes in quite nicely, thank you. It is reduced somewhat, along with the sensitivity, if negative grid bias detection is substituted for the ordinary grid leak condenser detection, but the statement may be resolved into the simpler one that the general sensitivity is reduced. The reduction applies as well to the noise as to the signal.

Needs Two Tuned Stages

Here, we use grid leak-condenser detection, yet it is of the power type, because of the low value of grid leak, again .02 meg. The sensitivity does not suffer more than a trifle, the noise level is not as bothersome as when a leak of the order of megohms is used, and carriers can be reduced to signals with excellent ease.

(Continued on next page)

LIST OF PARTS

Coils

Two sets of precision plug-in coils, four coils to a set, total eight coils.
One 800 turn radio frequency choke coil
One 50 mlh. copper shielded radio frequency choke coil
One 2.5 volt unshielded filament transformer with red center tap on secondary

Condensers

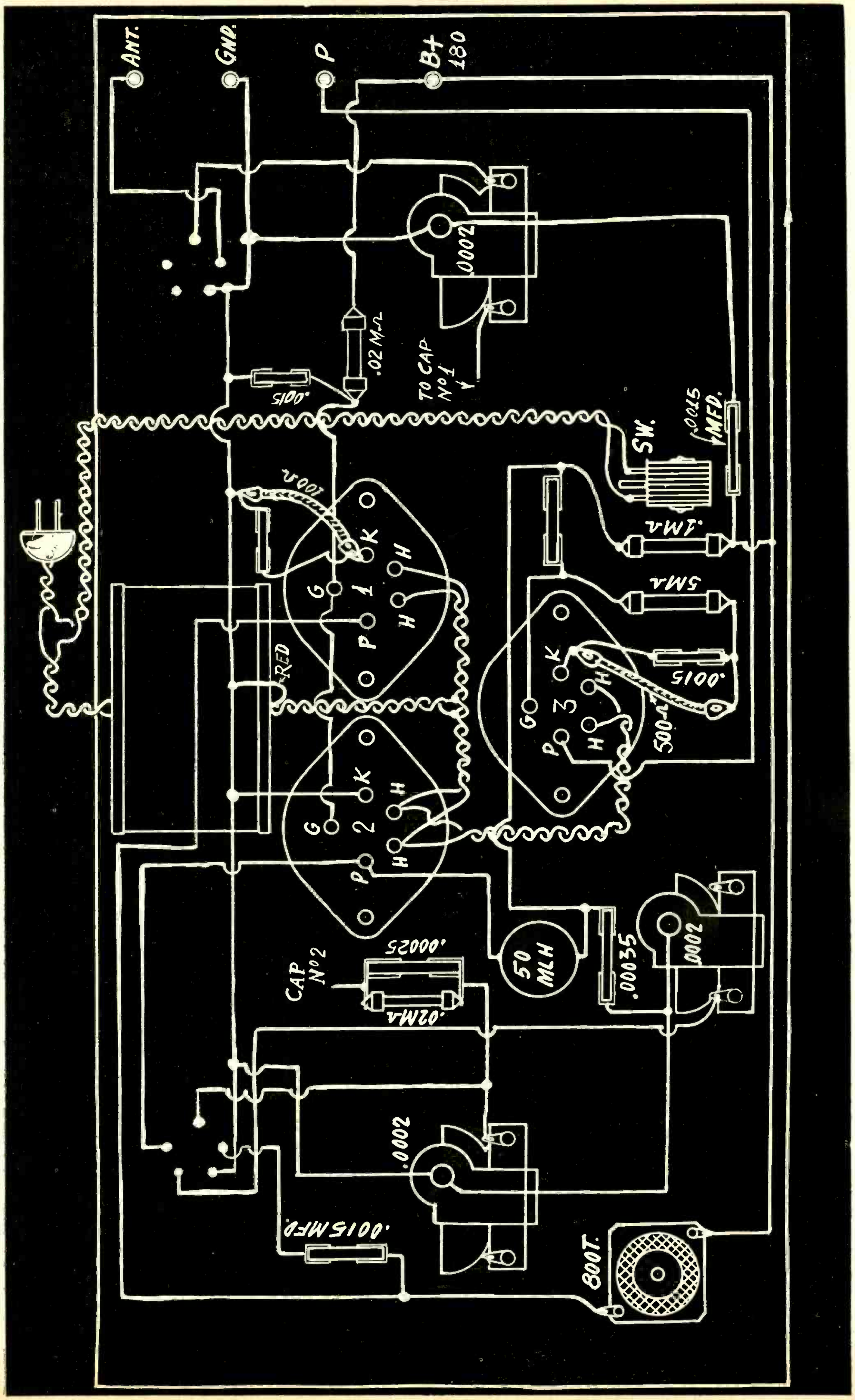
Three Hammarlund .0002 mfd. junior midline variable condensers
Six .0015 mfd. fixed condensers
One .00025 mfd. fixed condenser with clips
One .00035 mfd. fixed condenser

Resistors

One 100 ohm Electrad flexible biasing resistor
One 500 ohm Electrad flexible biasing resistor
One 0.1 meg. Lynch pigtail resistor
One 5 meg. Lynch pigtail resistor
Two .02 meg. pigtail resistors (20,000 ohms)

Other Parts

One 7x14-inch bakelite panel with five UY sockets
One walnut finish cabinet to fit
Two REL dials
One AC switch, shaft type
One AC cable with male plug
Four binding posts
Two knobs
One 6/32 screw, 2 inches long
One dozen 6/32 screws and nuts to match
One roll of hookup wire
Two grid clips


ANT.
GND.
P
B+ 180
.0002
.02 MΩ
TO CAP No 1
.0015
SW.
.0015 MFD.
.1 MA
5 MA
100 Ω
G
K
H
P
1
2
3
RED
.0015
500 Ω
.00025
CAP No 2
.02 MA
50 MLH
.00035
.0002
.0002
.0015 MFD.
800T.

Noise on Short Waves

By Brainard Foote

WHILE all radio sets are subject to occasional noise interference, short-wave receivers are particularly sensitive on this point. Whether you are using a short-wave set especially built for the purpose, or one of the several forms of short-wave adapters or converters connected with your regular broadcast outfit, the following suggestions will apply.

I believe that the ground connections offer the greater share of noise sources and it will pay every short-wave fan to examine the ground system with extra thoroughness. Turn on the set and set the volume control so the set is oscillating, as in this condition the set will respond most noticeably to noise sources. Jump on the floor, move lamps, draperies, cords, connecting wires, etc. and note whether there are any tell-tale clicks in the speaker to help you locate loose connections.

Trouble in the Cellar

The cellar offers a prolific source of radio noise, especially so far as short wave sets go. BX cables that criss-cross and touch each other, water pipes touching each other, BX cables touching water and steam pipes, etc., all provide points of uncertain contact and slight jarring will cause a click in the set. Pipes, wires, etc. all have a natural wavelength and because of their average physical dimensions such wavelengths fall in the sphere of short-wave radio sets. On this account, changes in such wavelengths due to changing contacts alter the ground circuit conditions and cause noises.

It is important to use as many ground connections as you can, as this use results in quieter reception and usually in louder signals. For instance, run one heavy wire direct to the water main where it enters from the street. Then in the room connect additional wires to radiators, water pipes, etc. And in the cellar, connect other water pipes, steam lines, etc., to the main ground lead, making sure to provide good contact preferably by soldering wires to each other. It is not possible to solder to water pipes, etc., so use good ground clamps, first carefully filing or sandpapering the paint and dirt off the pipes.

In the aerial, too, poor contact and nearness to other wires may cause noise. Do not use too long an antenna for short wave work, and you'll get louder results as well as less interference.

Poor contacts in the set are very bothersome, too. See that the tubes make good contact in the sockets and that all unsoldered connections are clean and screwed up tightly.

A defective grid leak is a common source of noise of the rasping and scraping variety. In short-wave sets high resistance leaks sometimes employed are more difficult to manufacture and do not last as long. Keep an extra grid leak or so on hand and test it once in a while for the sake of comparison.

The short-wave set is prone to inductive pick up of noise from the power lines, hum, etc. Keep lamp cords at a distance from the set, its wiring and the antenna lead-in.

Noises caused by household appliances may be eliminated by building or purchasing suitable filters and attaching them to the appliances. Little can be done about interference from automobile engines, electric motors in outside locations, etc.

Improved Reception

If the set makes a rattling sound as the tube commences to oscillate, try a different detector tube, as well as a different size grid leak. A radio man can install a potentiometer system for handling the grid return lead in the circuit to reduce this effect greatly and make the detector tube oscillate smoothly.

Long connecting wires in the set and to its accessories are detrimental unless by-pass condensers of about 1 mfd. capacity are liberally used.

Short-wave reception is crammed with fascination for any listener, and particularly so for those interested in learning the radio code. Reception is tremendously improved by attention to such details as I have outlined here, and well worth the effort necessary.

Coil Connections for Tookle's Set

(*Continued from preceding page*)

Another point is that tuning the radio frequency stage makes possible the elimination of crosstalk and crossmodulation. Crosstalk arises frequently nowadays because of foreign stations being on waves only slightly removed from the waves of American short-wave relay stations. In some parts of the country the nuisance of this interference with the much-desired foreign reception is great, and of course that dire situation is worst at points several hundred miles or more removed from the interfering transmitter.

It is a phenomenon of short waves that they skip the immediate locality of the transmitter, and some miles beyond, either leaving this territory as a dead spot or as an area in which the field intensity about the aerials, in respect to that transmission, is very feeble. The feebleness comes in handy, for once, because of sparing some foreign-reception addicts the disappointment of domestic interference, although it is quite true that a person in almost any part of the country is likely to run into domestic interference because of some transmitter located several hundred miles away.

Coils Is Important

Two tuned circuits, by a severe test, just get away with enough selectivity to make possible the reception of foreign stations without this interference.

An important part in any short-wave device is the coil. Here two plug-in coils are used for each single range of frequencies, starting with 200 meters and going down to about 90 meters, then starting at 92 meters and going down to 50 meters, then starting at 52 meters and going down to 50 meters, then starting at 29 meters and going down as far as practical, the depth depending somewhat on how the set is wired and other considerations beyond the capacity of the condenser and the number of turns on a given coil diameter.

Reach 15 Meters, Anyway

One may rely on 15 meters, anyway, provided the detector tube is keen enough to afford oscillation at such high frequency which is of course perfectly practical, provided the tube is a good one. Here is one position in which you must be doubly certain that the tube is a good one, and if you have no tester or method of testing the tube, take it to the dealer. The test to make is of its amplifying power, for the better amplifier it is, the better oscillator it will be.

The construction is clearly set forth in the pictorial diagram, while the schematic diagram is serviceable for check-up, and also for quick reading of connections, which is not possible in regard to a complete circuit like the present one when dealing with a picture diagram. The pictorials are important in wiring, but when it comes to bird's-eye viewing, a schematic is the thing.

The coil connections are designated on the schematic to correspond to the actual connections as shown in the pictorial diagram. Therefore K, HK, G, P and HP refer to socket springs for coils, and have nothing to do with tube prongs. H stands for heater, G for grid, and P for plate, K for cathode. HK and HP refer respectively to the heater adjoining cathode and heater adjoining plate. Watch these connections, for if you do not get them right you will not be able to tune in Europe.

The set is to be tuned from the top.

Standard Frequencies Transmitted Regularly

In connection with the calibration of the coils it is well to remember that the Bureau of Standards station WWV is transmitting a standard frequency of 5,000 kc. once every week from 1:30 to 3:30 and from 8:00 to 10:00, both P. M. Eastern Standard Time, almost every Tuesday. The signals are characterized by long dashes of unmodulated waves and vocal announcement of the frequency and station at intervals. This transmission is the most accurate in the United States and may be used for calibrating secondary standards of frequency and of oscillators such as those described here. To make use of the frequency it is necessary to have a receiver capable of picking up the signals. This receiver may be an ordinary sensitive broadcast receiver in conjunction with a short-wave converter such as have been described in RADIO WORLD.

This standard signal can be used for calibrating oscillators of both higher and lower frequencies than the transmission itself. For getting lower frequencies harmonics of the oscillator under calibration are used against the standard, and for higher frequencies harmonics of the standard are compared with the fundamentals of the local.

Sending on Micro-Rays

By Einar Andrews

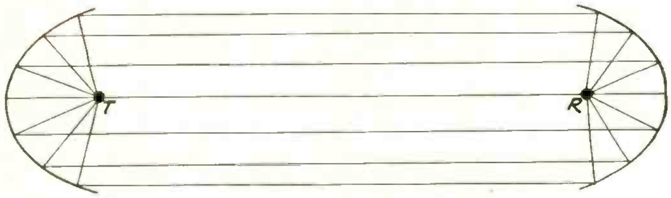


FIG. 1

This illustrates the use of parabolic reflectors for transmitting waves in a beam and for intercepting and strengthening the waves at the receiver.

THE rapid increase in the number of radio transmitting stations and the world-wide clamor for more channels are forcing the development of the ultra-short waves for communication purposes. An announcement has just been made of successful telephone communication across the English Channel between Dover, England, and Blanc Nez, France by engineers of the International Telephone and Telegraph Company on a wave-length of only 18 centimeters, or approximately seven inches, with a transmitter which radiated only about one half watt. It is reported that the received signals were steady and free of fading effects.

The new system with which this communication was carried out is called micro-ray radio because of the extreme shortness of the waves and the minute power required. It opens up a wide field for radio communication because in this region there is practically unlimited room for expansion. Eighteen centimeters is equivalent to 1,666,666 kilocycles per second and between 17.5 and 18.5 meters there are 9,260 ten kilocycle channels whereas in the entire broadcast band there are only 96 channels.

Directional Feature

Not only are there many channels in this micro-region but the waves may be focused and transmitted in a beam so that on any one frequency it is possible to use many stations without interference one with the other. Beams of any number of stations may cross without setting up any interference just so long as only one beam falls on the receiving reflector. In addition to the enormous channel and circuit possibilities the new system offers secrecy since it would be necessary to intercept a beam in order to eavesdrop. The micro-ray beams can be transmitted in a much narrower and intense beam than the longer waves now used in beam communication. And because of this intensification of the beam, communication may be carried on over longer distances with less power. The beam system of communication is similar to communication with searchlights. At the transmitting end a parabolic reflector of about 10 feet in diameter is used to concentrate the waves in a narrow, pencil-like beam and at the receiver a similar reflector is used to concentrate the intercepted portion of the beam on a point at which the tuner is located. This is equivalent to using a reflecting telescope for concentrating the light from a distant planet to produce an observable image.

One important application of the micro-ray will be to television. The frequency band that can be allowed each station is so wide that there will be practically no limit to the side bands that may be impressed on the carrier and visual signals of fine detail will be possible.

The details of the oscillator and receiving systems are not available at this time. Heretofore, one of the limitations to successful use of very short waves has been the vacuum tubes, which could not be made to oscillate at very high frequencies and which could not be made to receive efficiently due to the comparatively high values of interelectrode capacities. Neither the capacity nor the inductance could be made small enough to bring the frequency up to the enormous values. It is expected that the details of the circuits will soon be available.

Why Large Reflectors

The reason such large reflectors are used is that the larger the reflector the more of the energy from the transmitter can be collected and transmitted in the beam and the narrower the beam. Also, the larger the receiving reflector the more of the beam can be intercepted and made effective on the receiving circuit.

Five meter waves are used regularly for communication purposes. and with certain precautions ordinary radio tubes may be used for oscillators and amplifiers. Radio amateurs have been assigned a band of frequencies near 0.75 meter and some work has been done, but due to the difficulties encountered very little success has been achieved. Special tubes and other devices will have to be developed to open up this field. Undoubtedly, the technique developed for the 18 centimeter waves will open up the entire spectrum from the present limit of five meters to below 10 centimeters.

Other experimenters have worked with waves so short as to approach the red lightwaves in length and they are called quasi-optical waves. Details of these experiments are still lacking but they will shortly be revealed before the Institute of Radio Engineers, and they will be reported in RADIO WORLD as soon as they are available. These waves are of a length measured in fractions of a millimeter. If waves of this length can be made practical for communication there will be enough room for every individual to have a station for his private use. One of the advantages of such waves is that they pass through fog just like ordinary light waves pass through window glass.

Use of Light for Communication

Light waves from the longest infra-red to the shortest ultra-violet have been used for telephone communication over short distances and it is certain that this field will receive greater attention in the near future. At the present time this art has been developed to the point where telephone communication can be carried on between any two points in direct line of vision. That is, wherever it is possible to use light for signalling between one point and another it is also possible to conduct telephone communication. The photo-electric cell has made this possible. Now that extremely sensitive photo-electric cells have been developed it is possible to communicate over fairly large distances by means of tiny lights of the proper kind. Of course, it is necessary to employ sensitive amplifiers for intensifying the signals received optically.

Advance of Radio Communication

The successful telephone communication on 18 centimeters between Dover, England, and Blanc Nez, France, recalls the first successful radio communication between Dover and Boulogne, France, on March 27, 1899, when Senator Marconi first succeeded in spanning the 32-mile distance by means of electric waves and his first successful transatlantic signalling by radio on Dec. 12, 1901. In 1922, after the advent of broadcasting, Senatore Marconi demonstrated the efficacy of short waves just below 100 meters before the Institute of Radio Engineers in New York. Since that time the band between 100 and 10 meters has been developed for communication and it is already so crowded that more room must be found for additional applications of radio, and the only virgin territory is that below 5 meters. But that territory is infinite in scope. Thus there is ample room for the experimenter who wishes to cut himself a niche in radio for pleasure and possible future profits.

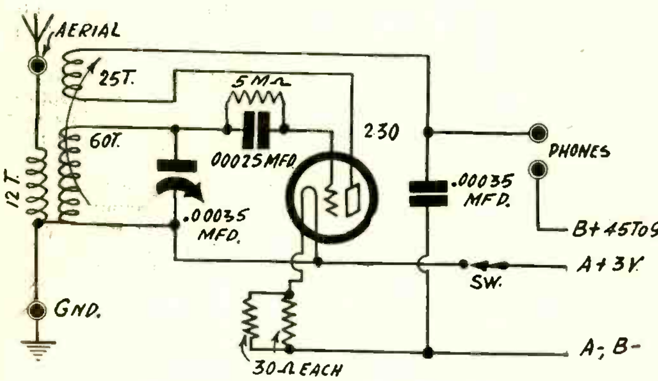
Antenna for 18 Cm. Waves

An interesting point in the 18 centimeter transmission is that the radiating antenna used was only one inch long. This miniature antenna was, of course, put in the focus of the parabolic reflector so that the radiated wave was sent out in a beam. This is similar to the headlight of an automobile, in which the light filament is located at or very near the focus of the parabolic reflector. Those who are not familiar with parabolas and paraboloids might think of a head light and the shape of the polished surface. In this miniature radio transmitter the diameter of the opening was ten feet. In an automobile headlight the opening is about 10 inches.

In Fig. 1 is an illustration of how transmission by means of beams in which a parabolic reflector is used at each end. T is the position of the transmitting antenna, located at the focus of the parabola. A property of the parabolic reflector is that when a source of light, or any other source of waves, is at the focus the waves all pass out in a parallel beam. Any ray of light, for example, that strikes the surface at a point back of the source is reflected so that its new direction is parallel with the axis of the parabola. Also, any ray of light striking the reflecting surface in front of the source is reflected in a direction parallel with the axis. If the parabola is short in comparison with its diameter, there will be some rays of light which will not strike the surface and they will not stay with the beam but will spread out.

The receiving reflector is just like the transmitting reflector and the two are facing each other. The receiving antenna, which should be just like the transmitting antenna, is located at the focus of the second reflector, at R in Fig. 1. If the axis of the two parabolas are coincident the parallel waves in the beam will be intercepted by the receiving reflector and brought to the focus there to actuate the antenna.

Building a One-Tuber



[Data on coils and other constants for a one-tube receiver were published last week in the April 11th issue.. The schematic diagram appears at the head of this column, while the pictorial diagram is published this week so that even the novice will find no difficulty whatever in making the set work properly.—EDITOR]

* * *

IN building the one-tube set that is the subject of this article, the tuning condenser should be attached to the front panel first, which is done by removing the slotted bracket from one end of the condenser and drilling out the remainder of the rivets, leaving the two holes clean. These holes will be found to coincide with two countersunk holes on the front panel. Into these panel holes the two flat-head 6/32 machine screws are inserted, with head at the front of the panel.

A roundhead screw, that holds the lug of the condenser's pigtail, will be found obstructive. Remove this screw and leave the hole blank. The pigtail lug then may be fastened by means of the upper nut on the left-hand side bakelite strip on the condenser. This upper nut may be removed with a screwdriver, the lug put in position, and the screw tightened against the lug. In this way, also, the pigtail can be kept free of collision with the moving plates of the condenser.

Mounting Condenser to Subpanel

The necessity for mounting the condenser first is that the front panel mounting screws for the condenser would not

LIST OF PARTS

Coils

One three-circuit tuner for .00035 mfd.
One short-wave parallel coil.

Condensers

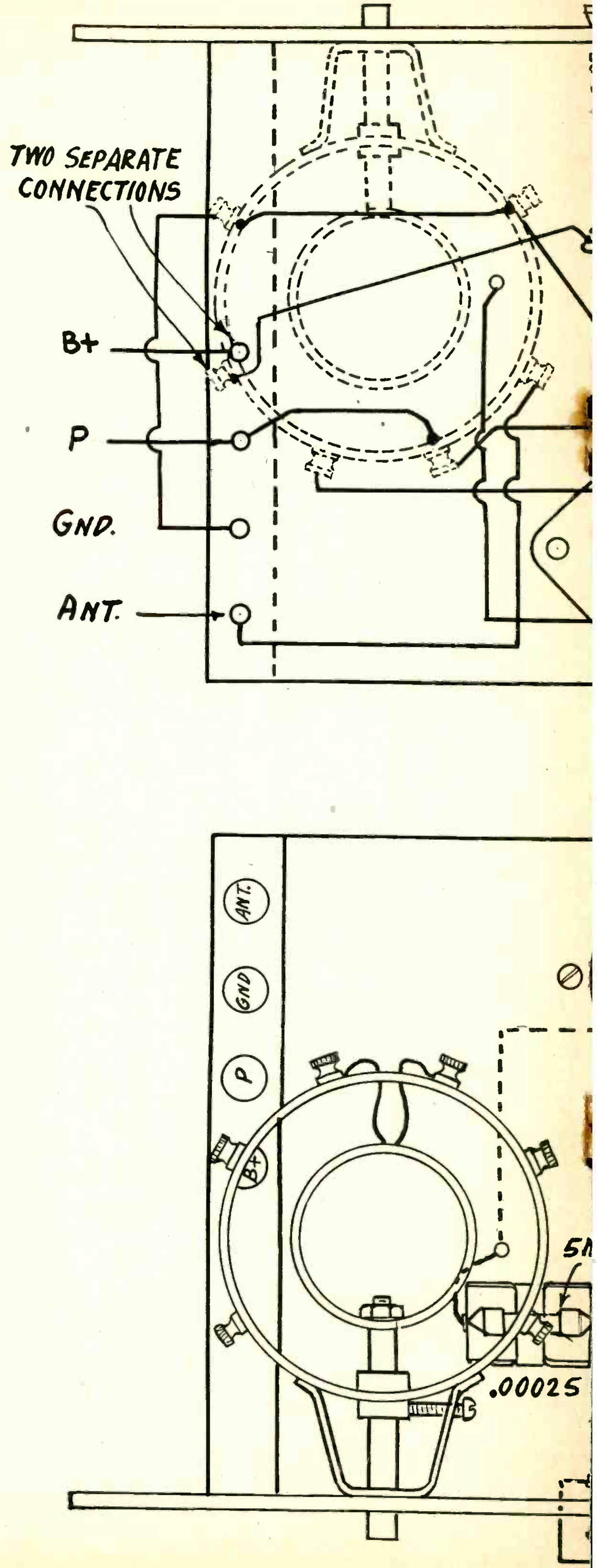
One .00035 mfd. tuning condenser.
One .00025 mfd. fixed grid condenser with clips.
One .00035 mfd. fixed condenser.

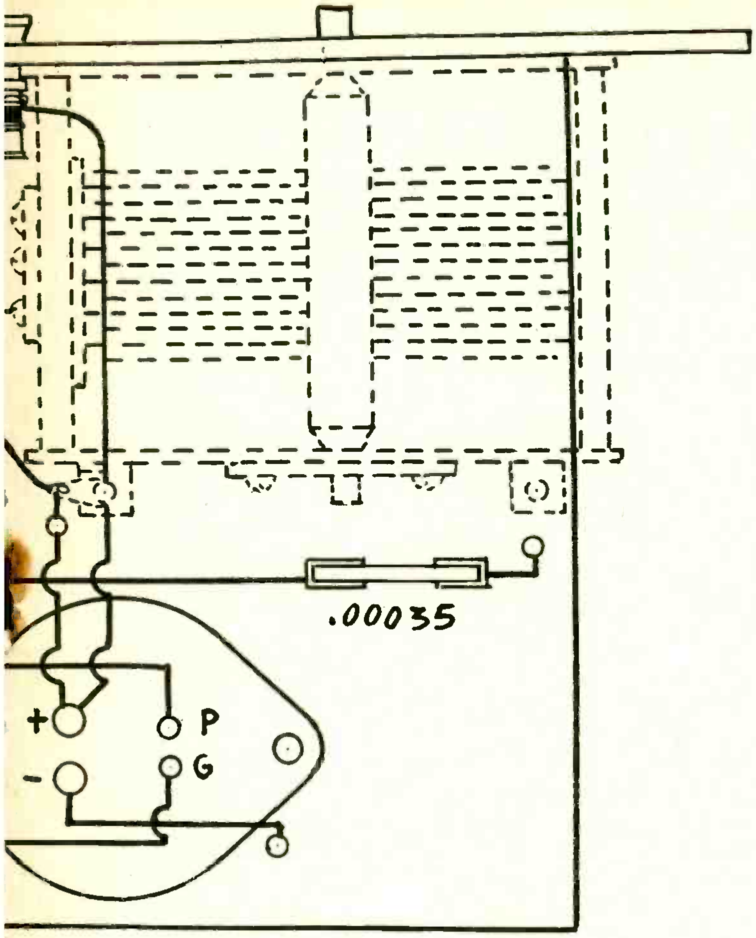
Resistors

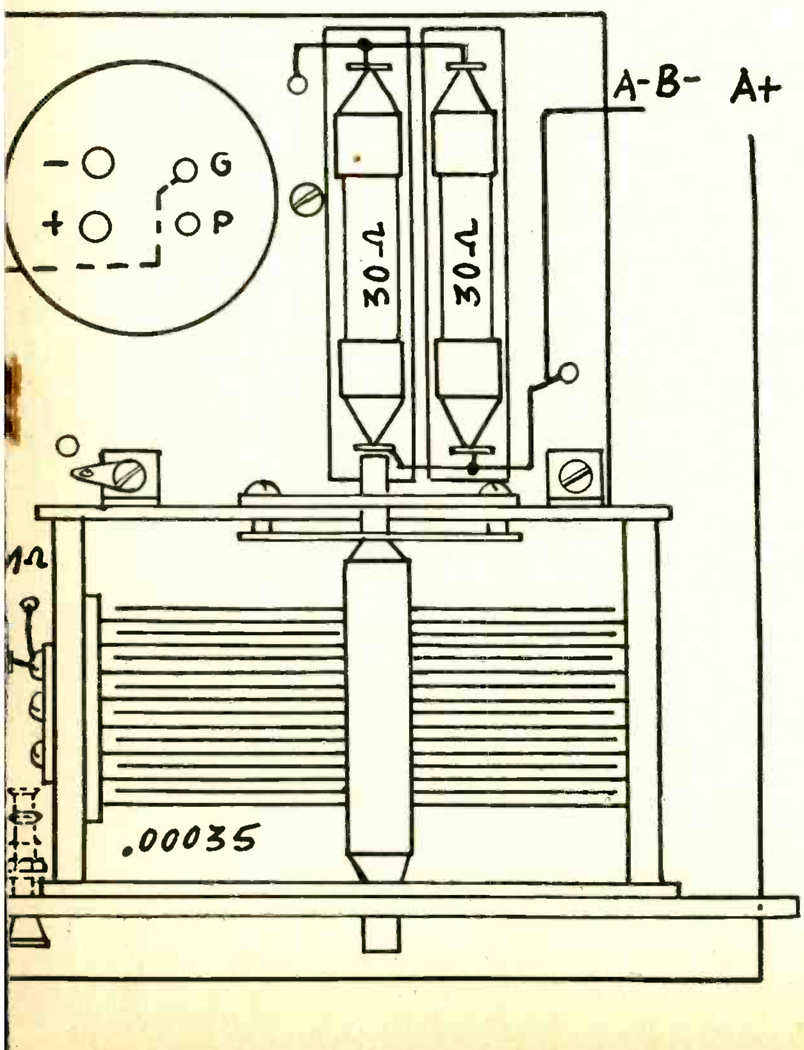
Two 30 ohm filament resistors with two mountings.
One 5 meg. grid leak.

Other Parts

One A battery switch.
One dial.
One knob.
One binding post strip, with four unmarked binding posts.
Two insulated wire leads for battery connections.
One 8x5-inch bakelite front panel.
One 6x4¾-inch aluminum subpanel with 4-prong socket attached.
One dozen roundhead 6/32 machine screws and nuts to match.
Two flathead 6/32 machine screws, for front panel condenser mounting.
Four milled bushings.
Six lugs.







Circuit Use Is Manifold

be accessible from the inside, to attach the nuts, if the subpanel were in place.

The condenser has two rear brackets. Holes are drilled in the aluminum subpanel to coincide with the holes in this pair of right-angle brackets. Then the condenser is fastened down to the subpanel with 6 6/32 machine screws and nuts.

Now there is sufficient rigidity, and the front panel can not be rotated in respect to the subpanel. However, the elevation is uneven. The difference should be taken up by four milled bushings, aided in two instances by two nuts for each bushing, and in the two other instances by the thickness of the bakelite strip used for the four binding posts. The dimensions for this strip, and location of holes, were given last week, as were the other dimensional data. The detail of equalizing the elevation also was fully explained then.

The elevation of the subpanel will be just enough to clear the spring of sockets, but if desired these springs may be bent back a little, although that is not necessary, provided the wire connections are made through the holes in the socket springs and then soldered neatly. No large gob of solder should be used at these socket positions as the elevation might be exceeded in that way and the assembly might then pivot on the socket when the set is stood up which pivoting otherwise will not take place.

How to Use the Pictorial Diagram

Leads are reasonably short, as shown in the pictorial diagram, but the shorter they are the better, and it is quite all right to make them shorter than shown, if possible, because the picture diagram was made with the primary purpose of clarity of connection and leads. This sometimes requires that a lead be shown as being longer than it actually is or need be in the wiring itself.

Connections are few and simple and anybody can follow them. The only required warning is to observe that two connections, that seem close to each other because of the top view necessitated for a picture diagram, are wholly independent. They must not be made identical nor confused with each other. This point is stressed in a legend printed right on the picture diagram, so watch this point carefully.

The parts required are few, the work to be done is trifling, and the whole set can be erected and wired in about forty minutes of leisurely procedure. When the set is finished you have the following:

1. —A one-tube regenerative receiver for bringing in broadcast frequencies.

2. —The dial may be calibrated, by loose coupling to a broadcast receiver, tuning both the receiver and the little set, and drawing a curve on plotting paper, using the frequencies of the known stations as tuned in on the regular broadcast receiver, and the corresponding numerical settings of the one-tube set. Then you will have a calibrated oscillator for broadcast frequencies, and will cover the entire broadcast band.

3. —Experimental work on short waves may be tried, condenser of any capacity at hand, even a small one, say, .00035 mfd., from the AC line to the plate. Then the 120 cycle frequency will be the modulation (second harmonic of the 60-cycle frequency of the line). The modulated oscillator, coupled to a broadcast set under test, will enable lining up of sections of gang condensers, correct adjustment of trimmers and calibration of the tested set in kilocycles. The equivalent wavelengths could be obtained from the 10-30,000 reversible conversion table published in last week's issue, dated April 11th, and indeed even the frequencies of the broadcast stations, since a complete list of those stations by frequencies was published in that issue.

4. —Experimental work on short waves may be tried, by cutting in a parallel coil, across the tuned secondary. Data on construction of this coil were published last week.

5. —The short-wave set-up may be calibrated and modulated an dused in the same manner as the broadcast set-up.

How Talkies Will Be Aired

By D. E. Replogle

WITHIN the next few weeks television will definitely pass from the purely engineering state to the nascent showmanship state. With the inauguration of the first radio talkies studio in New York City, artists and speakers will be seen as well as heard by the radio audience in homes provided with a television receiver in addition to the usual broadcast receiver. The programs will be of such varied and entertaining character as to provide fresh radio thrills to those who can look in as well as listen in.

Radio talkies, or combined sight and sound programs, are made possible by combining the television facilities of the Jenkins Television Corporation's station, W2XCR, 655 Fifth Avenue, with the sound broadcasting facilities of the General Broadcasting System's station WGBS.

The television transmitter, licensed for an output of 5,000 watts, operates on 2035 kilocycles or 147.5 meters, while the WGBS transmitter operates on 1180 kilocycles or 254 meters. The signals of W2XCR may be tuned in by means of a special television receiver with radiovisor for the pictorial component of the program. Tuning the broadcast receiver to 254 meters provides the synchronized sound component. The visual and aural combination is practically the same idea as the present-day talkies contrasted with the former silent pictures.

How the Subject Is Scanned

The radio talkies studio, in the same building as the television transmitter, is not unlike the usual broadcasting studio, with draperies and other acoustic treatment. However, in addition to microphones, the performer faces a sweeping beam of light which scans or analyzes the image to be transmitted.

The beam sweeps the subject in 60 parallel lines at the rate of 20 times or frames per second. This is 1,200 lines per second or 1,200 frames per minute.

The reflected light from the image is picked up by a battery of photo-electric or light-sensitive cells, sometimes referred to as electric eyes, which translate the varying amount of light into corresponding electrical terms. Amplified millions of times, the electrical terms are impressed on the television transmitter which propagates corresponding signals.

The scanning mechanism comprises a powerful arc light, a scanning disc, three lenses mounted on a turret for ready interchangeability, adjustable mirrors and stand. The operator can direct the scanning beam by means of lenses and mirrors, so as to pick up a close-up, a half length or a full length of the performer or performers. By means of lenses of different focal lengths, the operator can change from a close-up to a long shot without altering the relative positions of performer and scanner, which adds greatly to the entertainment possibilities, as in the case of motion picture technique. The photo-electric cells may be placed at any angle with relation to the subject, thereby obtaining various lighting effects in picking up the reflected light.

The microphone nearby picks up the voice, music or other desired sounds while the performer or performers face the televisor pick-up.

In addition to direct pick-up of living subjects, the radio talkies studio is equipped for the transmission of motion picture films. The film pick-up is based on the same general principle as the usual picture projector. As the film moves through the mechanism, it is scanned line by line, a beam of light passing through the film and on to a photo-electric cell. The film may be accompanied by synchronized sound or by incidental music supplied by phonograph records, or again by the voice of announcer or lecturer describing the action.

Can Send Recorded Talkies

Both microphone and televisor pick-ups must be monitored or amplified to a given electrical level for uniform broadcasting purposes. This function is carried on in the control room adjoining the studio and separated from it by large glass windows.

The control room operators listen to the sound component pick-up through a monitor loudspeaker, increasing or decreasing the "gain" or strength of the microphone pick-up so as to strike the happy medium.

Meanwhile, the operators follow the pictorial component of the program by watching the pictures through the televisor monitor, increasing or decreasing the gain so as to obtain the desired brilliancy and contrast for satisfactory transmission. The amplified sound component is then sent by direct wire to the WGBS control room and the radio transmitter at Astoria, L. I., while the amplified pictorial component is sent to the powerful television transmitter in the same building.

Needs Short-Wave Set and Special Output

Radio talkies may be readily intercepted in the average home provided with necessary equipment. There is nothing complicated or experimental about the interception of the sight-and-sound programs, now that refined equipment is available.

In addition to the usual broadcast receiver tuned to 254 meters for the WGBS signals, a special short-wave television receiver is required, operating in the 100-150 meter band in which television transmitters now operate. The television receiver is tuned to 147.5 meters, bringing in the W2XCR signals. The televisor or image-weaving device takes the place of the loudspeaker, when receiving television signals.

Since at any given instant the subject is illuminated by a single spot of light the reflection from which is picked up by the photo-electric cells and subsequently transmitted, while at the receiving end a single dot of corresponding light value appears before the looker-in, it is essential that both dots be exactly at the same point with respect to the entire image.

This function is called synchronization. Fortunately, where a common AC power system is available, the receiving and transmitting scanners are kept in perfect step by means of synchronous motors electrically geared together. Where different AC power systems are employed, there are other methods of maintaining the essential synchronization, including a synchronizing feature included in the television signal.

The change from the former 48-line, 15-picture-per-second scanning to the present 60-line, 20-pictures-per-second scanning system of W2XCR and other television stations, provides not only greater pictorial detail but also reduces flicker to a negligible minimum.

FREE AID TO A NEW JOB!

SITUATIONS WANTED AND HELP WANTED ADVERTISEMENTS WITHOUT COST!

Address: Industrial Dept., RADIO WORLD, 145 W. 45th St., N. Y. C.

SITUATIONS WANTED

YOUNG MAN, 21 YEARS OF AGE, wishes position in research or experimental laboratory, or with large corporation. Graduate of Bliss Electrical School and National Radio Institute. Wide experience in television, sound pictures and short-wave radio work. Now on test floor of large corporation. Best of references as to ability and character. E. H. T., Jr., 577 Page Blvd., East Springfield, Mass.

YOUNG MAN, AGE 21, desires position in radio. Has had more than 7 years' experience in building and servicing all types of broadcast sets. Joe Dennis, 940 Tilden St., Bronx, N. Y. Care of Mazzochi.

EXPERIENCED IN SERVICING. Graduate of National Radio Institute, age 17 years, would like connection with radio store in New York City, as service man or set builder. Willing to start at low pay. Joe Sofranko, 90 Greenwich St., New York City.

RADIO TRAINING ASSOCIATION OF AMERICA STUDENT with three years of servicing experience, wishes position in service and installation work. R. T. A. test equipment. Willing to do any kind of radio work. Member of I. R. G. and I. R. G. Will furnish references on request. G. Kenneth Smiley, R. D. 2, Carlisle, Pa.

GRADUATE OF NATIONAL RADIO INSTITUTE. Washington, D. C. Married, age 33. Three years' experience in radio service work. Desires position of any kind, that is permanent and where there is an opportunity for advancement. Inventively inclined, particularly interested in Public Address Systems, Sound equipment and research work. References: Washington, D. C. National Radio Institute, Student No. 180n44; W. L. Jones Electric Co., Lufkin, Texas; Knox Furniture Co., Trinity, Texas. Address: Wm. S. Burke, Box 654, Trinity, Texas.

RADIO SET BUILDER AND SERVICE MAN. Age 29. High school and college. Familiar with short-wave radio. Four years' experience servicing, design. Reasonable salary; locate anywhere. Stanley Morgan, P. O. Box 208, Bridgewater, N. Y.

21 YEARS OF AGE, colored. Have had two years' College work, with a major in Physics and Chemistry. Now a student of the R. C. A. Institute. Very much interested in radio. Would like to enter the practical radio field, to start as an apprentice and work up. Elnard Gordon, 821 Osage St., Leavenworth, Kansas.

YOUNG MAN, 19, RADIO OPERATOR COMMERCIAL CLASS—desires position as operator either aboard ship or ashore. Familiar with all commercial procedure, and competent touch-typist. Write Harold J. May, 277 Morris Ave., Springfield, N. J., or phone Millburn 6-0623-M.

Rewinding Transformers

How to Meet Different Voltage Requirements to Power the Set

MANY radio experimenters have transformers wound for voltages not suitable for the latest tubes and they wish to change them so that they can use them without the necessity of getting new transformers. For example, many have transformers wound for 226 tubes, which takes 1.5 volts, and they now want to use 227s, 224s, 235s, 245s, and the latest pentode, all of which take 2.5 volts. In other cases they want to change a 5 or a 7.5 volt winding to 2.5 volts. How can this change be accomplished?

The change must be based on the principle that the voltages are proportional to the number of turns. If we know the number of turns on the primary we can obtain the correct ratio of turns by computing the voltage ratio. Suppose the primary voltage is 110 volts and we desire a secondary voltage of 2.5 volts. The ratio of these voltages is 44. The ratio of primary to secondary turns should be the same. For example, if the number of turns on the primary is 1,500 the number for a 2.5 volt winding should be 1,500/44, or 34.1 turns. Modifications will be noted.

When Turns Are Unknown

The difficulty of using the turns on the primary as a basis for determining the number of turns on the secondary is that the primary turns are not known. But there is a simple way around that difficulty. Simply count the number of turns on the secondary as they are removed, or while they are still in position if that is possible. This number may then be used as a basis for determining the number of turns to be used on another winding of a different voltage. The proportion is direct. For example, suppose that a 1.5 volt winding contains 20 turns. A 2.5 volt winding should then contain 33 turns because 1.5/2.5 equals 20/33, very nearly.

The number of turns to use in any case depends somewhat on the regulation of the winding, that is, on the change in output voltage with change in current drawn. The direct relation between the primary and secondary voltages and turns discussed above holds for the total voltage in the secondary circuit, not for the net voltage at the terminals. In some cases it is necessary to increase the number of turns by a small amount in order to get the correct output voltage when current is drawn. If the wire used is heavy, the regulation will be good and it is not necessary to increase the turns.

If an AC voltmeter is available the voltage across the terminals should be measured while the full load current is drawn. If the voltage is too high the turns should be diminished by a factor equal to the factor by which the voltage is high. If the voltage is too low the turns should be increased by a similar factor.

Size of Wire

The size of wire to use on the low voltage winding depends on the current that it is to furnish. It is really the temperature of the wire that determines it and this not only depends on the current in the wire but also on the radiation and ventilation. If the winding is exposed to air and consists of a single layer a higher current is allowable in a given size wire than when the winding consists of two or more layers and when the transformer is housed so that there can be no circulation of air. For exposed single layer windings it is customary to allow 1,000 circular mils for each ampere, and for enclosed and multilayer winding it is customary to allow 1,500 circular mils per ampere.

A circular mil is an area equal to that of circle having a diameter of 0.001 inch, and the circular mils in the cross section of a wire is equal to the diameter in inches squared multiplied by 1,000,000. Or, expressing it differently, it is equal to the square of the diameter expressed in thousands of an inch. Thus a wire having a diameter of 0.005 inch has a cross section area of 25 circular mils.

The diameter of different wires and the corresponding circular mils may be obtained directly from wire tables. Some of these tables also give the current carrying capacity based on some arbitrary temperature.

Suppose we wish to make a winding which will carry 16.5 amperes when all the turns of the winding are exposed to air. We allow 1,000 circular mils for each ampere and therefore the wire should have 16,500 circulars mils. If we extract the square root of this number we get the diameter of the wire expressed in thousands of an inch. We get 128.5, or 0.1285 inch. The nearest size is No. 8 B & S. If we had allowed 1,500 circular mils per ampere, as we would have done if the winding had consisted of more layers than one and if it had been put in a container, the carrying capacity would only have been 11 amperes.

The wire sizes in the table herewith cover most of the practical cases for filament transformers and windings.

If the winding contains only a small number of turns it is not necessary to disassemble the core either to remove the old winding or to put on the new because the wire may be threaded through the window. This is facilitated if the total length of wire is estimated from the length of one turn and a wire of this length is cut off. Remember it is easier to remove a turn than to add one so that the wire should be made a little longer than required and the number of turns may be made larger than necessary in order to allow for the removal in case the test of the voltage on full load should prove that it is too high.

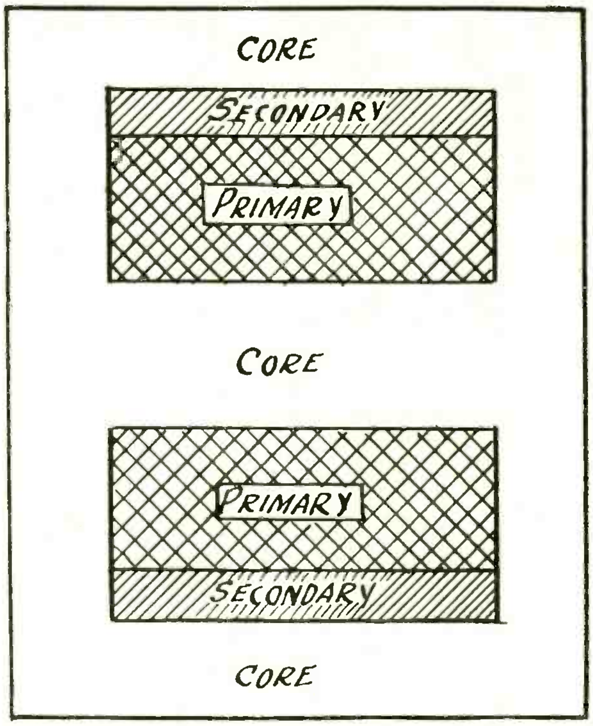


FIG. 1

The core of a shell type transformer showing the position of the high voltage primary winding and the low voltage secondary. The primary takes up most of the window space.

It may be that the window space on the core after the old winding has been removed is not large enough to hold the larger winding with the heavier wire, it may be that it would be large enough if the size of wire were reduced. Of course, if it is reduced the current carrying capacity will not be so good and neither will the regulation. Chances are that the temperature would be excessive and the voltage too low if the full current were drawn. The best thing to do in a case like that is to use the finer wire and limit the current. The table herewith shows what current should be allowed.

Insulation of Winding

The usual insulation on the wire for low voltage windings is double cotton covered. Sometimes enamel and a single layer of cotton serving are used. There is less chance of short circuit between adjacent turns if cotton enamel wire is used. The enamel covering is sufficient provided it does not get hot but the cotton increases the safety factor. After the turns are on and the form and the voltage has been tested a coating of shellac may be applied. A better substance is the sticky stuff used for making gaskets in automobile leak-proof. If there is nothing else available ordinary friction tape may be used over the winding.

Table of Current Carrying Capacity

Size B & S	Current capacity 1,000 CM per Amp.	Current capacity 1,500 CM per Amp.
8	16.5	11.0
9	13.1	8.7
10	10.4	6.9
11	8.2	5.5
12	6.5	4.4
13	5.2	3.5
14	4.1	2.7
15	3.3	2.2
16	2.6	1.7
17	2.0	1.4
18	1.6	1.1
19	1.3	.86
20	1.0	.68

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club, for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions.. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

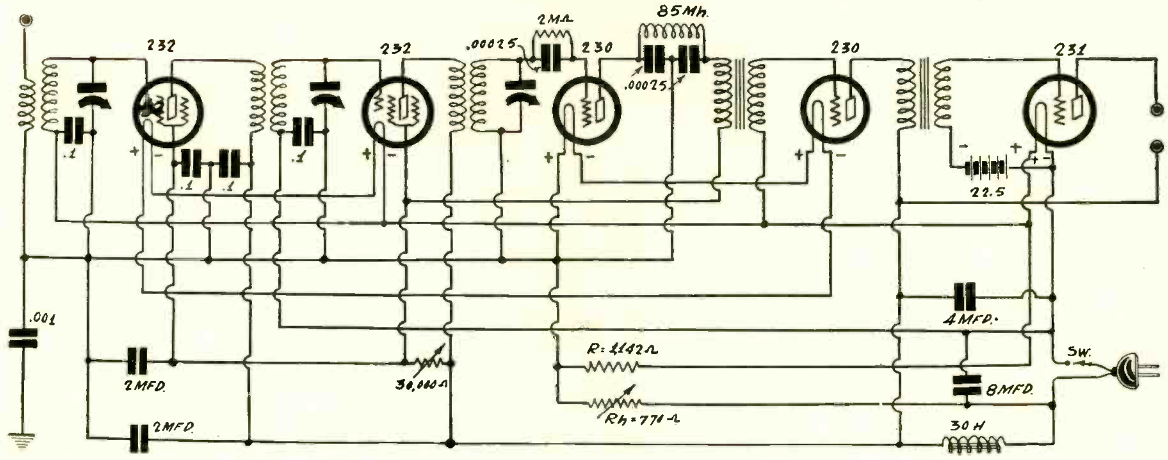


FIG. 908

The circuit of a 5-tube receiver using 2 volt tubes and designed to be used on a 110 volt DC line.

Series Connected Filaments

I WISH to build a small receiver to be used on a 110 volt DC line. Will you kindly publish a diagram showing the use of 2 volt tubes in a receiver of this kind? Are there any other tubes that can be used to good advantage?—B. W. V.

You will find such a circuit diagram in Fig. 908. It makes use of 232, 230, and 231 tubes with their filaments connected in series parallel so as to make the circuit most economical. New heater type tubes much more suitable for circuits of this type have just been announced. Since these are heaters they may be connected in the circuit without taking a lot of voltage from the line that is needed for the plates. Also, the heater voltage is 6.3 volts so that not so much energy is wasted in a ballast resistance. This does not mean that a receiver built with these tubes will be more economical than one built with 2 volt tubes, but it will be a better set so that there is really no comparison. Receivers incorporating these tubes will be described for home use on 110 volts lines, for automobile use on the storage battery, and for use on 32-volt farm lighting plants.

* * *

Curves for 231 Power Tube

PLEASE publish curves showing the relation between the grid voltage and the plate current for the 231 power tube. I am interested especially in the curve for 135 volts on the plate.—D. W. G.

Such curves are given in Fig. 909. The tube is supposed to take a grid bias of 22.5 volts, but this curve shows that a better value is 17.5 volts. When the grid is self-biased by means of a bias resistor it is better to allow the full voltage of 22.5 volts.

* * *

Converter Does Not Work

I HAVE purchased a short-wave converter but so far I have been unable to get a peep out of it. The circuit was supposed to have been tested but that does not help me. What do you think is wrong?—T. W. S.

There is a possibility that some lead broke in shipment. If you cannot find any broken connections chances are that the circuit is just the way it was when tested. It is quite common that converters don't work because they are so often connected incorrectly to the broadcast receiver. There are not many connections to make but they must be made correctly or the converter will not work. One of the chief troubles is that the converter is not given the proper plate voltage. Sometimes the positive lead is connected all right to some point in the receiver where the proper voltage obtains, but then the return lead is omitted. A converter should not be condemned until it has been tested on B batteries, with both the positive and negative terminals connected. And if the converter is connected so as to take the plate voltage from the receiver, it should not be condemned until the voltage on each plate of the converter tubes has been tested with a voltmeter.

* * *

Need for Battery Circuits

I HAVE built two or three new sets recently, two of them superheterodynes published in your paper. These sets worked very well. Down here we need sets that are sensitive and can reach out and get the stations.

Would you kindly publish a circuit of a superheterodyne set consisting of seven or eight tubes of the new 2-volt battery type? About 75 or 80 per cent of the sets used here are battery-operated. I believe such circuits would be a benefit to many of the rural people and farmers who have no electric current and must have battery-operated sets.

Our radio reception down here this Winter has been very good. Generally beginning in March we have static, sometimes so bad that we cannot get even the Havana stations only 90 miles away. We then have to resort to the short waves. I have a 3-tube converter made from one of the circuits you published. With this converter I have no difficulty in getting most

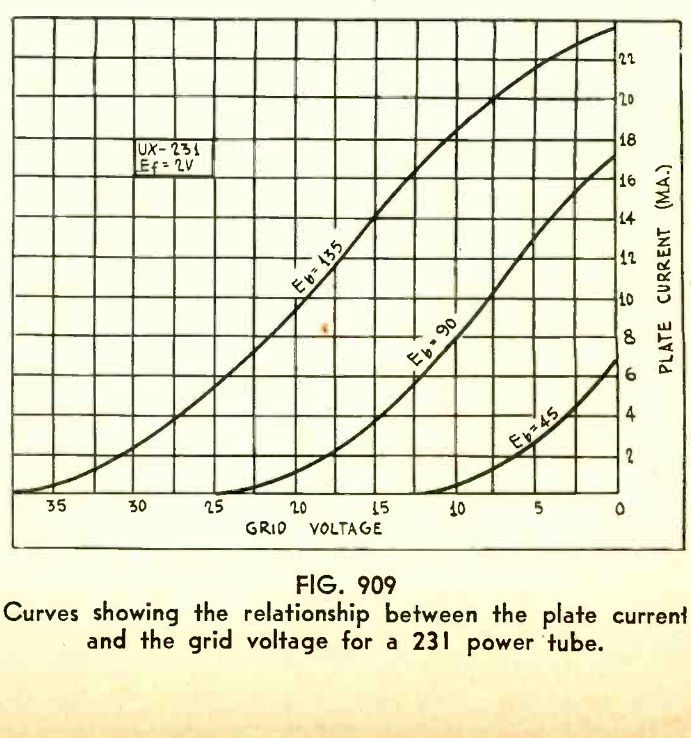


FIG. 909

Curves showing the relationship between the plate current and the grid voltage for a 231 power tube.

HOW TO GET QUESTIONS ANSWERED

QUESTIONS of general interest are answered by publication in this department, and the answers invariably are to questions submitted by members of RADIO WORLD'S *University Club. Copies of the answers, in such instances, are mailed promptly to the inquirers, so they will not have to wait to see the answers published in this department. We can not undertake to answer questions except those submitted by members of the University Club. For details of acquiring membership in this Club please see notice printed in the heading of this department.—Editor.*

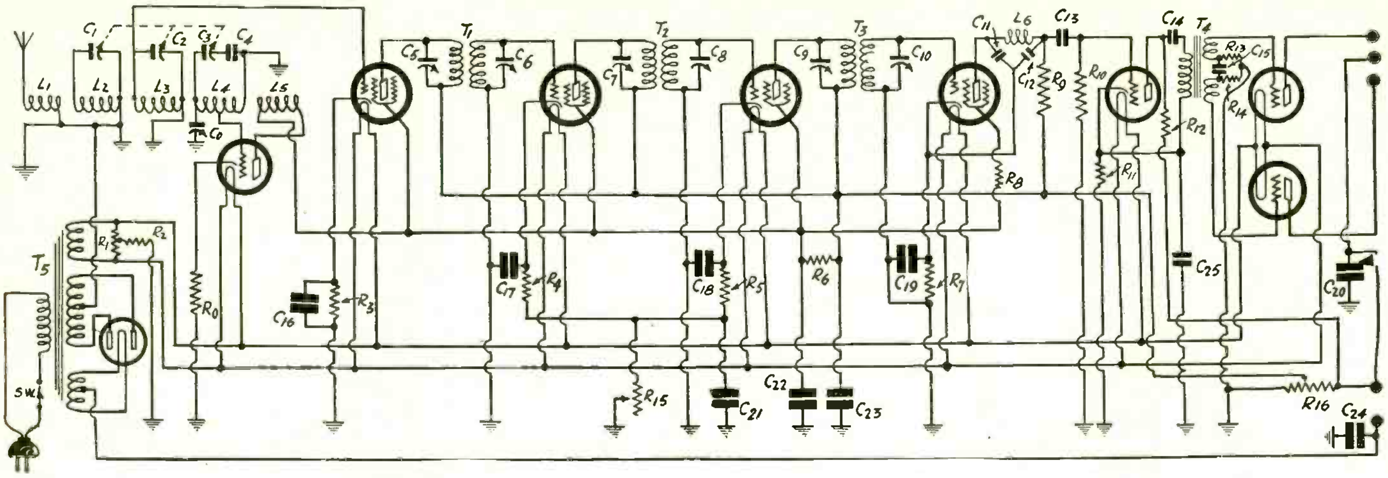


FIG. 910

Nine tubes are used in this superheterodyne circuit, which is one suitable for building a midget set. Complete AC operation is afforded. The coils L1, L2, L3, L4, L5 ma ybe on one form. There are two stages of intermediate amplification, and two audio, iwth push-pull 245 output. The two other tubes are 280 rectifier and 227 oscillator.

of the short-wave stations in the United States. Two or three times I have had G5SW in London—L. V.

For your guidance in an AC design the circuit shown in Fig. 10 may be used. This has a 280 rectifier, 227 oscillator and first audio, 224 modulator, first and second intermediate and detector, and 245 push-pull output. The constants correspond to those for a similar circuit published in the April 4th issue, except that the present circuit does not include a voltage regulator tube. As for battery model superheterodynes, J. E. Anderson is at work on his super, and this will be described constructionally for both AC and battery operation, as well as for 110-volt DC and 32-volt farm lighting plant operation.

* * *

Obtaining Voltages from a Set

IS it not possible to obtain the voltage from a broadcast receiver, so that a short-wave set may be worked into the broadcast receiver, for loudspeaker operation?—J. R.

Fig. 911 shows how this may be done. Since the radio frequency amplifying tubes in the reciver will not be used, it is permissible to remove them and plug into one of the RF sockets, so that the heaters of the short-wave outfit will be fed instead. As for B voltage, this may be obtained through the plate circuit of the RF tube socket into which the plug is inserted. Since this plate circuit has a load on it, a bypass condenser is necessary, but this would be present in the short-wave set, anyhow. A capacity of 0.1 mfd. may be regarded as minimum for this purpose, from B plus to grounded B minus. The only other voltages required are for screens and for bias, both being obtained through voltage drops in resistors. The circuit is for AC sets only, and has a stage of untuned radio frequency amplification, regeneration detector and one resistance-coupled audio stage. If there is a five-lead cable on the plug, use only the three specified wires, i. e., plate and two heaters. The only objection to this method is the plate load in the broadcast set, or a voltage reducer, as either may be a resistor that the current to the adjunct must encounter.

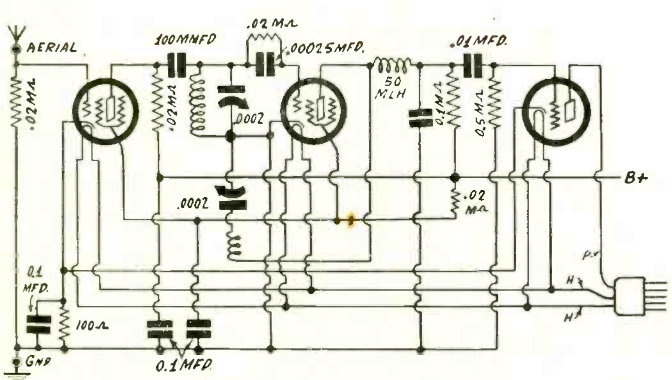


FIG. 911

A method of obtaining short-wave reception, using the circuit as a set and deriving the voltages from a broadcast receiver, utiliizng the audio channel of that receiver for loudspeaker reproduction.

Function of a Ballast

WHAT is a ballast resistance?—C. M.

It is a resistance unit the resistance of which varies in accordance with the amount of current drawn. It is intended for maintaining constant voltage drop in the resistor.

* * *

Formulas to Learn

WHAT are the principal formulas a radio staudent should learn?—F. S.

Ohm's Law for calculating volts, amperes or ohms from any two of these three constants; the rule for finding the power from the volts and amperes or from the resistance and current; formulas for finding the total resistance of resistances in parallel or in series; for finding capacity of condensers in parallel or in series; frequency and wavelength relations (meters and kilocycles); impedance or AC circuits having capacity, inductance and resistance; wavelength for resonance in circuit with given values of inductance and capacity; frequency for resonance in circuit with given values of inductance and capacity.

A THOUGHT FOR THE WEEK

RUM runners on the Massachusetts coast broke into the summer residence of a New Yorker, installed an elaborate radio plant, which was equipped to send and receive messages, and were much put out when State and Federal authorities scattered the crowd to the four or more winds. There is this to be said for the alcohol dealing gentry: They have the bravado of their brash concoctions. We'll wager that Captain Kidd turned uneasily in his unhallowed grave if he heard of the occurrence. Kidd was a weak sister compared with some of our modern toters of booze cases and sawed-off shotguns.

RADIO WORLD

Trade Mark Reg. U. S. Pat. Off.

The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; L. C. Tobin, advertising manager.

Television, Where and When?

IT is high water mark for the tide of television prophecy. The attraction of the moon is not the cause. Every now and then, although not with periodic regularity, the newspapers and magazines are filled with the quoted prophecies. But in fact, there is only one prophecy, and it has to do with the year when television will become a home entertainment on a commercially practical basis. Only the expected time is different. All hands agree that television will come along.

The tide is high when some station goes on the air with a regular television schedule for the first time, or when some broadcasting station undertakes to transmit sound in conjunction with a televsion transmitter's image radiation. Recently in New York City WGBS announced its participation in such a venture, soon after two television transmitters elsewhere had announced regular schedules. The tide rose.

The fact is that none of the prophecies is any more than any other prophecy, that is, a mere guess. A man is not necessarily a better guesser just because he may be associated with some company that is undertaking television work. On the other hand, the set manufacturers, faced by an economic situation anyway, dislike these television prophecies, because deemed to discourage the purchase of present model sets.

"I'll wait for television before I buy a new set," is one statement that set manufacturers don't like, and they quite correctly explain the foolishness of such delay.

On the opposite fence we find the "just-around-the-corner" enthusiasts. Anybody associated with the manufacture of television kits, sets and accessories, may be expected to state that television is "just around the corner." How definite is this? How can anything be "just around the corner," year in, year out?

At present television is experimental. Nobody knows when it will become commercially practical, even though a noted engineer or a famed executive, acting on the impulse of a gay banquet moment, may estimate the very date and hour. And who can blame even a dignified executive for becoming prognosticative, what with all the fortune-telling and astrology with which the air reeks?

Meanwhile television is going forward steadily, slowly, lives its life in the laboratory, and strains the leash with the yearning for wider and greener fields.

This Young Radio Life

BABY'S life to-day is an enlivening abundance of radio. Born into a world filled with reception, the infant soon finds that hearing the radio becomes a part of the ritual of life.

Even in its crib, at those early stages of life when sleep takes up twenty-two hours a day, the infant gets its breezy gushes of radio reception, usually steppy music. It is assumed by parents that music that enlivens them reacts likewise on the mite in the crib, who otherwise might be bawling. The first year scarcely has gone before the lusty terror to the household crockery can dance for company, to the tune, say of "The International Rag." Try to get the diapered amateur to dance without music!

At about the same time words in association begin to have some signifiance to the child. At a year and a half he or she may be expected to recognize that Uncle Don, asking "How's mamma?" and "How's papa?" is saying something about the two persons around whom the child's world is built.

Recognition of repeated tunes is an early sign of dawning intelligence. The little dance gets an impromptu start as the signature song is sung or played. But it must be a lively one. "The Perfect Song," used by Amos 'n' Andy, does not naturally set a tiny feet moving. Music that makes the little folk dance also takes on heirloom value for adults, for that very reason. Sponsors of programs who want their indentity and offering to stand out as in bas relief during the hours of children's wakefulness might bear in mind this juvenile dancing value.

The word "radio" itself is a teaser to struggling artists in first words. Strangers cannot understand what is wanted when what passes for the word "radio" is spoken. The gesture alone saves the outsider from humiliation.

New Corporations

Nakken Sound Products, motion picture apparatus—Atty. W. L. Morris, 258 Broadway, New York, N. Y.

The Radio Shoppe Maple Shade, radio equipment—Atty. Joseph S. Lowe, Camden, N. J.

Brown-Miles, radio broadcasts—Atty C. W. Davis, 11 West 42nd. St., New York, N. Y.

Mager's Music Shops, radios—Atty. E. Spector, 25 West 43rd. St., New York, N. Y.

Radiocraft Publishing Corp.—Atty. J. M. Herzberg, 342 Madison Ave., New York, N. Y.

Astor Radio—Attys. Hyman & Hyman, 103 East 125th St., New York, N. Y.

Edison Radio Stores—Atty L. D. Schwartz, 150 Nassau St., New York, N. Y.

Rothbaum's Auto and Radio Supply—Atty. F. T. Boelker, Lindenhurst, N. Y.

Vocamat Corp., New York, N. Y., sound recording devices—United States Corporation Co.

Bellaire Radio Shop—Attys. Lipston & Blank, 472 Gates Ave., Brooklyn, N. Y.

Rodney Radio Shop—Atty. C. Altman, 475 5th Ave., New York, N. Y.

Murray Radio and Electric Engineering. Electrical machinery—Atty. A. Kushner, 1,457 Broadway, New York, N. Y.

Kilster Corp., Newark, N. J., radios—Corporation Trust Co., Dover, Del.

Green's Radio and Auto Electric Service, Kearny, radio supplies—Atty. Anthony A. Cicchino, Newark, N. Y.

The Maxum Corp., Philadelphia, radios—Corporation Guarantee and Trust Company, Dover, Del.

MAKES DRY BATTERIES

Philco now makes dry batteries. The batteries are a 4½-volt C battery, a 45-volt standard B battery and a 45-volt extra heavy-duty B battery. C. E. Carpenter has been appointed manager of the company's tube and dry battery division. His headquarters will be at Philco's main offices in Philadelphia.

Forum

How He Solves Fading

THE news article headed "Fault Found With Supers," containing an interview with Mr. Warner in March 28th issue of RADIO WORLD, is exceedingly interesting and if Mr. Warner is correct it demonstrates another advantage of the old DC days over the modern AC era.

My radio experience began in 1924 and, owing to the construction and surroundings of our Michigan home it was practically impossible to use any overhead aerial. This made is necessary to confine my receiver assembly to supers operating on loops. We always had two, working in adjoining rooms, with a large archway between. Frequently they would both be operating at the same time, sometimes on one station and sometimes on two. We found this was the only way to overcome fading and when one is located at considerable distance from the transmitter this is quite essential when listening to spoken programs. The more important of these programs were sent out on chains and we would tune one receiver to one station and the other to some other station on the same chain. We never caught them both fading at the same time.

No particular attention was paid to making the sets selective at the input end and the coils of many of the best of the sets were simply in bakelite cases. Shielding was unknown.

And the sets never squealed.

My son operated his receiver at his home across the street and I had one always going when working in my shop in the garage back of the house. All four could be operated without any thought of the others. And they never suffered from one another's interference. It was always something else—and there was plenty of something else in those days.

Incidentally, I used to try to get definite constructive information about loops but never succeeded until I read "Effectiveness of Loop Antenna" in Radio University, March 28th issue.

A. B. GARDNER,
Box 296, Coconut Grove, Fla.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Reed Barton, 1718 Ridge Ave., Coraopolis, Pa.

Wm. J. Meritzer, 625 Woodbourne Ave., Pittsburgh, Pa.

C. E. Nelson, 1248 Watson Ave., St. Paul, Minn.

Willard H. Rhodes, 1050 Ibispo Ave., Long Beach, Calif.

Ben Morrison, 3 Inwood Ave., Toronto, Ont., Canada.

Louis Berjeau, 2345 Broadway, New York City.

P. R. Swan, 2801 Ohio Ave., Topeka, Kans.

Wm. J. Irvin, Radio Service, 51 State St., Portland, Me.

George Giles, 1707 Idaho St., Toledo, Ohio.

Harry Zian, 70 West End Ave., Brooklyn, N. Y.

Jack B. Schneider, Garwood Radio Lab., 17 Center St., Garwood, N. J.

Merton Ailes, 33 Spring St., St. Johnsbury, Vt.

James B. Alexander, Jr., 915 N. Leithgow St., Philadelphia, Pa.

Chas. J. Busby, 2275 Tyler Ave., Fresno, Calif.

Ray Gromentz, Jr., 144 Emerson St., Rochester, N. Y.

Herbert C. Luther, Phoebus, Va.

J. Scoger, 406 Milverton Blvd., Toronto, Canada.

A. Ross, M.D., Ponds Merigomish, N. S., Canada.

L. H. Veach, c/o Sou R. R., Union Station, Columbia, S. C.

Hartger E. Winter, 417 Monroe St., Allegan, Mich.

Harold L. Ross, 518 N. Elm St., Greensboro, N. C.

Wm. E. Marshall, 64 Linden Ave., Malden, Mass.

$10,000,000 IN STEEL ORDERED FOR RADIO CITY

A contract for the structural steel to be used in the erection of Radio City in New York has been signed by the engineers and builders representing John D. Rockefeller, Jr. The order was placed with the U. S. Steel Corporation and is for 125,000 tons costing about $10,000,000. This is the largest order ever placed with the company, according to James A. Farrell, President of the United States Steel Corporation.

The immensity of the order is indicated by statistics supplied by the Rockefeller engineers. The steel will make up from 5,000 to 6,000 carloads, and if the steel were placed end to end it would extend 700 miles, or if the steel were rolled into rails and laid down as a railroad it would extend from New York to Chicago. The quantity of steel is three times as great as that required for the Empire State building and two and a half times as great as that needed for the Hudson River Bridge.

The Contracting Parties

The contracting parties were Post & McCord for the U. S. Steel Corporation and the Metropolitan Square Corporation for the Rockefeller interests. Post & McCord, represented by Andrew J. Post and Robert C. Post, agreed to furnish and erect the steel, which will be furnished by American Bridge Co., a subsidiary of the U. S. Steel Corporation, and will be rolled by Carnegie Steel Corporation, another subsidiary. Acting for the Metropolitan Square Corporation were John R. Todd, James M. Todd, Hugh S. Robertson, Webster B. Todd, and J. O. Brown, of Todd, Robertson, Todd Engineering Corporation, and Todd & Brown, Inc., managing engineers and builders for Mr. Rockefeller.

Excavation Begins in June

The project will mean employment for 8,000 to 10,000 men and among these about 1,000 structural steel workers will be needed and about 200 engineers, draftsmen and checkers to supervise the work.

Lawrence A. Kirkland, attorney for the Metropolitan Square Corporation, said, after the signing of the contract, that it was hoped that excavation would start in June and that the erection of steel would begin in November and that the first building would be completed in the Fall of 1932.

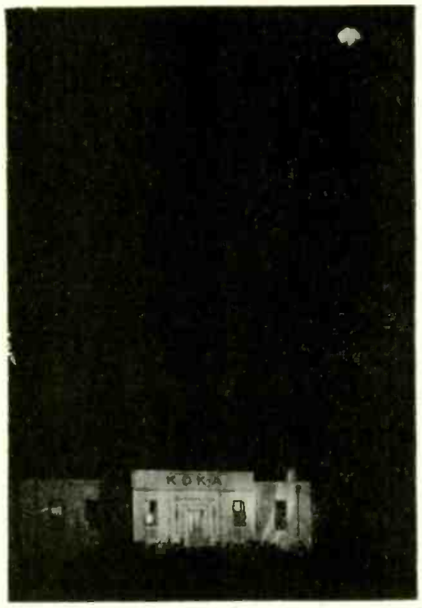
Control of WJKS Passes to R. L. Atlass

Ralph L. Atlass, formerly vice president and general manager of WBBM, Chicago, purchased a substantial interest in the Johnson-Kennedy Radio Corporation, operating WJKS, Gary, Ind.

Harry Cohen, for thirteen years an advertising executive on the Chicago "Tribune" and later business manager of the Chicago "Daily Times," has been apointed vice-president and business manager of WJKS.

Mr. Atlass will be general manager. He recently purchased controlling interest in WLAP, Louisville, Ky.

STAR ON KDKA TOWER



Neon lamps in the form of a star on top of the new KDKA antenna at Saxonburg, Pa., warn aviators. The red glow of the neon tube can be seen through fog through which more brilliant light would not penetrate.

TUBE BATTLE IN LAST STAGE

Washington.

Chief Justice Hughes announced from the bench that the Supreme Court of the United States has consented to review the controversy between the DeForest Radio Company and the General Electric Company over the validity of the General Electric Company's patent covering vacuum radio tubes. A petition for a writ of certiorari, by which review was sought, was granted by the court.

The patent in suit is the Langmuir patent, No. 1558436. Before that patent was granted the DeForest Company, under its own patents, manufactured tubes substantially like those of the Langmuir teaching, it was claimed, except that they were gaseous. The Langmuir tubes are vacuum tubes. With the development of the vacuum tube and its adoption into general use the DeForest Company began manufacturing them. An infringement suit was instituted by the General Electric Company, owner of the Langmuir patent, and the defense raised the question of the patent's validity.

In the proceeding in the District Court for the District of Delaware, Judge Morris held the patent invalid. On appeal to the Circuit Court of Appeals for the Third Circuit, that court first ruled that the patent was invalid, adopting the lower court's opinion, with Judge Buffington dissenting . But upon rehearing of the case, the Third Circuit Court, in an opinion by Judge Buffington, and concurred in by Judge Davis, reversed the District Court and held the patent valid and infringed, Judge Wooley dissenting.

FAN LETTER LEADS TO ALTAR

Theo Alban, National Broadcasting Company tenor, is one radio artist who made capital of a fan letter. Baroness Esmee de Laudin once wrote him a congratulatory note. Two years later they were married.

SYNCHRONIZED SENDING GIVES SOME TROUBLE

The synchronization experiments now being conducted by the National Broadcasting Company with stations WEAF and WJZ, New York; WBAL, Baltimore, and WTCI, Hartford, are successful in so far as the mechanical problems are concerned, and the stations have been completely synchronized, according to C. B. Jolliffe, chief engineer of the Radio Commission.

From the listeners' point of view, however, they have not been so successful, for there has been considerable interference and many complaints have been received by the commission, he added.

In certain areas synchronization has increased the fading, which at this time of the year is serious. The tests have proved that service area has been improved but that in some localities it has made conditions worse.

Near Baltimore there is an especially bad reception area at this time, Dr. Jolliffe said.

WJZ synchronizes with WBAL and WEAF with WTIC. This synchronization enables WBAL and WTIC to operate full time. Both these stations are assigned to 1,060 kc. channel on a time-sharing basis. Each station broadcasts on the 1,060 kc. wave during its allotted time, while the one not using the wave broadcasts on the wave of either WEAF or WJZ. Thus, when WTIC uses the 1,060 kc. wave, WBAL is synchronized with WJZ, using WJZ's wave and program, and when WBAL uses the 1,060 wave, WTIC broadcasts on the wave of WEAF, using WEAF'S program.

Short Waves the Most Important to Marconi

In an interview in London, Guglielmo Marconi discussed the study of short-wave wireless which he intends to carry out on his yacht, Elettra, in a short time. In a special cable to the New York "Times" he was quoted as saying:

"The short wave is the most important thing in wireless. It has revolutionized everything. If we can probe the secrets of the ultra-short waves the possibilities will be extremely interesting. But we have not done so yet."

He pointed out that below six meters the signal travels only a short distance and that they do not follow the path of the somewhat longer waves which go up to the Heaviside layer and then are reflected back to earth at distances far beyond the horizon. With the ultra-short waves communication is practically limited to places within sight of each other, he said. The short waves, he said, do not penetrate hills nor do they get around them. His present research deals with the problem of using the short waves over greater distances.

CALLS RADIO STABILIZER

Broadcasting is the greatest cultural influence in American life today, while the influence of the announcer will affect American thought and speech for years, according to Don E. Gilman, Pacific coast division vice president of the National Broadcasting Company.

"Radio's most positive effect lay in stabilizing business during the recent depression."

Canadian Stations by Call Letters

Call	Owner	Location	M.	Kc.	Watts
CFAC	The Calgary Herald....	Calgary, Alta.........	434.8	690	500
CFBO	C. A. Munro, Ltd........	St. John, N. B........	337.1	890	500
CFCA	Star Pub. & Prtg. Co...	Toronto, Ont..........	357.1	840	500
CFCF	Canadian Marconi Co....	Montreal, P. Q.......	291.3	1030	500
CFCH	Northern Supplies Ltd..	North Bay, Ontario..	250.0	1200	50
CFCL	The Dom. Battery Co..	Toronto, Ont............	517.2	580	500
CFCN	Wstrn. Broadcasting Co..	Calgary, Alta.........	434.8	690	500
CFCO	Victoria Broadcasting	Chatham, Ontario....	247.9	1210	100
CFCT	Weslan Ontario..........	Victoria, B. C........	476.2	630	500
CFCY	The Island Radio Co....	Charlottetown, P.E.I.	312.5	960	250
CFJC	D. S. Dalgleish & Sons, Ltd.	Kamloops, B. C......	267.9	1120	100
CFLC	Radio Assoc. of Prescott	Prescott, Ont.........	297.0	1010	50
CFNB	James S. Neill & Sons, Ltd.	Fredericton, N. B....	247.9	1210	500
CFQC	The Electric Shop Ltd...	Saskatoon, Sask......	329.7	910	500
CFRB	Rogers Majestic Corp. Ltd.	King York Co, Ont.	312.5	960	4000
CFRC	Queen's University.......	Kingston, Ont.........	322.6	930	500
CHCA	The Western Farmer....	Calgary, Alta.........	434.8	690	500
	(Uses CJCJ, The Albertan Publishing Co. Ltd., Calgary, Alta.)				
CHCK	W. E. Burke............	Charlottetown, P.E.I.	312.5	960	100
CHCS	The Hamilton Spectator	Hamilton, Ont........	267.9	1120	10
CHCT	G. F. Tull & Ardern, Ltd.	Red Deer, Alta.......	357.1	840	1000
	(Uses CKLC, The Alberta Pacific Grain Co., Red Deer, Alta.)				
CHGS	R. T. Holman, Ltd......	Summerside, P.E.I...	267.9	1120	100
CHLS	W. G. Hassell...........	Vancouver, B. C......	411.0	730	50
	(Uses CKCD, The Vancouver Daily Province, Vancouver, B. C.)				
CHMA	Christ. & Miss. Alliance	Edmonton, Alta......	517.2	580	250
CHML	Maple Leaf R. Co. Ltd..	Hamilton, Ont........	340.9	880	50
CHNS	Halifax Herald, Ltd.....	Halifax, N. S........	329.7	910	500
CHRC	E. Fontaine...............	Quebec, Que..........	465.1	645	100
CHWC	R. H. Williams & Sons..	Nr. Pilot Butte, Sask.	312.5	960	500
CHWK	Chilliwack Broadcasting Co. Ltd.................	Chilliwack, B. C.....	451.1	665	100
CHYC	Northern Elec. Co. Ltd..	Nr. St. Hyacinthe, Que.	411.0	730	5000
	(Uses CKAC, LaPresse Publishing Co. Ltd., Montreal, P. Q.)				
CJBC	Jarvis St. Bap. Church..	Toronto, Ont.........	434.8	690	5000
	(Uses CKGW, Gooderham & Worts, Ltd., Bowmanville, Ont.)				
CJBR	Sask. Co. Oper. Wheat Producers, Ltd.........	Regina, Sask.........	312.5	960	500
	(Uses CKCK, Leader Publishing Co. Ltd., Regina, Sask.)				
CJCA	The Edmonton Jour. Ltd.	Nr. Edmonton, Alta..	322.6	930	500
CJCB	N. Nathanson............	Sydney, N. S........	340.9	880	50
CJCJ	The Albertan Pub. Co. Ltd.	Calgary, Alta........	434.8	690	500
CJGC	London Free Press & Printing Co., Ltd......	Strathburn, Ont......	329.7	910	500
CJGX	The Winnipeg Grain Ex..	Yorkton, Sask........	476.2	630	500
CJOC	Harold R. Carson........	Lethbridge, Alta......	267.9	1120	50
CJOR	G. C. Chandler...........	Sea Island, B. C.....	247.9	1210	500
CJRM	J. Richardson & Sons, Ltd..	Moose Jaw, Sask....	500.0	600	500
CJRW	J. Richardson & Sons, Ltd..	Fleming, Sask........	500.0	600	500
CJRX	J. Richardson & Sons, Ltd..	Middlechurch, Man...	25.6	11720	2000
CJSC	The Evening Telegram..	Toronto, Ont..........	434.8	690	5000
	(Uses CKGW, Gooderham & Worts, Ltd., Bowmanville, Ont.)				
CKAC	LaPresse Pub. Co. Ltd..	Nr. St. Hyacinthe, Que.	411.0	730	5000
CKCD	Vancouver Dly. Province	Vancouver, B. C.....	411.0	730	50
CKCI	LeSoleil, Ltd............	Quebec, Que..........	340.9	880	22½
CKCK	Leader Pub. Co. Ltd.....	Regina, Sask.........	312.5	960	500
CKCL*	The Dom. Battery Co...	Toronto, Ont..........	517.2	580	500
CKCO	Dr. G. M. Geldert.......	Ottawa, Ont..........	337.1	890	100
CKCR	John Patterson..........	Waterloo, Ont........	297.0	1010	50
CKCV	G. A. Vandry............	Quebec, Que..........	340.9	880	50
CKFC	United Church of Can...	Vancouver, B. C......	411.0	730	50
CKGW	Gooderham & Worts, Ltd..	Bowmanville, Ont....	434.8	690	5000
CKIC	Adadia University........	Wolfville, N. S.......	297.0	1010	50
CKLC	Alberta Pac. Gr. Co. Ltd.	Red Deer, Alta.......	357.1	840	1000
CKMC	R. L. MacAdam..........	Cobalt, Ont...........	247.9	1210	15
CKMO	Sprott-Shaw Radio.......	Vancouver, B. C......	411.0	730	50
CKNC	Can. Nat. Carbon Co. Ltd...	Toronto, Ont.........	517.2	580	500
CKOC	Wentworth Radio & Auto Supply Co. Ltd........	Hamilton, Ont........	267.9	1120	50
CKOW	Nestle's Milk Products Ltd.	Toronto, Ont..........	357.1	840	500
	(Uses CFCA, Star Publishing Co. Ltd., Toronto, Ont.)				
CKPC	Metal Shingle & Siding Co. Ltd.	Preston, Ont..........	247.9	1210	25
CKPR	Dougal Motor Car Co...	Port Arthur, Ont.....	337.1	890	50
CKUA	University of Alberta...	Edmonton, Alta......	517.2	580	500
CKWX	A. Holstead & Wm. Hanlon	Vancouver, B. C.....	411.0	730	100
CKX	Manitoba Tel. System...	Brandon, Man........	555.6	540	500
CKY	Manitoba Tel. System...	Winnipeg, Man.......	384.6	780	5000
CNRA	C. N. R..................	Moncton, N. B........	476.2	630	500
CNRC	C. N. R..................	Calgary, Alta.........	434.8	690	500
	(Uses CFAC, Calgary Herald, Calgary, Alta.)				
CNRD	C. N. R..................	Red Deer, Alta........	357.1	840	1000
	(Uses CKLC, Alberta Pacific Grain Co., Red Deer, Alta.)				
CNRE	C. N. R..................	Edmonton, Alta.......	322.6	930	500
	(Uses CJCA, Edmonton Journal, Edmonton, Alta.)				
CNRH	C. N. R..................	Halifax, N. S........	329.7	910	500
	(Uses CHNS, Halifax Herald, Ltd., Halifax, N. S.)				
CNRL	C. N. R..................	Strathburn, Ont......	329.7	910	500
	(Uses CJGC, London Free Press & Ptg. Co. Ltd., Strathburn, Ont.)				
CNRM	C. N. R..................	Montreal, Que........	411.0	730	5000
	(Uses CKAC, LaPresse Publishing Co. Ltd., Montreal, Que.)				
CNRO	C. N. R..................	Ottawa, Ont..........	500.0	600	500
CNRQ	C. N. R..................	Quebec, Que..........	340.9	880	50
	(Uses CKCV, G. A. Vandry, Quebec, Que.)				
CNRR	C. N. R..................	Regina, Sask.........	312.5	960	500
	(Uses CKCK, Leader Publishing Co. Ltd., Regina, Sask.)				
CNRS	C. N. R..................	Saskatoon, Sask......	329.7	910	500
	(Uses CFQC, The Electric Shop, Ltd., Saskatoon, Sask.)				
CNRT	C. N. R..................	Toronto, Ont..........	357.1	840	500
	(Uses CFCA, Star Publishing & Ptg. Co., Toronto, Ont.)				
CNRV	C. N. R..................	Vancouver, B. C.....	291.3	1030	500
CNRW	C. N. R..................	Winnipeg, Man.......	384.6	780	5000
	(Uses CKY, Manitoba Telephone System, Winnipeg, Man.)				
CNRX	C. N. R..................	Toronto, Ont..........	312.5	960	4000
	(Uses CFRB, Rogers Majestic Corp. Ltd., Toronto, Ont.)				
CPRY	C. P. R. Co.............	Bowmanville, Ont.....	434.8	690	5000
	(Uses CKGW, Gooderham & Worts, Ltd., Bowmanville, Ont.)				

* The call CFCL is used by this station during Sunday broadcasts only.

[The list of United States broadcasting stations by frequencies, with full details of call, owner, location, power and time-sharers, was published in the April 11th issue, and comprised nine full pages. The list of short wave stations of the world, by frequency, with waves given, was printed in the March 28th issue, giving the hours on the air for all time zones in the Western Hemisphere. Additions to the short-wave list appeared in the April 4th issue. Send 45c for the March 28th, April 4th and April 11th issues to Radio World, 145 West 45th Street, New York, N. Y., and the copies will be mailed to you promptly.]

U. S. BROADCASTING STATIONS BY FREQUENCY

THE April 11th issue contained a complete and carefully corrected list of all the broadcasting stations in the United States. This list was complete as to all details ,including frequency, call, owner, location, power and time sharers. No such list was ever published more completely. It occupied nine full pages.

Two extra pages in the April 11th issue were devoted to a conversion table, frequency to meters, or meters to frequency, 10 to 30,000, entirely reversible.

Possess yourself with these two records, as they are highly accurate and valuable. This you may do by sending 15c for a copy of the April 11th issue.

RADIO WORLD
145 West 45th Street
New York, N. Y.

Short-Wave Converter Series

In the November 8th issue of RADIO WORLD there began a remarkable series of articles dealing with the construction of short-wave converters that really do work, and that work well. Besides, the cost of parts is low. One model, 30 to 110 meters, no plug-in coils, may be built of parts costing less than $5, for battery operation, or for AC with extra filament transformer external, while another model, 10-200 meters, two plug-in coils, using somewhat superior parts, filament transformer built-in, can be made up by you for less than $10. Surely these are prices within the reach of all.

Low price and high achievement go hand in hand in these designs by Herman Bernard.

The series ran in the November 8th, 15th, 22nd and 29th, and December 6th, 13th, and 20th issues. Send $1 and we will forward these seven issues and a blueprint of the AC $5 model. Or send $3.00 for 6 months' subscription and these copies and blue print will be sent FREE.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

Enclosed please find $1.00 for which send me the November 8th, 15th, 22nd and 29th, and Dec. 6th, 13th and 20th issues, containing the series of articles on short-wave converters of extremely low price, and a blueprint of the AC $5 model.

Name ....

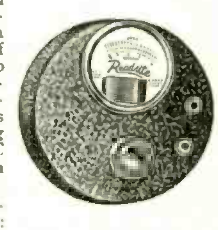
Address ....

City .... State ....

THREE-IN-ONE TESTER *FREE!*

EVERYBODY who does any radio work whatsoever, whether for fun or for pay or for both, needs a continuity tester, so he can discover opens or shorts when testing.

A mere continuity tester is all right, but—



Often it is desired to determine the resistance value of a unit, to determine if it is correct, or to measure a low voltage, and then a continuity tester that is also a direct-reading ohmmeter and a DC voltmeter comes in triply handy.

So here is the combination of all three: A 0-4½-volt DC voltmeter, a 0-10,000-ohm ohmmeter and a continuity tester. A rheostat is built in for correct zero resistance adjustment or maximum voltage adjustment. The unit contains a three-cell flashlight battery. Supplied with two 5-foot long wire leads with tip plugs. Case is 4-inch diameter baked enamel. Weight, 1 lb. Sent free with an order for one year's subscription for RADIO WORLD (52 weeks) at the regular rate of $6. Order Cat. PR-500.

Radio World, 145 W. 45th Street, New York, N. Y.

Enclosed please find $6 for one year's subscription for Radio World (one copy a week, 52 issues). Send Cat. PR-500 as premium.

Name ....

Address ....

City.............................. State...............

'BINDER' TO HOLD 52 ISSUES OF RADIO WORLD

Loose-leaf binder made of fine brown Spanish grain fabricoid. Built to stand heavy use. Preserve your magazine in a binder where you can easily reach it. Radio World, and year 1931-32 printed in gold on front cover. Binders for previous years can be supplied.

Alphabetical Index of articles in issues from Mar. 29, '30, to Mar. 21, '31, incl. Index shows the title of article as it appeared in Radio World, author, date and page.

- ☐ Loose-leaf binder, Cat. B-200—$2.00.
- ☐ Alphabetical Index, Cat. A-175—75c.

Kindly remit with order

SUPER CO.

1313 - 40TH ST. BROOKLYN, N. Y.

SHORT-WAVE NUMBERS OF RADIO WORLD. Copies of Radio World from Nov. 8, 1930 to Jan. 3, 1931, covering the various short-wave angles, sent on receipt of $1.00. Radio World, 145 W. 45th St., N. Y. City.

SOLDERING IRON FREE!

Works on 110-120 volts, AC or DC; power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

RADIO WORLD

145 West 45th St. N. Y. City

Your Choice of NINE Meters!

To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters below. Heretofore we have offered the choice of any one of these meters free with an 8-weeks subscription for RADIO WORLD, at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-weeks' subscription, entitling you to one meter; $2 for 16 weeks, entitling you to two meters; $3 for 26 weeks, $6 for 52 weeks, entitling you to six meters. Return coupon with remittance, and check off desired meters in squares below.

RADIO WORLD, 145 West 45th Street, New York, N. Y. (Just East of Broadway)

Enclosed please find $............for............weeks subscription for RADIO WORLD and please send as free premium the meters checked off below.

☐ I am a subscriber. Extend my subscription. (Check off if true.)

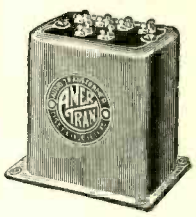
- ☐ 0-6 Voltmeter D.C. ....No. 326
- ☐ 0-50 Voltmeter D.C. ....No. 337
- ☐ 6-Volt Charge Tester D.C. ....No. 23
- ☐ 0-10 Amperes D.C. ....No. 338
- ☐ 0-25 Milliamperes D.C. ....No. 325
- ☐ 0-50 Milliamperes D.C. ....No. 350
- ☐ 0-100 Milliamperes D.C. ....No. 390
- ☐ 0-300 Milliamperes D.C. ....No. 399
- ☐ 0-400 Milliamperes D.C. ....No. 394

NAME ....

ADDRESS ....

CITY .... STATE............

AMER-TRAN AUDIOS



First stage, de luxe (illustrated), primary in detector circuit, has 200 henrys inductance at 1 ma; turns ratio, 1-to-3. Cat. DL-1, list price, $8.00 net $4.70.

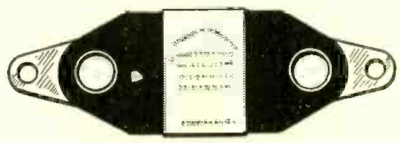
Push-pull input transformer, turns ratio, 1-to-2½; single primary; two separate windings for secondary; Cat. 151, list price, $12; net, $7.05.

[Remit with order and we pay transportation.]

GUARANTY RADIO GOODS CO.

143 West 45th Street, New York, N. Y.

Fixed Condensers



Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd. 10c	.006 .... 20c
.00025 mfd. 10c	.00025 with clips. 20c
.0003 mfd. 10c	All are guaranteed
.00035 mfd. 12c	electrically perfect and
.001 ....12c	money back if not
.0015 .... 12c	satisfied within five
.002 .... 18c	days.

GUARANTY RADIO GOODS CO.

143 West 45th St., New York, N. Y.

NEW DRAKE'S ENCYCLOPEDIA

1,680 Alphabetical Headings from A-battery to Zero Beat; 1,025 Illustrations, 920 Pages, 240 Combinations for Receiver Layouts. Price, $6.00. Radio World, 145 W 45th St., N. Y C

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR @ **$7.00**

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly, for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total, 64 issues for $7.00.

RADIO WORLD, 145 West 45th Street, New York, N. Y

ALL U. S. BROADCAST STATIONS BY FREQUENCIES

Nine full pages in Radio World dated April 11. Send 15c in stamps or coin for copy. Or start your subscription with that number. Radio World, 145 W. 45th Street, N. Y. C.

115 DIAGRAMS FREE!

115 Circuit Diagrams of Commercial Receivers and Power Supplies supplementing the diagrams in John F. Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the MOST IMPORTANT SCREEN GRID RECEIVERS.

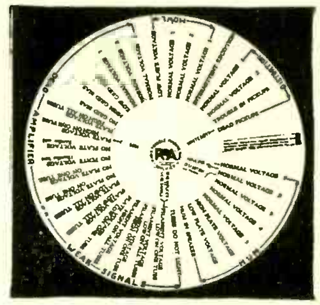
The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete. We guarantee no duplication of the diagrams that appear in the "Manual." Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A. C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

Subscribe for Radio World for 3 months at the regular subscription rate of $1.50, and have these diagrams delivered to you FREE!

Present subscribers may take advantage of this offer. Please put a cross here ☐ to expedite extending your expiration date.

Radio World, 145 West 45th St., N. Y. C.

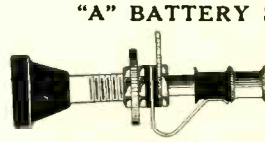
Trouble-Finding Dial FREE!



Here is an 8" diameter dial that you slide around to shoot trouble in an audio circuit or B supply or power amplifier. Trouble is divided into five groups: distortion, howl, dead amplifier, weak signals and hum. By sliding the dial to one of fifty different positions the cause of the trouble is read in the slotted opening. Invented by John F. Rider. Send $1.00 for eight weeks subscription for Radio World and get a Trouble-Finding Dial free with instructions on back. If extending an existing subscription please so state.

Radio World, 145 West 45th St., New York, N. Y.

"A" BATTERY SWITCH

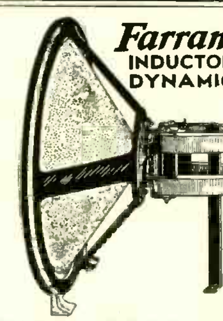


A push-pull switch for battery-operated sets. Made by Benjamin. Firm, sure contact, extremely long life. Price, 25c.

GUARANTY RADIO GOODS CO.

143 West 45th St., New York, N. Y.

Farrand INDUCTOR DYNAMIC



The inductor dynamic offers high sensitivity and true tonal response. It requires no exciting field current, unlike other dynamics. Order model B for 112 or 112A, and Model G for all other output tubes.

Cat. 9-G (9" extreme outside diameter) $8.49

Cat. 9-B $8.49

Cat. 12-G (12" extreme outside diameter) $10.03

Cat. 12-B $10.03

GUARANTY RADIO GOODS CO.

143 W. 45th St., New York, N. Y.

SHORT WAVE STATIONS BY FREQUENCIES

With schedule of hours on the air given for the five time zones. In Radio World dated March 28, 1931. Mailed on receipt of 15c in stamps. Or send subscription order to start with this issue. Radio World, 145 W. 45th St., N. Y. City.

SUBSCRIBE NOW!

RADIO WORLD, 145 West 45th St., New York City. Enclosed please find my remittance for subscription for RADIO WORLD one copy each week for specified period:

- ☐ $10.00 for two years, 104 issues.
- ☐ $6 for one year, 52 issues.
- ☐ $3 for six months, 26 issues.
- ☐ $1.50 for three months, 13 issues.
- ☐ This is a renewal of an existing mail subscription (Check off if true).

Your name ....

Address ....

City ....

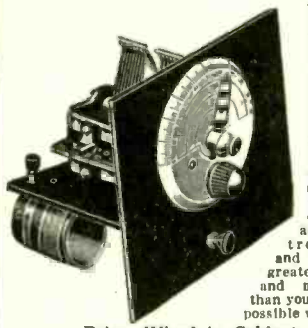
Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

7 cents a word—$1.00 minimum—Cash with Order

Selectifier

The Supertone Selectifier Makes Any Set Selective



This device is a band pass filter with 10 kc. band width and enables you to separate any station from any other, build up the volume of weak stations, subdue powerful locals so they are no longer troublesome, and bring in far greater distance, and more of it, than you ever thought possible with your set.

Price, Wired in Cabinet, $10
On 10-day money-back guarantee

175 KC TRANSFORMER

Supertone 175 kc. transformer, for screen grid tubes, with tuning condensers across primary and secondary, both accessible; in aluminum shield 2¾ inch diameter, 2¼ inches high, with removable bottom, both horizontal and upright mounting facilities. Sold on 10-day money-back guarantee. Order Cat. FF-175 @ $3.00
For other than screen grid tubes (secondary alone is tuned to 175 kc.; ratio is 1 to 4). Order Cat. FF-175-G @ $2.65

Supertone Products Corp.
216 Wallabout Street, Brooklyn, N. Y.

The New Jiffy Tester

Chromium-Plated Case and Accurate Meters

A NEW and improved Jiffy Tester, improved in both performance and appearance, is Model JT-N. The meters are of the moving iron type. Tested on precise batteries, they show errors not exceeding 2%. As for appearance, the case is first copper plated, then nickel plated, then chromium plated, giving a lustrous, permanent, non-peeling non-rusting finish. It is the same finish found on hardware in fine automobiles. The handle and lock strap are genuine leather.

Jiffy Tester, Model JT-N, consists of three double-reading meters, with cable plug, 4-prong adapter, test cords and screen grid cable, enabling simultaneous reading of plate voltage, plate current and filament or heater voltage (DC or AC), when plugged into the socket of any set. The ranges are filament, heater or other AC or DC: 0-10 v, 0-140 v; plate current: 0-20, 0-100 ma; plate voltage: 0-60, 0-300 v. It makes all tests former models made. Each meter is also independently accessible for each range. The entire device is built in a chromium-plated case with chromium-plated slip-cover. Instruction sheet will be found inside. Order Cat. JT-N.

[Remit $11.76 with order for JT-N and we will pay transportation.]

GUARANTY RADIO GOODS CO.

143 WEST 45th STREET (Just East of Broadway) NEW YORK, N. Y.

NEW VARIABLE MU TUBE

TO remedy cross-modulation and cross-talk, without circuit changes, a new AC screen grid tube has been developed, the G-51. In AC circuits where the volume control varies the grid bias or the screen voltage, or in which there is an automatic volume control, the new tube works wonders. This is the sensational tube developed by Stuart Ballantine. Price, $3.80.

RELIABLE RADIO CO.
143 WEST 45th St., N. Y. City

"MATHEMATICS OF RADIO"—A great help to everybody interested in radio. $2 postpaid. Radio World, 145 W. 45th St., N. Y. City.

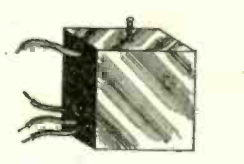
LOOK AT YOUR WRAPPER

You will see by the date thereon when your subscription for Radio World expires. If the subscription is about to run out, please send us renewal so that you will not miss any copies. Subscription Department, RADIO WORLD, 145 West 45th St., N. Y. City.

SOLDERING IRON FREE!

A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for RADIO WORLD and get this free! Please state if subscription is a renewal. RADIO WORLD, 145 W. 45th St., New York.

Three 0.1 mfd. in One Case



Three Supertone non-inductive fixed condensers of 0.1 mfd. each, (250 v.) in steel case, provided with a 6/32 mounting screw built in. The black lead is common to the three condensers, the three red leads are the other sides of the respective capacities. Size, 1½" square by ⅞" wide. Order Cat. SUP-31, list price, $1.00; net price, 57c.

GUARANTY RADIO GOODS CO.
143 West 45th St., New York, N. Y

Two for the price of One

Get a FREE one-year subscription for any ONE of these magazines:

- ☐ CITIZENS RADIO CALL BOOK AND SCIENTIFIC DIGEST (quarterly, four issues).
- ☐ RADIO LOG AND LORE. Quarterly. Full station lists, cross indexed, etc.
- ☐ RADIO (monthly, 12 issues; exclusively trade magazine).
- ☐ RADIO ENGINEERING (monthly, 12 issues; technical and trade magazine).
- ☐ RADIO INDEX (monthly, 12 issues) Stations, programs, etc.
- ☐ SCIENCE & INVENTION (monthly, 12 issues; scientific magazine, with some radio technical articles).
- ☐ AMERICAN BOY—YOUTH'S COMPANION (monthly, 12 issues; popular magazine).
- ☐ BOYS' LIFE (monthly, 12 issues; popular magazine).

Select any one of these magazines and get it FREE for an entire year by sending in a year's subscription for RADIO WORLD at the regular price, $6.00. Cash in now on this opportunity to get RADIO WORLD WEEKLY, 52 weeks at the standard price for such subscription, plus a full year's subscription for any ONE of the other enumerated magazines FREE! Put a cross in the square next to the magazine of your choice, in the above list, fill out the coupon below, and mail $6 check, money order or stamps to RADIO WORLD, 145 West 45th Street, New York, N. Y. (Just East of Broadway).

Your Name..

Your Street Address ....

City.......................................State.......................

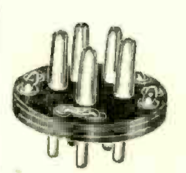
DOUBLE VALUE!

☐ If renewing an existing or expiring subscription for RADIO WORLD, please put a cross in square at beginning of this sentence.

☐ If renewing an existing or expiring subscription for other magazine, please put a cross in square at the beginning of this sentence.

RADIO WORLD, 145 West 45th Street, New York, N. Y. (Just East of Broadway)

SERVICE MEN'S NEW ADAPTER



Here is a new adapter that does the very trick you've wanted done—enables interruption of the connections to a tube, so current can be read, at the same time affording direct access to the prongs for voltage tests. Remove tube from socket, insert adapter in socket, put tube in adapter, and you're all set. Removable links, supplied with adapter, permit access to current.

For 5-prong tubes, Cat. B-1 @ $1.05.
For 4-prong tubes, Cat. B-2 @ $1.05.
Connecting cables, 2 ft. long, jack pins at both ends, Cat. 2067 (two leads), @ 36c.
Connecting cables, 2 ft. long, jack pin one end, forked lug at other, Cat. 2066 (two leads), @ 48c.

DIRECT RADIO CO.
143 West 45th Street,
New York, N. Y.