

SERVICE

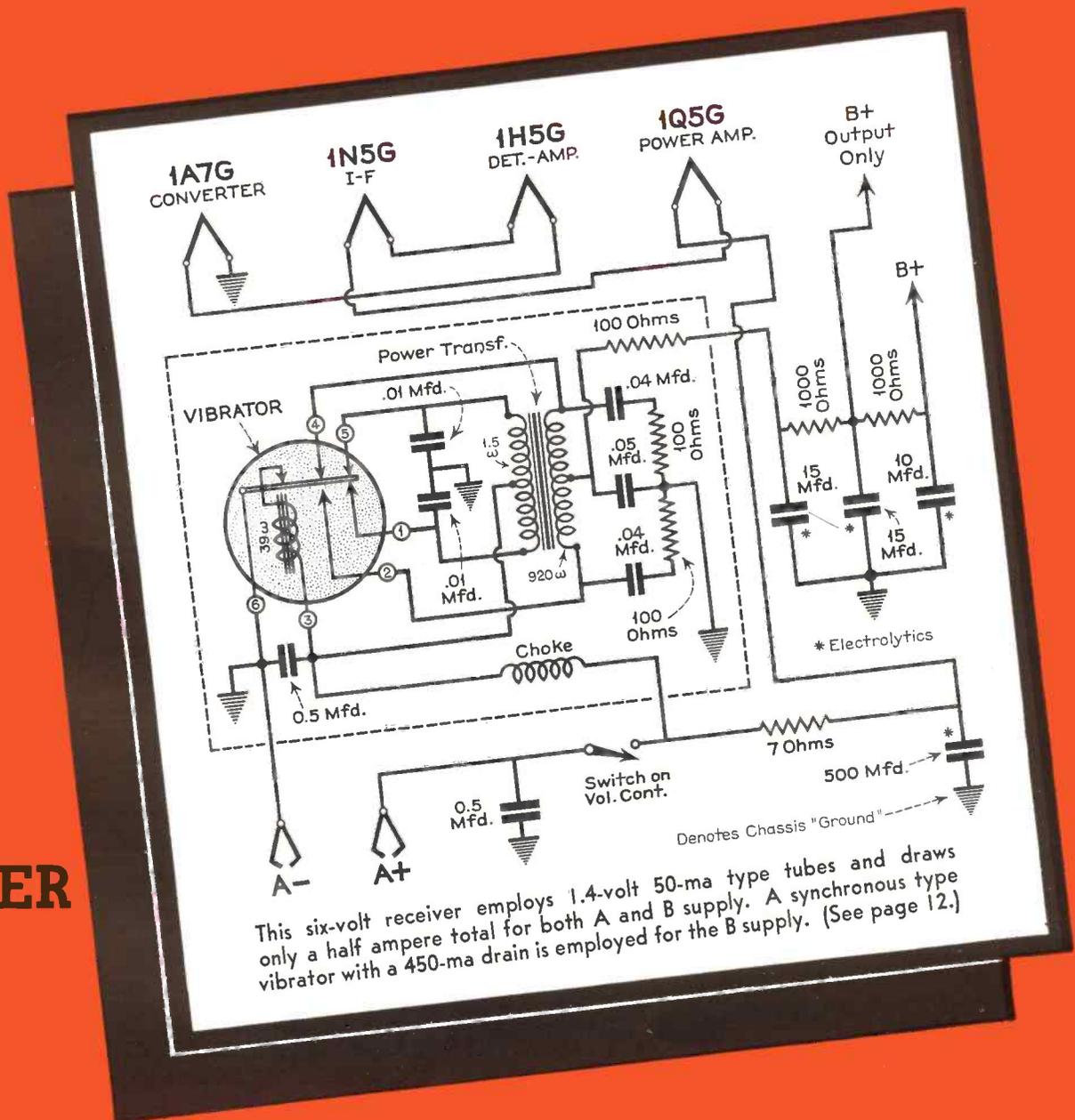
A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

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SERVICE



This six-volt receiver employs 1.4-volt 50-ma type tubes and draws only a half ampere total for both A and B supply. A synchronous type vibrator with a 450-ma drain is employed for the B supply. (See page 12.)

NOVEMBER
1941

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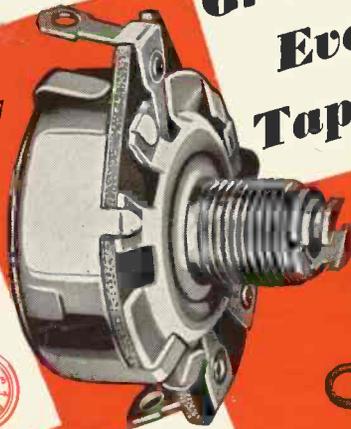
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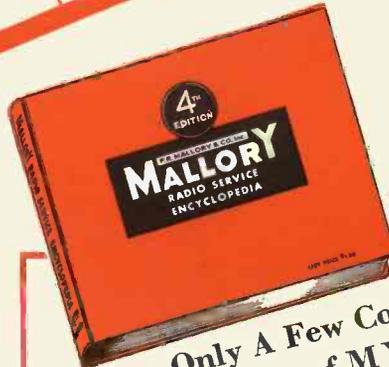
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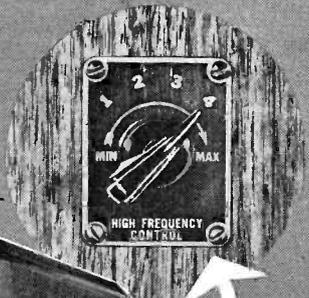
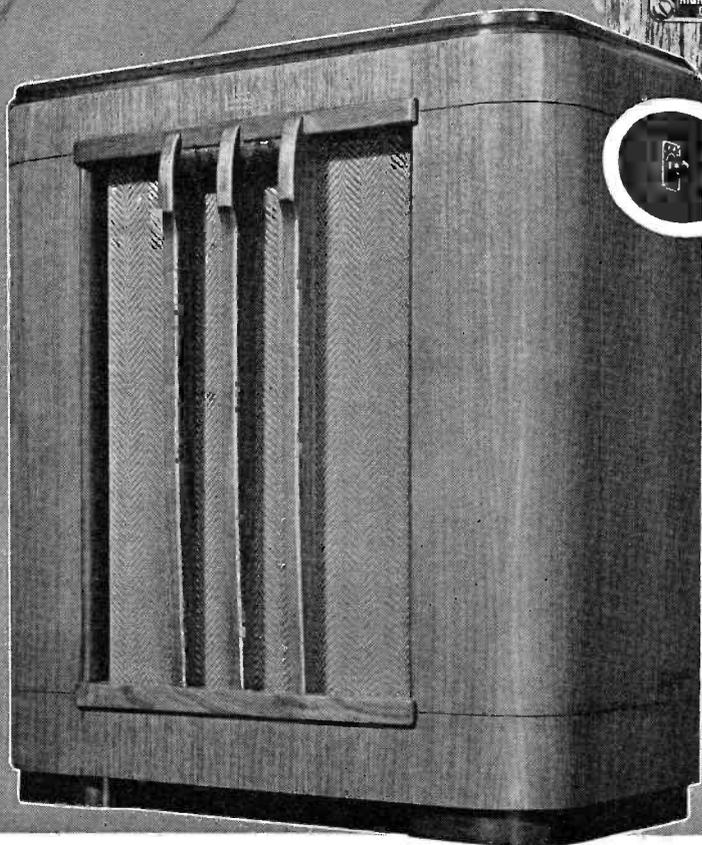
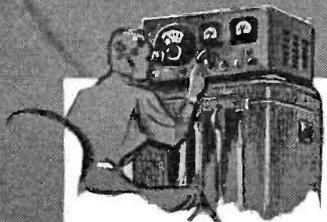
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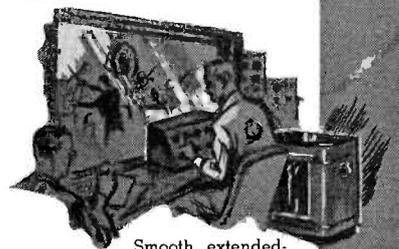
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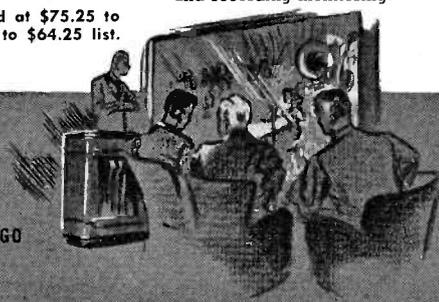
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If you need new apparatus, get in touch with your jobber immediately and fill out the necessary forms.

ON PAGE 5 of this issue we begin a series of articles which should help you clear up the headaches caused by shortages of component parts. While we believe this series will be quite timely, we can bring it closer to your needs if you write us and give us your views and problems. We have secured the cooperation of some of the best engineering minds in the country. The engineers are anxious to serve you. Much more can be done if you, too, will cooperate.

IN THIS ISSUE we feature a timely article on meters by Alfred A. Ghirardi. Mr. Ghirardi needs no introduction to most of our readers and we feel sure that they will welcome him once again on the pages of SERVICE. We promise many more articles from him in the very near future.

ANNOUNCEMENT has been made that the publishers of 'Radio Today' have purchased 'Radio Retailing'. The consolidated magazine will be published under the name of 'Radio Retailing combined with Radio Today'. SERVICE extends its congratulations and sincere wishes for success to Caldwell-Clements, Inc., the publishers.

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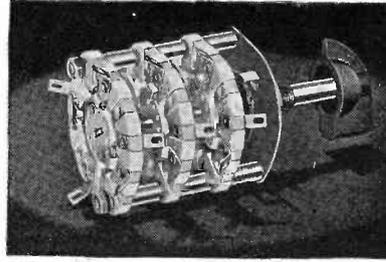
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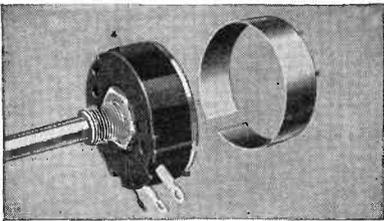
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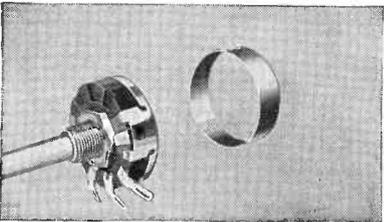


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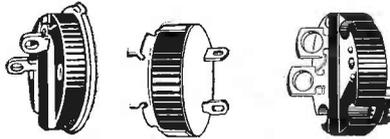
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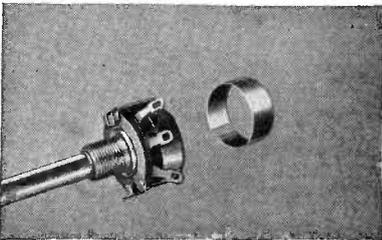
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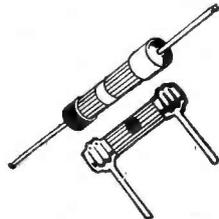
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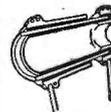


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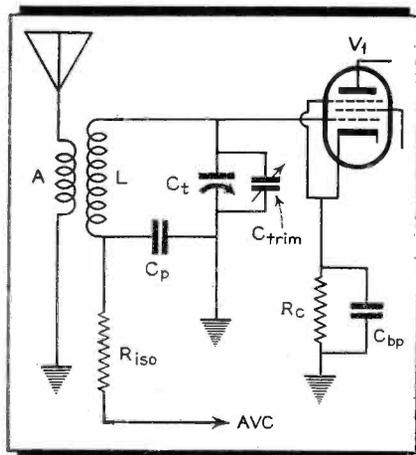
By **ROBERT G. HERZOG**

EDITOR

PARTS, parts, parts. . . . Service Men have already found it necessary to shop around from one jobber to another in order to obtain just the right part for the job on hand. With shortages of materials closing in on all sides, manufacturers and jobbers are finding it increasingly difficult to supply even the everyday needs of the Service Man. It does not take too much thinking to predict that some of these items will be completely missing from the jobbers' shelves in the very near future.

The information presented in this series is an attempt to give the Service Man a somewhat thorough working knowledge of the various receiver circuits. It is hoped that this knowledge will enable him to intelligently make slight changes in parts values, should the occasion arise, without disturbing the proper functioning of the receiver. The discussion, this month, centers on input r-f stages. Other sections of the receiver will be discussed in future issues.

Fig. 1. Coupling between the primary and secondary of this antenna coil is largely inductive.



THE PROMINENT receiver design engineers listed below have agreed to serve as an editorial advisory board in connection with the future articles of this series:

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SERVICE MAGAZINE

Circuit Considerations

In the accompanying circuits the antenna tuning system is made up of the coils A and L (the latter is usually a loop in more recent models) and the condensers marked C_t and C_p . The secondary of the antenna coil (L) is tuned by the variable condenser C_t which is part of the gang assembly. The condenser C_p is sufficiently large so that it has practically no effect on the tuning characteristics of the combination of coil L and condenser C_t . The condenser C_{trim} is used to align

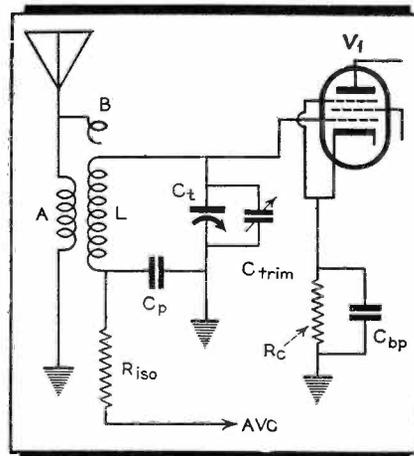
C_t so that it tunes in step with other sections of the tuning gang.

It will be noted that R_{iso} is shown connected between the lower end of the coil L and the bus which supplies the automatic volume control potentials. The purpose of this resistor is to isolate the tuned-radio-frequency stage from other r-f and i-f circuits in the receiver. Its use is essential if the set is to operate without interstage feedback.

R_c represents the resistance in the cathode circuit which will provide the proper grid bias for the r-f amplifier tube during those periods of operation when little or no signal is received. During such periods or during tuning, when no carrier is present in the set, the only bias available for the tuned r-f stage originates across the cathode resistor R_c .

The by-pass condenser C_{bp} across R_c is used to present a low-impedance path to ground for signal currents. Without C_{bp} these currents would build up across R_c and cause degeneration. In circuits where two or more cathodes are re-

Fig. 2. The link B provides additional capacitive coupling between primary and secondary windings.



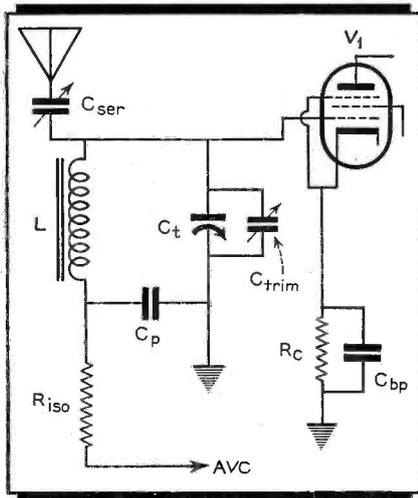


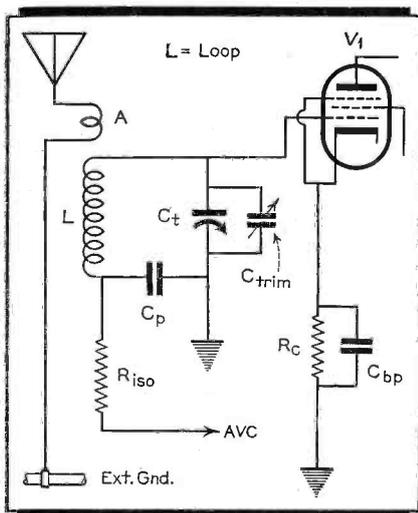
Fig. 3. Circuits somewhat similar to this, with a movable iron core, are also employed, but without condenser C_t .

turned through one common resistance, this condenser also prevents regenerative coupling by reducing the impedance of this common link.

In some circuits the r-f tube cathode is connected directly to B— (chassis) without the resistor R_c and the condenser C_{bp} . In these circuits the avc is provided with an initial bias or the no signal bias is obtained through the contact potential of the avc diode.

The antenna side of the first tuning coil does not present any particular degree of selection to incoming signals. However, the secondary tuning system, made up of coil L and condenser C_t does provide a considerable degree of selection. When the condenser is adjusted so that the combination of C_t and L resonates at a given frequency, there will be a voltage developed between the ends of the coil, for signals

Fig. 5. In loop circuits such as this the coupling between the winding A and the loop L is mostly capacitive.



at that frequency. Since the lower end of the coil is by-passed to ground by C_p and the upper end of the coil is connected to the control grid of the radio-frequency amplifier tube V_1 , the full voltage developed is impressed on the radio-frequency amplifier tube. Since resonance is necessary for the development of this voltage, a voltage will appear only at the frequency for which the condenser is set. There is not sufficient space to discuss resonance at length, but it is one subject clearly illustrated by a tuned-radio-frequency amplifier.

The plate of the amplifier tube is connected to the primary of a coupling unit which corresponds to coil A and coil L . This radio-frequency transformer performs in much the same manner as coils A and L and provides further selection of the signal before it is impressed on the grid of the next stage.

The radio-frequency amplifier tube V_1 is usually of the pentode, variable-mu super-control grid type. Such tubes have been employed in r-f stages since the type '35, the first of these, was introduced in the early thirties. They differ from the ordinary screen-grid tubes in that the former have a remote plate-current cut-off characteristic.

Super-control grid tubes were specifically designed for use in r-f amplifier stages which utilize avc systems that change the grid-bias voltages to alter the stage gain. Earlier screen-grid types would introduce cross-modulation effects when the bias voltages were shifted over a large range.

Except where a metal tube is used, or in types where the tube is adequately shielded internally, shielding of the r-f tube is required to reduce stray coupling.

Individual Variations

Figs. 1 to 8 illustrate antenna input stages of different types. Figs. 1 and 2 are high-impedance units. The transfer of energy from the antenna to the secondary circuit in Fig. 1 is purely inductive. Coil A is wound over the lower end of the tuning coil L and has an inductance somewhere between 20 to 200 microhenrys.

Coupling between antenna and tuning circuits in Fig. 2 is provided by a combination of inductance and capacity. Inductive coupling is provided by the coil A for the low-frequency range of the tuned circuit and capacitive coupling for the high frequencies is accomplished by the link B . The coil A is a universal or choke type winding below the tuning coil L . Its inductance ranges from 1.3 to 1.5 millihenrys (1300 to 1500 microhenrys). Through this combination of capacitive and inductive coupling the transfer of signal from the

antenna to the tuned circuit is fairly uniform over the entire tuning range.

In automobile radio sets and similar services where the antenna input signal strength is low, the circuit shown in Fig. 3 has been used. In such instances the coil L is of the iron-core type. The antenna series condenser C_{ser} is of the small two-plate, adjustable-trimmer type with a capacity range of approximately 3 to 30 mmfd. Similar circuits are used where variable iron cores are provided for tuning instead of the gang condenser C_t . Adjustment of C_{ser} is made on a weak signal at the high-frequency end of the band.

Fig. 4 represents the circuit of a set using either a coil or a loop as the inductance L . In either case, the condenser C_{tank} is provided as a common coupling link for the external antenna

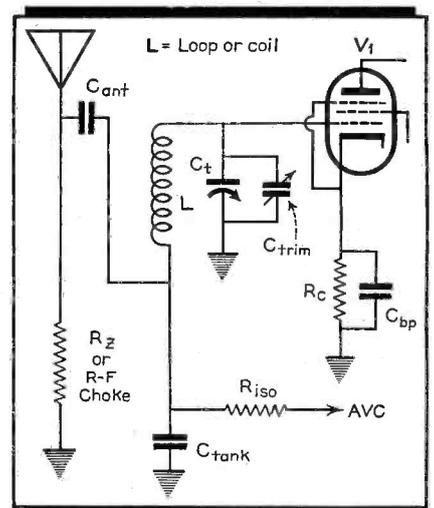


Fig. 4. The condenser C_{tank} provides a common impedance link for both the antenna and tuning tank circuits.

and tuning tank circuits. Since its value (0.002 mfd) is small enough to affect the tuning curve of the condenser C_t , the latter must have a higher maximum capacity to compensate for this. The resistance R_z is provided as a low resistance path for hum-modulation currents for receivers operated from the power lines. On straight battery operated sets the resistance is usually omitted.

Fig. 5 is the circuit of a loop operated r-f stage with provision for an external antenna. The coil A in this case is made up of any number of turns from 1 to 10 which are coupled to the loop. The more turns that are used for coil A , the further this coil must be from coil L to prevent mistracking. The coupling between A and L is largely capacitive.

Another type of loop circuit commonly found in recent receivers, is

shown in Fig. 6. In this circuit, a high-impedance primary is wound inside the loop to make provision for an external antenna. In installations that do not require this external antenna, the primary coil A should be shorted with a link that is provided. This latter precaution is necessary to prevent absorption of energy from the loop circuit at the resonant period of coil A.

Fig. 7 employs a loop (L) with a few turns and a high-Q loading coil in series with the lower end. This latter coil is inductively coupled to a primary which provides for an external antenna connection. This type of circuit lends itself particularly to multi-band receivers where the loop is used for the broadcast band only, but is also used in higher priced single-band sets.

A similar circuit is shown in Fig. 8. In this circuit, the coil L is inductively

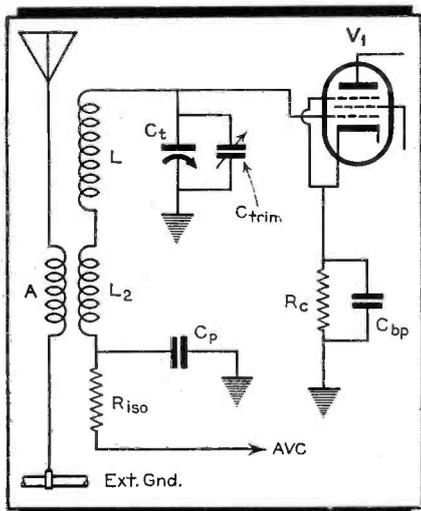


Fig. 7. The combined inductances of loop L and loading coil L_2 equal the single inductance L of the other figures.

coupled to the loop. The coil A provides some additional coupling, largely capacitive. The resistance R_L is used to broaden the period of the coupling coil L_2 in order to reduce absorption and to provide more uniform coupling over a greater tuning range.

Possible Substitutions

The following suggestions are given only as possible alternatives for the Service Man in the advent that he should find difficulty in obtaining the exact parts required. It cannot be over-emphasized that, at best, the alterations mentioned will produce only a make-shift. *In every case the exact value prescribed by the set manufacturer's specifications should be used if it is at all available.*

Whenever changes in parts values are made in r-f and i-f stages, realign-

ment of the receivers circuits will undoubtedly be indicated. Where changes or repairs of coils are made "knifing the plates" may also become a necessity.

Fundamentally, the various antenna input circuits shown in Figs. 1 through 8 can be divided into two or three classes. Within these classes there are no radical differences between one circuit and another. Should the occasion arise where one type of part is not available, yet another can be obtained, it is often possible to shift to the other circuit. This procedure may introduce some difficulties in tracking. Generally, however, these difficulties may be eliminated by removing (or adding) turns to adjust the inductance L at the low-frequency end and adjusting the trimmer (C_{trim}) at the high-frequency side of the tuning range. As a further precaution the set should be more accurately aligned by "knifing."

Breaks in coils may be repaired by unwinding one or two turns at the point of the break, twisting the loose ends together, sandpapering, and then soldering. In order to protect the coil during the latter two operations a narrow strip of cardboard should be slipped under the joint. After the repair is completed this strip should be removed and the repaired portion of the coil painted with coil dope or wax.

Where a primary winding on an antenna coil is burned out it may be removed and new turns wound on, or a new coil may be slid into its place. Wire for such purposes can be taken from an old coil should new wire be unobtainable.

Loop antennae have between ten and thirty turns depending upon their size and circuit connection. A single turn, or even a part of a turn, is a major portion of the loop's inductance. Should a damage occur in one of these components it is therefore necessary to replace any turns, which it has been necessary to remove, to make the repair. A narrow cardboard strip should be used under each splice while soldering, as in the case of the coils above.

The grid return isolation resistor R_{iso} and its associated condenser C_t are not critical in so far as their value is concerned. The resistor can have any value from 50,000 ohms to 1 megohm, and the condenser any capacity from 0.1 mfd down to 0.02 mfd. These components, however, do affect the time constant of the receiver's avc circuits. For this latter reason it is advisable to compensate for any great change in either part by a suitable change in the other, in the opposite direction. That is to say, if the value of either the resistor or condenser is increased appreciably, the value of the other should be decreased in proportion, and vice versa.

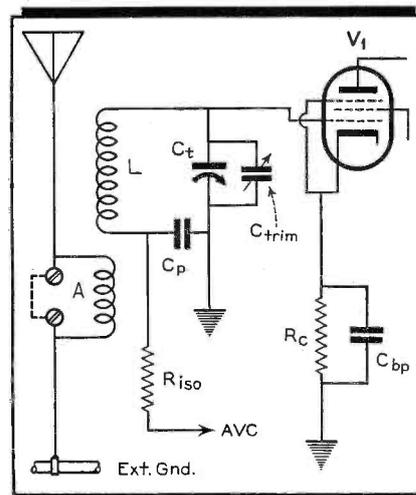


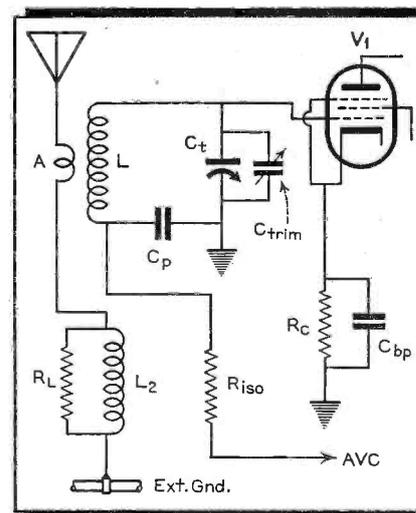
Fig. 6. If no external antenna is used with this circuit the coil A should be shorted to prevent absorption.

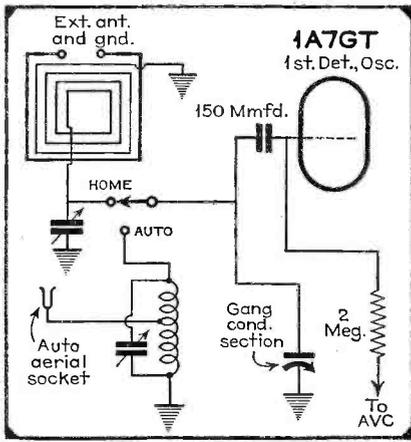
Resistors with values from 100 to 1000 ohms are used in the cathode circuit (R_c) to provide no-signal bias for the stage. Whether alterations of the value are possible would depend upon the particular receiver in question—on its sensitivity and stability.

Increasing the value of the cathode bias resistor R_c will decrease the sensitivity of the receiver. Most receivers that employ an r-f stage can afford some loss of sensitivity, however. Decreasing this resistor, on the other hand, will increase the sensitivity and possibly move the circuit toward instability. Here again, receivers of the better class that employ an r-f stage, are usually quite stable. Generally therefore, it is permissible to change the value of R_c as much as plus or minus 25% or more in r-f stages.

The by-pass condenser C_{bp} across R_c is of medium capacity and usually is

Fig. 8. The coil L_2 , coupled to loop L, provides additional inductive transfer between primary and secondary.





Airline Model 14WG680 switches from the circuit of Fig. 5 to one similar to that of Fig. 3.

not larger than 0.1 mfd, and can be much smaller. It is unnecessary for the by-pass condenser at this point to be larger than 0.1 mfd, since the only frequencies present are radio frequencies. This is especially true where only one cathode connects to R_c . In some instances the receiver will have sufficient sensitivity and stability to permit omission of the by-pass condenser without any undue effects.

In Fig. 3, the small series condenser C_{ser} in the antenna circuit may be any trimmer with an adjustable capacity range that includes 3 to 30 mmfd. Such trimmers are used in all multiband receivers to trim the coils in the various bands.

As mentioned above, the condenser C_{tank} in Fig. 4 is quite critical. Should it be impossible to obtain the exact value, however, an adjustable padder may be substituted provided it includes the required capacity in its adjustable range. This padder should be adjusted at the low frequency end of the band in the same manner as the padder in a typical oscillator circuit.

The resistor R_z in this same figure is not critical and the nearest value to the original that can be obtained between 5000 and 25,000 ohms, may be used. Some receivers use a small r-f choke in this position which suits the purpose better. In the event that such a choke is defective, the resistor may be substituted, however.

In Fig. 8 the value of the resistor R_L is not too critical and other values may be substituted. It is usually between 10,000 and 20,000 ohms but it is always best to try to make replacements with a value as close to the original as possible, within these limits.

Tubes

Much literature is available from the

tube manufacturers concerning interchangeable tube types, and much more could be said. In the circuits shown almost any variable-mu tube type can be used and a wide range of substitution is possible even to the extent of shifting socket connections. Of course, where glass tubes are substituted for metal, shielding may become necessary. And, as mentioned before, realignment of the receiver circuits will also be required.

Summary

1) Aside from slight variations, the antenna input circuits illustrated contain the same or similar elements.

2) Except for possible difficulties in tracking, one type of antenna circuit may be substituted for another in the average superheterodyne, should it be impossible to obtain the proper replacements. In such cases it is advisable to adjust the tracking at several points by "knifing the plates."

3) Coils may often be repaired by unwinding one or two turns at the point of damage, repairing the damage, and then painting the turns with coil dope or wax.

4) In the circuits shown winding A is not too critical. Should it prove defective it may be removed and a new one wound or slid in its place.

5) The resistor R_{iso} shown in the several circuits is used to isolate the tuned r-f stage from other tuned circuits in the receiver. Its value is not critical. Should any great change be made, the value of C_p should be changed in the opposite direction. (See item 6 below).

6) The condenser C_p presents the link between the bottom end of the tuning coil L and the grounded end of the tuning condenser C_t . Thus it not only by-passes the resistor R_{iso} but also completes the tuning circuit. Although its value is not too critical, it should be greater than 0.02 mfd. If any large change is made in the value of C_p the value of R_{iso} should be changed in the opposite direction. (See item 5 above).

7) R_c represents the resistance in the cathode circuit which provides the proper bias voltage for the stage during those periods when there is no signal. Increasing R_c will reduce the sensitivity of the receiver. Decreasing it, on the other hand, will usually increase sensitivity and may move toward oscillation and instability.

8) The condenser C_{bp} is of medium capacity and generally is not larger than 0.1 mfd and in most cases it may be smaller.

9) The circuit in Fig. 3 is used for installations such as auto radio sets where the antenna input signal strength is limited. The coil L in this circuit is generally of the iron-core type.

10) The condenser C_{ser} in Fig. 3 is usually of the small adjustable type with a capacity range from three to thirty mmfd. Any small two-plate, screw-type adjustable trimmer can be used.

11) In Fig. 4 the condenser C_{tank} provides a common impedance for the antenna and tuning tank circuit. Its value is somewhat critical and is generally 0.002 mfd.

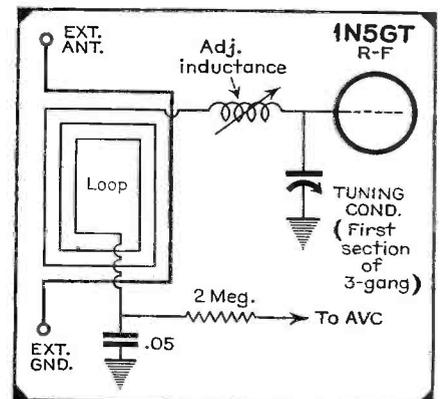
12) The resistance R_z in Fig. 4 provides a low impedance path for hum modulation currents. Its value is not critical and may be from 5,000 to 25,000 ohms.

13) Slight damages in loop antennae should be repaired by patching, instead of by removing turns, since even part of a turn represents a large section of the loop's inductance.

14) The resistor R_L in Fig. 8 is used to broaden the resonance characteristic of the coil L_2 in order to reduce absorption at the frequency of resonance. The coil L_2 is inductively coupled to the loop L, usually at its center. The value of the resistance R_L is not too critical and may be from 10,000 to 20,000 ohms.

15) The tube V_1 practically always used in r-f stages is of the variable-mu type. Its construction is such that alteration of the control grid bias changes the amplification factor (μ) of the tube and alters the gain of the stage. Substitution of one tube type with another having similar characteristics is permissible. Tube manufacturers supply "Interchangeable Tube Types" charts which list such possibilities.

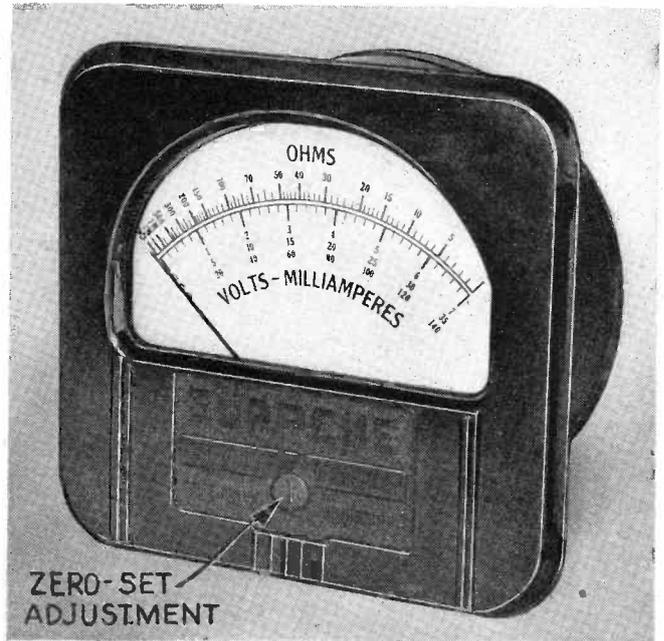
Air Castle Models CP5120 and CP5121 use an adjustable inductance in series with loop for trimming.



KNOW YOUR METER

By **ALFRED A. GHIRARDI**

AUTHOR OF
"Radio Physics Course"
"Modern Radio Servicing"



IN THESE days of national emergency it is more than ever necessary that the Service Man be intimately familiar with his meter equipment. The demands of the defense program are requiring more and more of the undivided attention of meter manufacturers with the result that their repair services are greatly slowed down and even they are suffering from a shortage of replacement parts for use in repairing meters of their own make. It appears likely that production of new and replacement meters for the open market will continue to decrease. Already there is a growing scarcity of meters and meter equipment on jobber's shelves.

All of this means that the Service Man may have to get along for quite some time with his present meter equipment. It is therefore only the better part of wisdom to make the most out of what he has by 1) treating it with the care and respect due the highly delicate equipment it is, 2) being sufficiently familiar with it to make certain repairs and adjustments himself.

To aid in this direction it is the purpose here to offer a discussion on the

operation, care, and use of d-c instruments of the moving-coil type—some suggestions also on diagnosing their ailments and correcting such of these as are within the practical ability of the average Service Man to handle are also

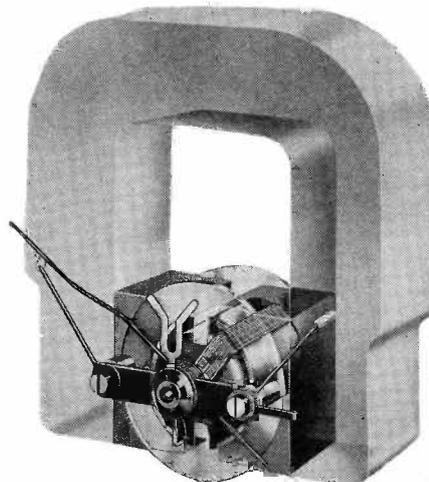


Illustration courtesy Weston
Fig. 1. The moving-coil type of d-c instrument consists of a coil of fine wire pivoted between the poles of a permanent magnet. The pointer is attached to this coil as are a pair of spiral springs.

included. This particular type of instrument is selected for discussion because it serves as the foundation for most of the universal multi-meter equipment now in use and is by far the most generally employed instrument in the radio service field.

As shown in Fig. 1, a typical instrument of this type consists of a coil of fine wire pivoted between the poles of a powerful permanent magnet in such position that any direct current flowing through this coil will cause it to rotate as a result of the magnetic field set up around it and the influence of the permanent magnet. At least such rotation will result if the current flow is sufficiently great to overcome the friction of the coil bearings, etc. Actually, unless some retarding action were purposely introduced, the slightest current would cause the coil to instantly assume a position in which its respective magnetic poles are closest to the opposite poles of the permanent magnet. It is for this purpose that two spiral springs are included in the assembly. (See Fig. 1 b.) These are attached to the moving coil in such manner that they cause the coil to return to the zero position of the meter scale when the current flow is discontinued. When current flows it not only must be such as to overcome the bearing friction, but must now also overcome the retarding effect of the springs. As a result rotation of the coil (and therefore of the pointer which is attached directly to the coil) is proportional to the amount of current applied. If the magnet, coil and springs are such as to allow the pointer to traverse the full scale with a current flow of 1 milliampere, it will traverse half the scale with 0.5 milliampere flow, etc.



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radio fundamentals and taught in an outstanding technical school for more than ten years.

His thorough knowledge of radio and his ability to explain complicated technical data in simple terms and charts has made him a leading authority on radio servicing.

We take great pleasure in bringing Mr. Ghirardi to the pages of SERVICE, and promise our readers more of his writings in early issues.

The propelling energy of a tiny cur-

rent such as 1 milliamperes or less required for the full-scale deflection of the indicating instruments employed in many modern test equipment designs, is necessarily very slight. Friction must therefore be reduced to a minimum through the use of carefully ground and highly polished pivot points seated in bearings of sapphire jewels, to support the moving coil. (See Fig. 1 c.) Then with friction substantially eliminated a precisely controlled degree of retardance must be introduced by means of the springs. These springs represent a very high achievement of the metallurgical arts. Not only do they provide just the right retarding value for a given coil, current range, and magnet combination, but this action must be progressive in order that the extent of the coil (and pointer) movement will vary directly with the amount of current applied to the coil. Then, in addition, the springs must be permanent in their mechanical characteristics if the meter accuracy is to be maintained and if the pointer is always to return precisely to zero when no current is applied.

To take fullest advantage of the slight electrical energy being measured, it is necessary that the gap in which the coil moves be very narrow, thus providing high concentration of magnetic flux. This involves precise alignment of all related parts if the moving coil is to swing clear without striking the core or pole pieces which constitute the walls of the gap.

All of this indicates something of the precision with which the modern indicating instrument is manufactured. In many respects such a movement is comparable with that of a fine watch and it should be treated with much the same care. Once this fact is recognized, the Service Man will enjoy a much greater degree of freedom from meter troubles. Too often the fact that meters will withstand considerable abuse leads to carelessness and excesses in this direction. They are bumped around on the bench, tossed into the service kit which as often as not rides on the floor of the car or truck on service calls, are overloaded, and in other ways treated as one would not think of treating any other delicate

device. *The effect of such treatment is likely to be cumulative.* Perhaps for a time no apparent damage results (a factor for which the meter manufacturer deserves full credit). Comes a day, however, when the accumulating effect of this sort of treatment passes the meter's limit of endurance. Its accuracy becomes seriously impaired or it may stop functioning altogether.

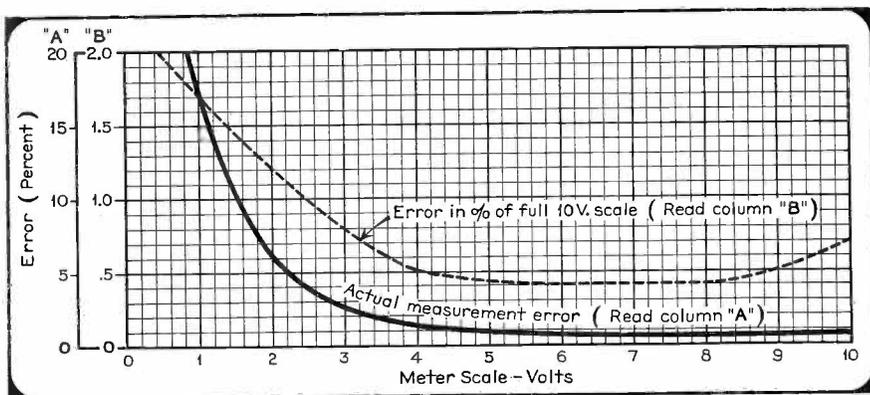
It is difficult to attempt to list all the little ways in which one may guard against such trouble. There are two major precautions, however, that will help greatly. One is to studiously avoid overloads. In a multi-range meter unit, for instance, it involves little extra time to switch the instrument to its highest range when attempting to measure an unknown value, to disconnect the leads from the load in changing from one type of measurement or range to another if the instrument is one which requires such a precaution, and so on. It is easy to be careless in these respects when making a series of voltage measurements on a chassis but it will be found definitely advantageous to do it the careful way. Even though the instrument may stand a 10 to 1 overload without burning out, this doesn't mean that the pointer will go through such an experience unscathed, or that a pivot can't be dulled or a jewel cracked. Such things can and do happen and they spell lost time and expense.

A second general precaution that will prove its worth in connection with a portable instrument, it to glue patches of sponge rubber on its case in such positions that when carried in the kit, or used on the bench, it will be insulated from strong vibration or mechanical shocks. A couple of short strips of this rubber at the edges of each side, bottom and top of the case will protect it should it tip over on the bench; in the kit it will always be "floating on rubber". In a pinch, a 20-cent kneeling pad will provide plenty of "shock-absorbing" material for several test instruments.

Meter Accuracy

In most phases of service work meas-

Fig. 2. Check of 10-volt d-c meter showing error both as percentage of full scale and as percentage of actual reading.



urements of voltage, current, resistance, etc., do not require laboratory accuracy. This is fortunate because extreme accuracy in meter equipment is obtainable only at high instrument cost. Typical radio test equipment is made to provide a combination of *reasonable accuracy* with sturdiness. Whether an individual Service Man obtains this reasonable accuracy depends as much on himself and his method of using the test instrument as it does on the instrument itself.

First of all, mistreatment may cause a considerable decrease in the original accuracy of the meter. It is even possible that such change may result from factors beyond the owner's control. An occasional check against a precision instrument is therefore worth while if it can be obtained. A fact not generally known is that arrangements can often be made with local schools or colleges for such a check, at little or no cost to the Service Man. The instructor in charge of the school's instruments, or a student who has access to such equipment, will usually cooperate.

Most meters used in standard service test equipment are rated at 2% full-

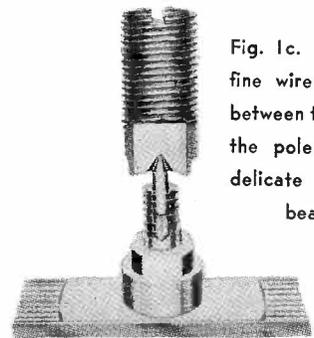


Fig. 1c. The coil of fine wire is pivoted between the pole and the pole pieces on delicate jeweled bearings.

scale accuracy. It is surprising but true that many technicians who know better fall into the habit of assuming that any measurement made with such an instrument will be accurate to within plus or minus 2%. They know, for instance, that a measurement made at the low end of a 100-volt d-c range might actually be off 50% and still that meter could be within its rated "2% of full scale". In this case 2% of full scale would be 2 volts but this is equivalent to 4% at half scale, 20% at 1/10th scale, and so on. This doesn't mean, of course, that a 10-volt reading on this range *will* be off 20% but rather that the error will not *exceed* this value.

From this it is obvious that the maximum error *may* become very appreciable for values at the lower end of the measurement range. Actually they are likely to be considerable over the lower 20% of the scale calibration. Fig. 2 shows an example of a check of a 10-volt meter against a laboratory standard. This is not presented as a typical example but serves for purposes of illustra-

tion. Although this meter had seen considerable service, and probably some abuse, it is still well within the manufacturers "2% of full scale" accuracy rating except at the extremely low end. This is shown by the broken line in Fig. 2. As a matter of fact an accuracy of better than 1/2% (of full scale) is maintained over approximately 50% of the range.

The actual percentage of error for different parts of the scale are shown by the heavy line of Fig. 2. Here it will be seen that all voltages between about 3.6 and 10 will be measured with an error of 2% or less but voltages below 3.6 will show rapidly increasing errors. For service work this instrument is adequately accurate for all measurements above about 2 volts. It would be unwise to employ it for measurements below this value.

An extensive study of meter errors encountered in a wide variety of modern test equipment indicates that it is always unwise to employ the lowest 20% of a d-c meter scale because it is in this portion of the range that maximum actual errors are invariable encountered. If a voltage (or current) under measurement falls in this portion of a measure-

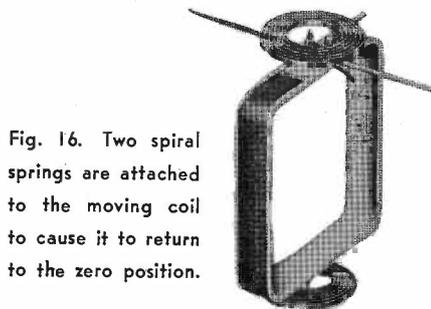


Fig. 16. Two spiral springs are attached to the moving coil to cause it to return to the zero position.

ment range it is far better to switch to a lower range where the desired value will be further up on the scale. This rule represents one of the means by which the user of the meter can insure better accuracy from his equipment.

Another source of error not uncommon in some test equipment is the variation that results when the instrument is in different positions. It is easy to check any instrument in this respect by first accurately adjusting its zero setting, then tilting first vertical then horizontal to see if the zero adjustment is maintained accurately. If so, there will be no error from this source. If the pointer position should shift off zero it will be best to use that instrument only in its intended position, usually horizontal in the case of portable test equipment.

The "Zero Adjust" screw provided on most indicating instruments is often misused. Its purpose is to bring the moving coil into the position in which the instrument was originally calibrated. If the pointer has been bent appreciably

Type of Trouble and Symptoms	CAUSES	LOCATIONS	REMEDY
MECHANICAL Sticking of movable system.	1. Small piece of foreign matter (fuzz, hair, metal) lodged in instrument.	On scale. At moving coil. At top or bottom spring. Near tail of pointer. In air gap.	Remove foreign matter with tweezers, needle or narrow strip of thin cardboard (such as strip cut from calling card).
	2. Break in surface of paper scale, obstructing pointer movement.	On surface of paper scale.	Remove obstruction with tweezers or knife-point.
	3. Moving coil touching core or pole pieces.	Loose bearings.	Carefully tighten bearings - <i>not too tight</i> .
	4. Friction.	Tight bearings.	Carefully loosen bearings - <i>not too loose</i> .
	5. Tangled springs.	Upper and lower springs	Untangle with needle.
	6. Bent pointer.	Pointer.	Straighten by pressing against flat piece of stiff cardboard.
ELECTRICAL No indications.	1. Open circuit. 2. Short circuit.	Moving coil. Series resistance in voltmeter. Shunt resistance in ammeter. Leads and connections.	Examine and test all parts and connections for opens and shorts.

Fig. 3. Typical meter repairs are listed together with their causes and remedies as a help in making repairs.

by overloading which caused it to slam against the stops, any attempt to compensate for the bend by readjustment of the zero setting will throw the whole scale calibration off because to make its bent end coincide with the zero position it will be necessary to rotate the moving coil to an abnormal zero position. This changed position of the coil introduces one error and the resulting altered spring tension introduces another with the result that the operating conditions of the moving element are thrown entirely out of kilter and the relationship of its movement to the scale calibration basically altered.

Care of Meters

Two of the major precautions for insuring long meter life and accuracy were mentioned earlier. One was the rather unorthodox stunt of mounting rubber shock absorbers on the meter case, the other the careful avoidance of overloads. Another precaution, which can logically be classed as major, involves the careful observance of correct polarity. An overload of reversed polarity is likely to be far more damaging than the same amount of overload of correct polarity. It is not an uncommon practice when handling unfamiliar circuits to check for polarity by momentary contact of the test leads without regard to the range for which the meter is set. The subconscious thought probably is that such a momentary contact cannot harm the meter even if it is set for a much lower range than required. This is quite incorrect. True, the chances of burning out the meter are reduced but that momentary contact is sufficient to slam the needle against the

stop, subjecting both the needle and coil bearings to abnormal strain.

A meter case should never be opened unless for a necessary repair. Perhaps the most common source of internal trouble in meters (aside from abuse at the hands of the owner) is that caused by particles of foreign matter lodging at some point where they interfere with the action of the moving parts. These may be metal filings or paper fibers lodged within the case during the manufacturing process and shaken into harmful positions by handling or transportation. Manufacturers take every precaution to insure against this but even their best efforts cannot always avoid it. When one opens a meter case there is always the likelihood of dust, hairs or metal particles gaining entry. The same condition is likely to result from a broken or cracked glass face and for that reason a damaged face should be replaced at the earliest possible opportunity. A good temporary repair can be made by covering a crack with transparent "scotch tape" or, lacking this, by cementing a strip of cellophane over the damaged area.

When transporting a meter on service calls, whether in the kit or separately, it will usually ride much more safely on the car seat where the bumps are cushioned, particularly in a passenger car where the seat cushion tilts sharply down toward the rear and will therefore prevent the kit or meter from slipping off onto the floor in case of a quick stop. In a relatively rough-riding truck some special cushion arrangement utilizing rubber, felt or suspension springs can be worked out. This may seem like going to extreme ends but such care is justified because it is during transportation that many portable meter units receive their roughest treatment. A one-mile trip on the floor of car or truck, over

(Continued on page 25)

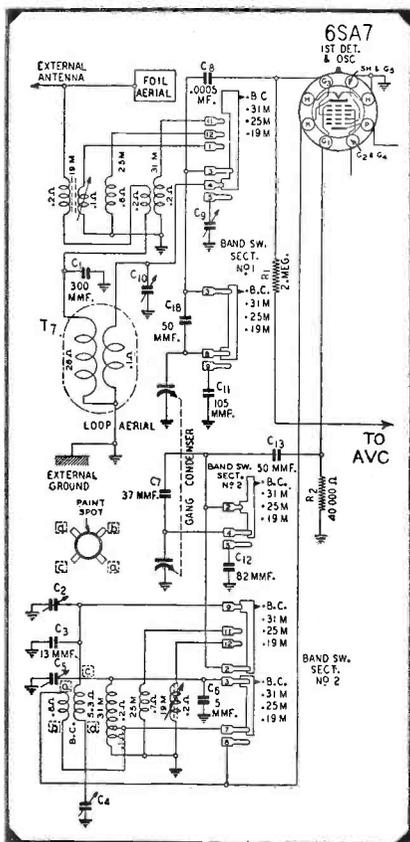


Fig. 6. Airline 14WG807 has three band-spread channels.

sets, hence more servicing at better prices is inevitable.

Zenith 12H678, 12H679 (Chas. 12A6)

This month's f-m receiver is a 12-

with those of the other frequency with-out interaction. The output of the first i-f stage splits into two channels. The a-m channel consists of a 7A4 connected as a diode detector followed by a twin 7F7 amplifier-inverter triode feeding push-pull 6V6s for output. The f-m channel proceeds with a second i-f stage, two limiter stages and discriminator detector. From here the audio signal is switched into the same amplifier as employed for the a-m channel. A single 12-inch electro-dynamic speaker is used.

The a-c line serves as a pickup for f-m in areas of ample signal level. The noise-reducing qualities of f-m prevent excessive noise pickup. In outlying regions, however, it is advisable to put up some sort of f-m antenna, preferably outside, as high as possible; doublet types are the most efficient. The f-m terminal is connected to the a-c plug through a 0.0001-mica condenser. An r-f choke from this point to the primary of the power transformer prevents grounding the signal. The other side of the line is by-passed to chassis in the usual manner. It is conceivable that, in some instances, the signal may be improved by reversing the line plug as one side is frequently more "live" than the other to the r-f signal. The phono motor connects directly to the plug, but the motor is off during radio reception. An r-f choke is used in the 6.3-volt line to the heaters of the f-m discriminator and limiter stages. (See Fig. 1.) An elaborate 6-point tone con-

Model 1141, features resistance coupling between the two i-f stages. The r-f stage and converter are standard. There is an i-f switch in the converter output circuit. The secondaries of the two intermediate frequency channel i-f transformers are in series, feeding the first i-f grid. Both i-f channels are amplified in the resistance-coupled second i-f stage. The two different i-f signals are divided in the output circuit of the second i-f, the f-m channel feeds a third stage, the a-m channel connects directly to the detector. (See Fig. 2.)

G.E. L630

General Electric Model L630 is a 6-tube, 2-band job, with a separate loop antenna for each band. On the broadcast band a 470-ohm resistor is used in series with the external antenna (when used) to broaden the response. On short wave reception the external antenna connects directly to a tap on the loop, autotransformer style. This is a typical 2-gang receiver with a r-f stage and untuned detector. Fig. 3 shows the novel tone control in the grid of the output stage. Note the 1000-ohm resistor in series with the grid.

Airline 14BR912A

Fig. 4 shows the circuit of Ward's Airline 14BR912A, a 9-tube, 5-band, record-changer combination. The broadcast band uses a loop in a series arrangement containing a tunable antenna loading coil, a 0.002-mfd condenser and a 9-mc antenna coil primary. The external antenna is fed through a "pi" network (consisting of two 25,000-ohm resistors and a 0.0005-mfd mica condenser) to the low side of the loop. A 3-gang permeability tuned element provides plenty of selectivity for broadcast and four band spread short-wave bands.

Two separate tone controls operate in conjunction with two taps on the volume control. A 1/2-meg resistor shunts the 2.8-meg volume control. The treble control works between the high side of the control and the first tap,

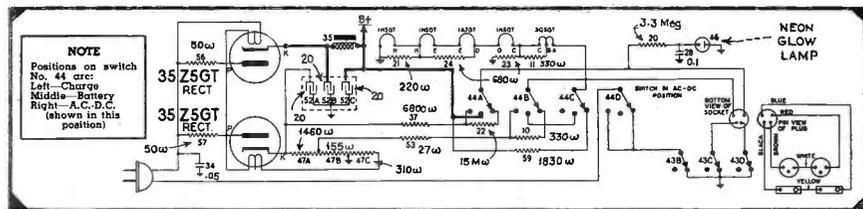


Fig. 8—Stewart Warner Series 207C charges dry batteries.

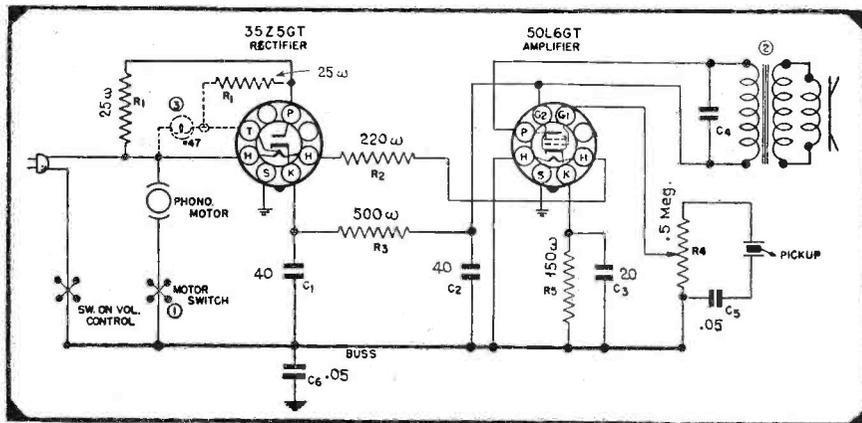
control is also featured.

Espey 1141, 1150

A new f-m, a-m receiver, Espey

tube phonograph combination, Zenith's Models 12H678, 12H679 (Chassis 12A6), a four-band a-m, f-m super-heterodyne. Several interesting features are included in the design, some of them being push-button operation on the f-m band as well as broadcast, iron-cored coils for the f-m band, a-c line serving as f-m antenna and separate wave traps for each intermediate frequency. The 7V7 r-f stage, the 7J7 dual tube converter and the 7V7 first i-f stage are common to both f-m and a-m, the latter including broadcast and two wide short-wave bands. The input and output i-f transformers of the first i-f stage are in series, eliminating the necessity of switching. (This idea has been covered in previous articles). The frequencies are so widely separated (455 and 8300 kc) that one set of transformers can easily operate in series

Fig. 10. Sonora KWU79 uses one tube for pickup amplification.



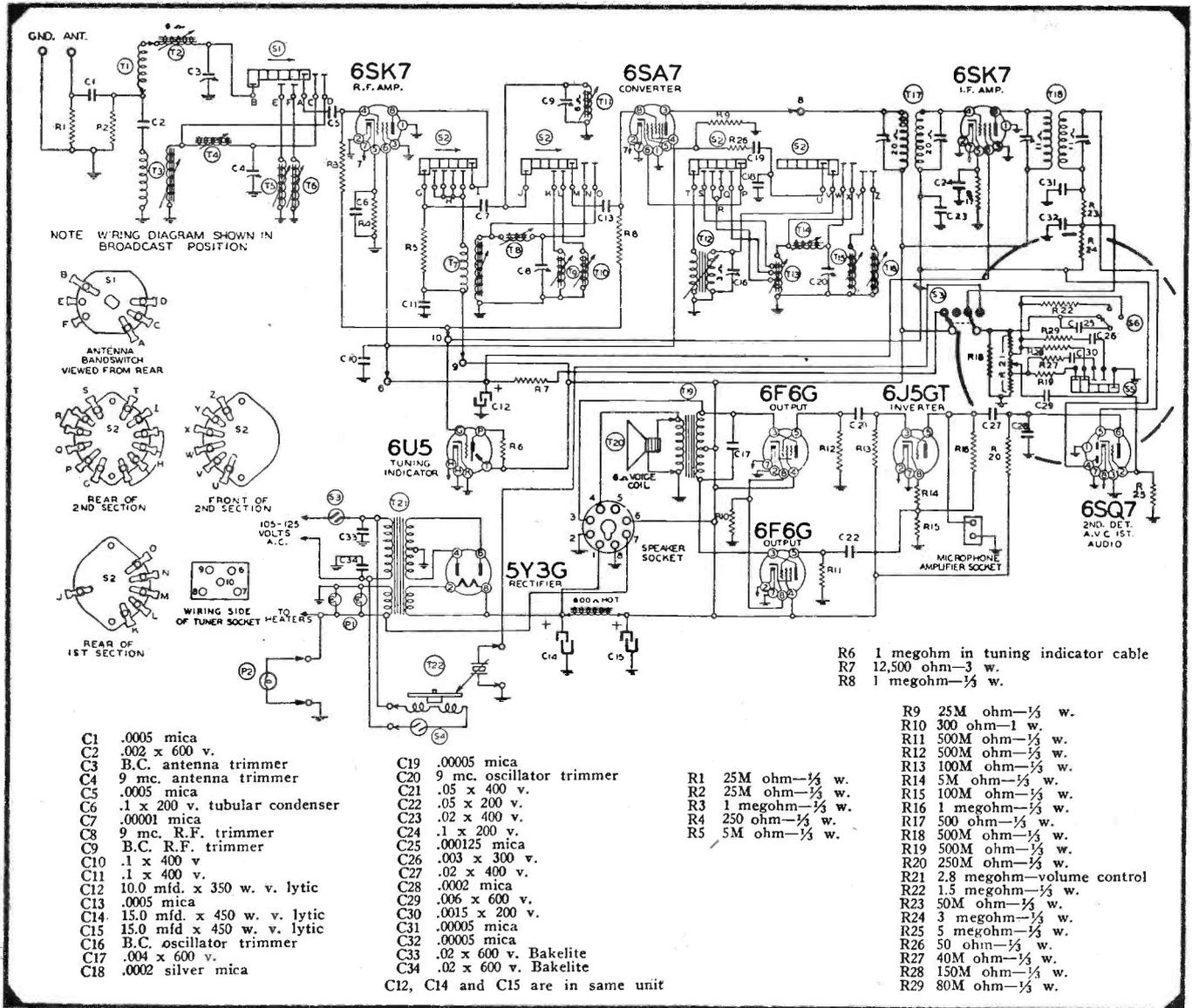
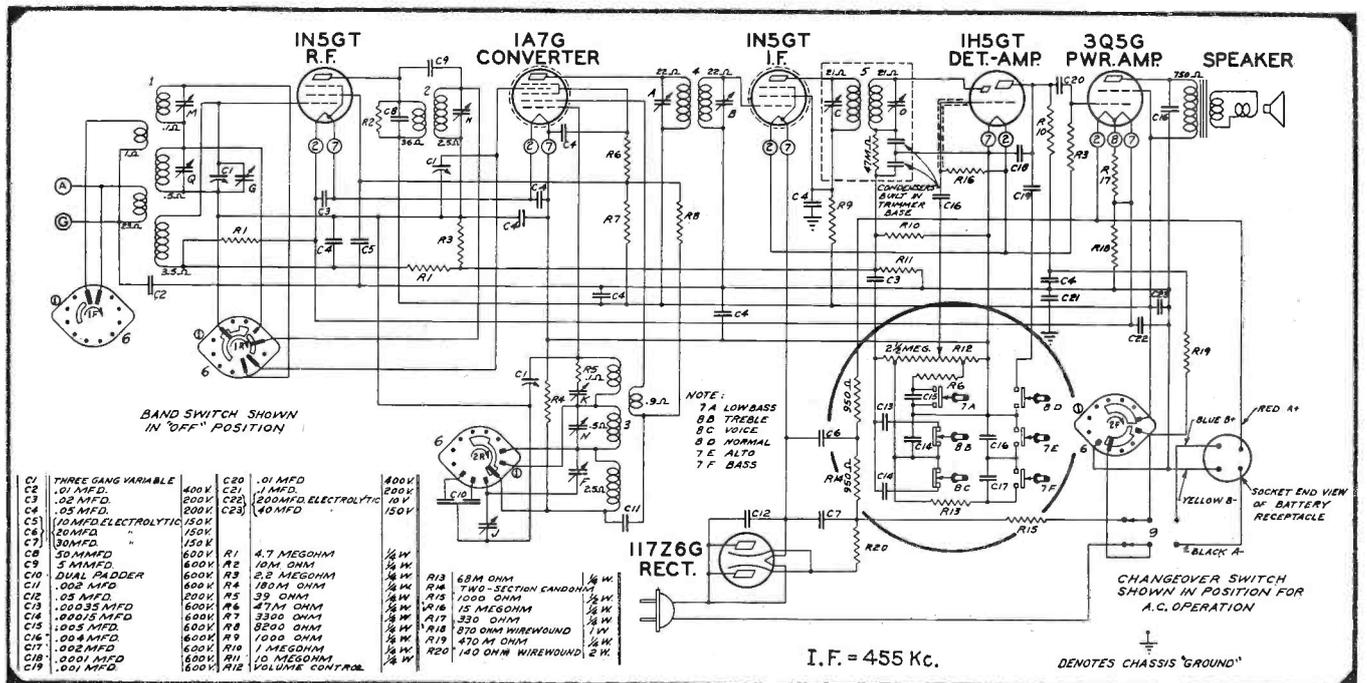


Fig. 4 (above). Airline 14BR912A employs two separate tone controls in a novel arrangement.

Fig. 9 (below). Zenith 6G638 provides this farm set with their 6-button "Radiorgan" tone compensator.



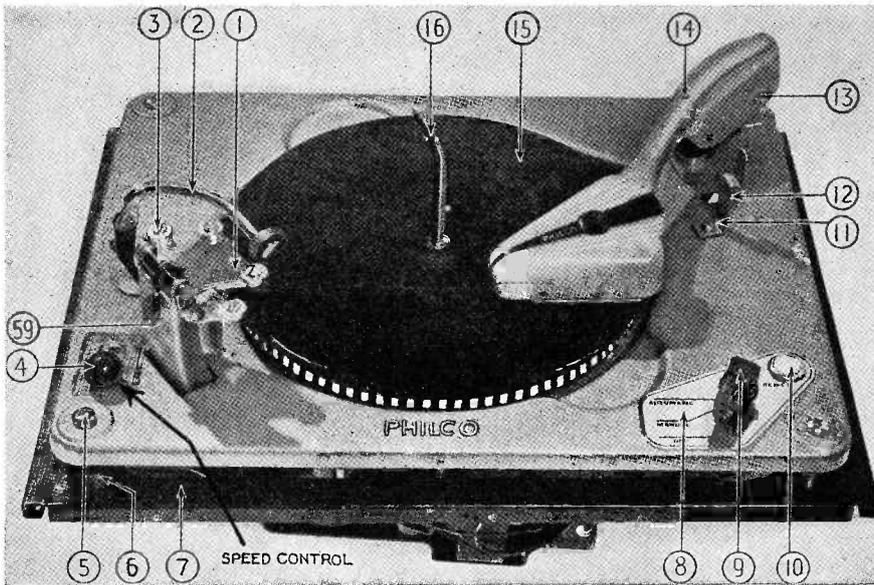


Fig. 11 and 12. Philco's phonograph models have white stripes on the turntable for stroboscopic speed control.

shunting this section with capacitance or combined resistance and capacitance. The bass control connects a variety of similar combinations between the taps and ground. A microphone socket is provided in the grid of the inverter stage for the possible addition of a cutter to convert the set for recording.

Stewart-Warner 207B Series

Stewart-Warner Models 207BA to 207BZ are 7-tubers with 3 bands, two of which are spread. Fig. 5 shows the oscillator circuit, emphasizing the method of spreading. The first detector has a similar arrangement. Two sets of coils are used. The broadcast band is standard. The intermediate band uses the short-wave coil with full variable tuning capacity. The short-wave band uses a much smaller variable capacity by inserting a 215 mmfd series condenser in the tuning circuit. The broadcast coil is shorted for the shortwave positions. Note the tickler system employed—cathode feedback in the broadcast coil and plate feedback in the short-wave coil.

In these sets, the loop antenna is part of the cabinet back; a plug is therefore provided for easy servicing. Provision is made for an external antenna on short waves, no internal antenna being used.

Airline 14WG807

A neat band-spread system is used in Airline Model 14WG807, which has 3 band-spread channels. The switching is particularly interesting. Note the details in Fig. 6. The broadcast coil uses a coupled cathode tickler while the main short-wave coil uses the cathode tap, Hartley circuit. For the two highest frequency bands, coils are shunted

across this tapped coil. The actual spreading is accomplished with the popular series condenser system; the detector uses only a 50-mmfd, while the value of the oscillator spreader is 37 mmfd.

Ward makes it handy to add a phonograph and a recorder when desired.

A separate switch is used for "Off," "Radio" and "Phono." A socket is provided in the first a-f plate for connecting a pre-amplifier which is included with the cutter attachment for recording.

Zenith 4B639 (Chas. 4B04)

In spite of the approaching winter, there is plenty of activity in all types of battery sets. The first is a very unusual 6-volt receiver that draws only 1/2 ampere for both A and B power and has an output of 370 milliwatts. Fig. 7 (see front cover) shows the power supply circuits of the Zenith 4B639 (chassis 4B04), which uses 4-portable type 50-ma filament tubes in series. This allows 450 ma for the vibrator, which is of the self-rectifying type. Due to the low filament drain, resistance capacity filtering is used in the filament circuit as well as for the B supply.

Stewart-Warner 207C Series

Fig. 8 shows a 7-tube battery-line receiver which places unusual emphasis on dry-battery charging, devoting a separate 35Z5 rectifier to this purpose. Separate load circuits permit charging the A and B batteries at the same time and in the proper proportions. To make the job easier and to eliminate switching difficulties, the filaments are operated in series.

The set is equipped with a neon lamp on the dial scale which indicates the

(Continued on page 24)

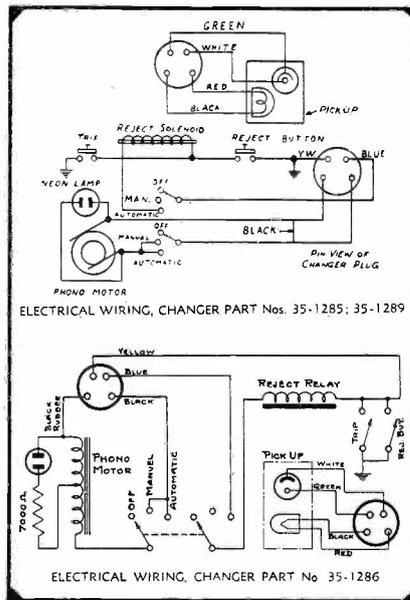
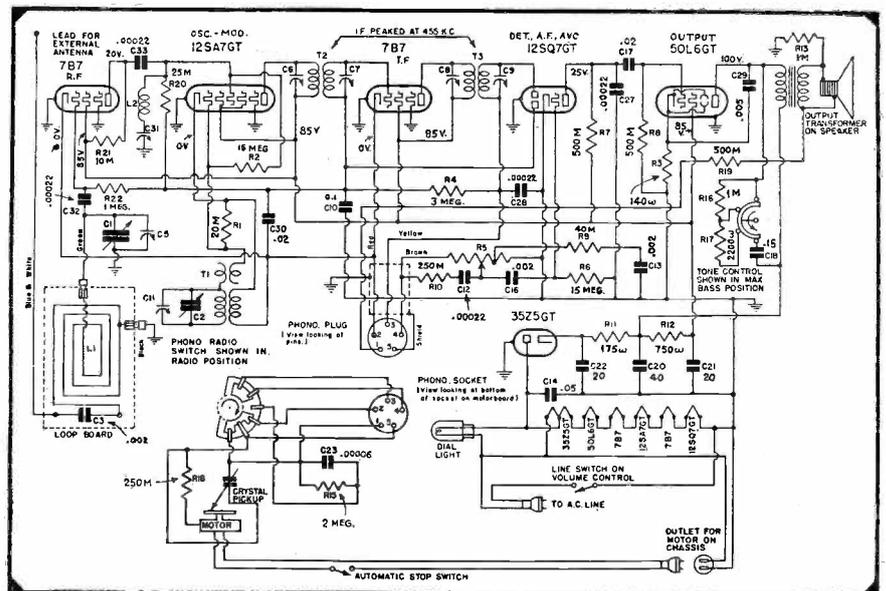


Fig. 13 (below). Emerson's FT383 employs a combination of octal and loktal tubes.



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BIAS CELLS

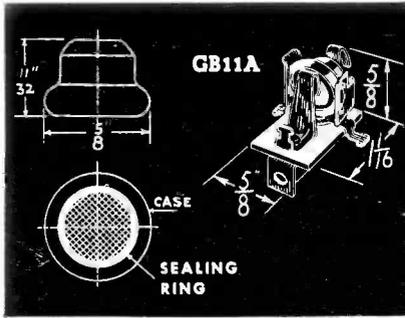


Fig. 1. The bias-cell is essentially a potential generating device of minute size. If no current is drawn from its terminals it will last indefinitely. Its action is chemical.

THE GRID bias cell is a small acorn-shaped, self-contained, voltage-generating device with dimensions as shown in Fig. 1. The metal case itself is the negative electrode and the black disc is the positive electrode. These cells are available in two types: the earlier type with a no-current potential of one volt and the newer with a no-current voltage of $1\frac{1}{4}$. These potentials are constant over a temperature range from minus 40° to plus 120° F. There is no change in cell characteristics even when exposed to a relative humidity of 90% at 120° F. The cell's life is practically indefinite and under years of normal operation it will show no change in characteristics.

The cell is non-reactive at audio frequencies and the d-c resistance ranges between 11,000 and 50,000 ohms on standard production cells.

Application

The grid bias cell was principally designed to furnish bias for high- μ tubes used as the first audio stage in modern high-gain receivers. Fig. 2 represents a typical circuit of this type in which the bias is obtained by a common cathode series resistor. Difficulty with this circuit lies in the necessity of providing a large capacity by-pass (C), usually a low-voltage electrolytic; this condenser is made necessary by the fact that the cathode is above ground. This circuit is susceptible to the usual degenerative effects of self-biased audio circuits.

Fig. 3 represents another bias circuit used by some manufacturers. In this case the cathode is grounded which is an advantage over the system shown in Fig. 2. The bias return is usually brought to a point in the negative power-supply return. Though somewhat more stable and less sensitive to the disadvantages of the system of Fig. 2, this circuit usually requires the filter R-C, involving a resistor and a condenser. Another disadvantage of the circuit in Fig. 3, is the requirement for a B-minus connection below chassis potential. Such a connection often complicates the plate supply filter network.

The circuit using the bias cell is shown in Fig. 4. This circuit furnishes a definite bias on the grid; this bias remaining independent of tube charac-

teristics due to tube variations, and the variations encountered in one tube throughout its life. This circuit avoids degenerative effects and is not so greatly susceptible to overload distortions. The cell replaces the R-C filter of Fig. 3, as well as simplifying the negative power return circuit; and replaces the

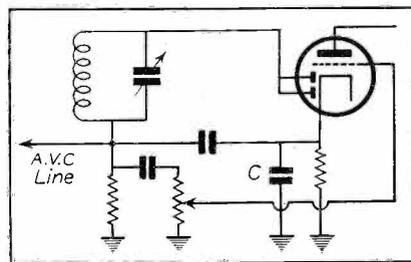


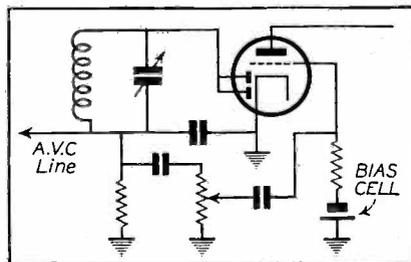
Fig. 2. Some detector-a-f amplifier circuits employ a self-bias resistor in the cathode circuit.

cathode resistor R and cathode by-pass C of Fig. 2, with the cell and grid resistor of Fig. 4.

In general, bias cells find application in the following types of circuits:

- 1) The audio stage of radio sets.
- 2) High-gain stages in voltage am-

Fig. 4. Several manufacturers employ the bias cell as shown for the a-f triode grid.



plifiers (microphone and photo-electric cell preamplifiers, etc.)

3) Minimum bias for automatic-vol-
ume-control circuits in radio receivers.

4) Miscellaneous vacuum tube circuits, where the tubes are operating under Class A conditions and where no appreciable grid current exists.

In these applications, bias cells generally simplify construction, eliminate parts; and usually provide improved operation.

Contact Potential

It has been stated that one of the disadvantages of the use of the high- μ

triode lies in the fact that the so-called "contact potential" at least in the early life of the tube, is close to the operating bias and this "contact potential" is not constant from tube to tube, nor does it remain constant throughout the life of the tube.

The bias cell has an inherent property which enables it to accommodate the bias value to a considerable extent to variations in contact potential, due to the fact that grid current in the grid-to-cathode direction will charge the cell more negatively, and its potential will increase under continued charging. This additional voltage will, after operation has ceased, gradually drop off and the cell will assume its original potential.

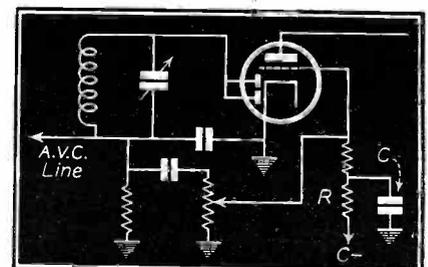
Test Method

Since the bias-cell potential is affected by a load even as high as 10 megohms, it is necessary to use a device which draws no current when measuring cell potentials. A vacuum-tube voltmeter, which has no resistance connected to the grid, but obtains its bias through the source it is measuring and thus indicates d-c voltage, may be used to measure the bias-cell potential. A vacuum-tube indicator, which compares the cell potential with an accurate low-resistance voltmeter is very convenient for use in checking bias cells, and can easily be constructed by the Service Man.

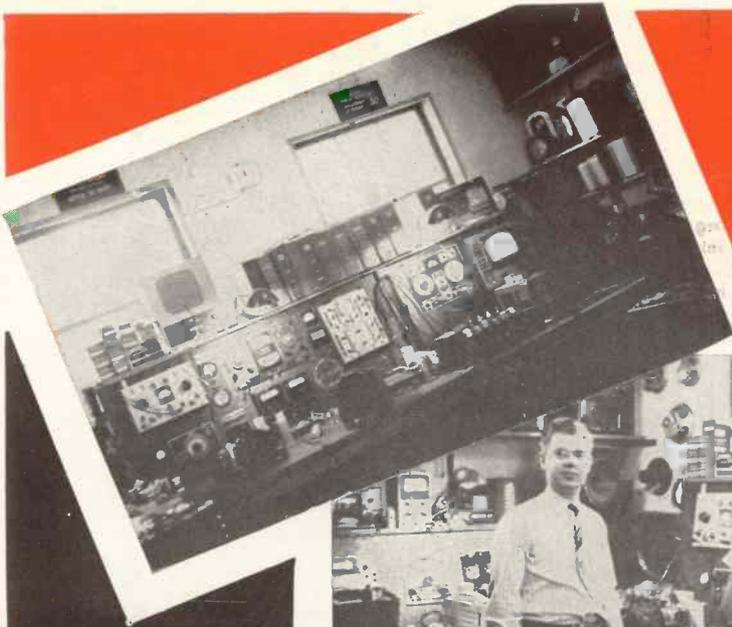
It is important to realize that no ordinary voltmeter, of the type used on the service bench, can be employed in checking the bias cell. This applies even to the 20,000-ohm-per-volt types.

Probably the simplest method of checking the bias-cell voltage is first to measure the plate current of the tube which uses the cell. The cell may then be removed and the mounting shorted. A second check of the plate current after this should show a considerable increase if the bias cell was normal.

Fig. 3. Another method of obtaining bias is by connecting the grid return to a suitable negative position on the voltage divider.



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METALS FOR TUBES

By LEWIS WINNER

EDITOR, COMMUNICATIONS MAGAZINE

PROBABLY no phase of the priority program has caused so much concern among Service Men as those regulations covering metals. Every component has been affected, some more seriously than others because of their complete dependence on metals. In many instances, non-metallic substitutions were made. Some of these substitutions may not have served to provide as effective a series of results as the original metal, but they served nevertheless to provide a practical solution to a stubborn problem.

In those cases where metals were vital, and few or no substitutions were possible, allowances were made by the priority authorities and thus production has been maintained, although perhaps in a modified way in some instances. Among those parts granted this 'go-ahead' privilege were tubes, particularly for replacement purposes, although critical stumbling blocks are already falling in line, here too. Oddly enough, some of these difficulties are only partly due to the scarcity of metals. The real problem appears to be "productive-facilities," not only for replacement tubes, but for new tubes as well.

It appears as if the equipment and operating personnel have been shifted over to production more directly concerned with national defense. The defense needs for tubes are so great that machinery has been taxed. In addition, some of the machinery used for tube production has also been adjusted for the manufacture of other precision parts required in war equipment. Taxing the "productive-facilities," too, are the tremendously increased "civilian" demands. Thus, even if the metals were all available, it would not be possible to produce all the tubes required by the public.

The second stumbling block does lie in the shortage of metals, but in those metals where such a comparatively small amount is used, that it is difficult to realize that scarcity has created such a condition. This is particularly true of copper and nickel, that may be called the real bottle-neck metals. Steel, which is also on full priority is, however, available for tube manufacture, although in not as great quantities as customary. Still, there is sufficient available to permit its use even as a substitute for nickel and copper, where possible. When

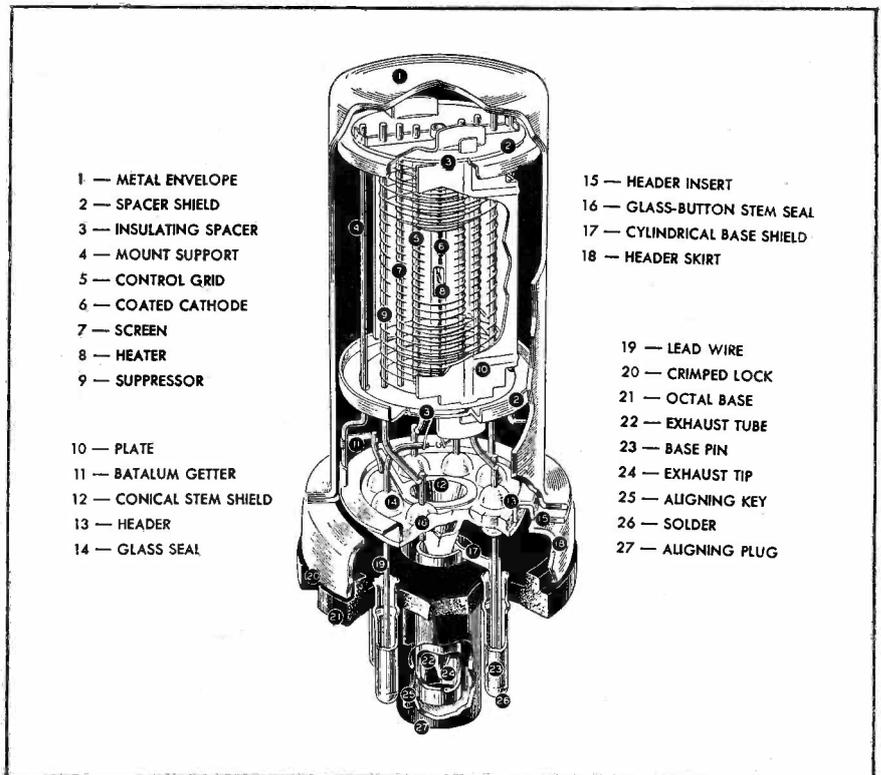


Illustration courtesy RCA

An amazing collection of metals and chemicals is used in the manufacture of tubes, both glass and metal. In spite of this collection, however, the total weight of the tube, including its shell, is only a little over an ounce.

the supply of steel, which is such a basic part of all industries, is completely cut off, then not only tube manufacture, but all manufacture will have to shut down.

In tube manufacture, the quantity of steel used is quite insignificant. For instance, out of an estimated steel production of some 89,000,000 tons, only 3,000 tons were used in tube production for shells and other allied pieces. Incidentally, the weight of a metal envelope is only 12 grams, certainly a trivial amount.

As stated before, the real bottle-neck is the nickel-copper scarcity, but undoubtedly this will be clarified soon, too, for the weight percentages are low. Take for instance the cathode sleeve which is made of nickel alloy ribbon, around 0.002" thick, and usually 0.060" by 0.35" in diameter. This metal generally is first grade electrolytic nickel,

containing approximately 0.2% manganese and 0.25% magnesium, as well as small percentages of silicon, iron and copper. Thus we have also priority metals in this nickel alloy, which it is difficult to replace as, for instance, magnesium, on which electron emission is so dependent.

In analyzing the many individual sections that are used in either glass or metal tubes, an amazing collection of metals and chemicals, other than the few just mentioned, will be found. Many of these materials are basics and any scarcity will affect all types, be they glass or metal. Thus with the scarcity of copper and nickel, all tube structure will be affected and with the scarcity of steel, complete stoppage of industry will prevail. Wherever the cycle begins, it is a dangerous one that will undoubtedly affect all forms of manufacture.

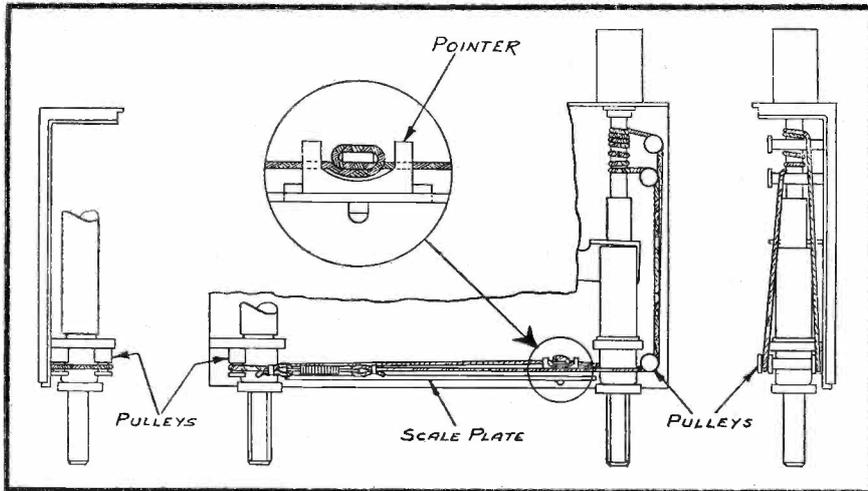
Present indications are that every attempt will be made to maintain tube manufacture, at a pace comparable to at least standard requirements. Research workers will provide whatever substitutions it is humanly possible to attain, to jog this production along.

CASE HISTORIES

PHILCO 1941 AUTO RADIO CONTROL UNIT

Installing the dial cord: To install a dial cord use the following procedure:

1) Remove the cover and place the con-



Routine procedure in replacing the dial drive cord of the Philco 1941 auto-radio control unit will simplify the operation.

control on the bench with the dial towards the front.

2) Remove the dial.

3) Hook the spring on one end of the cord.

4) Hook a paper clip through the eyelet to which the spring is attached, and fasten the clip to the left side of the tone switch wafer.

5) Bring the cord $\frac{1}{2}$ turn counter clockwise around the upper and lower brass pulleys at the left side of the control.

6) Run the cord along the bottom towards the right, then install the pointer as far to the right as possible.

7) Bring the cord $\frac{1}{2}$ turn counter clockwise around the bottom groove of the brass pulley on the right side of the control, then toward the back of the control, and a $\frac{1}{2}$ turn counter clockwise around the rear pulley.

8) Wrap a piece of bond writing paper or regular wrapping paper around the rear of the tuning shaft (in control) to act as a friction clutch.

9) Wrap the cord $6\frac{1}{2}$ turns clockwise around the tuning shaft, then a $\frac{1}{2}$ turn counter clockwise around the center pulley.

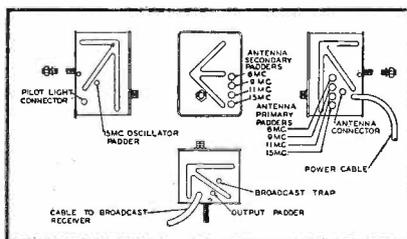
10) Bring the cord towards the front, then $\frac{1}{2}$ turn clockwise around the top groove of the right front brass pulley. Hook the end of the cord to the spring.

11) Replace the dial and check the pointer for proper position.

PHILCO 1941 AUTO RADIO

Ignition interference elimination when using the short-wave tuner: A new antenna filter choke, Part No. 77-0885, has been added to the short-wave tuner

to further reduce stubborn cases of ignition interference. In early production the tuners did not have this choke. However, when an installation is made, and motor interference persists, it may be necessary to use this new choke. On tuners which did not originally have this choke and it is necessary to add



Realignment of the Philco short-wave tuner is necessary when a new antenna filter choke is added.

this new part, the antenna primary and secondary padders must be readjusted. The padding procedure is as follows:

1) Connect a 10-mmfd condenser in series between the signal generator lead and the aerial lead, Part No. 95-0185. Plug the aerial lead into the tuner and set the generator to 1500 k.c. Turn the short-wave tuner switch to the broadcast position (extreme counter-clockwise). Tune in the signal and adjust the antenna padder in the radio to maximum.

2) Turn the tuner switch to the No. 2 position (6 m c band). Set the signal generator at 6.1 m c and tune in the signal with the tuning control knob. Pad the 6m c primary and secondary padders

(see illustration) for maximum response.

3) Pad the output padder (see illustration) for maximum signal. Do not readjust this padder again.

4) Turn the short wave switch to the No. 3 position (9 megacycles band) and set the signal generator to 9.6 megacycles. Tune in the signal with the tuning control knob and pad the (9 m c) antenna primary and secondary padders (see illustration) for maximum signal.

5. Turn the short wave switch to the No. 4 position (11 megacycle band) and set the signal generator to 11.8 megacycles. Tune in the signal with the tuning control knob and pad the (11 m c) antenna primary and secondary padders (see illustration) for maximum signal.

6) Turn the short-wave switch to the No. 5 position (15 megacycle band) and set the signal generator to 15.225 megacycles. Tune in the signal with the tuning control knob and pad the (15 m c) antenna primary and secondary padders (see illustration) for maximum signal.

Note: When a replacement choke is used, it is not necessary to readjust the padders.

It is rather difficult to perform the above operations with the tuner in the car. Whenever possible the tuner should be removed and repadded on the bench. It does not matter what model radio is used with the tuner to pad it, provided the radio has a power socket.

After the tuner is reinstalled in the car, the antenna padders should not be touched. The usual variation of antenna capacities in car installations have no material effect on the sensitivity of the tuner. Simply follow the usual installation instructions supplied with the tuner.

RCA Q16

Flutter with electro dynamic speaker:

To reduce flutter with an electro dynamic speaker the audio coupling capacitor, C25, should be changed from 0.0025 to 0.0015 mfd. Later production models included this change.

RCA 28T

Production change: In some models, C13, connected from the plate of the r-f tube, is connected to the switch side of C8 instead of the grid side of C8.

RCA V100

Production change: The capacitor C17 across the pickup is changed from 0.015 to 0.01 mfd.

STUDEBAKER-PHILCO 1941 AUTO RADIO

Ignition interference elimination when using the short wave tuner: See Philco 1941 Auto Radio.

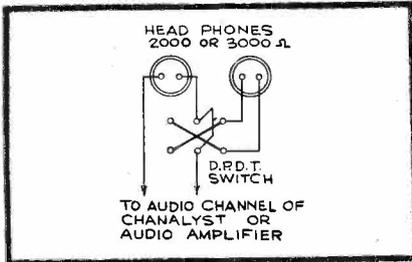
SPEAKER PHASING

ON RECEIVERS and amplifiers with two speakers it is essential that the speaker cones move in and out together. If one cone moves in while the other moves out, the tone will be impaired.

It is necessary to check phasing whenever a new speaker cone, field coil, or output transformer is installed, or whenever the speaker connections are altered in any way.

There are two general types of dual-speaker sets:

(1) *Two speakers with voice-coils connected in parallel:* This type is the easiest to phase. Connect a dry cell (1½ volts) across the secondary of the output transformer and observe, by sight or feel, whether



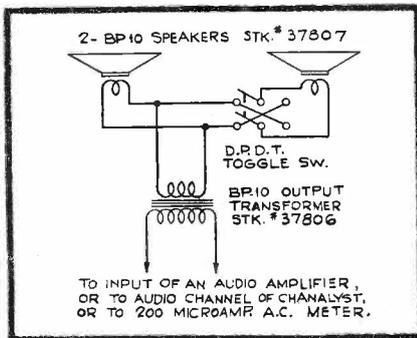
As described in the accompanying text a pair of phones make an excellent "phase checker" for proper connection of multiple speakers.

the cones both move in the same direction, as the battery connection is made. If one cone moves in while the other moves out, reverse the external connections to one of the voice coils. If one speaker is a p-m, and the other is an electro-dynamic, it is preferable to reverse the voice-coil connections to the p-m speaker to avoid upsetting the hum-bucking action of the electro-dynamic speaker.

If both speakers are electro-dynamics, but of different size, reverse the voice coil connections to the smaller one as this will generally have the least effect on hum.

If one or both of the speakers are electro-dynamic it is necessary to have the set in operation (volume control at minimum) to provide field excitation for the speaker(s) while making the test.

(2) *Two speakers with separate output transformers:* In this type of dual-speaker set, it is not possible to use the simple bat-



A pair of p-m dynamics will serve instead of phones in the construction of the simple "phase checker" for multiple speaker connection.

tery check for phasing because the voice coils are not connected in parallel.

The recommended method of phasing in this case is as follows:

Connect a pair of radio headphones ("2,000 or 3,000 ohm" type) and a double-

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pole, double throw toggle switch as shown in the accompanying diagram. Connect the two leads to an audio amplifier that has some form of output meter indicator. The audio channel in the chanalyst is ideal for this purpose.

Hold both phones close in front of one speaker. Feed a 400-cycle modulated signal into the receiver and advance the receiver volume control to obtain a reading on the meter. Throw the toggle switch to each position and note the position that gives the greatest output on the meter. Mark this position "in phase." Mark the other position of the toggle switch "out of phase."

Place one headphone unit close in front of each of the two speakers, with the 400-cycle signal still fed into the receiver, and with volume control advanced. Move the

toggle switch to each position and leave it at the position that gives the greatest output on the meter. Note the switch marking for this position. If it says "in phase" the speakers are correctly phased. If it says "out of phase" the speakers are out of phase and the external connections to the voice coil of one speaker should be reversed. The choice of which speaker to reverse is the same as outlined above under (1).

Instead of headphones, it is possible to use two small p-m speakers, a dpdt toggle switch and output transformer, connected as shown in the accompanying diagram.

A "phase checker" of this type will prove helpful in any radio shop.

Quality parts are your insurance of a job well done. Use them, and only them, in your everyday work.

CIRCUITS

(Continued from page 16)



For that
"PRO"
touch...

- When it comes to building or servicing sound-system amplifiers, heavy-duty power supplies, and especially those electronic gadgets in local plants, be sure to use these Aerovox Hyvol Capacitors to give your work the decidedly professional touch.

The popular Series -09 here shown mounts at any height above or below chassis. Adjustable mounting band. Larger units with mounting strap clamps placed on sides and gripping bead top or bottom. Smaller units with mounting lugs. Voltages up to 5000 D.C.W. • Or you can have the -05 series round can with high-tension pillar terminals. Adjustable mounting ring. Up to 3000 v. D.C.W. Series -12 up to 7500 v. • Series -10 is ideal for power pack filters and tight spots. Screw stud and lock nut for one-hole inverted mounting. Similar to metal-can electrolytic. Up to 1500 v. D.C.W.

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condition of the batteries when the selector switch is in the battery position. The neon lamp is included in an oscillating (R-C) circuit which has been designed to oscillate at approximately three pulses per second when the batteries are fully charged. As the battery voltage decreases with use the number of pulses per second decrease. When the battery voltage drops as low as 72 volts the pulses decrease to approximately one per second. The receiver should not be operated from battery power after this point is reached, until the batteries have been recharged. The manufacturer recommends that the batteries be charged for at least twice the time they were used, as soon as possible after they have been run down.

Zenith 6G638, 6G660 (Chas. 6B09)

Fig. 9 shows Zenith's new battery pack universal 6-tube, 3-band job. Made up in Models 6G638 and 6G660, these sets have 3-gang tuning and an elaborate 6-position tone control. The tuned r-f stage is not used on the short-wave bands.

Let's analyze the tone control. It seems too many Service Men who are otherwise complete have a tendency to neglect tone controls. Too often they replace volume controls having one or more tone-control or bass-compensation taps with simple untapped controls. The change is not always obvious, so they often get away with it. In an emergency, certain changes are reasonable, but the subject should be thoroughly understood. This Zenith control covers a lot of territory.

Referring to the figure, the 2.5-meg volume control is tapped at two points—let's call the tap near the "hot" end the high tap and the tap near the filament end the low tap. In "Normal" position, 500 mmfd by-passes the high tap to the "hot" end and 150 mmfd by-passes the high tap to filament; the high tap is also grounded through 68,000 ohms and a 0.002-mfd and .004-mfd all in series. Continuing the "Normal" arrangement, the low tap is grounded through 47,000 ohms and 0.005-mfd. A 0.001-mfd by-passes the first a-f plate to ground.

When the "hot" end-high tap capacity is reduced, highs are favored by cutting lows. This means of tone control is used for the "Voice" and "Treble" positions, the former increasing highs slightly by removing 150 mmfd, while the latter increases highs considerably by removing 350 mmfd. "Alto" is produced by shorting the 0.004-mfd, allow-

ing a little greater capacity from the high tap to ground; "Bass" by shorting the 0.002-mfd, permitting more by-passing to ground. "Low bass" is produced by shorting the 0.005-mfd in the low-tap circuit.

Sonora Phonograph Amplifier

Sonora has two models of electric phonographs which use only a single stage amplifier. One of the new type high level pickups is used, giving ample voltage for maximum power output with the greater majority of records. A single combination rectifier-pentode tube might be used by any home designer, but, because of the high cost of this type, not much is to be gained. Fig. 10 shows Sonora's circuit. A-c only, of course.

Philco Record Changer

Philco has a new line of automatic record changers (Part No. 35-1285, 1286 and 1289) which are adjustable for exact speed. A neon lamp is provided for stroboscopic speed adjustment, the turntable having a suitable pattern on its rim. (See Fig. 11.) This is a very useful feature for musicians of all categories. The speed may not only be standardized, but the phonograph may be tuned to any other instrument. (See Fig. 12.)

Stromberg-Carlson 920

In switching from radio to phono all sorts of methods have been used for preventing radio programs from coming through. We have featured many of them. Here's another. Stromberg-Carlson Model 920 opens the screens of the r-f and converter stages. Not so long ago simply grounding the i-f output was thought more than sufficient!

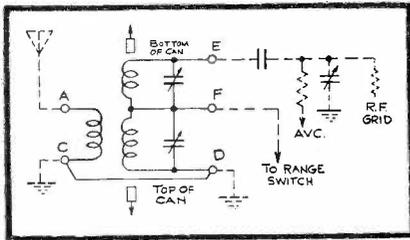
Emerson FT383

Fig. 13 shows Emerson's Model FT383, a 6-tube phono job. A plug is provided for disconnecting the phonograph which handles both the pickup and degenerative circuits. A motor plug is also provided, making for easy servicing. The feedback and switching systems are interesting. Note that the feedback occurs from output transformer to the high side of the crystal pickup through two resistors. In "Radio" position, the pickup is shorted. In "Phono" position, the cathodes of the r-f, converter and i-f tubes are opened.

A good, well equipped service bench is vital to successful servicing. Read SERVICE each month for the latest developments.

EXTERNAL ANTENNA COUPLER

ESPECIALLY designed antenna coupler is available for use in connecting an external antenna to RCA loop receivers. This coupler will prove useful for installations where it is desirable to elim-



inate the loop in order to improve the signal-noise ratio and increase sensitivity.

The antenna coupler may also be used as a fixed-tuned substitute for any standard loop antenna to aid in aligning loop receivers in the shop.

The coupler covers A and B bands, approximately 550 to 1,750 kc, and 1,750 to 5,000 kc. It has low-frequency and high-frequency adjustments on each band to insure adaptability and good performance on practically any loop receiver.

The circuit is shown in the accompanying diagram.

KNOW YOUR METER

(Continued from page 11)

rough roads, may subject the instrument to greater strain than months of ordinary bench service.

Meter Repairs

Normally it is by all means best to depend on the manufacturer of the meter, or upon a reputable specialist, for all meter repairs. They are equipped with the precision standards for checking, the special tools, replacement parts and trained mechanics necessary for the job and stand ready to guarantee results.

In emergencies where the repair job does not require replacing major parts and where it would be a hardship to get along without the instrument during the time required to send the instrument away for repairs, the Service Man who is capable of careful and precise work may find it practical to undertake the job himself. This course of action is more frequently justifiable now that the defense program has made long delays likely in having instruments serviced outside.

It will almost invariably be necessary to open the instrument in order to determine the cause of trouble. Once the cause has been determined the owner can decide whether the repair is within the range of his ability to handle. As an aid in trouble shooting the tabulation of Fig. 3 will be helpful. Simple equip-



In Defense of Your Business

So that the nation may continue to be informed—35,000,000 receivers in American homes and automobiles must be kept in first-class condition.

This is a responsibility of the trade—your responsibility and your contribution to the defense of the nation.

The replacement requirements which in the months to come will be more and more important to your business call for careful selection of parts in order to conserve resources and materials so important to defense and civilian needs. The requirements of Utah customers will be met as promptly and as completely as possible.

Many Utah products are being used in National Defense—for Army, Navy, Air Corps and important civilian communications. Utah engineers are continually at work, meeting the demands of the National Defense Program and its necessary restrictions on some materials. All the experience, knowledge and skill of the Utah production staff are required to comply with the ever-increasing demand for Utah Speakers, Transformers, Vibrators and Utah-Carter Parts.

Utah Radio Products Company, 816 Orleans Street, Chicago, Illinois. Canadian Office: 560 King Street, West Toronto. In Argentine: Ucoa Radio Products Co., SRL Buenos Aires. Cable Address: Utaradio, Chicago.



SPEAKERS

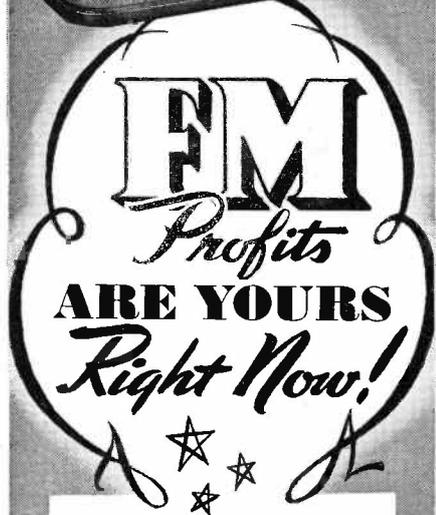
VIBRATORS • TRANSFORMERS • UTAH-CARTER PARTS

ment which will be found handy in making one's own repairs includes:

- 1) One or more jeweler's size screwdrivers.
- 2) Magnifying glass held in eye or otherwise supported to leave both hands free.
- 3) Medium or small darning needle.
- 4) Small tweezers.
- 5) Thin cardboard such as business or calling card. Narrow strip cut from this will serve to clear gap and other confined spaces of fuzz, etc.

On the whole it is probable that well over 50% of the repairs required by

meters are within the ability of the average service man to make. The balance which do require the attention of an expert are almost without exception ones which are the result of carelessness in handling or using the equipment, and could be avoided by following the suggestions stressed earlier in this article. In normal times due care of meter equipment is distinctly worth while. Under present emergency defense conditions, which add to the expense of outside repairs the inconvenience of possibly long delays, such care is doubly important.



FM is the most talked about subject in radio—you can cash in right now by selling the Meissner FM converter. Take one on your next service call, let your customer use it for a day—this converter sells itself. These extra profits are yours if you act right now!

The Meissner FM converter has everything, eye appeal, stability and performance. It is compact, easy to install and comes to you complete and ready to operate, with tubes, detailed instructions for installation, operation and servicing, including circuit diagram and voltage chart.

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ASSOCIATIONS

Radio and Electrical Appliance Service Association, Inc.

Events have been moving fast since Sept. 29th, when John F. Rider first presented a plan for a strong local radio Service Men's association. Meetings of representative groups of radio jobbers, radio and electrical appliance dealers as well as radio Service Men were held, and from these groups approximately \$1000 was contributed to start an organization.

At a meeting of delegates held at the Park Central Hotel on Thur., Oct. 23rd, an organizing Committee was selected by the group. This Committee met at the Park Central Hotel on Tuesday, Oct. 28, and decided on a name, a general platform, temporary officers, and board of directors for the new association. The name selected is: *Radio and Electrical Appliance Service Association, Inc.*

The proposed platform of the association is as follows:

The association shall

- 1) financially guarantee to the public the work done by its members.
- 2) establish standard trade practices that will be beneficial and equitable to its members and the public.
- 3) establish a program acquainting the public with the problems of maintenance and to establish cordial relations between the public and association members.
- 4) provide legal advice for the benefit of the association and its members.
- 5) act as a clearing house for all complaints, employing a paid inspector to determine whether the work was properly done.
- 6) provide an insurance plan for bonding its members and insuring the services rendered, in so far as possible.
- 7) prepare technical standards for its membership, and shop owners and employees actually engaged in service work shall be required to pass a qualifying test.
- 8) maintain an educational program providing, if necessary, a school for the benefit of the personnel of association members. Such a school would have as its function the teaching of proper trade technique, trade standards and technical material related to new developments in the trade.
- 9) provide an advisory service to its members in matters relating to advertising, business practices, etc.
- 10) prepare a code of ethics which shall be maintained by its membership.

The officers of the association are:

President: John F. Rider, publisher; vice president: Edward Lowe, radio and electrical appliance dealer; treasurer:

Charles Ollstein, radio jobber; secretary: Robert G. Herzog, editor, Service Magazine; alternate secretary: Max Spitalny, secretary, N. Y. Chapter RSA.

Radio Technicians' Association Long Beach, Cal.

At a meeting held October 4, at 2116 Pacific Ave., Long Beach, informal talks were presented by Norman B. Neely, Tom Bissett and Frank Koessler, all of Norman B. Neely Enterprises, manufacturers' agents representing the Radio Engineering Laboratories and other manufacturers, on the West Coast. The subject of the meeting was "F-M, General Considerations and Technical Circuit Descriptions." Several pieces of equipment were demonstrated, notably the REL Model 517 monitor receiver and the REL Model 517-CS speaker.

RADIO SERVICEMEN OF AMERICA

Chicago Chapter

Our meeting and service clinic of October 29 was planned to further our aim, "Learn more to earn more." The meeting was held at the shop of President Lowry Easley. Two of our members, who are using the Chanalyst in their daily work, showed us some of the tricks they have learned, using receivers with actual (not manufactured) troubles. A number of members brought faulty sets for the clinical diagnosis.

The improved Chapter service-form was presented for final adoption. The revisions, based on several years of use in the field, will make this form even more valuable in the selling and billing of "corrective services."

Al Kilian, Secretary

Danville Chapter

Earl Drollinger had charge of the program of the last meeting of the Danville Chapter, using "Servicing Radios With a Vacuum Tube Voltmeter" as his subject. He gave an interesting demonstration. While orating on the wonders of the vtvm, Earl thought "Oscar" was struck by lightning. . . . It was Evard Welch, official Chapter photographer, "Flashing" a picture.

From "Servicemen's Dirt," by Cal Stapp

Harry Ward, president of Radio Technicians' Association, is shown to left of REL loudspeaker. Norman B. Neely is on right with Frank Koessler and Tom Bissett beside him.



Book Reviews...

AERONAUTIC RADIO, by Myron F. Eddy, published by The Ronald Press Co., 15 E. 26th St., New York City, 502 pages, price \$4.50.

Radio has become part and parcel of aeronautics. Many pilots and members of the ground crews are required to hold radio operators' licenses. A general knowledge of aeronautical radio, its functions and applications, is necessary to these men, as well as to the designers of aeronautical radio equipment. Hence, the first eleven chapters cover the data necessary to prepare the average person to pass the theoretical part of the examination for an aviation operator's license. The next five chapters explain the application of radio to aeronautics.

This book covers its subject in a clear and elementary style. It is easy to read and the contents are presented in a logical sequence. The author begins with fundamental concepts before delving deeply into his subject. There are adequate illustrations to clearly impress the subject matter on the reader's mind. Much of the contents applies to radio in other applications as well.

This book is recommended to all those in the engineering profession who are interested in the subject. R. R.

POWER FACTOR PROBLEMS IN ELECTRICITY SUPPLY, by G. W. Stubbings, published by The Chemical Publishing Co., 234 King St., Brooklyn, N. Y., 174 pages, price \$3.50.

This book is intended to give a simple account of power factor, its meaning and the causes of its variation, its effect on cost of and the changes for electrical supply, and the ways in which it can be artificially changed. Power and lagging magnetism volt-amperes are considered to be objective quantities in an alternating-current supply, for both of which the consumer is required to pay under what are called power-factor tariffs; and the process of power factor correction is explained as one whereby the consumer generates part or all of his magnetizing volt-ampere supply instead of purchasing it from the supplier. The quantitative aspect of power factor is illustrated by examples. The important question of the economic units of power factor correction is fully discussed. Electrical measurements connected with power factor is discussed in elementary style.

The book is intended for practical engineers and students. However, barring the appendix which does require a familiarity with higher mathematics, anyone with a working knowledge of elementary algebra can readily read and understand the text. This book is recommended. R. R.

FLUORESCENT LIGHT AND ITS APPLICATIONS, by H. C. Dake and Jack DeMent, published by Chemical Publishing Co., 234 King St., Brooklyn, N. Y., 256 pages, clothing binding, price \$3.00.

This treatise is intended to cover the needs of practically all types of readers ex-

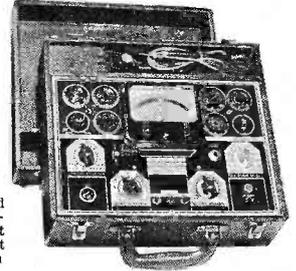
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NEVER before in radio servicing has there been such a profit opportunity! Already Defense demands have cut new set production to 25% of last year's output . . . may take even more. No longer will your customers be able to replace present sets, rather than pay for servicing costs. And never has the radio meant so much . . . been so vital to American life!

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JUST AS OUTSTANDING in features, performance and value is every instrument in the complete RCP dependable line. Catalog No. 125—just off the press—describes each model fully. Ask for a free copy. Prices subject to change without notice.

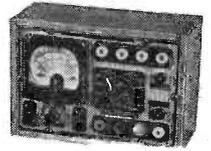
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RADIO CITY

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cept advanced students of fluorescence. It contains enough of the elementary treatment of the subject to satisfy the beginner. Yet there is sufficient technical information to make the book interesting to engineers. Of especial interest are Chapters 1 and 2. Chapter 1 delineates the historical aspects of luminescence in considerable detail. Chapter 2 discusses the fundamentals of radiation, color and perception. Subsequent chapters cover the theory of luminescence, methods of examination of luminescent materials, sources of ultra-violet radiation, fluorescent minerals, radioactive minerals, and luminescence of gems and uses of ultra-violet light. An excellent bibliography of several hundred references is included covering many phases of the art. The material in this book is well pre-

pared, logically arranged and the subject matter discussed in a most interesting fashion. It is highly recommended.

R. R.

(Continued on next page)

Standard, nationally known parts and accessories are guaranteed for quality and performance. It pays to use them—and only them—in your work.

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| 6. Window cards | 20. Characteristics Sheets |
| 7. Personalized postal cards | 21. Interchangeable tube charts |
| 8. Imprinted match books | 22. Tube complement books |
| 9. Imprinted tube stickers | 23. Floor model cabinet |
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| 13. Store stationery | 27. 3-in-1 business forms |
| 14. Billheads | 28. Job record cards (with customer receipt) |

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BOOK REVIEWS

(Continued from preceding page)

RADIO TROUBLESHOOTER'S HANDBOOK, Second Edition, by Alfred A. Ghirardi, published by Radio & Technical Publishing Co., 1941, 45 Astor Pl., New York City, 710 pages, 8½ by 11 in., hard covers, price \$3.50.

The Radio Troubleshooter's Handbook is an attempt to provide the radio Service Man with a reference volume that includes all the mass of practical information required by him in his everyday work. The second edition is a revision of the first and presents an increase of over 40% in content.

The book contains 386 pages of case histories as its principal feature. These should prove very useful to the maintenance of the 5,000 models which they cover. In addition there are 70 pages on i-f amplifier troubles, servicing and transformer replacement; a listing of the i-f peaks for over 20,000 individual superheterodyne models; an 18-page "Reminder Chart" for general troubleshooting and 50 pages of data applying to auto-radio installation and servicing; 8 pages of recommended battery replacements for 1250 portable receivers, together with dimensional data on batteries of 12 leading manufacturers; and 7 pages of plug-in resistors and ballasts data. The tube data presented includes not only data on individual tubes and their characteristics, but complete descriptions of the various tube types, numbering systems, preferred types, etc. RMA standards for color coding of resistors, condensers, transformer leads, speaker leads, battery cables, line cords and phono-motor leads are discussed and illustrated in detail. All of the material outlined in the foregoing occupies 620 pages. The next 50 pages includes formulas, charts and tables covering just about everything from Ohm's Law to tap-drill sizes.

Ghirardi finally winds up with classified directories of receiver, accessory parts, amplifier and test equipment manufacturers and directories of radio schools, publishers and publications.

This reviewer believes that *Radio Troubleshooter's Handbook* is definitely a "best buy". Its great store of much needed information, its many charts and its valuable buyer's guide make this volume a must for every man who earns his livelihood from the servicing of radio receivers.

R. G. H.

ADVANCED ELECTRICAL MEASUREMENTS, Second Edition, by Walter C. Michels, Ph.D., published by D. Van Nostrand Co., Inc., 1941, 250 Fourth Ave., New York City, 341 pages, Price \$3.50.

In recent years so many new and improved methods of making electrical measurements have been evolved that there has arisen a definite need for just such a book as Dr. Michels has written. Here we find, in addition to the more useful older types of electrical measurement methods, descriptions of the theory and application of such comparatively recent developments as the "Q" meter, the ultra-sensitive electronic voltmeter for d-c measurements, the radio-frequency bridge, as well as descriptions of the newer electronic methods employed in electro-chemical measurements.

The book opens with a discussion of the proper methods of presenting data de-

rived from electrical measurements and the factors which influence the accuracy of the results obtained. This is followed by three chapters devoted to methods of measuring fundamental quantities, such as resistance, current, and potential difference. The fifth chapter deals with capacitance, inductance, and mutual inductance measurements, magnetic circuits, magnetization and hysteresis, and the measurement of flux density. Three chapters are devoted to alternating current instruments, a-c bridges of various types and the application of the cathode-ray oscillograph. The concluding chapters cover electrical vacuum measurements, electrical thermometry, radiation and electro-chemical measurements. Supplementing the discussions of the various measurements are descriptions of sixty experiments to be performed by students, detailing practical applications of the subject matter.

While the book is directed particularly to the college student, it will be found useful for reference purposes in any advanced electrical laboratory. Dr. Michels writes clearly and concisely, and, as a result, he has been able to cover a tremendous amount of ground in comparatively few pages. Naturally, many discussions are necessarily limited, but a reference bibliography at the end of each chapter will be found of value to those who wish to delve more deeply into the subject.

J. H. P.

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Here is an AC-DC Volt-Ohm-Milliammeter with all the ranges you want . . . easily readable on the large 7" instrument with extra-long 6" scale, in a new up-to-the-minute three-tone case. DC Volts 0-10-50-250-500-1000 at 5000 Ohms per volt DC; 1000 ohms per volt AC. AC Volts 0-10-50-250-1000 at 400 ohms per volt; DC Ma. 0-1-10-100; Resistance ranges: 0-1500 Low Ohms; 0-150,000 Ohms and 0-7.5 and 0-15 Megohms. Maroon case with red and silver panel, attached handle.

Dealer Net Price, \$19.65

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READRITE METER WORKS, Bluffton, Ohio

News . . .

PAUL GALVIN PRESIDENT RMA

The Board of Directors of the Radio Manufacturers Association, meeting at the Roosevelt Hotel, New York on October 15, 1941 has elected Paul V. Galvin president of their association, to succeed the position vacated by James S. Knowlson who recently resigned to become Deputy Director of OPM Priorities Division. Mr. Galvin, President of Motorola Radio, was formerly a vice president of the RMA, and is present chairman of the association's set division, and also chairman of the association's priorities committee. Mr. Galvin will continue to direct the affairs of his company, the Galvin Manufacturing Corp.

RCA AD SERIES IN COLLIER'S

RCA is "going to bat" for the Service Man again in the second of a series of monthly advertisements currently running in Collier's Magazine. "Can You Measure a Millionth of a Volt?" is being asked of the nearly three million readers of the magazine in a full-page, two color spread in the Nov. 15 issue. The ad develops the theme that a radio performs better and lasts longer when serviced regularly.

Personnel . . .

• • • • R. C. Reinhardt, sales manager of the Atlas Sound Corp., Brooklyn, N.Y., announces the appointment of two sales representatives for Atlas Sound products. The state of Indiana will be covered by Bruce L. MacPherson, with headquarters at 1919 Wells St., in Fort Wayne. L. D. Lowery will sell Atlas Sound in Philadelphia; Eastern Pennsylvania; Southern New Jersey; Maryland; Washington, D. C.; Delaware; and Virginia. Mr. Lowery's office is located at 401 N. Broad St., Philadelphia, Pa.

• • • • Eddie Trefz of the Clarostat engineering staff is a busy man these days with National Defense orders and priority paper work and rigid inspections. One of his many jobs is to contact the aviation accounts now supplied with Clarostat controls and resistors. His membership in aviation clubs and his keen interest in flying generally are coming in handy at Clarostat.

• • • • Previously working out of Marion, Ind., as special factory representative in that territory, Jimmy Youngblood has recently been transferred to the Brooklyn headquarters and is now sales engineer for Clarostat Mfg. Co., at 285-7 North St. He has been assigned certain manufacturing accounts and is handling much of the National Defense matters in the East.

• • • • Appointment of I. J. Kaar as managing engineer of the receiver division of the General Electric radio and television department, Bridgeport, Conn., has been announced by W. Stewart Clark, manager of the G-E Bridgeport works. Since November, 1934, Mr. Kaar had been designing engineer of the division. In his new position, Mr.

To Simplify Resistor Replacements . . .

***Only \$6.00 list for two each of these 5 universal sizes.**

Use Adjustable 10-Watt Resistors for the Hard-to-Stock Sizes!

Sure you try to stock frequently used resistor values in half, one and two watt sizes, but it's difficult to have them all on hand at all times, and it's tough to hold up a job while you wait for the one you need.

Stock a couple each of the IRC type ABA adjustable ten watt resistors, 500 - 1000 - 2500 - 5000 - 10,000 ohms,* each of them adjustable by moving the slider for any resistance value up to the maximum.

These five units will handle any wattage requirements up to 10 watts and any resistance value from 50 ohms to 10,000 ohms. Use the low range units for high wattage-low resistance requirements because in all cases the wattage rating is based upon the full length of the resistor.

IRC Type ABA 10-watt Adjustable Resistors are made in all popular ranges from one ohm to ten thousand ohms and list at 60c each.



CLIMATE-PROOFED

IRC Power Wire Wound Resistors are made in a complete range from 5 to 200 watts—all standard types having the famous IRC "Climate-Proofed" Cement Coating to guard against the most common cause of power resistor failure.



POWER WIRE WOUND

RESISTORS

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia, Pa.

Kaar will be responsible for both engineering and manufacturing in the receiver division and will report to Dr. W. R. G. Baker, manager of the radio and television department.

• • • • Promotion within the radio tube division of the Hygrade Sylvania Corp. of R. P. Almy to the post of assistant renewal tube sales manager and A. R. Oliver to field sales supervisor was recently announced by C. W. Shaw, general manager of radio tube sales. Mr. Almy and Mr. Oliver are carrying on the work formerly handled by P. S. Ellison who vacated his post of sales and advertising manager of the renewal tube division to become director of advertising for the entire company.

STEWART-WARNER HUDSON SA40

Binding: If the receiver tunes improperly, check for binding in the dial and tuning mechanisms. There are several possible causes for binding.

Counter-weight strikes case: Should the gang condenser counter-weight strike the wrap-around case, loosen the four screws holding the tuning mechanism to the chassis and shift the tuning mechanism slightly so that the counter-weight clears the case.

Save your aluminum scrap for national defense. Every little bit helps. See your local Boy Scout or American Legion Commander.

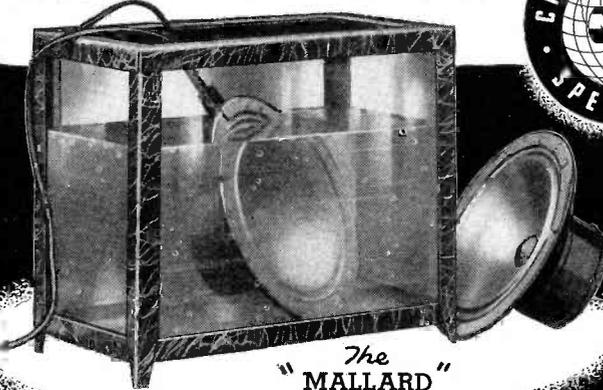
They Said it Couldn't be Done!

Defense wanted the speakers moisture-proofed! In meeting this requirement, CINAUDAGRAPH successfully tested the MALLARD under water.

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CINAUDAGRAPH SPEAKERS, Inc.

Dept. SE, 921 W. Van Buren Street
CHICAGO ILLINOIS



CASE HISTORIES

(Continued from page 29)

AIRLINE 14WG518, 14WG519

Production change: See Wells Gardner 5D8-1.

GENERAL ELECTRIC G61

Dial pointer will stick or not operate at all: This effect is the direct result of the small rectangular tab which is soldered to the copper (dial pointer) cable and will just touch either of two flat fiber pieces employed to insulate the pilot lights. Remove these pieces or secure them flush against the front of the dial assembly to the steel member which runs lengthwise supporting the pilot light fiber insulators and pilot lights.

Willard Moody

GENERAL ELECTRIC G55

Speaker output transformer burned out: This receiver when first examined would distort, cutting off completely with no click noticeable in the speaker when the 41 output tube was wiggled in its socket. A voltohmmeter check disclosed no short from the 41 plate to chassis, so it was assumed the fault was the result of too high plate-current caused by insufficient bias on the tube. A check revealed a shorted condenser

in the grid-bias circuit which eliminated the bias. The unit is a 0.5-mfd, 100-volt capacitor and was replaced with a similar type of higher voltage rating. It was necessary also to replace the bias filter-resistor as it had changed value because of the short.

Willard Moody

RCA 14AX, 14AX2

Production changes: Later models of this series used a 0.02-mfd condenser (C3) in the grid circuit of the 12SQ7 instead of the 0.015-mfd formerly employed in this position.

The condenser C5 in the 50L6GT plate circuit is changed from 0.025 to 0.02 mfd. C21, chassis ground to power ground, is changed from 0.2 to 0.1 mfd.

RCA 15X

Correction to 1940 bound volume of service notes: On page 206 of the 1940 bound volume, the oscillator coil is incorrectly listed as No. 34662. The correct number is 36234. The drive cord should be No. 34662.

RCA 45X1, 45X2

Changes in second production: The avc filter resistor R4 is changed from 2.2 meg to 3.3 meg.

The output tube bias resistor R8 is changed from 150 to 120 ohms.

RCA 46X SERIES

Dial lamp burnout: In Models 46X1, -2, -3, -11, -12, -13, -21, -23, -24, the dial lamp is a Mazda No. 47 (0.15 amp, 6.3 volt). In case of frequent burnout, a Mazda No. 51 (0.2 amp) can be used for replacement.

RCA V105

Production change: C17 and R16 shunted across the pickup are changed from 0.015 to 0.01 mfd and from 47,000 to 68,000 ohms respectively.

RCA RP158, RP160, RP162

Slow speed turntable: In cases of slow speed, adjust the bottom bearing of turntable spindle to remove binding and to obtain free rotation. Check by applying power to the turntable motor, allowing turntable to reach full speed, then pull motor away from turntable drive disc. The turntable should coast for at least twelve revolutions. (In R P-162, disengage motor from turntable by pulling idler away from turntable to observe coast.)

RCA V175

Low output and/or distortion: Check the following.—

(a) Rectifier tube 25Z6GT (slow in coming up to full plate voltage).

(b) Output tube 25L6GT (usually accompanied by high hum).

(c) Bias cell reversed. The negative side should connect to the grid of the 6SQ7. The bias-cell case is the negative and the black disc is the positive terminal.

STROMBERG-CARLSON 231R

Dial rubs: This receiver has a tuning arrangement that consists of a smooth-working dual-ratio vernier drive. The trouble was that the cabinet had warped very slightly, but warped enough to cause the dial to rub against the wood of the cabinet. The problem was solved by pulling back slightly on the tuning condenser front assembly, and securing the assembly by means of some small gauge insulated wire, so that sufficient clearance—a fraction of an inch—was obtained.

Willard Moody

WELLS GARDNER 5D8-1

Production change: Issues "A", "B" and "C" chassis of the above models used an antenna trimmer (C3) mounted on the loop aerial assembly.

On issue "D" chassis, the antenna trimmer (C3) has been replaced by a "Gimmick" fixed capacitance, consisting of 2 wires, one wrapped around the other. The 1400 kc adjustment is made at the factory and need not be made in the field.

MANUFACTURERS OF RECORD PLAYERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago.
 Ansley Radio Corp., 21-10 Forty-ninth Ave., Long Island City, N. Y.
 Autocrat Radio Co., 3855 N. Hamilton Ave., Chicago.
 Continental Radio & Television Corp., 3800 W. Cortlandt St., Chicago.
 Daniel Electrical Labs., 87 Walker St., New York City.
 DeWald Radio Corp., 440 Lafayette St., New York City.
 Electro Acoustic Co., 2131 Bueter Rd., Ft. Wayne, Ind.
 Emerson Radio & Phonograph Corp., 111 Eighth Ave., New York City.
 Espy Manufacturing Co., 305 E. 63d St., New York City.
 Farnsworth Television & Radio Corp., Ft. Wayne, Ind.
 Galvin Manufacturing Corp., 4545 Agusta Blvd., Chicago.
 Garrard Sales Corp., 396 Broadway, New York City.
 General Electric Co., Bridgeport, Conn.
 Harris Manufacturing Co., 2422 W. Seventh St., Los Angeles, Cal.
 Lafayette Radio Corp., 100 Sixth Ave., New York City.
 Magnavox Co., 2131 Bueter Rd., Ft. Wayne, Ind.
 Marconiphone, Inc., 679 Madison Ave., New York City.
 John Meck Industries, 1313 W. Randolph St., Chicago.
 Meissner Manufacturing Co., Mt. Carmel, Ill.
 Operadio Manufacturing Co., St. Charles, Ill.
 Pacent Engineering Corp., 79 Madison Ave., New York City.
 Philco Corp., Tioga & C Sts., Philadelphia, Pa.
 Philharmonic Radio Co., 21 W. 45th St., New York City.
 Presto Recording Corp., 242 W. 55th St., New York City.
 RCA Manufacturing Co., Inc., Camden, N. J.
 Radolek Co., 601 W. Randolph St., Chicago.
 Regal Amplifier Manufacturing Corp., 14 W. 17th St., New York City.
 Rock-Ola Manufacturing Corp., 867 N. Kedzie Ave., Chicago.
 J. P. Seeburg Corp., 1510 N. Dayton St., Chicago.
 Silcox Radio & Television Corp., 60 Wall Tower, New York City.
 Sonora Radio & Phonograph Corp., 2626 W. Washington St., Chicago.
 Sonata Phonograph Manufacturing Co., 410 E. 32d St., New York City.
 Sparks-Withington Co., Jackson, Mich.
 Speak-O-Phone Recording & Equipment Co., 23 W. 60th St., New York City.
 Stromberg Carlson Telephone Manufacturing Co., Rochester, N. Y.
 Talk-A-Phone Manufacturing Co., 1217 W. Van Buren St., Chicago, Ill.
 Transformer Corp. of America, 69 Wooster St., New York City.
 Troy Radio & Television Co., 1144 S. Olive St., Los Angeles, Cal.
 Universal Microphone Co., Ltd., 424 Warren Lane Inglewood, Cal.
 J. J. Warner Co., 1244 Larkin St., San Francisco, Cal.
 Webster-Rauland, Inc., 4245 Knox Ave., Chicago.
 Western Electric Co., 195 Broadway, New York City.
 Rudolph Wurlitzer Manufacturing Co., Tonawanda, N. Y.

MOTORS

Phonograph Motors

Alliance Manufacturing Co., Alliance, O.
 Diehl Manufacturing Co., Elizabethport, N. J.
 Garrard Sales Corp., 296 Broadway, New York City.
 General Electric Co., Schenectady, N. Y.
 General Industries Co., Elyria, Ohio.
 Presto Recording Corp., 242 W. 55th St., New York City.
 RCA Manufacturing Co., Inc., Camden, N. J.

Dial Drive, Etc.

Alliance Manufacturing Co., Lake Park Blvd., Alliance, O.
 Bodine Electric Co., 2262 W. Ohio St., Chicago.
 Diehl Manufacturing Co., Elizabethport, N. J.
 Electric Specialty Co., 211 South St., Stamford, Conn.
 General Electric Co., Schenectady, N. Y.
 General Industries Co., Elyria, Ohio.
 Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.
 Radex Corp., 1322 Elston Ave., Chicago.
 Signal Electric Manufacturing Co., Menominee, Mich.
 Utah Radio Products Co., 816 Orleans St., Chicago.
 Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.

JUST OUT!

NEW CATALOG 18

OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES • CHOKES • ATTENUATORS

For Radio, Television, Sound, Electronic and Industrial Uses

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ISSUED NOVEMBER 1941

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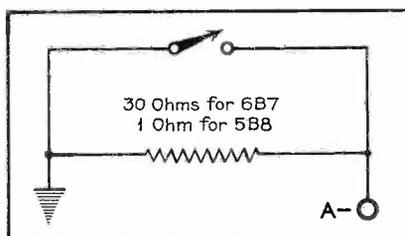
Especially useful today! Gives complete up-to-date information on the wide range of Ohmite stock resistors, rheostats, chokes and switches used in all types of applications . . . Lists over a thousand stock items, including new developments . . . Gives descriptions, ratings and prices . . . Helps you select the right units for each job, easily, quickly. Get your copy of this handy new Catalog 18 now! It's FREE. Send the Coupon today!

Be Right with OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES

WELLS GARDNER 5B8-1, 6B7-1

Economizer switch: Later models of the Series 5B8-1 have had an economizer switch and resistor added to the A battery circuit. The issue letter of the



chassis was advanced to B for this change. When the A batteries are new, the switch should be pushed to the right to the on position. When the A batteries have been in use for approximately 100 hours and reception becomes weak, the economizer switch should be pushed to the left to the off position. If the radio is operated approximately 3 hours a day, this would mean that the switch should be pushed to the left at the end of about 5 weeks. Be sure the economizer switch is pushed to the on position when replacing the A batteries.



BUILD CONFIDENCE

*with Astatic
Replacement Parts*

WHETHER it's a crystal microphone, pickup arm, recording head or cartridge replacement, the dependability of Astatic products insures a better and more satisfactory job. Careful design, engineering, manufacture and assembly insure highest operating efficiency. Checked against established standards of performance, Astatic products are guaranteed to live up to your highest expectations.

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New Products . . .

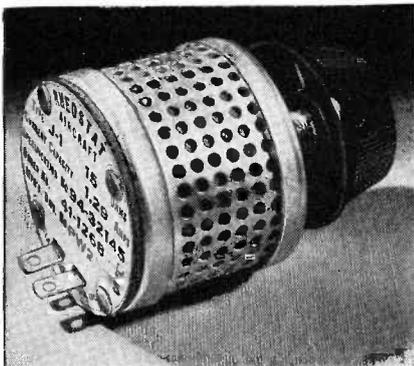
Additional information concerning the products and services listed below may be obtained without obligation directly from the respective manufacturer. Keep up to date on new components, write for descriptive bulletins today!

ARMORED POWER RHEOSTAT

To withstand hard usage, particularly where the unit is exposed, an armored type power rheostat is made by Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y.

The usual Clarostat 25-watt power rheostat is mounted in a perforated metal housing. Flat lug terminals are brought out at the rear of the casing. The front face has an ear or locking pin, which engages in a hole or indentation in the mounting surface to prevent turning. The $\frac{3}{8}$ " bushing and nut provide one-hole mounting.

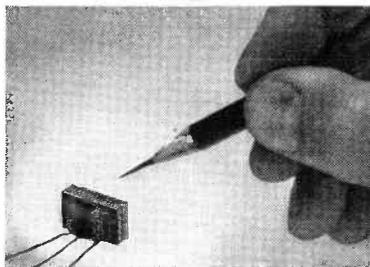
This power rheostat employs an insula-



ted metal core to support the winding which is embedded in a special inorganic cement. Units are available in standard resistance values of 1 to 5000 ohms, and other values on special order.

SMALL TRANSFORMERS

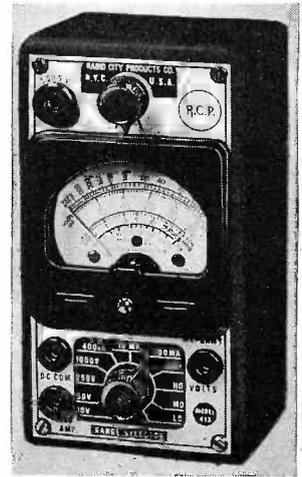
The United Transformer Corporation, 150 Varick Street, New York, N. Y., are



now in quantity production on a new group of small transformer components. These output coupling units weigh only three-tenths of an ounce, and have dimensions $\frac{1}{8}$ " x $\frac{1}{8}$ " x $\frac{3}{4}$ ". Almost 10,000 turns are employed in the coil structure to effect an inductance of approximately 70 hys. These units are in use for hearing aid, aircraft, and similar applications.

JUKE-BOX TESTER

Designed for testing and servicing coin-operated amusement devices such as pin-ball games, reproducers of recorded music, commercial voice recorders, etc., is the Model 415 introduced by Radio City



Products Co., Inc., 88 Park Pl., New York City. 6 inches long, 3 inches wide and $2\frac{3}{8}$ inches high, the unit requires little space in the service kit, yet is capable of the full variety of measurements required in servicing this type of equipment, it is said.

INTERCOMMUNICATING SYSTEM

Allied Radio Corp., 833 Jackson Blvd., Chicago, have announced a low-cost "Super-Selective" intercommunicating system designed to meet the needs of industrial installations. The new system provides $2\frac{1}{4}$ watts output and permits ten stations to carry on five simultaneous conversations.

VOLUME CONTROL TAGS

Printed tags designed to help radio technicians merchandise their service and reliability to the customer are now in-



cluded in the cartons with all IRC volume controls for replacement use. Entitled "Your Serviceman Knows Quality," the tags are signed by the International Resistance Co. and are designed to impress customers with the fact that the new controls installed in their radios are of the same design and construction as IRC controls used in marine and aviation radio, as well as in other exacting communications uses. The back of each tag invites the customer to recommend the Service Man to their friends.

Catalogs, Bulletins, etc. . . .

Copies of the catalogs and bulletins discussed below may be obtained directly from the respective manufacturers mentioned. Write for them today!

• • • • The Hallicrafters Co., 2611 Indiana Ave., Chicago, have issued their 1942 catalog of Hallicrafters receiving, transmitting and radiophone equipment.

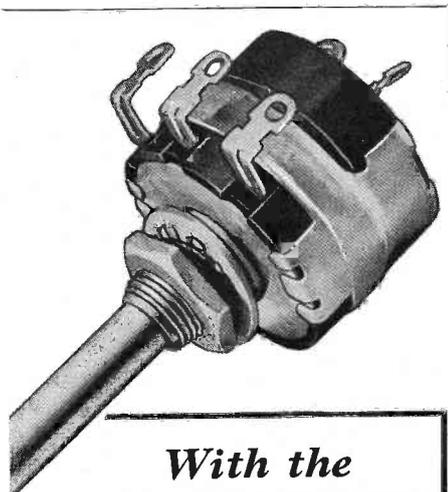
Included among the nine communications receivers described and illustrated are models in price ranges to meet the varied requirements of amateur and commercial operations as well as those of the broadcast listener who desires direct short-wave reception of foreign war news. All but one model includes provision for operation from either batteries or a car battery and vibrapack, in addition to its normal line operation.

Three amateur transmitters described have outputs of 25, 100 and 450 watts and provide both phone and c.w. operation. All include band-switching of exciter circuits and operate on desired bands from 10 to 160 meters while one also includes 5-meter operation. The marine radiophones range from a low-power, 3-channel model for harbor craft to a 50-watt ocean-going model which provides 5 transmitting and 6 receiving channels, all crystal controlled. A 110-18,000 kc. marine receiver and a compact radio compass round out the line of marine equipment.

• • • • National Union Radio Corp., 57 State St., Newark, N. J., have issued a 12-page catalog illustrating and describing N. U. Standard sound amplifiers and accessories. Both mobile and central sound systems are discussed in the booklet with power outputs ranging from 10 to 140 watts.

• • • • The 1942 line of radio and electrical test instruments manufactured by Radio City Products Co., Inc., 88 Park Place, New York City, is presented in a 20-page illustrated catalog just released. This new line includes more than 40 models of 22 basic test instruments and in this new Catalog No. 125 each of these models is illustrated and its specifications presented in concise, time-saving form.

• • • • The Walter L. Schott Co., 5266 W. Pico Blvd., Los Angeles, Cal., have issued a "Walsco Unibelt Reference Chart", which is available free to readers of SERVICE. Popular set models using dial belts are listed on the chart, which gives the part number of the required Unibelt and also specifies the length to which the belt should be cut in each case.



With the 1942 FEATURES

★ Perfected bakelite-support long-life carbon element virtually immune to wear and humidity; split-finger contact of special alloy; right-angle terminal lugs free from soldering troubles; accurate resistance values and tapers that stay that way — these truly 1942 features are found in today's Clarostat Controls.
★ Just try one. ★ Ask our jobber for latest servicing data — or write us direct.

CLAROSTAT MFG. CO., Inc.
285-7 N. 6th St. Brooklyn, N. Y.

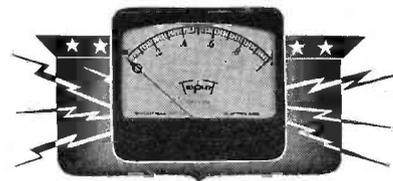


Expansion . . .

• • • • American Phenolic Corp. (Amphenol) have moved their general offices to 1830 South 54th St., Chicago. It is estimated that the output of the new plant will almost triple that of the old.

• • • • A new radio tube plant for the manufacture of special purpose radio tubes will be constructed for the Hygrade Sylvania Corp., in Montoursville, Pa., by the Industrial Properties Corp., Subsidiary of the Williamsport Community Trade Association, according to an announcement made by B. G. Erskine, president, and H. Ward Zimmer, general manufacturing manager, Hygrade Sylvania Corp. The property comprises some 16 acres of land on Broad Street, just East of Williamsport on the Harrisburg highway.

• • • • To meet expanded defense requirements with minimum interference to its regular production, the International Resistance Co., has added approximately 30% more manufacturing space at 401 N. Broad St., Philadelphia. The production of several types of resistors, required in quantities for national defense, has been increased materially through the addition of this space and the necessary special equipment. This makes the third expansion since IRC's removal to its present quarters five years ago and a total increase of 50% in floor space.



For Triplet Customers Only

Long before the state of emergency was proclaimed, the Triplet Company was getting ready to do its part in building our national security. We knew that we must meet important new responsibilities. At the same time, we felt keenly our continuing obligations to our customers—old friends with whom we have had happy business relations through many years.

We doubled—then tripled—our output to fill the needs of our old accounts. We added to our production facilities . . . hired many more men . . . are working extra shifts at time-and-a-half.

All this has not been enough. We have been called on to produce more and more for national defense. We are proud of the job we are doing to help meet the emergency, but it is difficult not to be able to serve our old friends equally as well. In the face of these conditions, the Triplet Company has adopted these policies "for the duration."

FIRST: We will continue to serve you by our service to our mutual responsibility—the national emergency.

SECOND: We will continue to do everything we can to fill orders from our regular customers, even though some deliveries may be temporarily delayed. No business from new accounts has been nor will be accepted until after our old friends have been served, except where priorities make it impossible to do so.

THIRD: Our engineering and research departments will continue to work on the development of superior equipment and improved methods to serve you still better when we can resume normal operations.

The present emergency is incidental and as we work towards the future, we will do our best to continue to merit your confidence and loyalty.

Ch. L. Triplett

President
The Triplet Electrical
Instrument Company

MANUFACTURERS OF PRECISION
ELECTRICAL INSTRUMENTS

YOU SAVE \$ 1 00

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**Group
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OUR GROUP SUBSCRIPTION PLAN enables you and three or more of your co-workers to subscribe to SERVICE at one-half the regular yearly rate. In other words it will cost you and your friends only \$1.00 each for twelve issues of SERVICE. The G-S-Plan low rate only applies when 4 or more subscriptions are ordered at one time. (Foreign \$2.00.)

Speak to three or more of your friends . . . let them sign up with you and then you can remit for the whole group. (Renewals or extended subscriptions are acceptable as part of a group.)

TEAR OUT AND MAIL

SERVICE—19 E. 47th St., N. Y. C.

Please enter annual subscriptions (12 issues) for each of the undersigned for which payment is enclosed at the rate of \$1.00 each; foreign \$2.00. (This rate applies only on 4 or more subscriptions when occupations are given.)

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State whether Employer is a Service Organization, Dealer, Jobber
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State whether Employer is a Service Organization, Dealer, Jobber
or Manufacturer

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or Manufacturer

"We Quote"

"Our hindsight is always better than our foresight—so let us, looking back, project ourselves to this period in 1942. The government's warning regarding the scarcity of metal parts becomes a reality. Aluminum can condensers are non-existent, despite the fact that the government gave the radio repair parts industry a satisfactory priority rating, and that all manufacturers used as many substitutes as possible wherever metals were formerly used.

"Service Men will have to cooperate with distributors and with the parts manufacturer when servicing radio receivers. Exact duplicate condensers will be unobtainable, the physical dimensions of capacitors will be changed frequently depending upon the material on hand for the manufacture of such condensers. You will have to redesign a receiver in order to use the parts obtainable. Electrically, the condensers will be perfectly satisfactory for their requirements—mechanically they probably will not be satisfactory. A reshuffling of all parts in the receiver, whether they be defective or not, will be necessary in many cases to make room for some over-sized part or for some sort of different mounting arrangement than was previously used in the receiver. The net result being that your service charges will be increased to offset the extra time that it will take you to replace a condenser that ordinarily could be handled in quick order. Estimates will probably have to be made after the set is in your shop, and not at the time that you take the order from the customer. Your business will be greater—your expenses will be greater—you will have to buy the best in test equipment and replacement parts. Just another condenser or resistor or tube will not suffice. In 1942 you will have become Service Man extraordinary and radio engineer."

*Harry Kalker, Sales Manager,
SPRAGUE PRODUCTS COMPANY.*

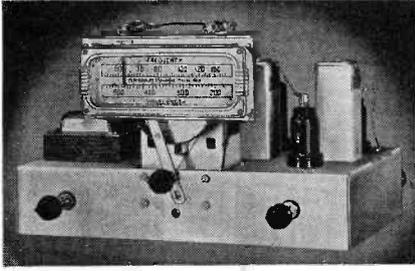
"While we are all symbolically in khaki, an ultra-important task confronts you—that of holding your customers' loyalty. Let his loyalty slip away from you now and it will be twice the job to win it back when the emergency is over.

"We cannot forget that this loyalty is our best asset, regardless of the sacrifices we are willing to make for Uncle Sam. We must nurse it along by explaining how priority orders are interfering with normal manufacture and distribution. Above all, each customer must be convinced that he is not pleading for goods in vain, while they are slipped out the back door to a favored few. The strain of the current situation gives rise to dark suspicions. They must be vigorously stamped out before they become convictions.

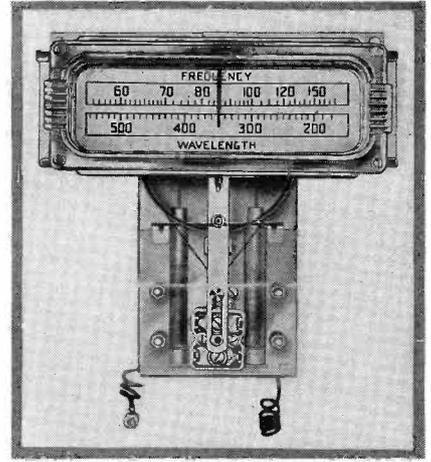
"Happy will be the man, when things return to normal, who can look his customers in the eye and say that there was no fluctuation in his loyalty, that he played no favorites, and that he did the best he could for everyone with the means and materials at hand."

*Milton Reiner,
RADIO CITY PRODUCTS CO., INC.*

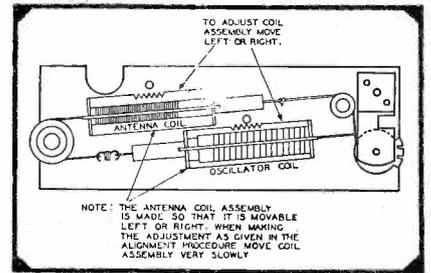
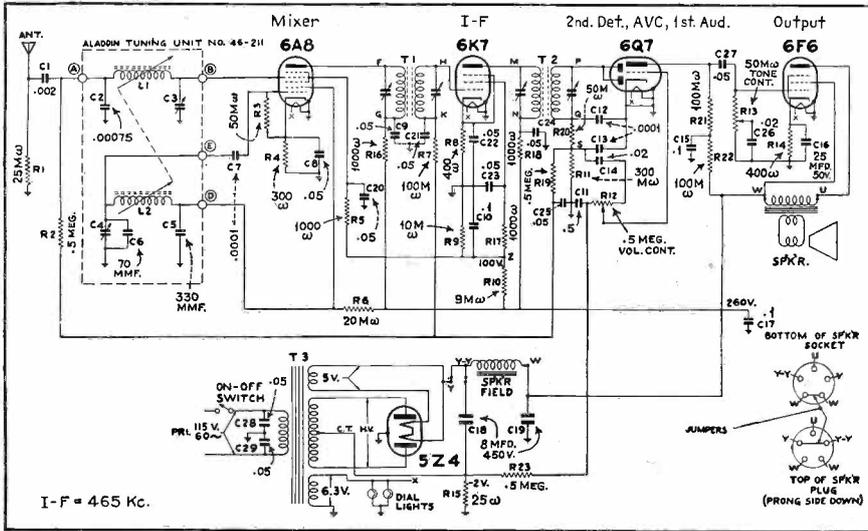
PERMEABILITY TUNING



PERMEABILITY tuning units, such as the one shown in the accompanying illustrations, have been used in low- and medium-priced receivers for the past few years. A typical receiver is shown to the left with its circuit diagram below. It is a simple five-tube single-band a-c superhetrodyne. The same circuit, with only slight modifications has been used in a-c, d-c powered receivers.



A simple means is employed to move both cores together. A string extends from an eyelet, at either end of the core, and passes over small pulleys as shown. The string is also looped over the main or drive pulley, which is connected to the tuning dial shaft.



STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of SERVICE—A Monthly Digest of Radio and Allied Maintenance published monthly at New York, N. Y., for October 1, 1941. County of New York, } ss.: State of New York,

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of SERVICE—A Monthly Digest of Radio and Allied Maintenance, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

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Sworn to and subscribed before me, this 26 day of September, 1941.

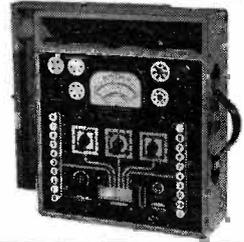
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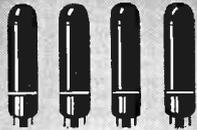
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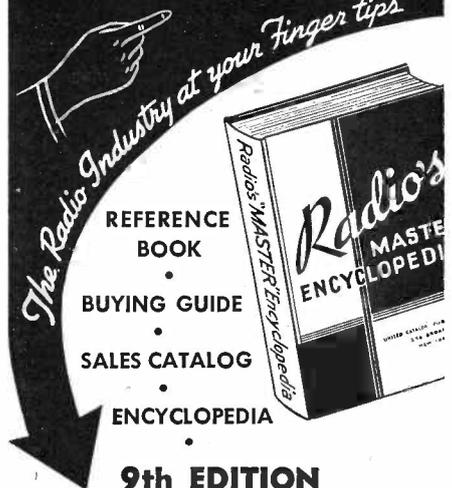
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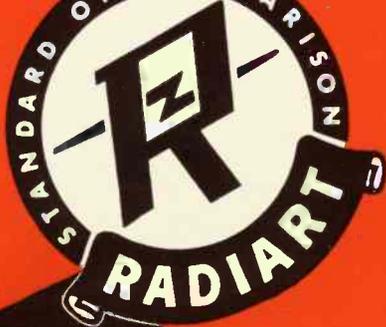
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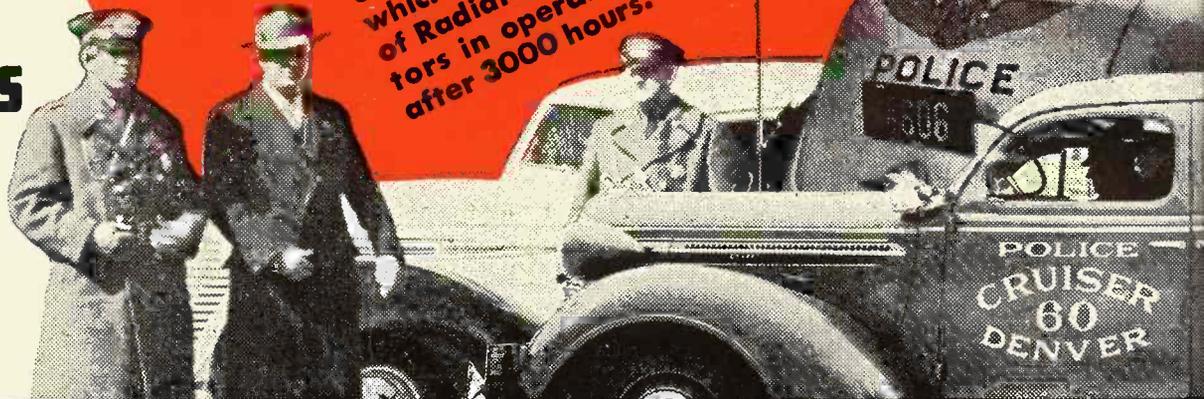
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