SERVICE

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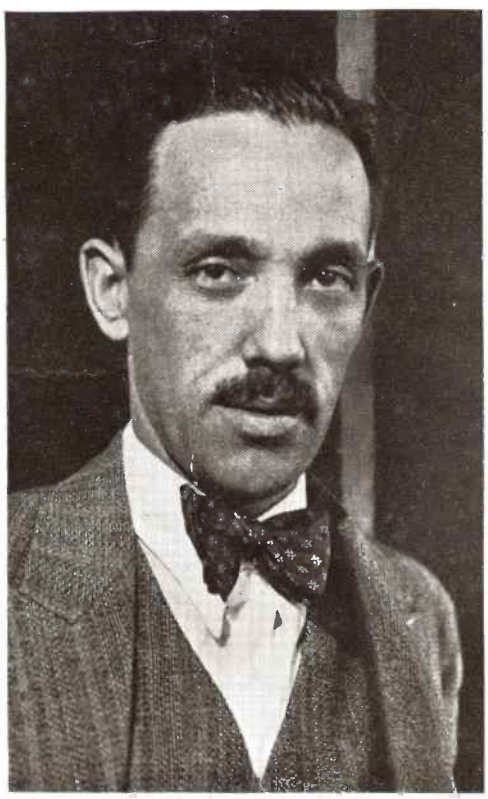
RADIO

AND ALLIED MAINTENANCE



Way down east . . .

(see page 195)

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AUGUST
1932

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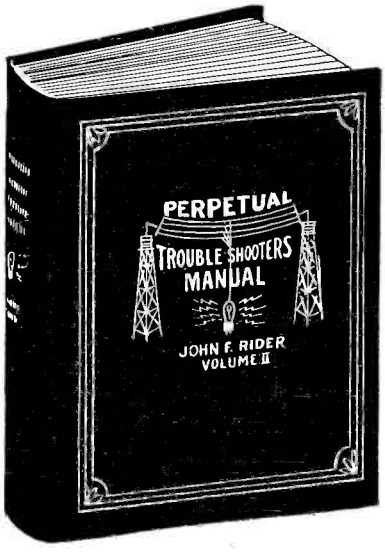

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Volume II has been prepared on the basis of the results of a comprehensive survey, made to determine *exactly* what Service Men want and need in a Manual. It includes wiring diagrams, chassis layouts, socket layouts, alignment data, peak frequencies, location of trimmers, color coding, electrical continuity of units sealed in cans, special notes, circuit peculiarities, voltage data and other important information. Special attention has been given to auto-radio, automatic record changers, superheterodyne converters—everything necessary to the successful operation of a service business.

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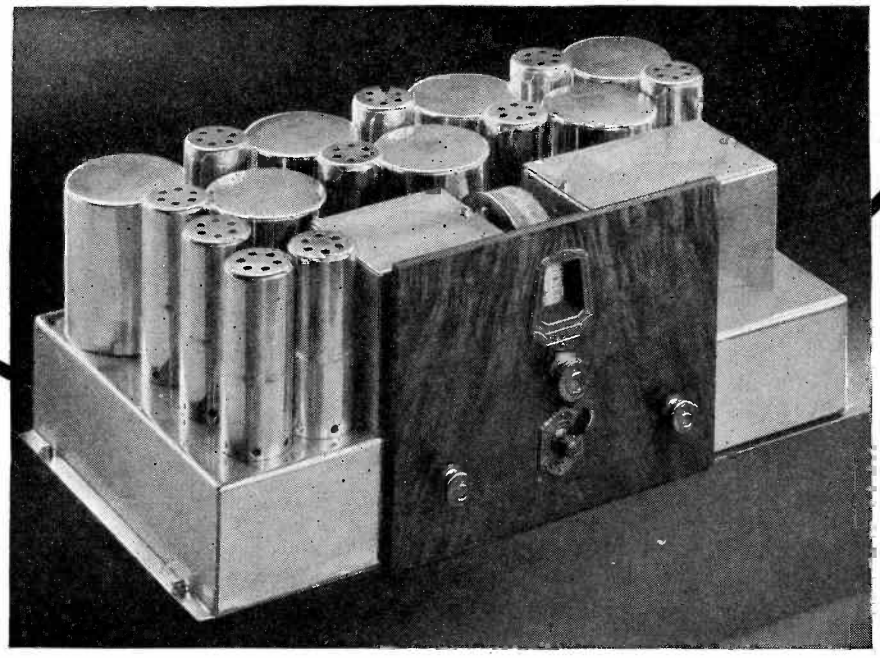

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There is no question—no doubt—no gamble in the purchase of a Scott Allwave Deluxe. No mere hope, to be followed by bitter disappointment. You KNOW—*before you spend your money* for a Scott Allwave Deluxe—exactly what you are going to get in performance. You KNOW you will hear England, France, Germany, Spain, Australia, South America and many more of the 300 intensely interesting foreign stations regularly received by owners of Scott Allwave Deluxe receivers. You know these things, *before you buy* because this receiver is *positively guaranteed* to give you *actual* world-wide reception . . . every day . . . regardless of which state you live in!

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It might seem strange that no one else can offer the purchaser such absolute certainty of satisfaction on the subject of foreign reception. Yet it is *not* strange when all the facts are understood, because . . . only the Scott Allwave Deluxe has the electrical characteristics that make possible an absolute guarantee of actual world-wide reception. Only the Scott Allwave Deluxe has a sensitivity of 4-1000ths microvolt per meter at 1400 K. C.! That's one reason. The second is that the Scott Allwave Deluxe is the ONLY receiver having such a low natural noise level that the 4-1000ths microvolt per meter sensitivity can be used to yield loud, clear reception over distances up to 10,000 miles!

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

AUGUST, 1932
Vol. 1, No. 7

EDITOR
John F. Rider

MANAGING EDITOR
M. L. Muhleman

Editorial Contents

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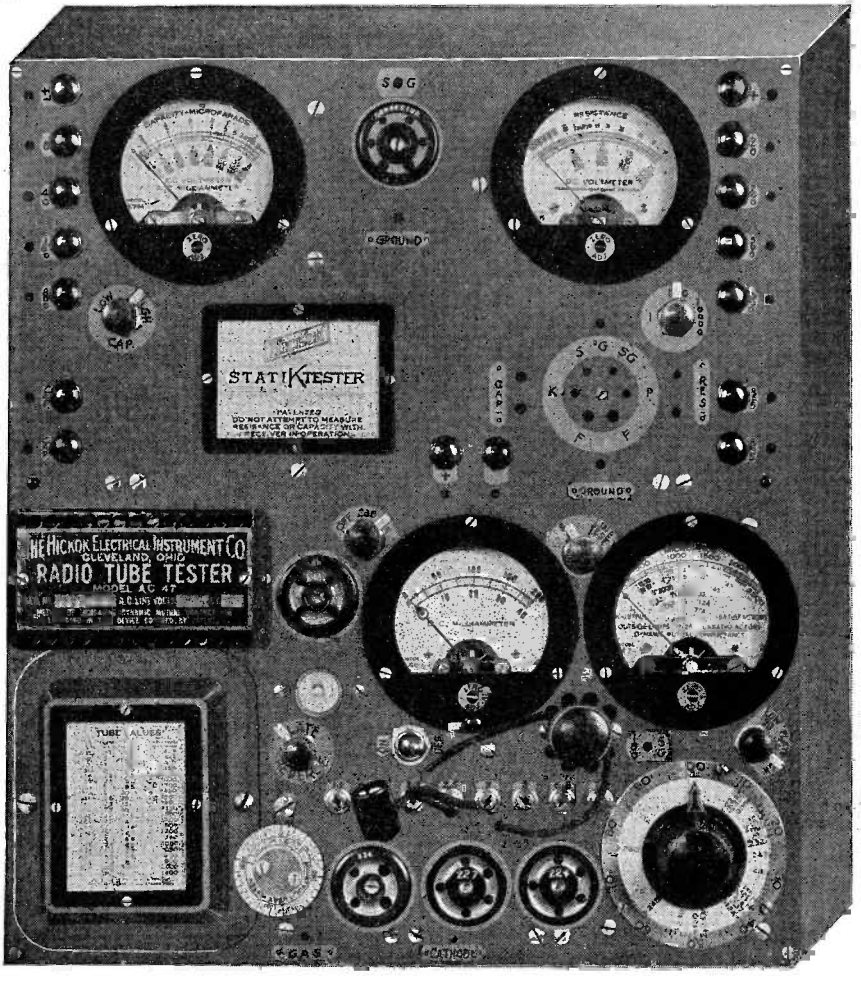

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THE ANTENNA...

HOW about carbon resistors? The service industry as a whole is interested in learning more about the testing of these units. At the present time we know that wire-wound and metallized resistors may be checked at any value of voltage within the wattage rating of the unit without fear of unjust condemnation of the unit on the grounds that the measured value shows some deviation from the rated resistance, due more to the testing circuit rather than the resistor itself.

At the present time there is no doubt about the fact that the voltage co-efficient of carbon resistors results in variations occasioned by the testing voltages, and that carbon resistors are unjustly condemned. What are the correct voltages which should be applied to carbon or composition resistors during the process of testing in order to ascertain the accepted value of resistance for that resistor? In contrast to other types of resistors, the wattage rating is not the determining influence, that is, as far as testing in the field is concerned. The variable current flow which may occur when various testing voltages are applied, all within the wattage rating, will result in various values of resistance.

In due justice to the instrument manufacturer, the Service Man, the receiver manufacturer, the customer and the carbon resistor manufacturer—all of whom are vitally concerned when a carbon resistor employed in a receiver is being tested for its ohmic value—the service industry would like to know what value of test voltage to apply to carbon resistors of various ohmic values and various wattage ratings. This information is of paramount importance when an ohmmeter is being applied to a receiver. Particularly so when ohmmeters are being made with increased resistance scales, which require higher than customary voltages to extend the range into megohms.

The RMA Engineering test standards as applied to composition resistors cover the subject in an elaborate and comprehensive fashion as far as engineering is concerned, but as can be expected, in view of the fact that it is out of their sphere of operation, they do not cover the subject from the angle of resistance measurement in the field by the Service Man.

The service industry at large admits the need for counsel in this direction and no one is better fitted to furnish this advice than the people who produce the products.

• • •

MORE and more we note the trend towards resistance measurement methods of service analysis. Ever since the exploitation of this idea in the editorial and text pages of SERVICE, we have been receiving letters to the effect that more and more men are using the system and that a large number have been using the system in the past. The old timers welcome the "push" behind the system as vindication of their ideas.

In the meantime, the subject is receiving attention from the receiver manufacturers and an increasing number of the present crop of service manuals are devoting space to resistance measurement data.

A critical examination of the present (1933) output of radio receivers, low as well as high priced, shows the definite need for resistance measurement methods of service work. The increased complexity of receiver design with increased sensitivity, automatic volume control, etc., requires more extensive isolation of the respective circuits. This isolation is secured by means of grid and plate filter resistors. The presence of these high-resistance units definitely interferes with the exact determination of the effective voltages applied to the respective tube elements. This fact has been long established, but it is of greater interest today because every major receiver manufacturer employs grid filter and plate filter resistors, and if indications are a barometer, then more resistors will be found in future receivers.

There is no doubt about the fact that future receivers will be more expensive than present-day receivers. Higher sales prices are required for the survival of the industry. Higher sales prices are invariably accompanied by a greater number of tubes. The 10, 12, 14 and 16 tube receivers displayed at the show are forerunners in this field. Any receiver with this number of tubes must be well designed to remain stable in operation. Stability requires isolation of circuits. Isolation means the use of resistors. The greater the number of high-resistance units in circuits which involve voltage measurement, the more logical is the need for resistance measurement as the conclusive test.

• • •

AERIALS are being neglected. Perhaps this may sound old-fashioned in this day of highly sensitive receivers, as well as the comment by the dealers' salesmen that, "this receiver will operate without an aerial." But the fact remains that the aerial is still a necessity for consistent and satisfactory reception. It is much better to operate a receiver at a low volume level with an aerial and to have noiseless higher volume available when desired, than to operate a receiver almost wide open without an aerial and have a noisy system when "full on" for some special occasion.

Because of high receiver sensitivity, any type of aerial is considered as being satisfactory. That is incorrect. A poor aerial is worse than none because it may lead to undesired consequences. One of these is noise. The other is poor sensitivity. There still are many locations where nothing but a good aerial will produce good results. Good aerials mean just that. Slipshod erection, insulation and grounding may be inexpensive at the outset, but expensive later. The newer type of noise-reducing aerials must be of good construction to be effective. Give the receiver manufacturer and the customer a break. Give them what they are entitled to receive —a good installation.

• • •

WE are pleased to see that the advertising in this issue is of special nature. Examine it . . . you will see that 100% of the copy is written for the Service Man. All of the products and literature offered are prepared exclusively for you.

John F. Rider.

SERVICE MEN! DEALERS!

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Take these 5 FREE OFFERS

National Union, maker of the famous National Union Radio Tubes, is continuing this amazing free offer a few weeks longer.

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You can have absolutely free any one or all of the equipment featured in this advertisement . . . with a small purchase of National Union Radio Tubes.

Think of it! 5 pieces of valuable equipment that are indispensable to any service man. Equipment that will save hours of time . . . and make more profits!

So take advantage of this opportunity at once! Read the details about this equipment, then mail the coupon below at once!

Oscillator and Output Meter

Service men! You can't service super hets properly without this meter! Absolute necessity for up-to-date servicing. Free with small purchase of National Union Tubes.

Two Service Manuals

Volume 1 and Volume 2 above are written by J. F. Rider, radio scientist and lecturer.

Vol. 1 contains over 2,000 diagrams on voltage, electrical values, color coding, peculiarities of receivers, amplifiers, and eliminators.

Vol. 2 has more than 700 pages of valuable information. For the first time receivers are broken down and point-to-point resistance data is furnished, which makes possible the operation of the continuity, capacity, and resistance tester at the right. Free with small purchase of Tubes.

FREE! Tube Base Layout Chart compiled by John F. Rider—absolutely no obligation—write for one!

The Readrite Tube Tester

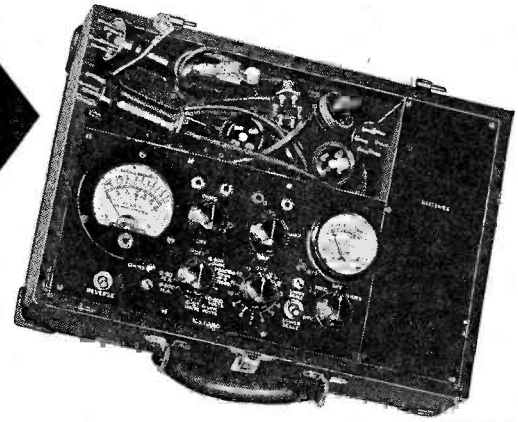
Compact, easily carried. No more squinting in dark corners! This tester has an illuminated dial which shows reading in even darkest corners!

Hundreds of service men have already learned what this tester has meant to them in more profits! Yours free with purchase of small quantity of National Union Tubes.

NEW! LATEST METHOD OF SERVICING!

New Readrite Continuity, Capacity and Resistance Tester! No more chassis pulling! With the new Readrite Resistance Tester you can make every test, continuity, capacity, and resistance . . . without taking the set apart!

Operates easily, quickly, efficiently. And that means more profits to you! Yours free with purchase of moderate amount of National Union Tubes, and small deposit.



NATIONAL UNION RADIO CORPORATION
400 MADISON AVENUE · NEW YORK CITY

Dear Sirs: Please tell me how I can have above equipment free. I am checking those in which I am interested:

READRITE TUBE TESTER ☐ OSCILLATOR AND OUTPUT METER ☐ VOL. I ☐ VOL. II ☐
READRITE RESISTANCE TESTER ☐

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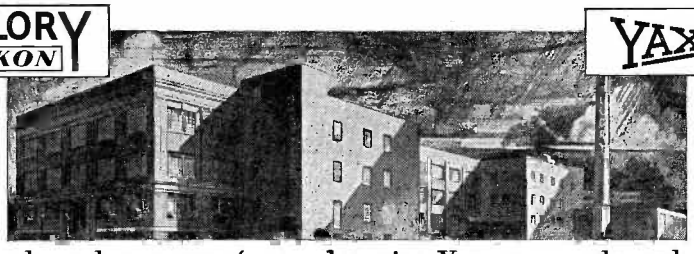
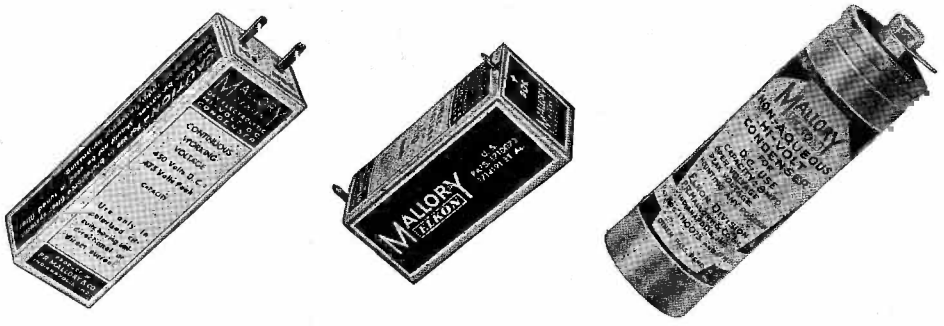
REPLACEMENT PARTS HEADQUARTERS

MALLORY ELKON

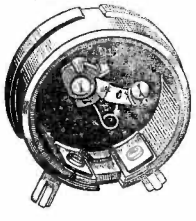


YAXLEY

Your *customers* depend upon you for good service. Your *success* depends upon your own efforts *and* the *suitability of the replacement parts you use.* When you come to replacement parts headquarters *you can depend* upon efficiency, long life and complete satisfaction of any parts you specify. Your *customers can depend* upon you for all 'round satisfaction. And you can depend upon their continued custom and good-will.

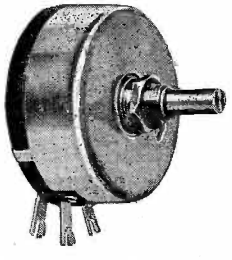


With the development of Mallory-Elkon condensers the user is now assured of characteristics and performance never before obtainable. The efficiency of Mallory-Elkon condensers from the standpoints of power factor, leakage, permissible overload voltages and life has been definitely and widely established. Mallory-Elkon Condensers in metal cans are available in either the upright or the inverted type. Mallory-Elkon By-Pass Condensers are becoming increasingly popular. Write for our latest bulletin showing the right condenser to replace in each set.



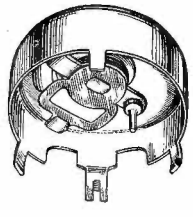
YAXLEY

Showing the dependable built-in switch and resistance securely housed in the Bakelite base, safe from accidental damage.



YAXLEY

The contact arm is of new and improved construction. The pressure is always uniform—the action smooth and silent.



The combined knowledge, experience and resourcefulness of two distinguished radio engineering groups are responsible for this most valuable contribution to the science of volume control. Yaxley engineers developed the principle, Yaxley engineers *and* Mallory engineers carried it to a point of practicability that brings to the industry a degree of volume control performance now attracting nation-wide attention.

You will be quick to appreciate the advantages of this extremely flexible wire wound volume control with inclosed switch (listed as standard by Underwriters' Laboratories) and contact arm, insulated or grounded style optional. This control is of unusual compactness and has a minimum number of parts. The simple, efficient switch, of the rotary "click-on" type is especially desirable... and the new resistance coil assures smooth operation. Write for Bulletin which shows the right Yaxley replacement control for each set on the market.

And don't forget to write for full details covering the Mallory-Elkon "B" Eliminator that has made auto radio all electric.

Service Men The Country Over Use These Yaxley Replacement Parts

Volume Controls, Rheostats, Potentiometers, Short and Long Wave Switches, Radio Convenience Outlets, Resistances, Jack Switches, Push Button Switches, Tip Jacks, Phone Plugs.

P. R. MALLORY & CO., Incorporated, INDIANAPOLIS, INDIANA

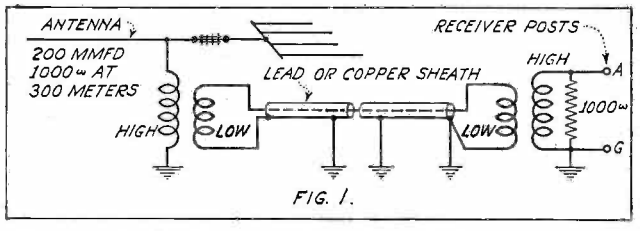
Kill That Noise . . .

A GREAT amount of effort is being made to either reduce or eliminate both natural and man-made electrical interference from the provinces of radio waves. This effort to clear the "air" of extraneous noises on the one hand and to incorporate noise-reducing systems in antenna circuits and radio receivers on the other hand is worthy as a beneficent cause in the name of better radio. Possibly this noise-reducing movement was first prompted by a growing impatience on the part of the listening public (for the impatient public is always with us, as are the rich). Be that as it may, the success of the whole movement is dependent almost entirely on the Service Technician, who is the only one in a position to take care of individual cases.

This article is our slight contribution to the cause. Much of the material has been written (and re-written) before and therefore may be old news to you. Some of the material is rather new, while other bits are of little value except where the set owner is sufficiently solvent to stand the expense of an elaborate "noise catcher."

Why Noise Anyhow?

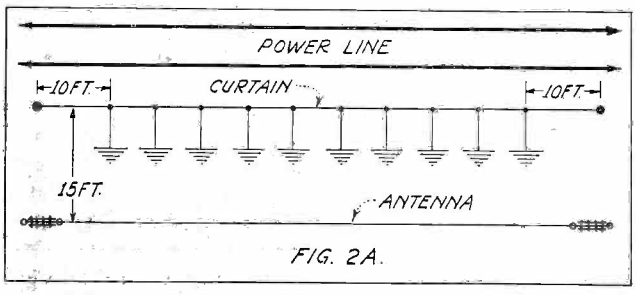
Electrical interference is generally due to small arcs or sparks, or to devices such as switches and certain types of rectifiers which suddenly make or break a current-carrying



Here are the details of a typical noise-reducing transmission line, using shielded lead-in wire in connection with two impedance-matching transformers. The 1000-ohm termination resistance across the aerial and ground posts of the receiver is used only with low-impedance inputs

circuit. A great deal of such man-made interference is radiated into the ether directly by the apparatus causing it, and by the associated wiring. Since the high-frequency components of such interference represent a small amount of power, and since the effective height of the radating members (apparatus frames and wiring) is usually small, the effective range of man-made interference is limited to a relatively small area in the vicinity of the offending equipment. This is rather sporting of the equipment, but the equipment, like anxious candidates, has a way of gathering closely around the radio sets. It must be a part of the scheme of life to have all noise-making devices as near the radio as possible.

It is a fact that certain types of interference are transmitted along the power lines and as a result such lines may radiate interference or conduct it directly to the radio receiver. But this usually accounts for a very small amount of the pickup and in most cases may be discarded with a snap of the fingers because most modern sets employ static shields between the primary and secondary windings of the power transformer. These shields effectively reduce the amount of such interference that enters the receiver through



An antenna can be shielded from power-line interference by the use of an "electric curtain." Details of such curtains are given in Figs. 2E and 2D

the power supply. In other receivers a small buffer condenser is frequently employed to short-circuit such intereference back to the ground side of the power line from whence nothing returns.

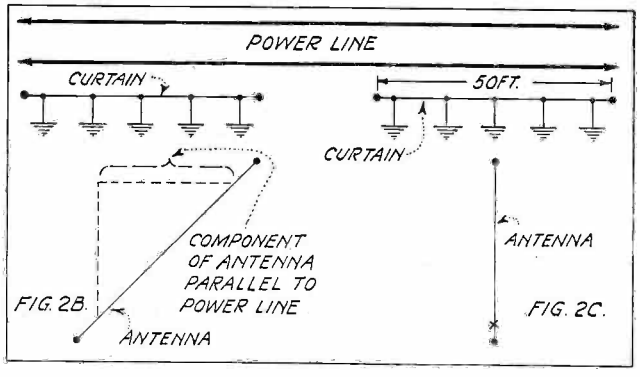
Here is another point to consider in connection with the same sort of racket: The power transformers in most receivers have the primary winding near the core and the outer layers (the layers of the primary nearest the secondary) are tapped for various power line voltages. When this is the case and the full winding (highest line voltage tap) is not used, the outer layers of the primary will act as a static shield if this side of the primary is connected to the ground side of the power line. Reversing the power plug to reduce interference is now such common practice that this connection quite generally obtains. There is, therefore, little chance for interference to slink its way into the radio receiver via the power supply.

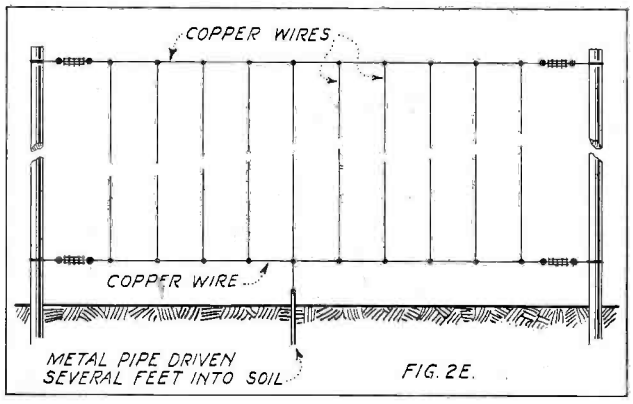
Of course, similar interference may be picked up by exposed circuit elements in the radio receiver, but this is certainly not apt to happen in modern receivers for, unlike modern bathers, nothing worth looking at is left exposed. In some of the less modern exposed receivers it may be desirable to shield some of the circuit elements to prevent this condition. However, it is seldom that such precautions are necessary.

Lo—The Antenna!

Undoubtedly the most effective method of minimizing interference lies in providing a stronger, interference-free signal. This requires first a high antenna located in a posi-

Electric curtains should be higher than both the aerial and power wires, and should always have a length exceeding the effective component of the aerial parallel to the power line





This sketch, and that of Fig. 2D below, give the details of effective "electric curtains." It is seen that they are made up in the form of a wire grid. In both cases the wires represent a single conductor

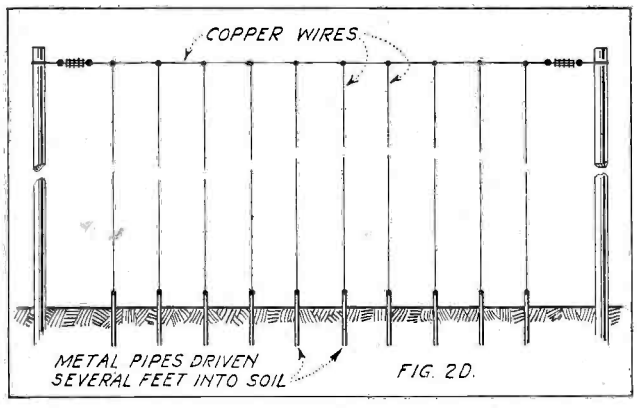
tion free from interference, and a shielded lead-in to conduct the signal to the receiver through the interference-infested areas.

There is a great deal of misinformation on antenna construction. For broadcast reception a single horizontal wire about 100 feet in length is probably the best answer among known antennas. Either an L or T type is satisfactory, that is, either an aerial with the lead-in from the center, or an aerial with the lead-in from one or the other end. It is a common error to assume that antenna performance depends upon the number of feet of wire employed in its construction, regardless of how the antenna wire is run. A zig-zagging or curved antenna should always be avoided since in most cases it will reduce rather than increase the signal. Thus, the voltage induced in the two legs of a V-shaped antenna with lead-in at one end will subtract and the resultant voltage is often considerably less than that from but one leg of the V alone.

The antenna should always be as high as possible and should be run at right angles to power or telephone lines. It should not cross above or below such lines. If erected in the back yard it should be several feet above the tops of neighboring trees. If on the roof, it should be kept as far as possible from all metal parts of the building, as such parts are capable of re-radiating interference. Metal roofs should always be grounded. Really good insulators should be used at each end of the antenna and should be placed 5 or 6 feet from their supports. And, of course, all joints should be carefully soldered.

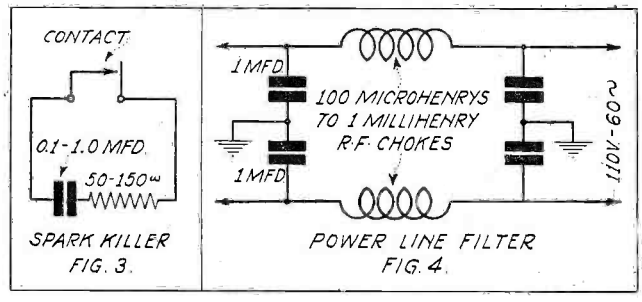
Shielded Lead-Ins

The shielded lead-in may consist of an insulated copper wire shielded with copper braid or a lead sheath. ("Wire-mould" lead sheathed wire may be used satisfactorily.) The lead sheath is preferable since it is a more effective static shield and will, therefore, be more effective in eliminating interference than with the copper braid. The shield should be grounded at a number of points along its length if possible. (See Fig. 1). Otherwise it should be grounded at the receiver end only. The sheath should start as close to the antenna as possible and should be continued to the ground binding post of the receiver.



Signal Loss

Of course, there is a sizable loss of signal in a shielded lead-in. In the usual shielded lead-in this may amount to 90 per cent or more of the signal picked up by the antenna for stretches of 100 feet. This loss is seldom serious, since it is usually more than offset by the additional signal picked up by a good antenna. However, if the shielded lead-in is converted into a transmission line (a la Bell Tel.) by the simple procedure of providing impedance-matching transformers at the antenna and receiver ends, the signal loss in the lead-in may be reduced to say 5 per cent of the signal in a 100-foot length. (Impedance-matching transformers are very



The arrangement shown in Fig. 3 is effective for most any type of make-and-break circuit. The circuit of Fig. 4 will quell line surges

successful if correctly designed.) As an example, an average antenna 20 feet in height and 100 feet in length has a capacity of about 200 micro-microfarads, an inductance of 20 to 40 microhenrys and a resistance of probably 50 ohms. At 1000 kc. (300 meters) this antenna impedance is therefore about 1000 ohms. A long transmission line, or a short one properly terminated in a resistance, has an impedance of about 50 ohms. There are several transformers on the market, any one of which will step-up the transmission line impedance to about 1000 ohms. The induced antenna voltage will then be divided between the 1000 ohms capacity reactance of the antenna and the 1000 ohms resistance presented by the antenna transformer. That is, about 70 per cent of the induced voltage will be developed across the transformer primary.

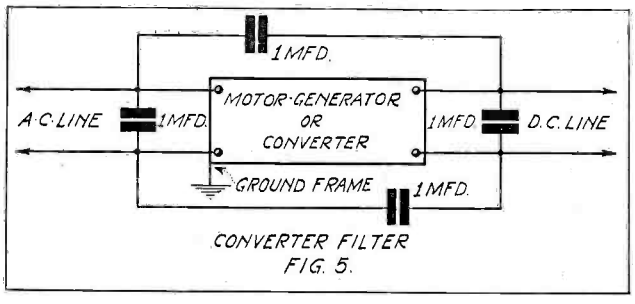
If a similar transformer is connected between the transmission line and radio receiver and a non-inductive resistance of 1000 ohms connected across the radio receiver terminals, 70 per cent of the antenna voltage will again appear across the receiver terminals, neglecting line losses, which are of the order of 4 or 5 per cent for a 100-foot length of line. The complete arrangement is shown in Fig. 1

It is a fact that most modern receivers have a high-impedance input, usually 1000 ohms or more, and while this impedance is not entirely resistive, it is frequently a satisfactory termination for the transformer, so that the 1000-ohm resistor may be omitted. For short lines of 150 feet or

less, it is usually advantageous to omit the termination resistance. If a lead sheath cable is used it is always advantageous to bury it, and thus in addition to insuring a good ground reduce the interference pickup considerably by the additional shielding of the surrounding earth. In some instances it may be deemed satisfactory to omit the transformer at the receiver end of the line. This will usually reduce the received signal from 70 per cent of the antenna voltage to about 25 per cent. If the antenna is located in a space relatively remote from interference, such a setup is entirely satisfactory.

Source Cures

A last resort in dealing with interference lies in effectively suppressing it at its source. Since there are usually so many interfering devices in any one locality, this is frequently both difficult and expensive. A certain amount of this sort of thing cannot be avoided, however, since in some cases it is impossible to select an antenna location sufficiently remote from all interference-generating devices. Shielding of the noise-making elements is probably the most effective pre-



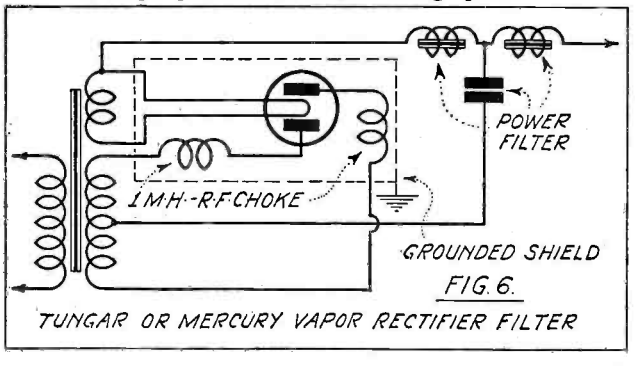
A very effective arrangement for use with motor-generators and converters. Note that the frame of the machine is grounded

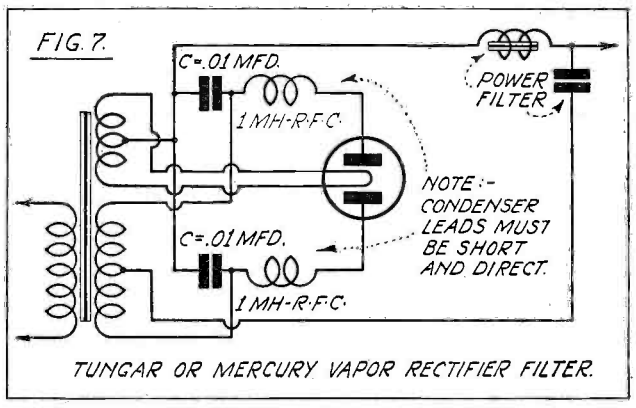
ventive measure that can be applied. Of course all metal frames and casings should be carefully grounded.

Interference from overhead trolley and power lines can often be reduced by suspending a number of grounded vertical copper wires between the power line and the antenna. (See Figs. 2-A, B, C, D, and E.) The spacing of these vertical wires depends on the intensity of the interference, a horizontal separation of one or two feet being quite a common procedure. This so-called curtain should be somewhat longer than that component of the antenna parallel to the power line (see Fig. 2-B) and should be higher by a few feet than either the power line or antenna, if possible.

In Figs. 3 to 7 are shown some common types of interference-suppression devices, most of which are self-explanatory. Radiation from the spark plugs of an internal com-

R-F. chokes should be used in the anode leads of mercury-vapor rectifiers to eliminate possible interference from r-f. surges produced at critical voltage points





The effectiveness may be increased by the addition of condensers. The r-f. chokes and rectifier tube should be enclosed in a grounded shield, as in Fig. 6

bustion engine may be naturally reduced by insertion of a series resistance of sufficient value (usually 20,000 to 50,000 ohms) to damp out oscillation after the initial spark has ceased. A similar result may be accomplished by inserting a shielded r-f. choke in series with each spark plug.

Brushes and brush holders of motors should be thoroughly inspected at regular intervals to prevent dirty contacts or chattering brushes. Belting used with insulated pulleys and shafting will frequently collect a static charge which may periodically discharge to nearby conductors. This may be eliminated by collecting the belt charge by means of a grounded metal brush contacting the belt. Metal shafting should also be carefully grounded by means of a wiping contact. In a similar manner the shaft of a motor or generator may become insulated from the bearing by a film of oil or grease and thus cause interference due to the collection and discharge of a static charge. In such cases the most effective remedy lies in the use of a grounded wiping contact on the shaft.

In general it is always good practice to ground any metal frames, cores, etc., carefully and to shield leads to and from devices causing interference, even though other suppression measures have already been employed.

Accidental or intermittent grounds due to various factors are one of the most frequent causes of trouble and are eliminated either by grounding the floating element or preventing the intermittent ground. Obviously, the latter may be difficult to locate.

The Man on the Cover

Rockwell M. Gray

Assistant Manager, Silver-Marshall

ROCKWELL M. (ROCKY) GRAY is one of the most colorful figures in the radio industry. He is a down-easterner who still says "idear." A graduate of the Boston University. Ex-radio dealer and star jobber salesman—all before he became one of Silver-Marshall's first employees. He held the position of New England District Manager from 1926 to 1930, when he was called into the factory as Assistant Manager of the Parts Division. For the past year he has had complete charge of parts, kits, the chassis and sound equipment divisions.

He is an engineer, a crack salesman, a good manager and not nearly as hard-boiled as he looks.

Resistance Measurement Method of Service Analysis

By JOHN F. RIDER

PART III

THE application of point-to-point resistance measurement to d-c. operated receivers differs very little from the process of analyzing an a-c. receiver. There are some few minor variations, but on the whole, the test is the same. It is this feature of versatility which makes the resistance measurement method of service analysis so valuable.

As to reference points, the chassis is still the major one. Supplementary to the chassis, we have the negative and the positive power plug lugs. Of these two, the negative lug is invariably common to the chassis, so that the reference points are not more than two in number. In this manner the rectifier filament in a-c. circuits is replaced by the positive lug of the power cable plug in d-c. circuits.

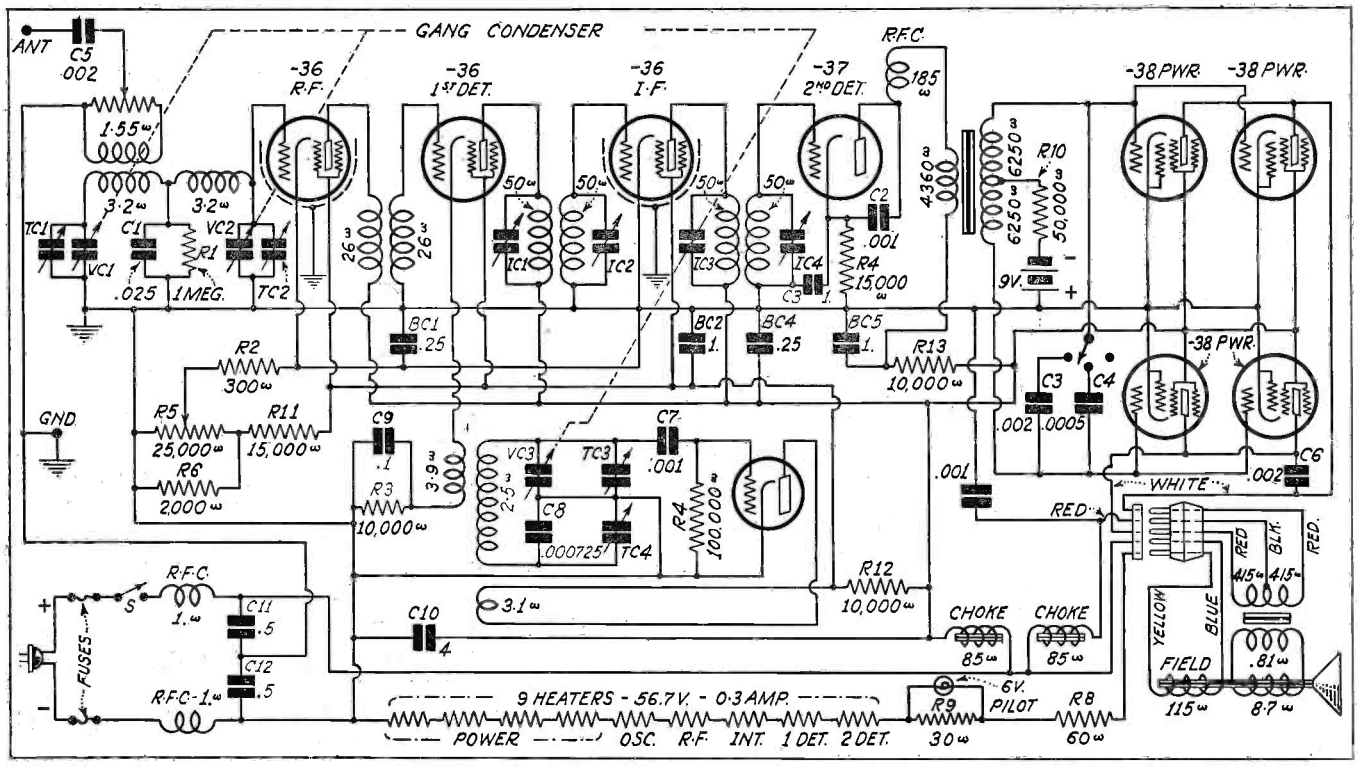
The removal of the speaker or speaker field is the same in all types of circuits. It is possible that the opening of these circuits may interfere with the continuity of some other circuits in the receiver, but the exact condition is a variable, depending upon the design.

At first glance the resistance network in the diagram shown in Fig. 1 is quite confusing. A simplified version of the various resistors and chokes, with the exception of the heaters, is shown in Fig. 2. All of these units bear the same relation to each other as indicated in the schematic diagram of Fig. 1. As is evident, any of the tube elements can be utilized as the secondary reference point with respect to the plus or minus lug upon the power plug, or the chassis, which is also joined to the negative power lead through the 1-ohm choke.

Once the test points have been established, the testing of the circuits remains identical to any a-c. circuit. It is necessary to mention that there exists the possibility of a more complex circuit in a d-c. receiver than in an a-c. receiver. This for the reason that some of the filaments or heaters have shunt resistors. Also because of the division of the power-line voltage between filaments or heaters, the plates and the speaker field. In a-c. circuits, the heater- and plate-voltage are secured from separate sources. In d-c. circuits they are secured from a common source. But with the tubes removed in d-c. systems, the entire heater circuit is eliminated and testing of the plate and grid circuits can progress without further trouble or worry about the heater systems.

If you will examine Fig. 2, you will note that the distribution of the plate voltages takes place by means of a voltage divider, connected across the power-supply line, just as if that system were the power pack filter output in an a-c. receiver. Generally speaking, this method of distribution is employed in the majority of modern d-c. receivers, but is not necessarily true in some of the older receivers. Even when not used, analysis is no more diffi-

Fig. 1. Schematic diagram of Kolster D-C 83 and 93, discussed in the text



cult. Whether it is, or is not used, the sole difference lies in whether or not any one tube element is directly connected to the plus as well as the minus lugs upon the power cable.

In Fig. 1 we can check the resistance between the output tube plates and either the plus or minus lug upon the power plug. However, if a voltage divider were not used —that is, the connection to the negative power lead would be the midtap upon the output tube heater or filament and the plate voltage were secured directly from the plus power plug lug—there would be no direct connection between the plate terminal upon the output tube socket and the negative lug upon the power plug when the output tube was out of the socket, or inoperative. A circuit such as described is the duplicate of the early type a-c. systems wherein the various plate voltages were secured via individual resistors connected between the various tube plates and the "high" lead of the power pack filter.

Circuit Check

Let us check some of the tube circuits shown in Fig. 1. The initial requirements for a d-c. receiver to be checked by means of resistance measurement are as follows:

1. Test all tubes independently of the receiver.
2. Measure the line voltage. Disconnect all batteries.
3. Test aerial and ground system.
4. Check the output transformer and speaker voice coil systems.
5. Remove all tubes from the receiver. Remove the pilot light. Disconnect the speaker inclusive of the voice coil. If the output transformer is a part of the speaker and its plug is connected to the receiver proper, remove the plug, thus opening the output tube plate circuits and also the field system. It is possible that a separate plug is provided for the field coil.

Assuming that the above has been completed and the tests indicate that the fault is in the receiver proper, we would work along the following lines.

From chassis to:

R-F. Control Grid—Slightly more than 1. megohm.*

*The input circuit of the r-f. stage is so arranged that a direct circuit through the two r-f. coils is not possible when working between the control grid and the chassis. Only one coil, that nearest the control grid, can be checked through the 1. meg. resistor. Of course, one cannot expect to note a variation of 3.2 ohms in 1,000,000 ohms so that it would be necessary to separately test the two coils by checking between the control grid and the stator of the first tuning condenser TC-1.

R-F. Cathode (V.C. Max.)	300 ohms
R-F. Cathode (V.C. Min.)	2,151 ohms
R-F. Screen Grid (V.C. Max.)	16,851 ohms
R-F. Plate	26,877 ohms*

*Since we are checking the continuity of the r-f. plate winding, a supplementary test is required to show the resistance of the r-f. plate winding. Such a test would be from:—

R-F. Plate to '47 Screen Grid 26 ohms

The last named test is preferred to a test between the r-f. plate and the plug lug upon the power plug cable, because the latter includes two additional units, namely the 1.-ohm r-f. choke in the plus power lead, and the 85-ohm filter choke.

Proceeding to the next tube, the test between the tube elements and the chassis continues:

1st Detector Control Grid	26 ohms
1st Detector Cathode	10,000 ohms*

*This resistance should really be 10,003.9 ohms, since the coupling coil of 3.9 ohms is in series with the 10,000 ohm resistor. However, we cannot hope to discern a discrepancy of 3.9 ohms in 10,000, hence it is necessary, in order to check the d-c. resistance of the coupling coil, to test across its terminals. Continuing:

1st Detector Screen Grid	16,651 ohms
1st Detector Plate	26,901 ohms*

*Once more it is quite difficult to detect any error in the d-c. resistance of the i-f. transformer primary located in the 1st detector plate circuit. Consequently, it is necessary to test this winding by working between the plate of the 1st detector tube and the output tube screen grid, thus:

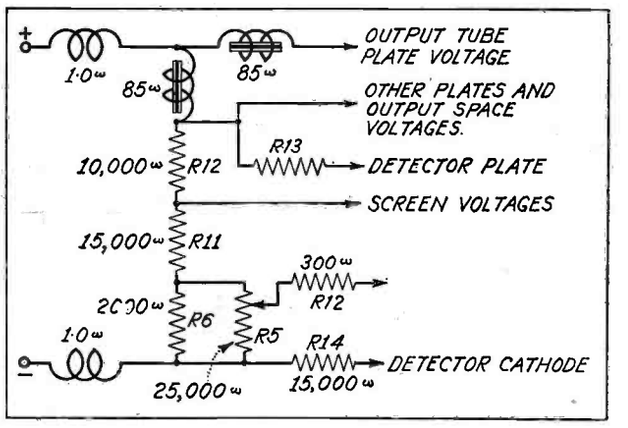
1st Detector Plate to '47 Screen Grid—50 ohms*

*Now, we find that the resistance between these two points is substantially zero, although the rated value is 50 ohms. There is no doubt about the fact that the trouble is related to this winding. Maybe the shunt condenser is shorted or the winding itself is shorted. Whichever it is, it is not the best practice to immediately desist making further tests. It might be best to complete a routine test of the remainder of the circuits. While it is true that troubles are, as a rule, singular in number, still one can never tell. As it happens, the nature of this fault is such as to be free of an influence upon the other circuits in the receiver, so that all further tests can be made without considering the probable effect of the short circuit.

The balance of the tests follow as outlined, so that there is no need for duplicate explanation, with the exception of the filament circuits. We note that with the tubes in their sockets, the various heaters and filaments are in series, but that the circuit is not closed unless the speaker plug is inserted into its socket. By checking the speaker field independently of the balance of the receiver and then testing between the negative power plug lug and the correct contact upon the speaker socket, we can check the resistance of one leg of the entire filament system. For that matter, it is possible to check the important control resistors in the filament circuit without ever inserting the tubes into their sockets. Thus the r-f. choke in the negative leg can be checked by operating between the negative lug upon the power plug and the chassis. The 30-ohm resistor can be tested by checking across the pilot light terminals and the 60-ohm control resistor can be tested by working between the pilot light and the correct lug upon the speaker socket. Between one pilot light contact and the speaker socket, we include the pilot light resistor and the other control resistor and between the other pilot light contact and the speaker socket lug, we include only the 60-ohm control resistor.

(*This series is to be concluded next month with an article on electrolytic condensers present in resistance-measured circuits. The condenser tester mentioned in an earlier installment of this series will also appear in the September issue.—Editor*).

Fig. 2. Equivalent network of the power-supply filter and voltage-dividing resistors of the circuit of Fig. 1



General Data . . .

Kolster Rejectostatic K-140, K-142

The Kolster K-140 is for operation on a 110-volt, 60-cycle line, while the K-142 is for operation on a 110-volt, 25-cycle line. The changes in the power-supply equipment for these two models are indicated on the accompanying schematic diagram. It should also be noted that the resistance values of all units, including transformers and coils, are given in the diagram, which permit the point-to-point resistance measurement method of servicing. The actual continuity test data is given in Table 1. As an added assistance in checking, the color coding for both condensers and resistors are included with the diagram.

The Circuit

The superheterodyne circuit is used, and employs type 58 tubes as first r-f., first detector, first i-f. and second i-f. A type 56 is used as second detector and automatic volume control, and a second type 56 employed as intermediate audio-frequency amplifier with manual volume control and "Radio"-"Phono." switching in the grid circuit. A third 56 tube is used for the oscillator and two 47 tubes are used in push-pull in the power stage which feeds twin speakers. Note from the diagram that the smaller of the two dynamic speakers plugs into a receptacle located on the larger speaker, from whence there is a cable for simultaneously plugging both speakers into the outlet on the side of the chassis.

External Connections

The radio-phonograph switching arrangement may appear a bit confusing. Referring to Fig. 1, the phonograph attachment plate is shown mounted on the rear wall of the chassis. The pickup leads should be connected to posts 1 and 3. When the jumper connects posts 1 and 2, the set is in readiness for phonograph reproduction. When the jumper connects posts 1 and 3 (as shown) the phonograph pickup is shorted out of the circuit.

In this same sketch the short-wave adapter socket is shown. This same socket is also shown in the schematic diagram, to the right of the pilot light.

Tube Shields

When taking out tubes in either of these models, remove the tube shields very carefully. Make sure that the grid leads are disconnected from the caps on top of the tubes which utilize them and are pushed through the openings in the sides of the tube shields through which the leads run. Do this before attempting to lift any of the "58" shields. These "58" tube shields have an internal partition shield. It is of equal importance that these particular shields are

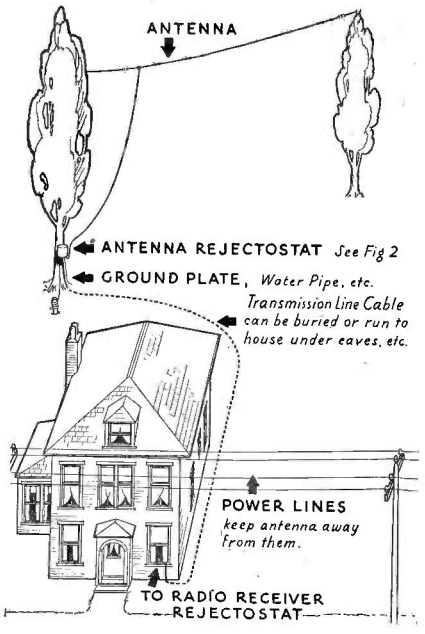
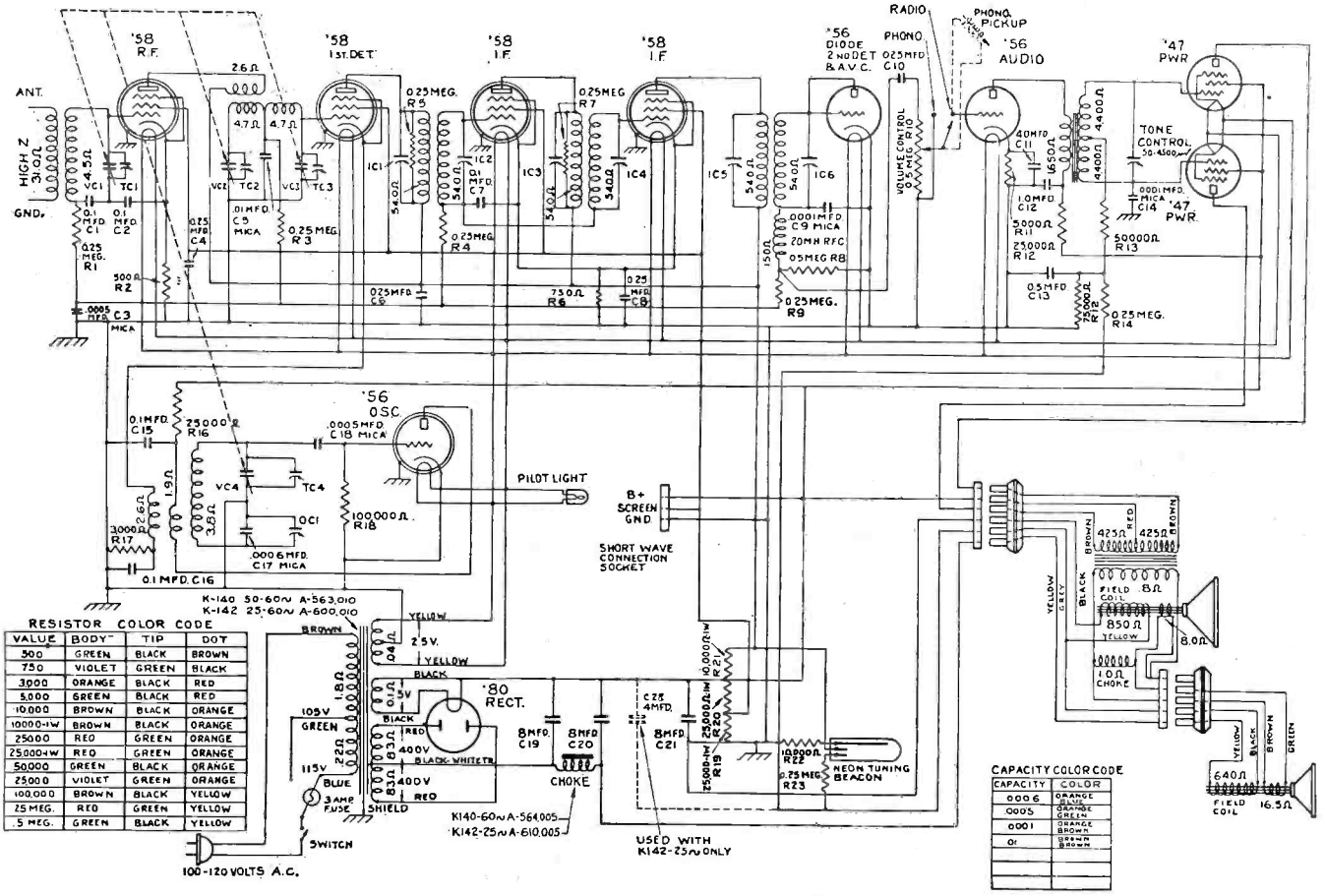


Fig. 2. A typical installation. The aerial should be free of power lines, etc., and free of any obstructions

Schematic diagram of the Kolster K-140 and K-142. Note the unusual speaker plug connections. The filter choke in the power-supply circuit has a resistance of 85 ohms, with a tolerance of plus or minus ten percent



VALUE	BODY	TIP	DOT
500	GREEN	BLACK	BROWN
750	VIOLET	GREEN	BLACK
3,000	ORANGE	BLACK	RED
5,000	GREEN	BLACK	RED
10,000	BROWN	BLACK	ORANGE
10000-1W	BROWN	BLACK	ORANGE
25000	RED	GREEN	ORANGE
25000-1W	RED	GREEN	ORANGE
50,000	GREEN	BLACK	ORANGE
25000	VIOLET	GREEN	ORANGE
100,000	BROWN	BLACK	YELLOW
25 MEG.	RED	GREEN	YELLOW
.5 MEG.	GREEN	BLACK	YELLOW

CAPACITY	COLOR
0006	ORANGE BLUE
0005	ORANGE GREEN
0001	ORANGE BROWN
01	BROWN BROWN

used over the "58" tubes, and not confused with the shields used over the "56" tubes.

The pilot light used in the K-140 and K-142 is a Mazda Type 41 with a 2.5-volt filament.

The Rejectostatic System

The Rejectostatic System is and is not a part of the receiver proper. It is in the sense that the entire chassis, including the tubes and all coils, are shielded against pick-up beyond the usual measure. It will be noted from Fig. 1 that the antenna and ground leads from the antenna transformer are also shielded, and from the circuit diagram that the primary of the antenna transformer is ungrounded. This latter measure is taken so that there is no chance of any power line interference, etc., of being impressed on this input circuit and thereafter amplified by its passage through the other circuits. And incidentally, since this primary is ungrounded, a separate ground connection is necessarily added to the short-wave adapter socket to provide a return path for the "B" current.

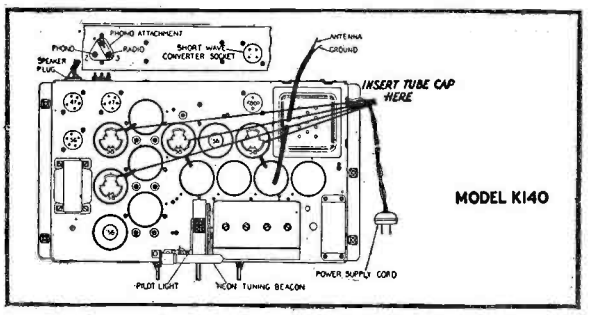


Fig. 1. Chassis layout of the K-140. When using the Rejectostat, extra shields are placed over the usual '58 tube shields. The arrows indicate the location of the four tubes so treated

The remainder of the Rejectostatic System is external to the set and does not necessarily have to be used. Nevertheless, it is very effective and if there is bothersome noise in the vicinity of the aerial, it is advantageous to use the system.

The Rejectostatic System is composed of the usual form of aerial 75 to 200 feet in length (not counting length of lead-in) which should be erected in a location as free from electrical disturbances as possible, and strung at right angles to any power lines. A typical residential installation is shown in Fig. 2.

Attached to the aerial proper is the Antenna Rejectostat, shown in Fig. 3. This should be mounted with the leads down to shelter them from rain. From this Rejectostat runs the lead-in wire, which in this case is referred to as a transmission line. It consists of two conductors in a shielded, insulated cable and it may be any length from practically nothing up to as much as 1,000 feet, without introducing the usual losses.

To the other end of the transmission line is connected the Receiver Rejectostat, which in turn is connected to the aerial and ground terminals in the receiver. This Rejectostat and the manner of making the connections is shown in Fig. 4.

Two other typical installations of the Rejectostat System are shown in Fig. 5. In cases of this sort it is important to remember that the usual window lead-in strip must not be used. The shielded transmission line must run intact directly to the terminals of the Receiver Rejectostat. Any break or discontinuance for a space of the shielding will undo the advantages of the system.

Special Considerations

Take note of the fact that there is a ground connection at the Antenna Rejectostat as well as the Receiver Rejectostat. Make each as good a ground as possible, preferably a water pipe or a girder of the building, or in the case of a residential installation, a ground rod or plate if no water pipe is handy nearby.

Do not allow the transmission line to

TABLE 1

Reference Points	*Value in Ohms*
Aerial to ground	31
*From Chassis to:**	
R-F. control grid	1 meg.
R-F. grid coil only	4.5
R-F. cathode	500
R-F. screen grid	25,000
R-F. plate	60,002.6
R-F. plate to neon lamp	2.6
1st det. control grid	1 meg.
1st det. control grid to 2nd tuning condenser stator	9.4
1st det. cathode	3,002.6
1st det. screen grid	25,000
1st det. plate**	60,054
1st det. plate to r-f. plate	56.6
1st i-f. control grid	1,000,054
1st i-f. cathode	750
1st i-f. grid coil only (i-f. trans. sec.)	54
1st i-f. screen grid	25,000
1st i-f. plate***	60,054
1st i-f. plate to 1st det. plate	56.6
2nd i-f. control grid	1,000,054
2nd i-f. grid winding only	54
2nd i-f. cathode	750
2nd i-f. screen grid	25,000
2nd i-f. plate	60,054
2nd i-f. plate to r-f. plate	56.6
2nd det. control grid	500,204
2nd det. grid winding only	54
2nd det. grid r-f. choke only	150
2nd det. control grid to plate	0
2nd det. cathode	0
Osc. control grid	100,000
Osc. cathode	0
Osc. plate	75,001.9
Osc. plate coil only	1.9
Osc. grid winding only	3.4
1st a-f. control grid (V.C. max.)	500,000
1st a-f. cathode	5,000
1st a-f. plate	76,650
1st a-f. plate to '47 screen	26,650
'47 control grid to control grid	8,800
'47 control grid	129,400
'47 control grid to neon lamp	554,400
'47 screen grid to '80 fil.	0
Large plate terminal of neon lamp	10,000
Rectifier filament winding	.1
'80 anode to anode	166
'80 anode to speaker socket	186
Heater (2.5)	.02
Following not to chassis:	
Output trans. pri. (total) (Br.-Red-Br.)	850
Output trans. sec.	.8
Large speaker field coil (Blk.-Gray)	850
Large speaker voice coil	8
Small speaker field coil (Blk.-Yellow)	650
Small speaker voice coil (Br.-Green)	16.5
Between large speaker voice coil and output trans. sec.	1
Across a-c. plug (105 v.)	1.8
Across a-c. plug (115 v.)	2.02

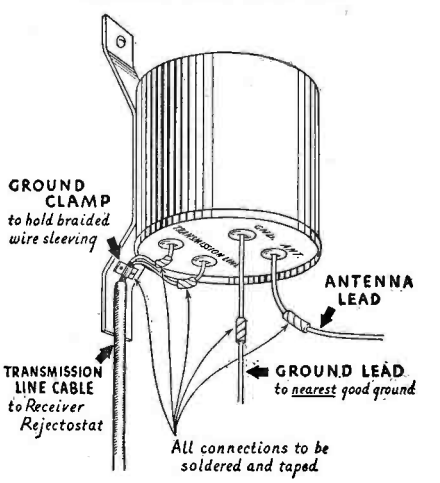
*Measurements should be made with all tubes out of sockets and both speakers disconnected. Neon lamp removed from socket and short-wave converter, if used, should be disconnected from plug, and pilot light removed from its socket.

**A .25-megohm resistor is shunted across the i-f. transformer primary in the 1st detector plate circuit.

***A .25-megohm resistor is shunted across the i-f. transformer primary in the 1st i-f. tube plate circuit.

NOTE: All voltage-divider resistors and all resistors intended to produce a voltage drop are plus or minus 10%. All high-impedance circuit resistors, grid filters, etc., are plus or minus 20%.

Fig. 3. The Antenna Rejectostat. This should be mounted with leads down to shelter them from rain



hang from the Antenna Rejectostat. It should be tied off to several supports on the way down to the receiver.

The Receiver Rejectostat may be mounted anywhere within the cabinet of the receiver just so long as it is within the reach of the shielded antenna and ground leads from the

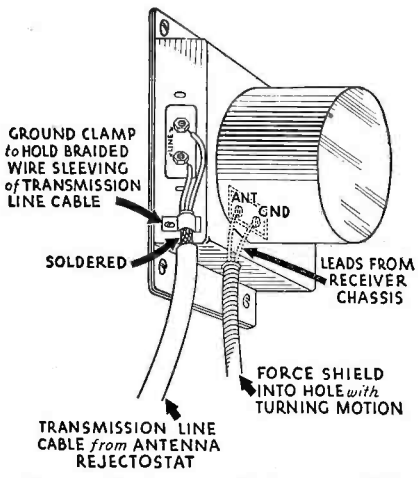


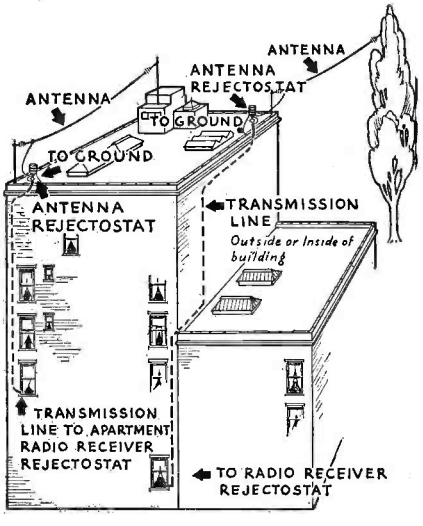
Fig. 4. The Receiver Rejectostat. This unit is mounted in the receiver cabinet. Be sure the shield is replaced over the aerial and ground leads

chassis. When connecting up these leads the cover plate of the Rejectostat must be removed. Be sure it is replaced after the connections are made. It is also necessary to ground the shielding of the transmission line at this point. A water pipe is preferable.

REJECTOSTAT EQUIPMENT

The Rejectostat Kit consists of one transmission line antenna impedance-matching transformer (Antenna Rejectostat) covering 550 to 1,900 kc., one transmission line receiver impedance-matching transformer (Receiver Rejectostat) covering 550 to 1,900 kc., and three additional tube shields to be placed over the openings in the tops of the tube shields for the type 58 tubes. The

Fig. 5. Showing two satisfactory methods of installing the system on an apartment house. An outside antenna must be used



positions for these extra shields are indicated by the arrows in the sketch of Fig. 1.

The transmission line may be No. 18 rubber covered copper, twisted pair, shielded with copper braid sleeve, and covered with 1/16" rubber covering.

A more detailed explanation of a similar noise-reducing transmission line system will be found elsewhere in this issue.

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Resistance Data for Radiola 66

The following values of resistance of some of the units used in the Radiola 66 may be of interest during point-to-point resistance measurement, or some other kind of similar test.

Antenna coil primary, 40 ohms. Secondary, 5 ohms.

R-F. transformer primary, 44 ohms. Secondary, 5 ohms.

First i-f. transformer primary, 20 ohms. Secondary, 100 ohms complete.

Second i-f. transformer primary, 20 ohms. Secondary, 100 ohms complete. The taps upon the i-f. transformer secondary windings are situated at the 50-ohm point.

Third i-f. transformer primary, 20 ohms. Secondary, 100 ohms.

A-F. transformer primary, 1,050 ohms. Secondary, 5,000 ohms.

Power transformer plate winding, 240 ohms total.

First filter reactor (choke), 220 ohms.

Second filter reactor (choke), 800 ohms.

Output choke, 515 ohms.

Speaker transformer primary, 1,485 ohms.

•

A-K Volume Controls

The following are the reputed values of volume controls employed in some A-K receivers. In contrast to the measured and known values of fixed resistances quoted elsewhere in this section, the values in this paragraph are compiled from sources believed to be accurate.

Models 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, 52 and 53 use an antenna volume control rated at 500 ohms. (*Courtesy, Centralab*)

•

Crosley Receivers

The early 40-S, 41-S, 42-S models employed Type J speaker fields which required 85 milliamperes for excitation. Later models employed Type M, 45-milliampere speaker with plug connections.

Early models had no pickup terminal; pickup connected directly to detector grid. Later models have pickup terminal. In some instances a choke and a .001-mfd. condenser are in the pickup lead. Three types of volume controls used. Types 1 and 2 are similar except that in Type 2 the antenna resistor was shunted across the winding. In Type 3 no antenna shunt resistor was used.

Models 20, 21 and 22 were built for use with Type E Dynacones. When the Type C Dynacones with separately excited field were introduced, two terminals, Red and Black, were added to the chassis for supplying the current to the Type C field coil. The field coil is connected directly across the filament supply.

Fada Notes

The Model 25 Fada receiver is available in two productions. The early type employs the 180 electric unit. The later type employs the M 250 electric unit. The former production can be recognized by the fact that it employs two neutrodones. The later production has three neutrodones. One of these is the regeneration control. It is unnecessary to remove the chassis to note the model. The neutrodones can be seen from the top when looking down upon the chassis.

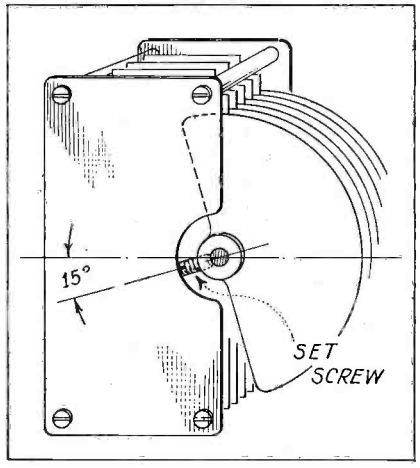
•

Hidden Condenser Short

A short time ago I ran into a peculiar condition in a superheterodyne receiver that had me stumped for a while. All voltages were correct and yet the set would cut out at KDKA and above that point be dead.

This condition would ordinarily indicate shorted plates in one of the gang condensers, but they proved to be all right.

It finally came about that one of the set



An odd case: The set screw on the rotor shaft became loose and touched the stator section when about 15 degrees below the center, as shown

screws on the third condenser shaft had become loose and touched the stator, due to gravity, when it reached a position about 15 degrees below the center line, as shown in the accompanying sketch.

W. J. Gilliland.

•

Fada Speaker Fields

Editor, SERVICE:

With reference to a paragraph concerning "Fada Speaker Fields" on page 167 of the July issue of SERVICE, it might interest you to know that there is no confusion in the identification of Fada speaker field coils as the first part of the article would indicate.

First of all, we wish to advise that there is a misprint in connection with the speaker used with the Model 66 Receiver. The speaker used on this model is a 12-B, not a 12-A, and it uses a 3-1407-Ms field coil.

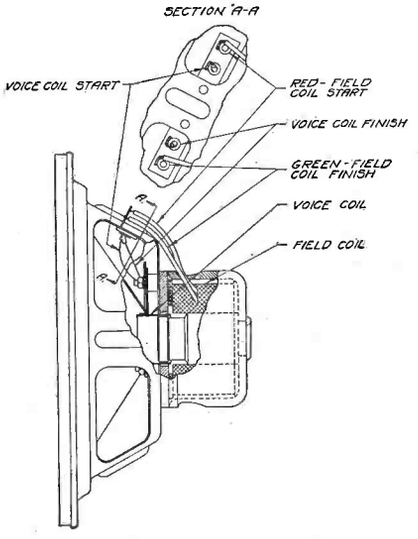
With this exception the rest of the data is correct and should prove of value to a certain class of Service Men.

L. J. BELL, *Service Manager,*
FADA RADIO AND ELECTRIC CORP.

Clarion AC-280 and 25-280

The Clarion (Transformer Corporation of America) Models AC-280 and 25-280 are both 12-tube AVC superheterodynes, the first for 60-cycle lines and the latter for 25- to 40-cycle lines. The power consumption of both models is 129 watts at 115 volts.

The accompanying schematic diagram provides most of the necessary details. It should be noted that a pair of 27 tubes are used in a push-pull diode connection for detection and automatic volume control. Automatic volume control is obtained by the drop in voltage across the 25,000-ohm resistor. The voltage drop is impressed on the grids of the r-f. and i-f. tubes.



Color-coded connections to the G-1503, 400-ohm field, dynamic speakers in the Clarion AC-280 and 25-280 receivers

Also note that four type 46 tubes, connected up as pentodes, are used in the power stage. They are paralleled in a push-pull circuit. These tubes can create noise and it will be found that a felt ring has been placed over the top of each one to prevent vibration and the possibility of one tube coming in contact with another.

Two dynamic speakers are used, the fields of which are connected in series and form a part of the filter system of the power-supply unit. Note that they are tied in the negative side of the filter system and create the necessary voltage drop for biasing the grids of the 46 tubes.

SERVICING

A voltage analysis is provided in Table 1. Readings are based on a line voltage of 115, and should be taken with the volume control at maximum and the muting switch "out."

A whistle similar to oscillation will be caused to appear on the sidebands of strong stations if the antenna is too long, due to overloading of the first detector tube, and should be remedied by inserting a .002-mfd. to .00025-mfd. condenser in series with the lead-in to the set, or by cutting down the physical dimensions of the aerial.

It might be well to add that general oscillation in the receiver may be caused by an open screen-grid bypass condenser, an open r-f. cathode bypass condenser, poor ground, or a high-resistance connection in series with one of the above bypass condensers, or a disarrangement of wiring in the r-f. section of the chassis.

The adjustment of the trimmer condensers should be carried out in the usual manner: i.e., by the use of an external oscillator. The i-f. frequency employed in these two models is 175 kc., therefore the external oscillator should be set at 175 kc. and fed into the input of the receiver.

TABLE 1

Tube	*Fil.*	*Plate*	*Grid*	*Cath.*	*Screen*	*Plate M.A.*
R-F.	2.2	250	.2	4.	77	4.
1st Det.*	2.3	242	4.	5.	85	.25
I-F.	2.2	249	.2	4.	77	2.
Osc.	2.2	110	.05	0	0	8.
Duo Dets.	2.2	0	2.	5.	—	—
1st A-F.	2.3	237	3.	9.5	—	3.
Pwr. Tubes**	2.4	245	32.			3.
Rect.	4.9	340				108

* Suppressor grid=0
** Outer grids=245 volts

Lock-In System

Wurlitzer engineers compel owners of Lyric receivers to tune correctly by having instituted in the Lyric circuit a so-called "channel control system." This arrangement employs another tube, in addition to the AVC tube, whose purpose is to automatically prevent any signal coming through the receiver until the listener has tuned almost exactly to the carrier. Therefore, no such device as a tuning meter is necessary.

This extra tube gets an r-f. input through a very selective input but refuses to release hold of the following tubes, over which it has control, until this r-f. input is within 2 kc. of the exact center of the r-f. carrier.

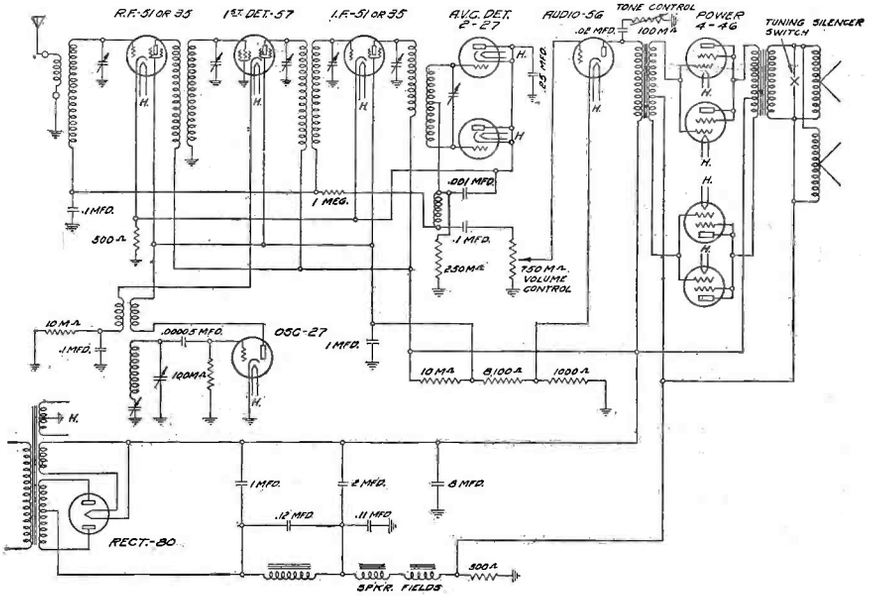
It is understood that this "channel control" circuit was developed in the labs. of the National Union Tube Co., and manufacturers reputed to be working with the idea are Zenith, U. S. Radio and Television, Colonial and Echophone. So, tighten your belt and get ready for another queer circuit to test.

•

Adjusting Crosley Musicones

It may appear strange in this day of dynamic speakers to give adjustment instructions covering old type magnetic units. However, a great deal of these units are in use and interest has been evidenced therein. These speakers must be readjusted when the plate voltage applied to the output tubes is changed. This applies to an increase or decrease. Use a long shank screw-driver. Connect the speaker to the receiver with which it is being operated. Tune to a station. Now turn the adjusting screw clockwise until the speaker chatters. Now turn the adjusting screw counterclockwise, counting the number of turns, until the speaker again chatters. Now turn the adjustment screw clockwise exactly one half the number of turns previously manipulated counterclockwise. The adjustment now is complete.

Schematic diagram of the Clarion AC-280. Note that four type '46 tubes are used as pentodes in a paralleled push-pull output circuit



New Fada Models

The Fada "RA" series covers the Models 74, 76, 83, 87, 88 and 89 receivers. The "RE" series (detailed in this issue) covers Models 73 and 85 receivers. The "RC" series covers Models 78 and 79 receivers.

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Atwater-Kent Chassis Specifications

A certain amount of confusion may be existent relative to the type chassis to be found in certain Atwater-Kent cabinet models of last year. The following are the complete models and the chasses employed:

Model 70 Lowboy: Used Chassis L for 60-cycle a-c. service; F for 25-cycle a-c. service; D for 110 volts d-c. service; Q for battery service.

Model 72 Superhet. Lowboy used Chassis H for 60-cycle a-c. service.

Model 74 Table Model used Chassis L for 60-cycle a-c. service; F for 25-cycle a-c. service, and D for 110-volt d-c. service.

Model 75 Phono-combination used Chassis P for 60-cycle a-c. service.

Model 76 Highboy used Chassis L for 60-cycle a-c. service; F for 25-cycle a-c. service; D for 110-volt d-c. service; Q for battery service.

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Atwater-Kent Resistance Values

The following tables provide the values in ohms of all resistors in 24 distinct models of Atwater-Kent receivers. The color codings for the carbon type resistors are also included. The wire-wound resistors in the receivers listed are not color-coded.

TYPE 55-55C No. 14900
(With Transformer-Coupled R-F)

1 AF Cathode Bias ..	1,000	
2 AF Filament Shunt		
2 A F Filament Shunt (Total)	10	
2 AF Bias No. 2....	7,500	Yellow
2 AF Bias No. 1....	10,000	Maroon
1 AF Plate Filter....	30,000	Gray
Detector Cathode....	100,000	Blue-Red
1 AF Grid Leak....	100,000	Blue-Red
Detector Coupling...	50,000	Black
Detector Plate Filter	50,000	Black
Bleeder	6,500	All Purple
	or	
	5,000	Purple Band
RF Filament Shunt (Total)	10	

TYPE D-I-16700

Detector Grid Leak..	2 megs.	Green
Condenser Discharge	100,000	Blue-Red
Screen Grid No. 2..	20,000	Black-Red
Screen Grid No. 1..	10,000	Maroon
Detector Plate Filter.	20,000	Black-Red
1 AF Filter.....	7,500	Yellow
Bleeder	4,500	Blue-Green
3 RF Filament Shunt.	23	
2 RF Grid Bias	10	
1 AF Grid Bias	23	
3 RF Grid Bias	23	
1 RF Grid Bias	35	
Filament Screen No. 2	37-250	
Filament Screen No. 1	600	
AF Filament Shunt..	300	
	and 300	

TYPE D-2

Detector Grid Leak..	2 megs.	Green
Condenser Discharge	100,000	Blue-Red
Screen Grid No. 2..	20,000	Black-Red
Screen Grid No. 1..	10,000	Maroon
Detector Plate Filter.	20,000	Black-Red
1 AF Filter.....	7,500	Yellow
Bleeder	4,500	Blue-Green
3 RF Filament Shunt	23	
2 RF Grid Bias	10	
1 AF Grid Bias	23	
3 RF Grid Bias	23	
1 RF Grid Bias	35	
Filament Screen No. 2	37-250	
Filament Screen No. 1	600	
AF Filament Shunt..	300	
	and 300	

TYPE F CHASSIS

2 AF Bias No. 1....	50,000	Black
2 AF Bias No. 2....	30,000	White
1 AF Grid Leak....	100,000	Blue-Red
Detector Bias.....	30,000	White
Detector Coupling...	50,000	Black
Detector Plate Filter.	30,000	White
1 AF Plate Filter....	30,000	Gray
Detector Grid 2	megs.	Green
RF Bias Resistor....	200	
1st RF Bias	1,000	
1st AF Bias	1,000	
Bleeder No. 2.....	1,200	
Dial Light	1	Yellow
Filament Shunt (Total)	10	
Bleeder No. 1	6,000	
1 AF Grid Resistor..	30,000	Gray

TYPE L-I CHASSIS NO. 16,000

2 AF Bias No. 1....	50,000	Black
2 AF Bias No. 2....	30,000	White
1 AF Grid Leak....	100,000	Blue-Red
Detector Bias	30,000	White
Detector Coupling...	50,000	Black
Detector Plate Filter	30,000	White
1 AF Plate Filter...	30,000	Gray
Detector Grid.....2	megs.	Green
RF Bias Resistor....	200	
1st RF Bias.....	1,000	
1st AF Bias.....	1,000	
Bleeder No. 2.....	1,200	
Dial Light	1	Yellow
Filament Shunt (Total)	10	
Bleeder No. 1.....	6,000	

TYPE P CHASSIS

2 AF Bias No. 1....	50,000	Black
2 AF Bias No. 2....	30,000	White
1 AF Grid Leak....	100,000	Blue-Red
Detector Bias	30,000	White
Detector Coupling ..	50,000	Black
Detector Plate Filter	30,000	White
1 AF Plate Filter ..	30,000	Gray
Detector Grid 2	megs.	Green
RF Bias Resistor ...	200	
1st RF Bias	1,000	
1st AF Bias.....	1,000	
Bleeder No. 2.....	1,200	
Dial Light	1	Yellow
Filament Shunt (Total)	10	
Bleeder No. 1.....	6,000	

TYPE Q CHASSIS

Detector Plate Filter	30,000	Gray
Detector Grid Leak..	2 megs	Green
Detector—AF Filament	1	Yellow
1st-2nd RF Bias (Total)	22	
3 RF Bias.....	20	

TYPE H-1—(72 Chassis)
(Below Serial 5,855,201)

IF Screen No. 1....	50,000	Black
IF Screen No. 2....	20,000	Black-Red
1st Detector Bias ..	7,500	Yellow
1st Detector Screen..	10,000	Maroon
Oscillator Grid Leak	50,000	Black
Oscillator Filter	10,000	Maroon
2 AF Bias No. 1....	50,000	Black
2 AF Bias No. 2....	30,000	White
1 AF Plate Filter....	30,000	Gray
2 Detector Plate Filter	30,000	White
1 AF Grid Leak....	100,000	Blue-Red
2 Detector Coupling	50,000	Black
2 Detector Bias	30,000	White
1st IF Screen.....	10,000	Maroon
2 Detector Grid....	2 megs.	Green
1 AF Bias	1,000	
IF Bias	400	
Filament Shunt (Total)	10	
Dial Light	1	

TYPE H-2—(72)
(Above Serial 5,855,201)

Dial Light	1	
Filament Shunt (Total)	10	
1 AF Bias.....	1,000	
IF Bias	400	
2 AF Bias No. 1....	50,000	Black
2 AF Bias No. 2....	30,000	White
1 AF Plate Filter ..	30,000	Gray
2 Detector Plate Filter	30,000	White
Bleeder No. 2.....	10,000	Maroon
1 Detector Bias.....	7,500	Yellow
Oscillator Grid Leak	30,000	White
Oscillator Filter	10,000	Maroon
1 AF Grid Leak....	100,000	Blue-Red
2 Detector Coupling..	50,000	Black
2 Detector Bias.....	30,000	White
2 IF Screen	10,000	Maroon
Bleeder No. 1.....	20,000	Black-Red
2 Detector Grid....2	megs.	Green

TYPE 80-80F AND 83-83F

Bleeder No. 3.....	15,000	Yellow-Gray
1 AF Grid Leak.....1	meg.	Blue-Gray
2 Detector Coupling	250,000	Red-Yellow
2 Detector Bias.....	30,000	Gray
2 Detector Screen...	250,000	Yellow-Red
Bleeder No. 1.....	6,000	Purple
Bleeder No. 2.....	7,500	Yellow
Oscillator Grid Leak.	100,000	Red-Blue
AF Bias No. 1.....2	megs.	Green
AF Bias No. 2.....	500,000	Black-Purple
Quality	10,000	Maroon
1 Detector Bias.....	2,000	
Filament Shunt (Total)	10	
Bleeder No. 4.....	100	

TYPES 81 AUTO RADIO

1 AF Screen.....	10,000	Maroon
Detector Grid 1	meg.	Blue-Gray
Control Grid Leak...1	meg.	Blue-Gray
Detector Bias	50,000	Black
Quality	20,000	Red-Black
Control Plate.....	800,000	Red-Gray
Bleeder 1	meg.	Blue-Gray

TYPES 82D-84D
(Early 84D does not have resistor marked)*

IF Bias	8	
2 AF Filament Shunt	50	

Filament Series No. 1	60 and 170	(Total 230)
Filament Series No. 2	35	
Oscillator Grid Leak	50,000	Black
1 Detector Screen No. 1	10,00	Maroon
1 Detector Screen No. 2	30,000	White
2 Detector Plate Filter	50,000	Black
1 AF Grid Leak	250,000	Yellow-Red
2 Detector Coupling	100,000	Blue-Red
*2 AF Grid	250,000	Yellow-Red
Quality	10,000	Maroon

TYPES 82-82F-85-85F

(Some few early model 85 do not have automatic volume control. 85F made only in late model.)

Bleeder No. 1	6,000	(85 early)
Bleeder No. 1	8,000	(85F late)
Bleeder No. 2	6,000	
Bleeder No. 3	350	
Bleeder No. 4	100	
Bleeder No. 5	8,000	
Bleeder No. 6	800	
Bleeder No. 7	700	
AF Bias No. 1	50,000	Black
AF Bias No. 2	500,000	Black-Purple
Filament Shunt (Total)	10	
Filter Resistor	1,000	(not used in 82F and 85F)
Oscillator Grid Leak	100,000	Blue-Red
2 Detector Bias	30,000	Gray
Control Plate Resistor	800,000	Red-Gray
2 Detector Coupling	250,000	Red-Yellow
2 Detector Plate Filter	50,000	Black
AF Grid Leak	500,000	Purple-Black
Quality Resistor	10,000	Maroon
1 Detector IF Screen	10,000	Maroon
2 Detector Screen	100,000	Blue-Red
IF Bias	1,000	(85 early)

TYPE 82Q

Filament Series Resistor No. 1	1	
Bleeder No. 2	50,000	Black
Bleeder No. 3	100,000	Red-Blue
2 Detector Screen Resistor No. 1	100,000	Red-Blue
2 Detector Screen Resistor No. 2	100,000	Red-Blue
1 AF Plate Filter	50,000	Black
2 Detector Plate Filter	30,000	Gray
2 Detector Coupling Resistor	250,000	Red-Yellow
Bleeder No. 1	500,000	Black-Purple
Quality Resistor	10,000	Purple
Oscillator Grid Leak	100,000	Red-Blue

TYPES 84-84F
(*Early Type*)

1st Detector Bias	300	
Oscillator Grid Leak	30,000	White
IF Bias Resistor	1,000	
Filament Shunt (Total)	10	
Bleeder No. 1	6,000	
Bleeder No. 2	6,000	
Filter Resistor	1,000	(only in 84)
AF Bias No. 1	50,000	Black
AF Bias No. 2	500,000	Purple-Black
2 Detector Bias	20,000	Black-Red
2 Detector Screen Resistor	100,000	Blue-Red
2 Detector Plate Filter	50,000	Black
2 Detector Coupling Resistor	250,000	Red-Yellow
AF Grid Leak	500,000	Purple-Black
Quality Resistor	10,000	Maroon

TYPES 84-84F
(*Late Type*)

AF Bias No. 1	50,000	Black
AF Bias No. 2	500,000	Purple-Black
Filter Resistor	1,000	(84 only)
1 Detector Bias Resistor	1,500	
Filament Shunt (Total)	10	
Bleeder No. 1	6,000	
Bleeder No. 2	4,000	
Bleeder No. 3	70	
2 Detector Screen Resistor	100,000	Blue-Red
2 Detector Bias Resistor	20,000	Black-Red
1 Audio Grid Leak	500,000	Black-Purple
2 Detector Plate Filter	50,000	Black
2 Detector Coupling Resistor	250,000	Red-Yellow
Quality Resistor	10,000	Maroon
Oscillator Grid Leak	100,000	Blue-Red

TYPE 84Q

Filament Series No. 1	1	
Oscillator Grid Leak	100,000	Blue-Red
Screen Resistor No. 1	100,000	Blue-Red
Screen Resistor No. 2	30,000	Gray
2 Detector Coupling Resistor	250,000	Yellow-Red
2 Detector Plate Filter	30,000	Gray
1 Audio Grid Leak	100,000	Blue-Red
1 AF Coupling Resistor	50,000	Black
2 Audio Grid Leak	500,000	Black-Purple
Quality Resistor	10,000	Maroon

TYPE 85Q

Filament Series Resistor	1	
Oscillator Grid Leak	50,000	Black
Local Distance Resistor	10,000	Maroon
2 IF Plate Resistor	100,000	Red-Blue
2 Detector Screen Resistor No. 1	100,000	Red-Blue
2 Detector Screen Resistor No. 2	30,000	Gray
2 Detector Coupling Resistor	250,000	Red-Yellow
Bleeder No. 1	500,000	Black-Purple
Bleeder No. 2	50,000	Black
Bleeder No. 3	100,000	Red-Blue
2 Detector Plate Filter	50,000	Black
1 AF Plate Filter	50,000	Black
Quality Resistor	10,000	Maroon

TYPES 86-86F

Filament Shunt Resistor (Total)	10	
Bleeder No. 1	8,000	
Bleeder No. 2	6,000	
Bleeder No. 3	1,000	
Bleeder No. 4	400	
Bleeder No. 5	8,000	
Bleeder No. 6	800	
Bleeder No. 7	700	
Filter Resistor	1,000	(86 only)
Dial Light Resistor	1	
Oscillator Grid Leak	100,000	Blue-Red
RF, 1 Det, IF Screen Resistor	10,000	Maroon
Control Tube Plate Resistor	250,000 or 800,000	Red-Yellow / Red-Gray
2 Detector Bias	30,000	Gray
2 Detector Screen Resistor	100,000	Blue-Red
2 Detector Plate Filter	50,000	Black
2 Detector Coupling Resistor	250,000	Red-Yellow
1 AF Grid Leak	500,000	Black-Purple
Quality Resistor	10,000	Maroon

86 ABOVE SERIAL 5,876,861
AND
86F ABOVE SERIAL 7,168,925

Bleeder Resistor 3A	500	
Bleeder Resistor No. 4	350	

TYPE 87

Filament Shunt (Total)	10	
2 AF Bias	200	
Bleeder No. 1	6,000	
Bleeder No. 2	6,000	
Bleeder No. 3	100	
Dial Light Resistor	1	
Oscillator Grid Leak	50,000	Black
1 Detector Bias Resistor	7,500	Yellow
2 Detector Grid Resistor	2 megs.	Green
2 Detector Bias Resistor	50,000	Black
2 Detector Coupling Resistor	100,000	Blue-Red
2 Detector Plate Filter	50,000	Black
1 AF Grid Resistor	100,000	Red-Blue
1 AF Grid Filter Resistor	500,000	Black-Purple
1 AF Bias Resistor	3,000	Green-Red
1 AF Plate Filter	30,000	Gray
Quality Resistor	10,000	Maroon

87 ABOVE SERIAL 2,525,871

Bleeder 3A	400	

TYPES 89-89F

AF Bias Resistor	200	
Quality Resistor	10,000	Maroon
Filament Shunt (Total)	10	
Bleeder No. 1	8,000	
Bleeder No. 2	8,000	
Bleeder No. 3	2,000	
Bleeder No. 4	400	
Bleeder No. 5	8,000	
Bleeder No. 6	800	
Bleeder No. 7	4,000	
Dial Light Resistor	1	
Oscillator Grid Leak	100,000	Blue-Red
Screen Resistor	20,000	Black-Red
Control Plate Resistor	250,000	Yellow-Red
2 Detector Bias Resistor	50,000	Black
Control Grid Resistor	500,000	Black-Purple
2 Detector Coupling Resistor	100,000	Blue-Red
2 Detector Plate Filter	50,000	Black
1 AF Grid Resistor	100,000	Red-Blue
1 AF Bias	3,000	Red-Green
1 AF Plate Filter	30,000	Gray

Public Address . . .

"Class B" P-A. Amplifiers

Part II

The general criteria relating to the design of public-address systems, and the design information of Class B public-address amplifiers, have been described in the June and July issues of SERVICE. We will now proceed with the actual circuit design of such an amplifier, from which it will be comparatively simple for the reader to construct his own unit.

THE COMPLETE CIRCUIT

Fig. 1 is the circuit of the complete amplifying unit. This amplifier has a gain of about 80 db. and an output power of about 20 watts. It must of course be realized that specific designs may depart from the circuit shown in several particulars to utilize available apparatus, or to meet specific problems. However, it is believed that the general arrangement shown will be typical, and suitable to most imposed conditions.

The circuit shown consists of three stages, the first a single 57 amplifier resistance-coupled to a 46 driver, and the last a transformer-coupled Class B push-push stage, using two 46 tubes. The input transformer T-3 may be any good quality transformer designed for the particular circuit from which it is intended to operate. Suppose a double-button carbon microphone is to supply the amplifier. Then the transformer T-3 should have a turns ratio of 1 to 40 or 50. For single-button carbon microphones T-3 should have a turns ratio of about 1 to 65.

PUSH-PUSH TRANSFORMERS

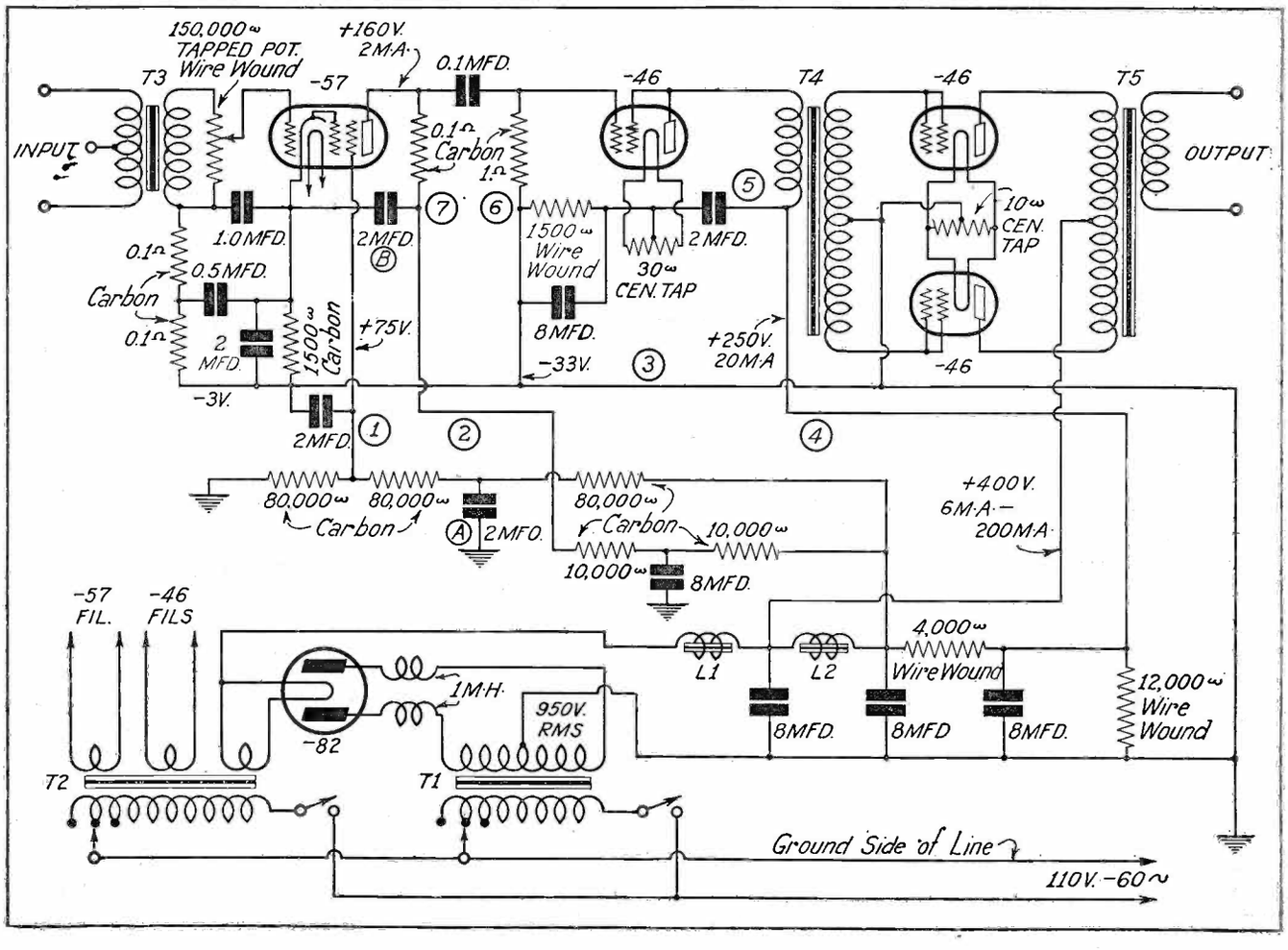
The input and output push-pull transformers, for push-push operation, are special, and it should be understood that the usual type transformers cannot be used in these two positions. Thus, the transformer T-4 is of the step-down type and should have an impedance ratio (primary to one-half of secondary) of about 4 to 1. The output transformer T-5, on the other hand, should have a 1 to 1 ratio. A number of transformers of these types are now available.

It will be noticed that the suppressor grid of the 57 tube is connected directly to the cathode. This is advisable to minimize noise (120 cycle hum or its harmonics) from the tube due to secondary emission from the screen. It is because of the increased hum due to screen emission that screen-grid tubes have never been particularly successful as preliminary stages in a-c. amplifiers. Such random effects cause both an increase in a-c. hum and in tube noise (so-called Schott Effect). The auxiliary grid when tied directly to the cathode effectively shields the plate circuit from such effects.

THE 57 AMPLIFIER

It is desirable to use the highest possible local impedance to realize as much gain as possible from this tube, which has an output impedance of about 2 megohms. If a choke coil is used to supply plate current (2 milliamperes in this case) it must have an inductance of at least 500 henrys to be effective. Since an inductance of 500 henrys has an equivalent reactance at 50 cycles of only about 150,000 ohms, it is evident that the plate impedance will be limited to this value, which is not sufficiently better than the 0.1-megohm resistor shown to warrant the expense. Moreover, due to the high distributed capacity of most chokes available for this service, they are likely to cause irregularities of considerable magnitude in the frequency characteristic of the amplifier in the useful frequency spectrum. In addition, they are subject to noise pickup from

The complete schematic diagram, with values and voltage data, for the Class B Public-Address Amplifier



the rectifier (particularly where an 82 is being employed) or other circuit components due to their high impedance and such couplings may be extremely difficult to eliminate.

We believe that the above makes it quite clear why it is best to use a resistor. However, even in the case of resistors, considerable care should be exercised in the choice of a resistor for this coupling since some units are apt to be noisy. A quiet composition unit, of molded carbon, is therefore recommended for both the 100,000-ohm and 1-megohm units. Since the 100,000-ohm unit will carry a current of 2 milliamperes, the wattage dissipation will be about 0.4 watt. Therefore, it is well to use a unit rated at 1.0 watt. It is a good rule to use composition resistors at something less than half their rated wattage in all cases. The 0.1-mfd. condenser which forms a part of the coupling unit may be a paper condenser mounted in a non-metallic container. It should also be mounted as far as possible from the frame or other metal to insure low capacity to ground. A tubular condenser with wire terminals is excellent for this purpose.

The Power Transformers

Two power transformers are shown in the diagram. The first supplies all filaments and the other the high voltage for the rectifier plates. Separate primary switches are shown. These are provided so that the filaments of the rectifier and amplifier tubes may be turned on some 45 seconds before the high voltage is applied. While this represents good design practice, it is not necessary to use separate transformers or to allow the filaments to heat up before the high voltage is applied.

The high-voltage transformer T-1 is also of special design and should have a resistance per side of about 150 ohms. The filament transformer T-2 must, of course, be able to supply the proper voltage and current for the filaments of all the tubes. Both types of transformers are now being marketed.

The Filters

The chokes L-1 and L-2 each have a d-c. resistance of about 200 ohms and an inductance of 12 to 25 henrys. These also are obtainable on the market, but in selecting chokes of this type make sure that they have a current rating of from 100 to 150 ma.

It will be noticed that 8-mfd. 500-volt electrolytic condensers are specified for the power-supply filter. Either the wet or dry (Hic) type are satisfactory. Moreover, due to their high capacity, they are very effective in the prevention of motor-boating or low-frequency oscillation which is a source of considerable difficulty in high-gain, three-stage amplifiers. The best preventative for this type of trouble is sufficient low-frequency filtering. Choke coils are not particularly effective at frequencies of the order of a few cycles per second. Consequently it is good practice to employ resistance-capacity filters to obtain the necessary degree of isolation between stages. This type of circuit is made more necessary due to the fluctuation of the plate current of the push-push tubes. Thus, the voltage across the first filter condenser may vary as much as 50 volts during operation. This variable component which may be of the order of one or two cycles per second, must be filtered out of the plate, screen and control-grid supply of the first tube. For this reason the separate resistance-capacity filters for plate, screen and control grid have been employed. Since the change in screen voltage has considerably more effect on amplification through equal changes in plate voltage, it is essential to filter this lead more completely than the plate. In some cases it may be necessary to increase the values of condensers at A and B to 8 mfd.

Due to the numerous high-resistance filters employed, it is obviously impossible to use a voltmeter for testing more than a few filter voltages. This is, therefore, an excellent example of a circuit that can only be properly analyzed by the resistance measurement method of servicing.

Special Precautions

There are a number of precautions that should be taken in the design of this amplifier. They are as follows:

1. All tubes, in particular the 82, should have plenty of ventilation.

2. It is a wise precaution to mount all tubes vertically.

3. All condensers should be well removed from hot tubes or transformers.

4. The input transformer T-3 should be removed as far as possible from the rectifier circuit and should be rotated to the position of minimum pickup.

5. All grounds should be brought to one point and then tied to the ground wire.

6. All metal cases, cores, etc., should be separately tied to the ground wire.

7. None of the leads of the signal circuits should be cabled unless they have been by-passed outside the cable. Thus, as indicated in the diagram (1), (2), (3) and (4) may be cabled while (5), (6) and (7) should not be included in the cable.

8. The output impedance must always be equal to or greater than the load impedance for which the output transformer is designed. Otherwise the output tubes may draw excessive plate current and be destroyed.

9. All filament leads should be twisted. It is also good practice to run them in copper braid which is grounded.

Loudspeaker Considerations

It is quite true that a Class B public-address system of this type may be used with the usual type of dynamic speaker the impedance of which varies considerably with frequency. It is best from the viewpoints of results and safety to both tubes and speaker, to use dynamic reproducers with substantially flat impedance characteristics. A number of manufacturers have placed upon the market speakers specifically designed for Class B work.

As to the number of speakers which may be employed, it would be best to re-read the article, "P-A. System Design" in the July issue of Service. This article likewise covers the matter of impedance matching which is decidedly important.

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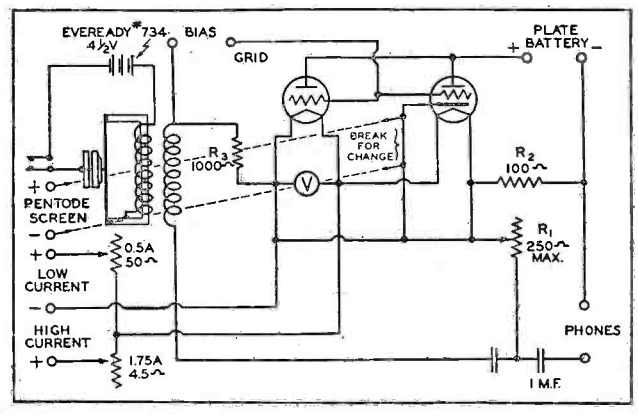
Measuring Pentodes With G.R. Mutual-Conductance Meter

The Type 443 General Radio Mutual-Conductance Meter, developed several years ago for testing triodes, can be used equally well with four-element tubes. After a minor modification, both heater-type and filament-type pentodes can be measured.

The modified schematic diagram of the mutual-conductance meter is shown in Fig. 1. The dotted lines show the change in wiring necessary to make the Type 443 suitable for measuring pentodes. It will be seen that the cathode circuit has been broken and its two ends connected to two new binding posts. These posts are marked + and — Pentode Screen.

For the measurement of the heater-type pentode tubes the two posts referred to above should be shorted, and battery connections are made as if a screen-grid tube were being measured.

The screen grid of a filament-type pentode is connected to the prong corresponding to the cathode of heater-type pentodes. Tests have shown the necessity for a source of voltage for the screen separate from that for the plate in the filament-type pentode, such as the '47. The connections for the screen grid are, therefore, made to the two new binding posts indicated in the diagram.



The dotted lines in this diagram show the change in wiring necessary to make the Type 443 Mutual-Conductance Meter suitable for measuring pentodes

Short Waves . . .

Philco Models 4 and 4C

These two models are Short-Wave Converters, and differ only in the cabinets employed. It will be noted from the schematic diagram that the changing of wavebands is accomplished by a change in the capacities of adjustable condensers rather than a switching in and out of sets of coils.

The Converters are designed to operate on an intermediate-frequency of 1,000 kc., which means that the broadcast receiver with which the Converter is used should be tuned to 1,000 kc. Since there are broadcast stations operating on and near 1,000 kc., a trap circuit (17) is included in the antenna circuit to suppress interference.

The frequency coverage for each switch position is given in the schematic diagram. A sketch of the underside of the chassis is also shown, with the location of each part designated.

Servicing Data

The tube socket readings are given in Table 1. These readings should be taken from the socket terminals, using a 1,000-ohms-per-volt voltmeter. A set tester cannot be used either for voltage or plate current readings because of the effect of the long leads through the set tester cord.

Under no circumstances should any attempt be made to adjust the compensating condensers in the field, unless proper equipment is available. The adjustment is extremely critical.

When adjustment is necessary use a modulated oscillator, accurately calibrated at 3,600 kc. (Should be electron-coupled or crystal-controlled type). The various harmonics and image frequencies of the oscillator signal are used to adjust the compensating condensers at the different short-wave dial settings. If the oscillator is off frequency, the harmonics and image frequencies will be off correspondingly.

For adjustment proceed as follows: Remove Converter from its cabinet. Connect it to the broadcast receiver in the usual manner, with the ground wire connected and the aerial disconnected. It is important that the broadcast receiver be accurately calibrated at 1,000 kc. and that the dial be set exactly at this point.

For adjusting at 3.6 megacycles on lower scale, place the oscillator in operation and couple it with a wire to the antenna connection of the Converter. Be sure that the oscillator is grounded. Set the dial at 3.6 megacycles on the lower scale and set the frequency-control switch of the Converter in its proper position. Carefully adjust the "3.6 L" compensator, shown in the accompanying sketch, by means of a fibre wrench (Philco part 3164), until maximum signal is heard in the loudspeaker. It may be necessary to reduce the oscillator output by removing the oscillator from the coupling wire in order to obtain a faint input signal, the maximum strength of which can be readily determined by ear.

TABLE 1

Tube	*Plate Volts*	*Screen Volts*	*Grid Volts*	*Cathode Volts*
Det.*	25	25	.3	0
Osc.*	110	—	.1	0
Rect.	(170 volts on each plate)			

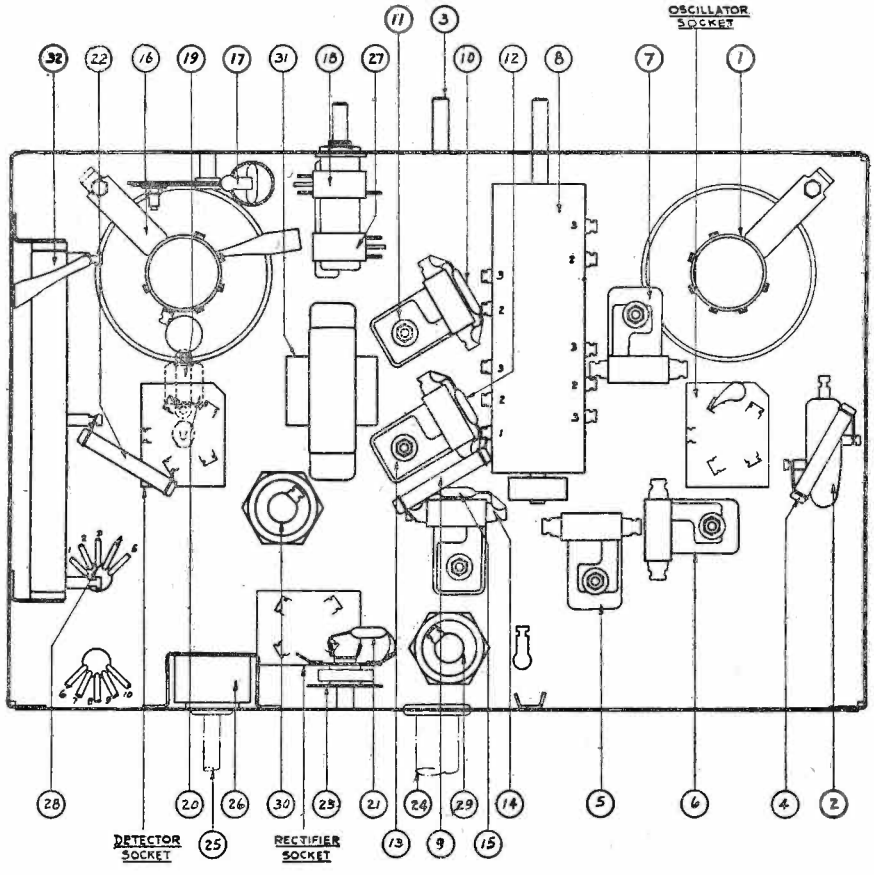
*Filament voltage, 2.4.

For adjusting at 1.6 megacycles, set the dial at 1.6 megacycles and adjust the "1.5" compensating condenser in the same manner as described above.

For adjusting at 7.2 megacycles, set the dial at 7.2 mc. and set the frequency-control switch in its proper position for the middle dial scale. Connect the oscillator output direct to the antenna terminal of the Converter. Adjust the "8.5 M" compensating condenser for maximum output in the loudspeaker.

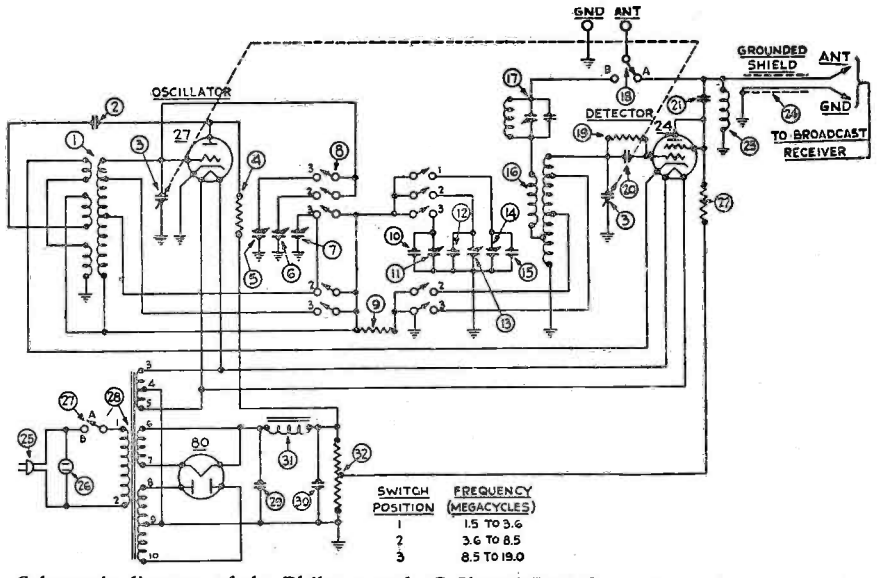
For adjusting at 3.6 mc. on middle scale, turn the dial to 3.6 mc. and adjust the "3.6 M" compensator.

For 18 megacycles, set the dial at 18 and the frequency-control switch in its corresponding position. Adjust the "19" compensator. More than one signal will be heard as the adjustment is being made. Be sure to adjust for the one which is heard second as the compensating condenser capacity is reduced from its maximum (adjusting nut all the way in). When this adjustment has been made correctly, the oscillator signal can be heard at 18, 16, 14.4 and 12.4 megacycles. This adjustment is the most critical of any, and will require more care in getting the correct point.



No.	Description	Part No.
(1)	Oscillator Coil	03733*
(2)	Bypass Condenser (.05 mfd.)	3615-M
(3)	Gang Condenser	03692
(4)	Resistor (13,000 ohms)	3766
(5)	Compensating Condenser (19 mc. end of top scale)	04000-E
(6)	Compensating Condenser (8.5 mc. end of center scale)	04000-E
(7)	Compensating Condenser (3.6 mc. end of bottom scale)	04000-E
(8)	Frequency Control Switch	03751
(9)	Resistor (240,000 ohms)	3768
(10)	Condenser (1250 mmfd.)	5886
(11)	Compensating Condenser (8.5 mc. end of top scale)	04000-F
(12)	Condenser (800 mmfd.)	5878
(13)	Compensating Condenser (3.6 mc. end of center scale)	04000-F
(14)	Compensating Condenser (1.5 mc. end of bottom scale)	04000-F
(15)	Condenser (250 mmfd.)	3082
(16)	Detector Transformer	03731
(17)	Frequency Filter	03662
(18)	Antenna Switch (plus 27)	5796
(19)	Resistor (2 Megs.)	03879
(20)	Condenser (110 mmfd.)	03879
(21)	Condenser (250 mmfd.)	3082
(22)	Resistor (99,000 ohms)	3767
(23)	R-F. Choke	03103
(24)	Shielded Cable	L-1278
(25)	Power Cord and Plug	L-943-A
(26)	Outlet Receptacle	5439
(27)	On-Off Switch	5796
(28)	Power Transformer (50-60 cycles)	5785
	(25-40 cycles)	5786
(29)	Electrolytic Condenser (6 mfd.)	4916
(30)	Electrolytic Condenser (6 mfd.)	4916
(31)	Filter Choke (50-60 cycles)	4951
	(25-40 cycles)	5930
(32)	Tubular Resistor (9500 ohms; c. t.)	

* Includes matched oscillator coil and detector transformer



Schematic diagram of the Philco 4 and 4C Short Wave Converter. The numbers in this diagram correspond to the numbers on the chassis and in the parts list on the opposite page. The voltage data for the three tubes is given in Table 1

When adjusting at 8.8 mc., turn the dial to 8.8 and adjust the "8.5 H" compensating condenser in the same manner as described above.

In some cases it may be necessary to reset the 1,000-kc. wavetrap (17) in the antenna circuit. If it is impossible to find a point between 950 and 1,050 kc. at which interference is not heard, the wavetrap should be readjusted by means of the fibre wrench until the interfering station is tuned out.

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Zenith Peak Frequencies

Zenith Models 210-5, 211-5 and 270-5 Standard and Long Wave Receivers, with a range of 200 to 2,100 meters, have an i-f. peak frequency of 125 kc.

Models 210 and 220, covering the range of 200 to 550 meters, have an i-f. peak frequency of 175 kc.

The Standard and Short Wave Models 250, 260 and 272 have an i-f. peak frequency of 175 kc. for the standard band and 1,000 kc. for the short-wave bands.

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Noise-Reducing Aerials

Transposition aerials (see June SERVICE) and shielded transmission lines (see article in this issue) are being extensively employed for the reduction of man-made interference occurring in the broadcast bands. The same systems may also be employed for noise reducing on the short-wave bands, though a bit of revision is necessary.

The transposition aerial is employed commercially for short-wave reception, and generally consists of a single wire running in a straight line—or as near to a straight line as local conditions permit—and broken in the center. At this point an insulator is inserted, so that there exists two aerials rather than one.

Two leads are brought down to the receiver, one from each of the aerial wires, and these leads are spaced about a foot apart and transposed every 15 inches, That is, the two leads cross each other every 15 inches so that they are "continually out of phase." Square sheets of insulating material or insulating spacers are used at the points where the wires are transposed. The result is a sort of criss-crossed feed line.

This feed line, instead of connecting directly to the antenna and ground posts of the short-wave set, has a 400-ohm resistor in series with each lead and the other terminals of the two resistors connect to a coil made up of about 5 turns of wire. This coil is coupled to the secondary coil of the antenna transformer in the short-wave set. No ground connection is used as a part of the antenna system.

This form of aerial is directional. Reception will be maximum at right angles to the run of the aerial. Thus, if the aerial points north and south, the best reception will be from the east and the west.

(*Arthur Lynch, Radio-Craft, Sept.* 1932)

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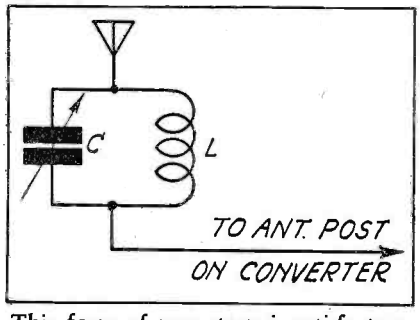
I-F. Interference

One of the major complaints heard here in the East about short-wave converters, at least the early crop, is that broadcast-station interference upon the converter i-f. peak is very pronounced. In due justice to those units which are equipped with trap circuits tuned to the i-f. frequency, let it be said that the reason for the complaint is the absence of such a trap circuit.



This form of wave trap is satisfactory for the elimination of an interfering signal of broadcast frequency which falls on the i-f. frequency of the short-wave converter. The coil and condenser should be mounted in a shield

Fortunately for all concerned, the circuit is assembled with little trouble and once adjusted requires no further attention. The trouble is equally rampant with converters with i-f. peaks at either 1,000 kc., or thereabouts, or at 550 kc. With the broadcast receiver tuned smack on the nose to the 1,000 kc. signal, very little stray capacity in the converter is required to enable the passage of a 1,000-kc. signal from the aerial attached to the converter into the set, thus ruining all hope of listening without broadcast-station interference. This is particularly true if the station operating at the frequency employed is the intermediate frequency for the converter, and is nearby and powerful.

The circuit attached herewith illustrates the application of the filter which is arranged as a parallel resonant trap in the aerial circuit of the converter. The trap circuit finds application despite the provisions usually incorporated to allow changing of the converter i-f. peak over a range of perhaps 50 kc. either side of the rated intermediate. The following data is prepared for trap circuits to be tuned to any one of the frequencies named with a .00035-mfd. condenser, utilizing about 50 per cent of the capacity in the condenser. The frequencies are 1,500 kc., 1,100 kc., 1,000 kc., 650 kc. and 550 kc. The trap is located close to the converter antenna post and should be shielded. If desired, it can be connected within the converter, between the aerial post and the short-wave coil connection thereto. All forms are 2 inches in diameter and all coils are wound with No. 32 DCC wire. No spacing between turns. Approximate capacity to be used is .000175 mfd. Since the condenser is variable, the required adjustment may be made.

For 1,500 kc. use 36 turns.
For 1,100 kc. use 45 turns.
For 1,000 kc. use 49 turns.
For 650 kc. use 91 turns.
For 550 kc. use 111 turns.

To adjust the trap circuit, wire into circuit and set condenser to about half of maximum capacity. Now make the b.c. receiver most sensitive to intermediate frequency adjustment. Tune exactly to the short-wave i-f. frequency. Note the presence of the interfering station and readjust trap accurately until the station is tuned out. It must be understood that the trap circuit suggested is for the elimination of the broadcast station operating upon the short-wave converter intermediate frequency and not for short-wave stations which may interfere with other shortwave reception.

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Socco!

What this country needs is a good self-healing milliammeter.

•

Ha Cha

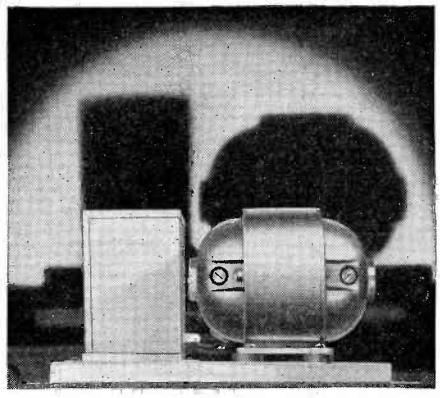
A broadcast listener phoned us and said that his new 1933 set went on the blink and now he gets nothing but muting!

Auto-Radio . . .

Carter Genemotor Data

The Genemotor consists of a motor, which operates direct from the storage battery in the car, coupled to a d-c. generator. The generator feeds into a double filter (to the left of the motor-generator in the illustration) which employs chokes and condensers.

Under most conditions the Genemotor draws less than 2 amperes from the storage battery, but this of course varies to a certain degree, depending on the milliampere drain of the auto radio receiver with which the Genemotor is used. With a receiver drain of 30 ma. the standard model Genemotor will draw 2.2 amps. from the storage battery with 180 volts output, and 1.7 amps. at 135 volts output. On other models of the Genemotor the storage battery drain is 1.94 amps. and 1.65 amps. respectively. The percent of regulation in practically all cases is 88%.



The Carter Genemotor. The double filter is in the case to the left of the motor-generator

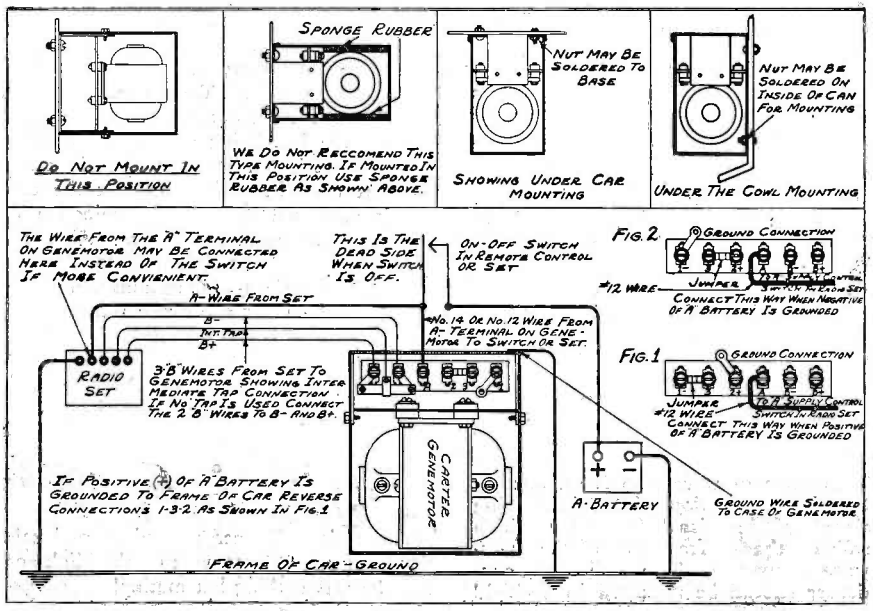
INSTALLATION

Genemotors 4680A and 4635A weigh 11 pounds and measure 4½ by 6½ by 6 inches. Genemotors 680A, 633A, and 6680 weigh 14 pounds and measure 5 by 5¾ by 9½ inches. They may be mounted in any desirable location in the car—except in the engine compartment—but should be attached so that the motor-generator hangs down. The correct and incorrect ways of mounting are shown in the accompanying sketch. Figs. 1 and 2 of this sketch indicate the connections to the connector strip when the positive lead of the storage battery is grounded, and when the negative lead is grounded. The same sketch as referred to above also shows the complete connections for a typical installation job.

Since many auto radio sets were originally designed to operate on 135 volts "B," the set will naturally be more sensitive, and the noise level between stations will be more apparent, particularly on superheterodynes, if a 180-volt Genemotor is used. Likewise, due to increased screen voltage, the set will tend to oscillate. In such a case, either use a 135-volt Genemotor, or adjust the intermediate tap on the 180-volt Genemotor to the proper voltage by altering the position of the sliding contact on the voltage-divider resistor. Obviously, the same results can be obtained by increasing the values of the screen resistors in the set, if such resistors are used. And a resistor may be used in series with the 180-volt tap and the receiver if this voltage must also be reduced.

Radio sets having only two "B" wires do not, of course, require an intermediate tap at the Genemotor, as the necessary voltage-reducing resistors are in the set. In such cases merely disregard this tap, but do not remove the resistor. Sets having three "B" wires require the intermediate tap, which is set at the factory at 90 volts on the 180-volt Genemotors and at 67½ volts on the 135-volt Genemotors. Usually these are the proper settings and should not be varied unless the set fails to operate properly. To change the intermediate voltage tap, loosen the screw that holds the contact on the resistance unit and move the contact to a position where the best results are had from the receiver. Then tighten the screw so that the contact cannot vary its position.

Connection and installation details for the Carter Genemotor. Note in particular the terminal connections shown in Figs. 1 and 2



Janette Auto "B" Diagrams

We have received word from the Janette Manufacturing Company, 556 West Monroe Street, Chicago, that Service Men may obtain upon request diagrams showing the method of installation of the Janette Auto-B-Power on Majestic, Philco, Delco and Atwater Kent auto radio sets.

There are two diagrams for each type of set, one showing method of installation where the negative car battery lead is grounded, and another showing installation where the positive car battery lead is grounded.

Diagrams covering other makes of auto radios will be issued shortly.

Reducing "C" Battery Voltages

It is customary to reduce "B" battery voltages by means of a series resistor. The voltage drop developed across the resistor reduces the voltage effective at the unit connected to the resistor, as for example the screen grid or plate of a tube. However, the same is not true in "C" bias circuits, for the simple reason that current does not flow in the circuit. Hence, there can be no voltage drop across the series resistor. The most effective method of reducing "C" bias voltages is to arrange "bucking" voltages. Thus, if a "C" voltage of about 16.5 volts is required and the battery available provides 22.5 volts, another 6-volt "C" battery, with polarity reversed, can be connected in series with the 22.5-volt lead and the final voltage will be 22.5 minus 6, or 16.5 volts. When arranging such bucking batteries, the minus lead of one is connected to the minus terminal of the other. The plus terminal of the bucking battery then becomes the minus terminal of the system. The final voltage is equal to the smaller voltage subtracted from the greater voltage and the polarity of the voltage supply is that of the greater voltage.

The opportunity for such a circuit arrangement may arise in connection with automobile and other types of battery-operated receivers.

Interference Helps

Some Buick cars do not have the windshield grounded. Grounding the windshield as well as the metal pieces at either end will be found helpful.

In Chevrolet cars, other than the latest models, it might be well to bond the rain spout to the chassis. Bonding at several points is preferable to a single point.

If you are confronted with the bonding of an aluminum plate, which under normal conditions cannot be soldered, drill a small hole in the shield and rigidly attach a brass screw. You can then solder to the screw.

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Instantly tells the resistance value of any resistor according to the R. M. A. Color Code.

SERVICE LABELS
For placing in back of sets to properly record the job and leave your own reminder-ad.

FOOTBALL and World's Series! Every radio fan agog! And, those sets that have seen summers and winters of service are beginning to show the strain.

Resistor replacements are in order in thousands of cases. Set owners rely on you for getting *results* and you must be sure of the parts that give *results.*

We've made everything *simple, sure* and *profitable* for the Service Man. "Protect-O-Packed" Resistors to keep wire-leads straight, resistance value and brand name stamped on each piece, publicity to popularize resistor importance — these, and many other features are back of OHIOHMS.

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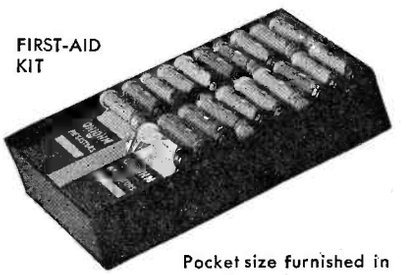

Pocket size furnished in 1-watt and 2-watt types.

SPARK SUPPRESSOR SETS

For eliminating ignition interference on auto radios

OHIOHM

ON THE JOB . . .

FIRST PRIZE

TONE QUALITY—SATISFIED CUSTOMERS

By A. M. Hayes

It has been our experience in the last few years of over-production, inflation and consequent failures of our business houses that even though it has brought about forced economies on the part of the receiving set owners, who are our largest number of customers, it has not decreased the desire for natural tone quality. With this fact as a basis to work on, we have been enabled to make a good many honest dollars by continually bringing it to the attention of our customers.

The sales field is unlimited for the Service Man along this line. We have found it to be composed of the owner who has a beautiful piece of cabinet work containing an obsolete receiver, having very poor selectivity and distorted tone; also the owner who has a receiver which is fairly modern but does not give the full timbre of tone which is so desirable.

It would seem that most receiver owners have adopted the attitude of "whatever your faults may be, I love you anyway," as far as his particular set is concerned. This attitude is formed because the cabinet fits into his home furnishings scheme in a particular spot or fashion, and because he has become used to its tuning and volume control peculiarities. It may be that when he bought the receiver it was perfection in tone quality, and his ear has become so accustomed to it, he still believes it to be perfect. This is the sales resistance which must be broken down, and it can only be done by direct appeal to his ears through the demonstration of a complete receiver of modern design, having perfect tone quality (as far as the ear can detect) or a demonstration of how his present receiver can be improved upon to bring it up to the present high standard.

Up to the present time there are only a few production receivers which, to our critical ears, can be used for a convincing demonstration of true tone, and we have adopted one in particular as our standard.

When we go out to make a complete receiver demonstration, we take the chassis of our adopted "standard" with its dynamic speaker fastened to a two-foot square baffle. The demonstration is made convincing by first playing the owner's set and then our "standard" set, calling his attention to lack of low tone and smoothness in his own set as compared to the "standard." In the majority of cases the difference is so great that there is no room for doubt on the owner's part as to the real beauty he has been missing in the radio programs. This generally results in the sale of the demonstration chassis and speaker with its installation in the owner's cabinet, giving him a modern receiver for well under a hundred dollars which cannot be surpassed in tone quality and performance by complete receivers costing three times as much.

For the owner who cannot afford a new set we demonstrate how his present receiver can be brought up-to-date at a slight cost. One demonstration in particular which has made many sales is due to the condition—especially in earlier receivers using two a-f. stages with a '27 in the first a-f. and a cathode bias resistor in this circuit—where there is inadequate bypassing of the bias resistor (mostly for the sake of economy) and its failure to pass the lower frequencies. To demonstrate the failings of this condition we make an adapter to reach the cathode connection at the socket, and with the receiver operating we show the difference in tone by placing an 8 mfd. condenser in series between cathode and "B" negative.

This is only one of several demonstrations whereby tone improvements can be shown by proper bypassing, as the improper condition extends to all other circuits in many of the earlier receivers.

Another convincing demonstration can be made in tone improvement where a receiver has no r-f. choke in the detector plate lead. Our method of illustrating this is a plate-break adapter which cuts in an r-f. choke which is bypassed to cathode.

The wide-awake Service Man can always keep busy and make money if he will adopt an honest policy in his servicing and sales, and push tone quality in receivers.

•

SECOND PRIZE

PROFITS IN NEW AUDIO CHANNELS

By C. L. Fairchild

I have arranged a portable audio system with dynamic speaker with the highest possible tone quality with the connections made so that it is possible to tap in at the output of the detector or first audio tube of any type receiver.

Whenever I am able to sell a customer on the idea of a real tone demonstration—and this is not at all difficult—I hook in the portable amplifier and "show up" the customer's set.

As soon as I feel that the customer has recognized the vast difference in tone, I explain to him that tone is largely determined by the type and quality of audio units used in a set. I finally get around to quoting him a price on a job which will make his set sound like the demonstrator. Usually just a change of a-f. transformers, or the use of larger tubes does the trick.

I have successfully closed alteration jobs running as high as $35 and these jobs have turned out to be the best form of business-getting for me, as the owner is bound to boast to his neighbors about the tone of his improved set.

I range these jobs from $12.50 up, according to what I have to install, and if times were normal I could keep one man busy on this work alone.

•

THIRD PRIZE

FORM A CLUB

By W. O. Barnet

Some time ago I decided that if I could gain the confidence of a group of young men it would greatly assist me in furthering my servicing business with the older people. This decision of mine was based on the time-worn, but truthful, saying, "What my son says goes."

Consequently, I started off with the names of about 15 energetic young men of high school age whom I knew to be interested in radio. To each of these young men went a letter, cordially inviting them to attend a ten-week session of one night a week, of radio classes. Everything free, of course.

The response was very good, and at the first meeting I saw to it that each young man became well acquainted with the others. The whole thing was handled just like the usual kind of radio club.

At each of these weekly sessions I gave them a lecture on radio, starting off with elementary electricity, and explaining everything in language they could understand. I had them ask questions, too, and they learned rapidly.

This little radio club idea has worked out splendidly, and I am starting my fifth class this coming October. The young men have not only transmitted their confidence in me as a "technical radio man" to their fathers but have advertised me outside their homes as well.

•

Five Years Hence

The High Vacuum Tube Company has just issued its latest 1,000-page catalog listing the various tubes manufactured by said company. The first five pages are given over to an explanation of how to find the tube you are looking for. Included in the catalog is the latest 20-pin tube, type 56789-A-TZ-219, which beats as it sweeps as it cleans.

ENTER THIS CONTEST

Every month SERVICE *awards prizes for the three best merchandising, sales or management ideas used by Service Men to improve or increase their business. First Prize, $7.00. Second Prize, $5.00. Third Prize, $3.00. Your idea may win. Send it in now!*

ABOUT COGNOVIT NOTES

We are indebted to Mr. R. W. Cutts, of Bloomington, Indiana, for his advice that Cognovit Notes are taboo in his State. Their use constitutes a misdemeanor punishable by a fine of $50 to $500 and/or imprisonment from one to six months.

Similar laws may hold in other States. Therefore, if you have any idea of using a Cognovit Note on your bills, check up on the local laws first.

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Models—Lyric 90, (25 cycle); Lyric 90, Lyric D & H.

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Models (superheterodyne) 10, 20, 36, 37.

ATWATER-KENT
Models 37, 38, 55, 55-C, (late model) 55, 55-C; (early models) 60, 60-C, H-1, H-2, L-1, L-2, 82, 85, 82-F, 85-F; (early and late type) 84-F, 80, 83, 80-F, 83-F, 87, 89, 89-P, 89-F, 66.

BOSCH
Models 29, 825.

BELMONT
Models 41, 41-A, 47, 50, 51, 51-A, 51-B, 70, 71. (25 cycle) 42, 42-A, 48, 72.

BRUNSWICK
Models (60 cycle) 14, 21, 81, 82, S-14, S-21, S-81, S-82; (Chassis D) 12, 12-A 16, 16-A, 18, 18-A, 33, 33-A, 10; (25 cycles) 14, 21, 81, 82, S-14, S-21, S-81, S-82; 2KR0, 3KR0, 3KR6, 5KR, 5KR0, 5KR06.

COLUMBIA
Model SG-8.

CROSLEY
Models (Chassis 73) 40-S, 41-S, 42-S, 82-S.

EARL
Models 31, 32, 32-S, 41.

EDISON
Models (Chassis JR and JC) R1, R2, C2.

EVEREADY
Models—Series 30, 40, 50.

FREED
Models 65, 78, 79, 79-S, 90, 95.

FREED-EISEMANN
Model NR-85.

FRESHMAN
Models Q15, Q16, 3Q15, 3Q16, QD16S.

GENERAL ELECTRIC
Models H-31, 51, 71, T41C.

GENERAL MOTORS
Model Chassis S9A.

GRAYBAR
Models 310, 311, 700, 770, 900.

KELLOG
Models 523, 526.

KENNEDY
Models 10, 20.

KOLSTER-BRANDES
Models K20, 22, 25, 27, 37, 24, 36, 43, B15, 16.

KOLSTER-COLUMBIA
Model 950.

MAJESTIC
Models 90, 9P6, 180, 8P6; (plate) 70, 7P6; (filament) 70, 7P6; (plate) 180, 8P6; (filament) 50, 15-A, 90-B, 100-B. Chassis 20 unmounted 21, 22, 23, 130-A, 230-A. Unmounted 25, 25-B.

PHILCO
Models 20, 65, 76, 77, 82, 86, 87, 95, 96, 296, 11, 211. For 245 tubes 112, 212. Using 247 tubes 112, 212. 70, 270; (60 cycle) 511, 521, 531, 541, 551 561 571; 511-A 521-A 531-A, 541-A, 551-A, 561-A, 571-A, 581-A.

RCA RADIOLA
Models 80, 82, 86, 60, 62, 44, 46, 47; (60 cycle) 18, 17, 33, 51, 64, 67, 66, 48; (25 cycle) 42, 48.

RCA-VICTOR
Models R-32, R-52, R-35, R-39, RE-37, RE-45, R-75, 7-11, 7-25, 9-18, 9-54; (25 cycle) R-15.

SILVER-MARSHALL
Model Sheridan 750.

SPARTON
Models 931, 589, 89-A, 301, 410, 420, 25, 26, 26-AW.

STEINITE
Models 40, 59, 102, 40-C, 41-C, 60-C, 102-C.

STEWART-WARNER
Models (Series A & B 60 cycles) 801, 801-A; (Series A & B 25 cycles) 811, 811-A.

STROMBERG-CARLSON
Models 641, 642, 652, 654, 846, 848, 10, 11.

TEMPLE
Models 8-60, 8-80, 8-90, 8-61, 8-81, 8-96.

UNITED AIR CLEANER
Models 108, 108-A, 110, Sentinel 104.

TRAV-LER
Model B.

WESTINGHOUSE
Models WR-4, 5, 6, 7; (25 cycle) WR-4.

ZENITH
Models 50, 60, 70, 10, 11, 12.

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THE FORUM . . .

About "Two-Speaker Sets"

Editor, SERVICE:

I have read with interest in the June issue of SERVICE the abstract on page 132 entitled "Two-Speaker Sets."

It appears to me that a person not well versed in the science of acoustics might easily assume from this abstract that the 3 db. increase in efficiency, due to the use of two loud speakers, extended over the entire frequency range. As a matter of fact, in the original article dealing with this matter (Wolff, *Physical Review,* June, 1929), it was shown that the theoretical gain to be expected from two 8" diaphragms, in contact, over one such diaphragm, was zero above 350 cycles. Measurements that we have made in this laboratory have indicated that the gain extended somewhat above this frequency, possibly to 700 or 800 cycles, for reasons which we have as yet been unable to determine. We have quite positively concluded, however, that there is no gain above 700 or 800 cycles.

The *Electronics'* article appears to have been condensed for publication from a longer original paper. It seems probable that this and the further abbreviation occurring in your abstract would tend to omit some qualifying statements that would safeguard the reader against the idea that the efficiency may invariably be doubled over the entire frequency range by the use of an additional loud speaker.

The last paragraph in the abstract is, I believe, incorrect as it stands, because there is a flow of air from one speaker to the other, only in cases where the diaphragms are out-of-phase or where they differ greatly in size.

BENJ. OLNEY, *Acoustical Engineer,*
STROMBERG-CARLSON TEL. MFG. CO.

•

Charges and Profit

Editor, SERVICE:

We have been asked the question, "What is a Rightful Service Charge?" One man replies that his charge is only one dollar per hour and seems to infer that he cannot charge more because the plumbers and bricklayers in his town only charge that much. He admits that the plumber charges for time to and from the shop yet says that, personally, he does not. Why? Is not his time as valuable to his clients as is the plumbers' time?

I'll bet that every Service Technician worthy of his name is occupied with the problem of the probable defect in his client's radio from the moment he receives the call until the defect is eliminated, for certainly, when receiving the call, he will make inquiry as to the make and model, and whether or not the radio is only weak, or noisy, or stone dead.

Does the plumber do as much? Perhaps he does—but even if he did not, he would still be entitled to remuneration for time spent in preparation for making the repair, which includes traveling to the place where repair is needed. And, having completed the repair, he cannot well afford to abandon his bag of tools, but must return them to his base of supplies for use on subsequent calls.

Radio servicing, having become a highly technical profession, requires that the Service Man who would keep abreast with his profession, to study and experiment constantly, buy or build the most advanced servicing equipment, provide himself with complete sets of circuit diagrams and service information on all makes and models of radios, and maintain a fairly complete stock of tubes and replacement parts for the more commonly used models, which always includes the latest.

In addition to the technical part of the profession are the business and ethical parts. These latter, consisting of the bookkeeping in connection with the records of repairs and other services, the computation of charges and the collection of accounts, the records of cost in materials and time, and the professional ethics involving personal contact with customers, and relations with brother Service Men, manufacturers and dealers, also consume time and require constant study and revision to meet the needs of the growing art.

Therefore, the Service Man who would give honest and efficient service to his clients must first invest considerable in thought, in time and in equipment and supplies. Experience is a valuable and absolutely necessary asset. It costs him money to render service, and it costs him more to keep prepared for rendering service. It has already cost him much to acquire his experience.

If, after making all of these expenditures, of time in patient study, for parts and accessories with which to experiment, for text books, trade periodicals, and expensive tools and servicing instruments, he has fitted himself for the job of making that sick radio sing again, is he not entitled to a professional fee for his services on a par with a doctor's fee?

Even though the patient is incurable, as he sometimes is, the doctor has used his well-earned knowledge and skill in an honest effort to effect a cure. So, also, has the Service Technician used his equally well-earned knowledge and skill in an effort to correctly diagnose and eliminate the defect in the radio.

It has been said that the Service Man sells time and knowledge, and that these are his stock in trade. His services are entirely professional and his one purpose is to get the radio working as it did originally. To accomplish this is sometimes only a few minutes work after he has arrived on location. Sometimes it takes several hours.

No standard scale of prices for his services has ever been set, nor can be set to adequately fit the individual call. In many cases the repair bill, if computed at a flat rate per hour, would be greater than the value of the radio repaired.

However, it is fast becoming standard practice to set a flat rate per hour upon all calls, plus the list price of materials and parts used, the minimum rate being for one hour, and the time being computed from the time of departure from the shop until returning thereto. The rate per hour actually charged seems to vary between $1.50 and $2.50 in the majority of reports, appearing in the trade papers, which have been noticed by the writer.

Upon entering the profession of radio servicing, a little less than three years ago, the writer decided that one dollar per call, plus fifty cents an hour for more than one hour, was about all that his clients could stand. At the end of the first year he found he had cleared the magnificent sum of $13.97 over and above the cost of equipment, and not counting the sum of $13.25 in unpaid customer accounts. So he raised the ante to a flat rate of $1.00 per hour and, at the end of the second year, had cleared the tidy fortune of $109.38, not counting unpaid customers' accounts totaling $40.15.

By this time several of his customers had new radios with pentode tubes and various other troubles, including oscillators and automatic volume controls. New test equipment was absolutely necessary. So he invested an even $300 more and shoved up his rates to $1.50 per hour, plus materials, and with a minimum charge of $2.00 per call.

After the first nine months of the third year he finds that he still owes $133 for his test equipment, and that he is owed $118.65 on outstanding customer accounts. He hopes to have his "budget balanced" by the end of the third year, but is becoming a little skeptical. With six-prong tubes at hand and seven-prongers promised for the near future, it looks as though the only fellow who can profit at radio servicing is the manufacturer of servicing equipment.

The writer's guess is that if we Service Technicians are to stay in the profession, and if we desire to elevate and maintain the profession at a standard above that of a plumber or bricklayer, we may have to charge as much as $5.00 a visit, or else refuse to answer calls on radios which are equipped with tubes having more than seventeen grids per tube and three or four automatic volume controls.

At the same time the writer acknowledges the fact that multiple grid tubes, refined methods of volume control and noise suppression, with their attendant and more or less complicated circuits, will do much to raise the standards of the servicing profession by eliminating the quacks and cut-rates from the field, and by making it absolutely essential that the Service Technician, so-called, be that in fact and not merely in name. He is bound to answer many calls where the substitution of new tubes will not make the radio play any the better nor satisfy the client.

M. K. BARBER,
Fort Ethan Allen, Vermont.

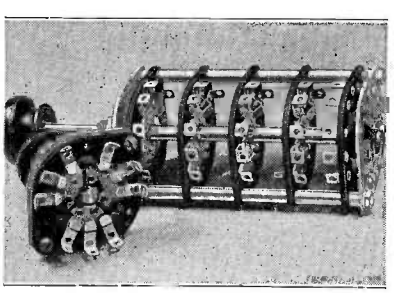
THE MANUFACTURERS . . .

Oak All-Wave Switch

The Oak Manufacturing Company of Chicago have announced a particularly worthy wave-changing switch for short-wave receivers and converters. This switch is minus many of the disturbing inadequacies of numerous switches of this type and seems to have had placed upon it a generous amount of engineering study before the final design was reached.

One of the features may be referred to as "noiseless switching." However, this phrase does not exactly cover the situation, as the switch is equally as noiseless when in a state of rest. This suggests an absence of any high-resistance contacts. This is accomplished by the utilization of silver-plated contacts of such shape and design that they bite into the surface of the contact rotor, removing all foreign particles (such as good old household dust) from the contacting surfaces and providing a connection reputed to have a resistance below one-thousandth of an ohm.

A simple stopping mechanism is provided which brings the switch to a very definite stop at the position of contact and yet allows the knob to be easily turned to the



next contact. This stopping mechanism is not a part of the functioning of the contacts, but rather is a separate unit.

The switch is so constructed that any conceivable switching circuit can be embodied with a minimum number of sections, and hence a minimum cost. As many as three poles can be placed on one rotor.

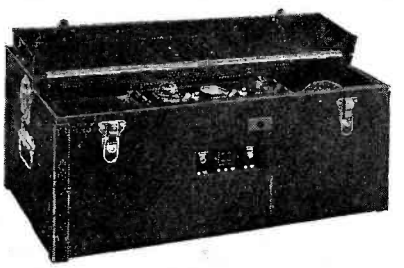
The dimensions of this switch are 1-3/4" by 2-5/16" and it can be mounted below a 2-inch chassis using a single 3/8" mounting hole. A keying pin to prevent the switch from turning is also included. Length depends upon the number of switching sections required. The mechanical construction is sturdy and has the following features: Steel end-plates, 1/4" steel shaft, heavy brass side supports, brass bearings and silver-plated phosphor bronze contact clips. The stationary contacts are assembled on high grade bakelite insulation.

•

All-Purpose Power Amplifier

The new Model 17 Combination Power Amplifier Unit, just announced by the Operadio Manufacturing Company of St. Charles, Illinois, has a characteristic design of its own that allows plenty of flexibility in application.

Nearly every sound application—including airport, sound truck, amusement park and dance hall installations requiring up to 15 watts undistorted output—may be filled by this unit. An additional output stage may be had to boost the output up to 30 watts.



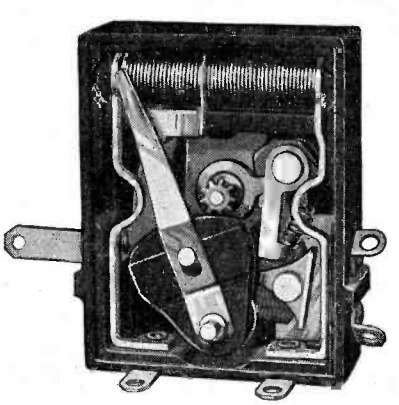
The control panel of the amplifier has provision for microphone, radio and phonograph inputs. Operating switches and volume controls for each input, an amplifier tone control, and all input connections are segregated on this separate unit that may be removed from the amplifier housing when remote control operation is desired. Extension cables up to 500 feet in length may be used without affecting the operation of the amplifier.

The amplifier and control box are normally mounted in a crystalac-finished metal case provided with carrying handles and snap cover fasteners. Ample ventilating provisions are made. The amplifier may be slipped out of the end of the case for inspection. Knock-out holes in the case provide for conduit wiring.

•

New Tapped Bradleyometer

A new tapped Bradleyometer is announced by the Allen-Bradley Company of Milwaukee, Wis., which provides automatic tone correction with volume control. It is well known that the sound pressure representing the threshold of audibility varies greatly with the frequency and is a great deal higher at low and high frequencies than in the middle register. Therefore a type of volume control is necessary which varies the frequency characteristics of the audio amplifier so that the apparent quality of reproduction remains the same for all volume control settings. The new tapped Bradleyometer achieves this result in any one of several audio-frequency networks and automatically accomplishes tone correction with volume changes.



The resistance element of the tapped Bradleyometer consists of 50 individual resistance steps molded in disc form and stacked alternately between metal discs of somewhat larger diameter. The contact arm makes contact along the edges of the large metal discs, and therefore the resistance units are not subjected to mechanical wear. A special tap on the resistance element is brought out to a fourth terminal. The network necessary to provide tone correction is usually connected between this tap and the grounded or low-potential end of the resistance element.

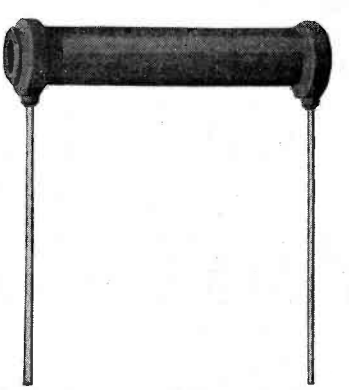
This new tapped Bradleyometer can be built up to provide any resistance-rotation curve, and in some designs each of the 50 steps may be different from the others. Controls can be provided with a logarithmic resistance-rotation curve to provide uniform decibel increments with knob rotation.

•

I.R.C. Power Wire Wound Resistors

A new line of Power Wire Wound Resistors has been introduced by the International Resistance Company for the Engineer and Service Man. These resistors are made in 3-watt and 5-watt sizes, and within the next few months there will be units made up to 100 watts in steps of 10, 15, 25, 50 and 75-watt sizes.

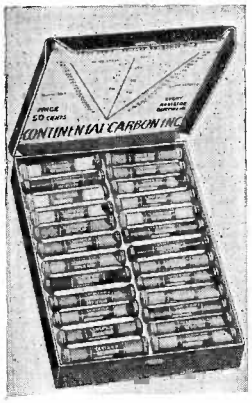
Particular attention, however, is being called to the 3-watt and 5-watt sizes at the present time. Both types have pigtails for ease in mounting, similar to the Metalized line of I.R.C. resistors.



Both the 3-watt and 5-watt I.R.C. resistors are made in this form, and differ only in size

The 3-watt resistor is made in ranges up to 5,000 ohms and the 5-watt resistor is made in ranges up to 15,000 ohms. These units were designed to meet the demand for a smaller resistor capable of dissipating high wattage. The 3-watt resistor is about the same size as the ½-watt Metalized resistor, and the 5-watt resistor is about the same size as the 1-watt Metalized resistor.

Everything you need to service resistor troubles—at a profit



Continental Resistor Replacement Kit

THE new Continental Resistor Kit has taken every bit of uncertainty and confusion from the repair of resistor troubles. You need every one of these helps to increase your profits from resistor repairs:

(1) Twenty-five Continental "Certified" resistors in a small handy size steel kit in the most used values to provide immediate replacements.

(2) The Resistor Combination Chart which shows graphically and without calculation how to combine standard resistors in parallel to form unusual values frequently needed.

(3) R.M.A. Color Code Selector to obtain instant identification of resistors by color marking.

(4) The new Continental Replacement Resistor Guide (now on the press) to specify exact replacements for all receivers, old and new.

This kit, complete with all above items is a remarkable offer. Get yours today, and start making money on resistor repairs. Use the convenient coupon at the bottom of the page.

Continental Resistor Kit—
Net to Servicemen $3.50

Continental "Certified" Suppressors

Spark Plug Suppressor Type S8

Distributor Suppressor Type T9

Screw in Cable Suppressor Type C10

USED by practically every large manufacturer of motor car radio sets, and recommended by leading motor car manufacturers, Continental Certified Suppressors likewise find equal favor with the serviceman.

Ease of installation, ability to withstand heat and vibration, and absolute elimination of noise from spark plug and distributor discharges are assured when you demand the genuine Continental Certified Suppressor.

Three convenient types are provided. Type S8 for spark plugs, Type T9 for Distributor lead, and Type C10 that screws into the ends of a cut ignition cable. This last type is very popular for use where space does not permit the use of the standard types. Supplied singly and in kits for 4, 6, 8, and 12 cylinder motors. List price, Continental Suppressors Types S8, T9 and C10..$0.50

CONTINENTAL CARBON Inc.

Use this coupon or write your jobber

Continental Carbon, Inc.
13900 Lorain Ave., Cleveland, O.

Canadian Plant,
Toronto, Ont.

Gentlemen:

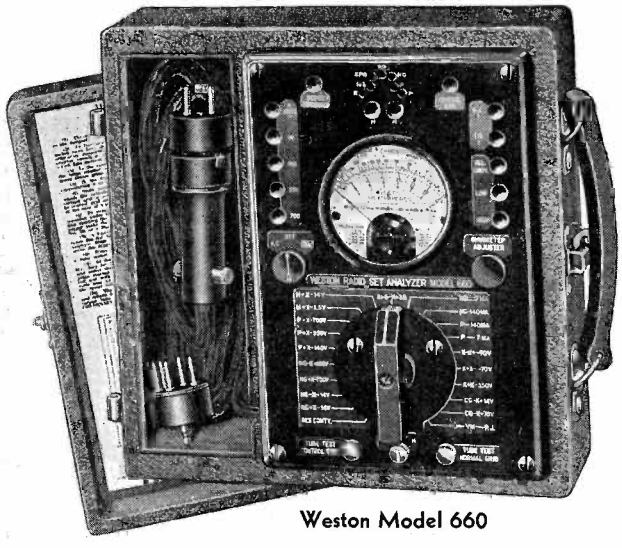
Please ship C.O.D., one Continental Resistor Kit, complete with R.M.A. Color Code, Resistor Combination Chart and card entitling me to the new Continental Replacement Resistor Guide.

Name .....

Address .....

My Jobber is .....

New ... A Weston Single Meter ANALYZER



Weston Model 660

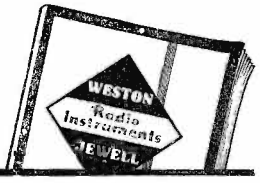
Every necessary socket voltage and current measurement, both A. C. and D. C., can be made on all modern receivers with this remarkable Weston Single Meter Analyzer.

Point-to-point tests are provided for with three resistance and ample voltage and current measuring ranges, available at pin-jacks on the panel. Full description is contained in the new Weston-Jewell catalog.

Pattern 675 Tube-Checker

A new, low-priced instrument that checks all present types of tubes without the use of adapters. Sixteen tube sockets are ingeniously arranged to occupy small space. Test limits for all tubes are etched on the instrument panel. Write for the Weston-Jewell catalog describing this great instrument value!

WESTON JEWELL



Weston Electrical Instrument Corp. } **604 Frelinghuysen Ave.**
Jewell Electrical Instrument Co. } **Newark, N. J.**

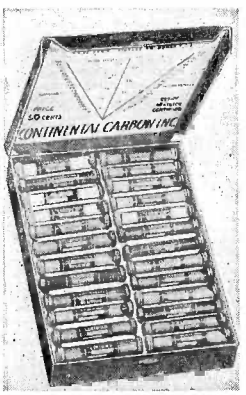
Please send me a copy o fyour new catalog listing the complete Weston-Jewell line of radio instruments.

Name .....

Address ..... **City** .....

Continental Replacement Kit

A new resistance replacement kit has just been announced by Continental Carbon, Inc., of Cleveland, Ohio. The kit contains 25 one-watt carbon type resistors, a novel resistor paralleling chart, an RMA color code



selector, and a resistor replacement guide . . . which makes it pretty complete.

The resistor paralleling chart is an ingenious diagram that allows standard resistors provided in the kit to be paralleled to form most any resistance values that may be needed for exact replacements.

The RMA color code selector is composed of three colored celluloid discs that may be revolved in position to indicate the color combination and corresponding resistance value of any standard RMA color code marked resistor.

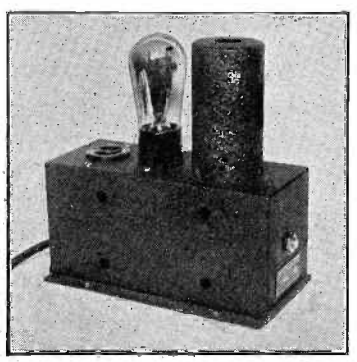
Included with each kit . . . we nearly forgot this . . . is a card which entitles the purchaser of each kit to the new Continental Replacement Resistor Guide, which will be available as soon as data is secured for the latest radio sets.

•

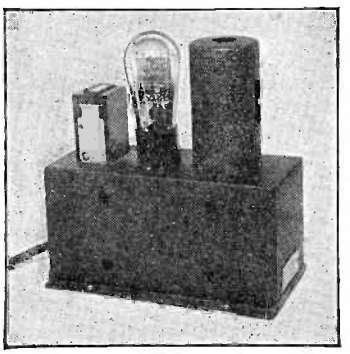
Photoelectric Equipment

The American Photoelectric Corporation of New York City have introduced some neat photoelectric equipment which has a whole list of uses.

First on the list is a Photoelectric Relay, employing a standard photoelectric cell, a '71-A amplifier tube and a relay with a current-carrying capacity of 25 watts, non-inductive load. The equipment is in a self-contained unit, and is designed to operate directly from an a-c. or d-c. 110-volt light



The A.P.C. Photoelectric Relay



The A.P.C. Photoelectric Counter

supply, or from batteries. In operation the unit consumes less current than a 40-watt lamp.

On the side of the case is a special adjusting screw whereby the unit may be set to operate at any desired light value. The relay may be had in either the normally open-circuit or normally closed-circuit types, as desired.

Second on the list is the A.P.C. Photo-

The A.P.C. Projector

electric Counter, which is the same in all respects to the Photoelectric Relay just described except that it is equipped with a four-digit (0-9,999) counter which is coupled to the relay, and will count passing objects at any rate up to 360 per minute.

And last but not least is the A.P.C. Type A Projector designed to meet the need for a small, compact light source for energizing photoelectric cells. This projector was designed particularly for use with the Relay and the Counter previously described, and the center of the light beam is at the correct height (6¼ inches from the base) to strike the photocell of either of these instruments without further adjustment.

The projector uses a 32-c.p. automobile lamp and under normal conditions will throw a sufficiently powerful beam to operate the Relay over a distance of 30 feet and the Counter over a distance of 20 feet.

The projector is equipped with a polished metal reflector and with a ground and polished lens which is adjustable to permit sharp focusing of the light at any distance. When desired, filter holders and infra-red filters can be supplied for this projector so that the light beam will be invisible.

The Type A Projector can be supplied for use on the following voltages: 110-120 volts a-c.; 110-120 volts d-c.; 6 volts battery supply.

•

ER-52 Tube

The Eveready Raytheon Tube Division of the National Carbon Company has announced the new ER-52 Dual Purpose Power Output Tube. This tube has been designed for use as a Class B amplifier in auto radio receivers or as a Class A amplifier in 110-volt d-c. receivers.

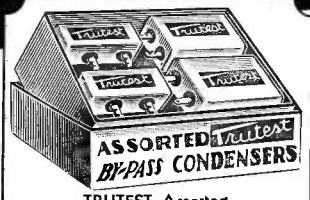
The widely different characteristics required for these two types of service are obtained by employing two separate grids which are connected to separate base prongs. When used as a Class B amplifier in auto radio sets, the inner and outer grids are connected together and used as a control grid, thereby making the tube a high-mu triode. When used as a Class A amplifier in 110-volt d-c. receivers, the inner grid is used as the control grid and the outer grid is connected to the plate, thereby providing a low-mu triode.

The characteristics of the tube are as follows:

Fil. Voltage	6.3
Fil. Current	0.3
Base	5 prong
CLASS B AMPLIFIER	
Plate Voltage	180 max.
Grid Bias (both grids)	0
Plate Current* (2 tubes)	3.0 ma.
*At zero signal	
CLASS A AMPLIFIER	
Plate and Outer Grid Volts	100 (120 max.)
Grid Bias (inner grid)	0
Plate Current	42 ma.

Increased output may be obtained by the use of two ER-52 tubes connected in push-pull, with zero bias. In this case either an 85 or 171-A may be used as a driver, with preference towards the latter.

SERVICE MEN!



TRUTEST Assorted By-Pass Condensers

A very handy assortment for the Service Man. Contains 12 of the most popular capacities in drawn metal cans; assorted as follows:

No.	*Cap'y Mfd.*	*Voltages*
1	.1	200
1	.25	200
2	.5	200
2	1.	200
1	.1	300
1	.25	300
1	.5	300
1	1.	300
1	.5	400
1	1.	400

9D3289—Your Cost..... **$3.25**

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Make "Wholesale Radio" your replacement parts headquarters! We maintain a huge stock of REPLACEMENT PARTS FOR ALL SETS. Brand new factory merchandise at lowest wholesale prices. A guarantee of satisfaction on every purchase. Immediate service.

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Advance yourself above the thousands of radio service men! Let me assist you to a BETTER UNDERSTANDING of RADIO and TELEVISION ENGINEERING. Higher technical knowledge is the only safeguard to success!

Here's a Story for the Man Who's Already in Radio

This booklet, "Practical Radio Engineering" gives you complete information regarding our advanced home study course in Radio Engineering, written for the radio man with sufficient vision to see the opportunities that await him. Send for this FREE BOOKLET today, and for information about these courses . . . no obligation, whatsoever.

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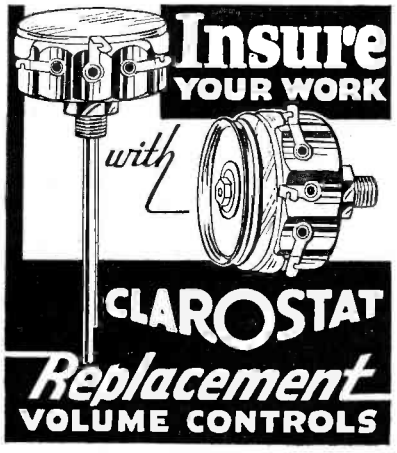
14th and Park Rd., N. W., Dept. SM-8., Washington, D. C.



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CLAROSTAT Replacement Volume Controls are "Custom-made" to exactly suit the receivers for which they are offered. Not a makeshift job lot idea.

The resistance, taper, shape and shaft are made according to the proper specifications.

There is no delay in installing them. There are no comebacks when you use CLAROSTAT products.

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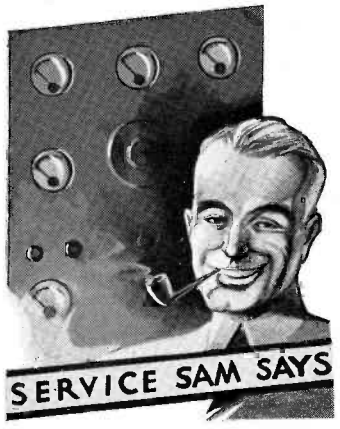
IRC Service helps . . . . .



The Newest Method of Servicing

The measurement of resistance is fast becoming the recognized method of analyzing troubles in receivers.

Have you an ohmmeter which will measure the resistance between different points in a radio set? We will show you how you can easily build an economical ohmmeter from any 0-1 milliammeter which you may have or can purchase for a few dollars. This ohmmeter can have any number of desired ranges to encompass all resistance values in present day sets.

IRC precision wound resistors are available in numerous values and have a high degree of accuracy so that in spite of the low cost, this ohmmeter will be comparable in efficiency with the manufactured instruments.

By using a plug-in cable or prods which will reach the different points in a receiver, you can apply this ohmmeter for point-to-point resistance measurement.

If you do not have an ohmmeter, we will show you how to make one. If you have an ohmmeter, we will show you how to extend its range by using the accurately calibrated, precision wound IRC resistors.

Write us for complete information. We will send you FREE, full constructional details AND an ohmmeter scale which you can use on Weston and Jewell 0-1 milliammeters.

MOTOR RADIO SUPPRESSORS must withstand severe mechanical shock and vibration; be unaffected by temperature and moisture and be able to suppress ultra short waves generated by the spark. IRC MOTOR RADIO SUPPRESSORS are suitable for most makes of cars. They are *moisture-proof—shock-proof—fire-proof and heat resistant.* They have *low capacity—positive contact—long life.*

Send for Free Folder on Information on the Suppression of Motor Radio Noises. This folder is also enclosed in every kit of IRC Motor Radio Suppressors.

I CAN'T say I blame some Service Men for having "installation fright" when they tackle auto radio jobs. There has been too much "theoretical" and "technical" literature floating around which would give most anyone the idea that an auto radio job was in the same class as a telephone switchboard installation.

There are, of course, a few simple rules that must be followed if the job is to be a good one. For example, you've got to use a suppressor resistor on each spark plug, and one on the distributor. It is also vital that these suppressor resistors be capable of withstanding the heat from the motor and the high-tension current. If just one resistor breaks down under the strain it will cease to "suppress" and turn itself into a crackerjack noise-maker.

Now, believe it or not, the suppressors may be sufficient to reduce noise to the point where it is not noticeable in the receiver. However, a few 1.0-mfd. fixed condensers may have to be tucked in here and there to reduce sparking and surges. Like this: One from the "high" side of the ignition coil to ground; another across the interrupter contacts; a third across the generator brushes.

After all, the noise problem should be tackled with common sense—not theory. Which brings me to leads. They should be shielded for exactly the same reason we shield radio receivers . . . except that in one case we do it to "keep the noise out" and in the other case to "keep the noise in." Again for the same reason, the leads should be as short as possible, and the shielding should be bonded *directly to the chassis of the receiver.* This shielding should continue right up to the point of the lead contact.

What else? Connections! Like the Chesterfield Cigarette advertisements say, "They've *got* to be good." One poor connection may cause as much trouble as an "unsuppressed" spark plug, and keep you sweating around on the nastiest noise-hunting expedition you ever had. Make all connections "super-connections" in the first place, and you will end with a good job with no kinks to be ironed out.

The IRC people have a swell pamphlet on the subject, if you want one. No cost.

Service Sam

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Precision Wire Wound Resistors For Meters and Test Equipment

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Automobile Models in both 6" and 8" sizes.

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Careful selection of materials and critical inspection of workmanship insure quality products that are not sacrificed for price.

Lay your condenser problems before us. Our engineers will carefully consider them, working out units best-suited for the use.

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