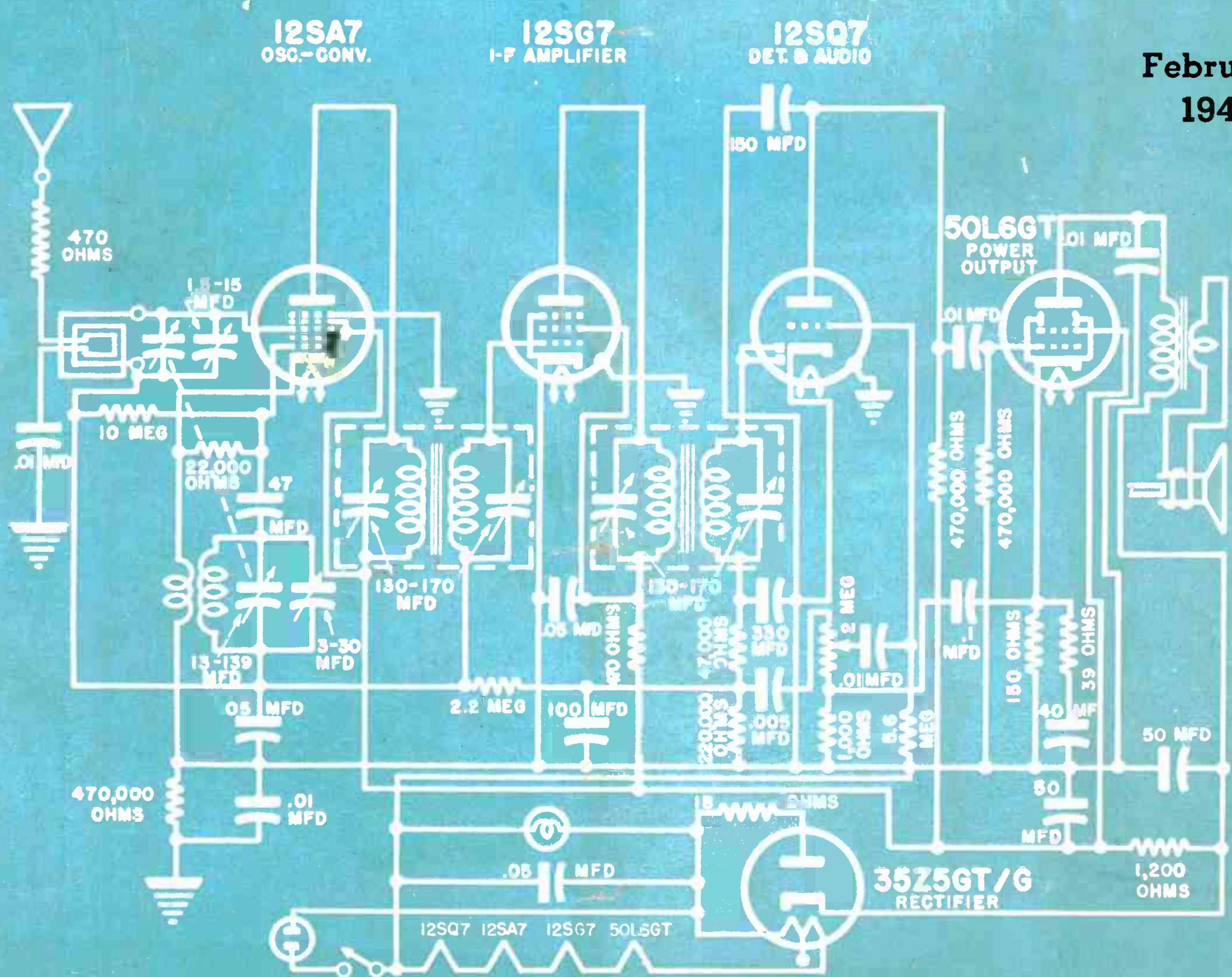
RADIO · TELEVISION · ELECTRONIC

SERVICE

February
1946



Four-tube and rectifier postwar receiver featuring high-gain i-f amplifier and iron-core i-f's. *(See page 47.)*

THE TECHNICAL JOURNAL OF THE RADIO TRADE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EDITORIAL

GENEROUS quantities of direct viewing and projection type television receivers will be available within the next 120 days. So report manufacturers in the East and Middle West. In reply to hundreds of inquiries from Service Shops, dealers and distributors, the manufacturers have now answered such vital questions as . . . *when will sets be available . . . what about their price ranges . . . what types will be made . . . who will make them . . . what bands will be used . . . what sets will have television . . . what about color television.*

Most manufacturers say that this summer will see substantial models on the shelves. Prices will begin at $100. A variety of types will be made. RCA, for instance, indicates that their first model will be a 7" or 10" direct-viewing model. A large screen model providing an 18"x20" picture will also be produced. This model, by the way, will include a-m and f-m, and may sell for around $500. One G. E. model is expected to use a 10" tube, while another model will use the projection system to provide a 16"x22" picture. First models of Emerson will be direct view. DuMont is expected to produce a 15" and 20" tube direct-viewing type. Stromberg-Carlson will also produce a direct-viewing type, using a 10" tube. A direct-viewing and projection-type unit is also planned by American Television Laboratories in Chicago. The initial models of Admiral are expected to use 7" and 10" tubes for direct viewing.

Other manufacturers who have indicated that they would produce television receivers for summer or fall delivery include . . . Lear, Sparks-Withington, Farnsworth, Galvin, Hallicrafters, Rauland, Belmont and Philco. This list will undoubtedly be expanded during the next few weeks.

Discussing coverage, manufacturers state that television no longer has a restricted coverage to worry about, thanks to the coaxial cable and very high frequency radio links.

Most of the receivers will cover all of the 13 channels, which include . . . 44 to 50 (*1*); 54 to 60 (*2*); 60 to 66 (*3*); 66 to 72 (*4*); 76 to 82 (*5*); 82 to 88 (*6*); 174 to 180 (*7*); 180 to 186 (*8*); 186 to 192 (*9*); 192 to 198 (*10*); 198 to 204 (*11*); 204 to 210 (*12*); and 210 to 216 megacycles (*13*). Initial telecasts will be made in the first six channels.

All telecasts will be in black and white. Most manufacturers state that color on any wide scale will not be available for quite awhile. They point out that many, many months will be required to produce the necessary superhigh frequency transmitters, links and receivers. And then extensive experiments will be necessary to systematize the method. Standards will also have to be set up. While black and white transmissions are still in the study stage too, the received pictures are very satisfactory. In addition, practical standards have been set up, so that it is possible to produce receivers and transmitters on a wide scale.

Television appears to be definitely on the right track now and the Service Shop Man should begin an intensive study of the art. To assist in this program, SERVICE will continue to feature articles discussing the various phases of television receiver and component operation and installation.

By the way, we suggest that you read the excellent television articles in this issue of SERVICE by Paul W. Schwehn and R. B. Carwood, appearing on pages 7 and 10. They are jammed with information that you need.

RADIO · TELEVISION · ELECTRONIC
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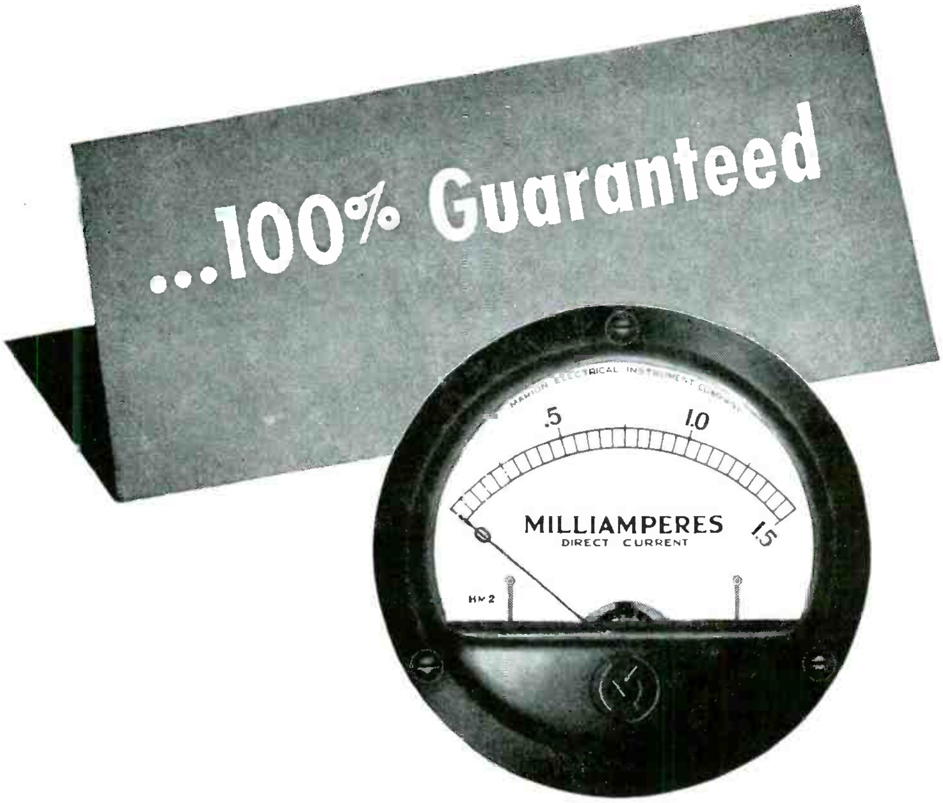

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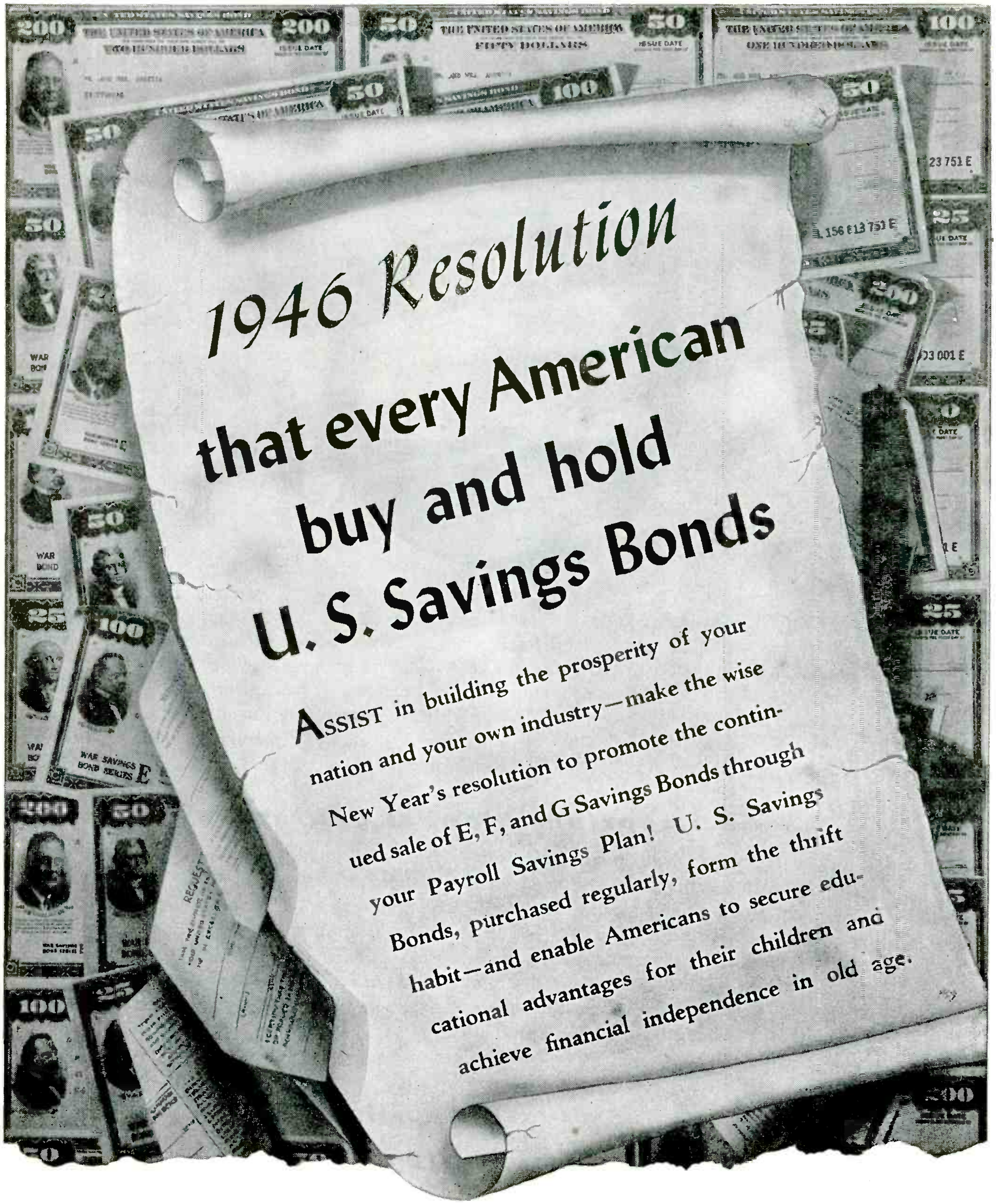
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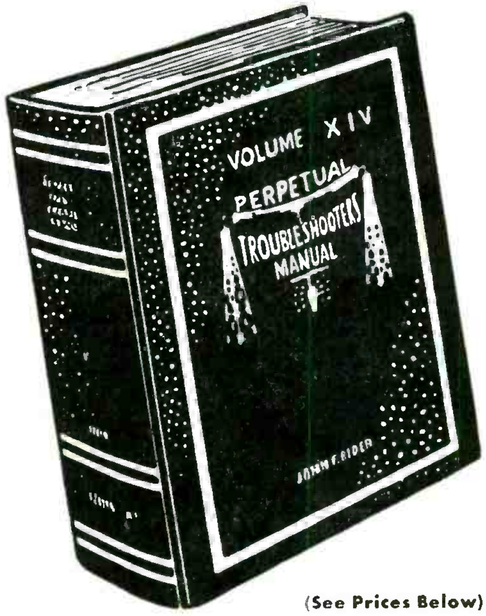

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by FRANK FAX

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ANTENNAS FOR TELEVISION

Installation Problems and Their Solutions

by PAUL W. SCHWEHN

Farnsworth Television and Radio Corp.

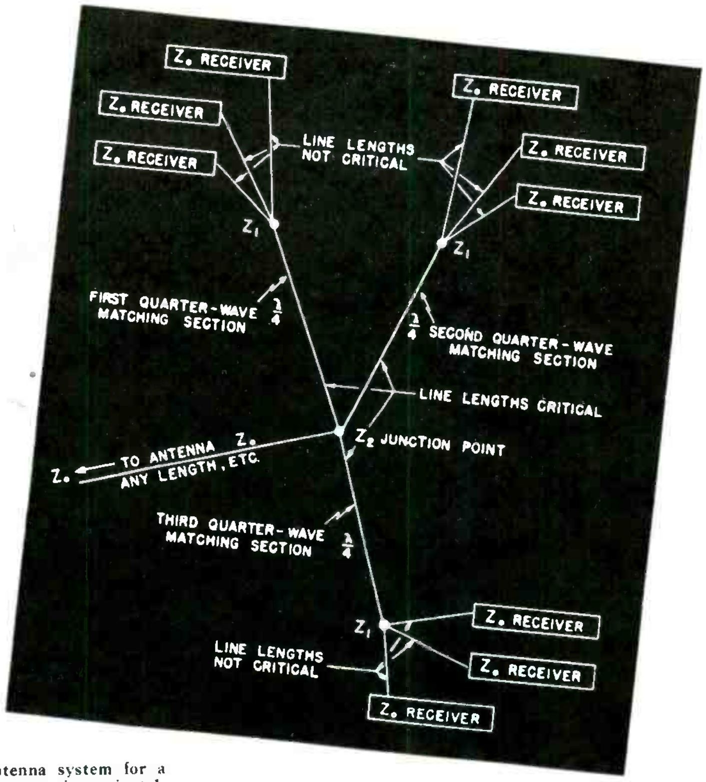
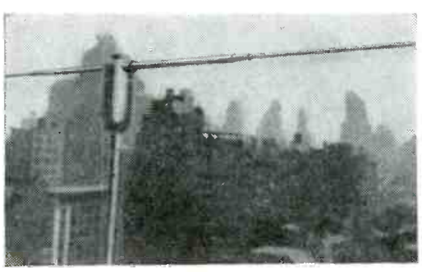


Fig. 1. A nine-antenna system for a multiple television receiver installation.

TELEVISION is a service that practically everyone in the United States will want, some 30 million families. The art is not exactly new, for the experiments made prior to the war and the valuable broad experience during the war have taken this industry out of the embryonic stage.

Today there are nine commercial or experimental television stations operating in five major markets. In New York City alone there are 5,000 set owners with an approximate viewing audience of 25,000 to 30,000. The Service Man may say that this is a comparatively small number. It is; however, when we see that the FCC has allocated 13 television channels that might be used by over 400 transmitters we can visualize the rapid growth of this industry once these transmitters go on the air. Television will become a point of prime interest and entertainment in the American as well as the European home.

Fig. 2. A 3-section tunable dipole for television, covering a 46.5 to 117 mc range.



In Great Britain, television was quite popular before the war and will soon expand rapidly. In 1939 the British television system had nearly 25,000 receivers and an estimated 100,000 viewers. This audience is expected to double and triple soon.

It has been predicted that 5,000,000 television receivers will have been purchased by the American public at a total list price value of *750 million to one billion* dollars in the next five years. This will make the average unit list price to the consumer in the neighborhood of $150. This projected audience may sound high, but if we study the period of straight radio sales from 1926 to 1930, we note that the public purchased 14,636,800 radio receivers and paid $1,668,000,000. In this instance the unit sale price was approximately $116. Therefore, if we assume 30 million eligible homes in the United States, in a five-year period, we find that one radio set was placed in one out of every two homes, while in television the conservative projection places only one television receiver in one out of every six homes.

Coaxial Cables

Coaxial cables will play a major role in boosting television receiver sales. Coaxial cable operation between New York and Washington was inaugurated on February 12, with a very successful telecast. There should be other cables between Washington and North Carolina some time this year. Several years from now there may be in operation a coaxial link from New York to California via Chicago. It can therefore be assumed that in approximately five years there will be a

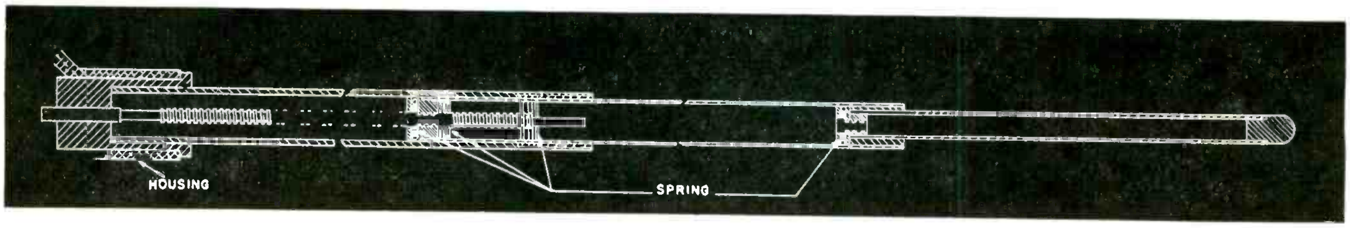


Fig. 3. One extensible leg of an experimental 3-section remotely-tuned dipole.

television network linking all major cities.

Radio relays will also aid television sales. At least two companies are installing radiobeam networks between Boston and New York and in other sections of the country. It is anticipated that a network of *radiobeam stations* will, before long, cover the entire country, reaching into every city and village, thereby greatly expanding the coverage of television networks.

Microwave frequencies will be used extensively in the radiobeam networks, with automatic repeaters being used to relay television signals beyond the normal horizon distance.

Because of the great flexibility provided by microwave radiobeam systems and the relatively low cost as compared with an equivalent network of coaxial cables, it is predicted by some engineers that the radio relay systems will be used more widely than the wire networks of coaxial type.

An airborne radio-relay system is also being tried. In this system the television signals from a ground station will be transmitted to an aircraft, continuously flying at an elevation of approximately 25,000 feet. The signals will then be retransmitted from the aircraft to home receivers within a large area, estimated to be as great as 200 miles in all directions about the airborne television station.

Television Dipoles

Regardless of the means used in distributing signals from the point of origin, a good antenna system will be a prerequisite to receive the high definition pictures to be provided by the television broadcasting stations. In fact, the better the definition of the television picture, the more important the home antenna becomes.

Many do not seem to realize that in most instances they will need a special dipole antenna so that they can receive television signals properly. The installations will have to be handled by the Service Man.

In the majority of cases the dipole type of antenna must be be mounted on roofs. If there is more than one television transmitter station in the area, it will then be necessary to orient the dipole.

Apartment House Installations

The apartment house installation is one of the most difficult. A typical installation might include four robot-type antennas, each mounted atop a 10′ mast at a corner of the apartment house roof. The robot feature would be used for the purpose of experimentation only, and to take care of reasonable changes in assignments, power changes or station partiality.

Each of the four antennas would be supplied with a twinax transmission line, with a matched impedance. Thus far standards for lines have not been determined, but RMA expects to announce them soon. A special distribution system would also have to be installed.

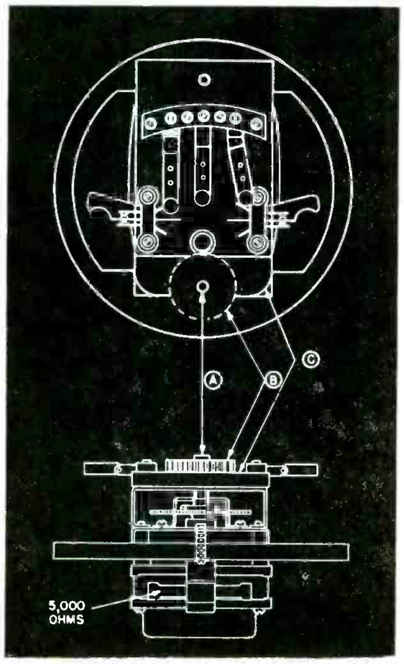
Master Dipole for Each Channel

In any multiple television receiver installation, it seems unavoidable that one master antenna will have to be used for each channel. Also, to avoid severe reflection trouble, at least one end of each line of a multiple-line distribution system must be terminated by a reasonably well-matched load.

If the receiver input is not matched to the line, individual cathode followers or amplifiers must be used for each receiver. In this case, the tubes will have to be centrally located, although this will result in rather large signal losses in most cases. This situation can be improved by locating the tubes at the receiver end of the line, if the receiver input, Z, is relatively high. Matching will then be required at the junction of the individual lines. In both these cases, probably conventional coaxial cable should be used.

If the receiver input impedance is well matched to the line as by a constant-impedance, *IRC* (inductance, resistance, capacitance), circuit, a simple and completely passive matching arrangement can be used, Fig. 1. The method is applicable to either balanced or unbalanced lines, and involves electrical segregation of the receivers into groups of N, each group being fed from a junction via a quarter-wave section of transmission line. N individual lines are paralleled to give a proper impedance match. N groups of N receivers are then paralleled on N quarter-wave feeders to give a resultant input impedance, which properly terminates a line of random length from the antenna to the junction of the feeders. Impedance matching may or may not be used at the antenna. In the system illustrated in Fig. 1, $N = 3$, where there are nine receivers in all. In any case, the total number of receivers is N^2. The impedance relations given above are strictly true only at one frequency, and variations will occur over any appreciable channel width.

One hundred receivers seems to be about the the maximum total amount possible with this system, although multiples of N^2 receivers may obviously be supplied by suitable matching and isolating of the individual input



Figs. 4 (right) and 5 (left). Fig. 4 illustrates a 2-section dipole with a 1.8:1 tuning range, 46.5 to 85 mc. Length of antenna is 36″ when closed, 66″ when open. Fig. 5. Rotatable motor assembly of remote dipole. A, B and C represent control pin and gear mounts.

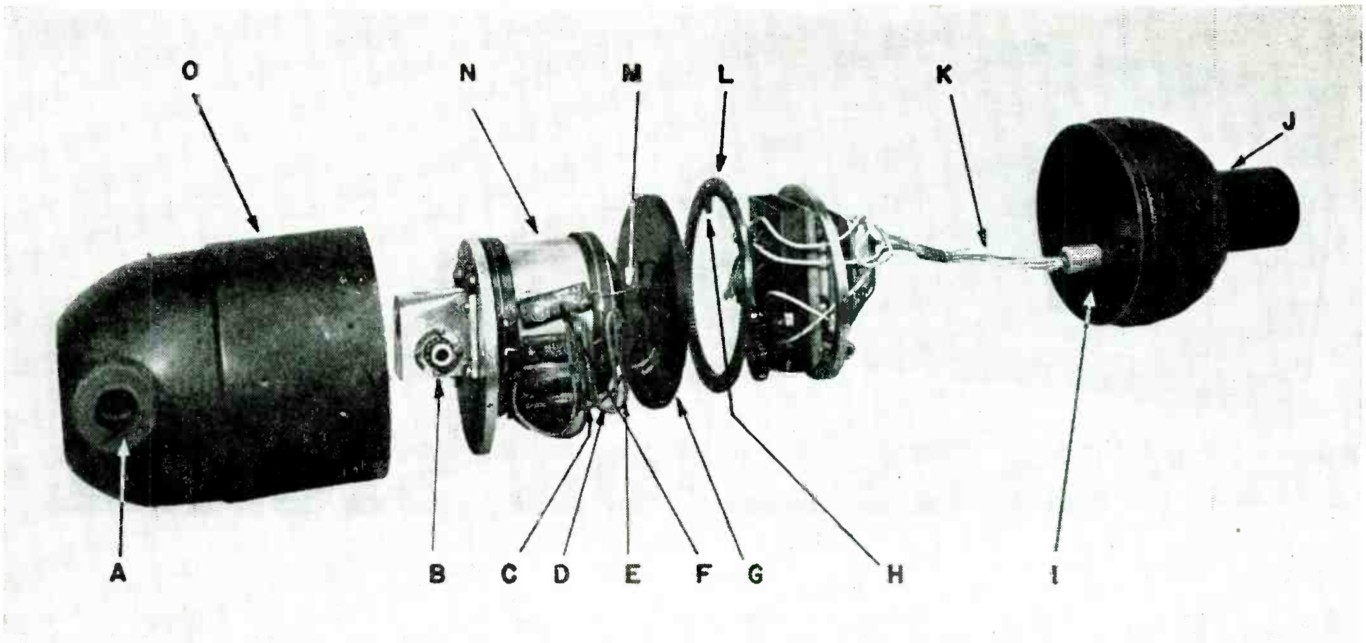


Fig. 5. Remote control assembly. *A*, hole for antenna arms; *B*, gear box to drive extensible arm; *C*, common ground; *D*, retracting lead; *E*, extending lead; *F*, 10-mfd capacitor; *G*, insulating plate; *H*, automatic safety stop; *I*, plug to a 5-lead twinax cable; *J*, bottom motor housing; *K*, 5-lead cable (one common, two leads for clockwise and counter-clockwise rotation, and two leads for extending and retracting antenna arm); *L*, ring gear for rotation; *M*, extending lead; *N*, reversible motor for extending arms; *O*, top motor housing.

impedances. If the number of receivers to be supplied does not equal N^2, the system may still be used by connecting a maximum of two resistors of the proper values at the proper junction points. The lines required by the system are all located at a convenient central junction point, and the lines to individual receivers and to the antenna may be of any desired length.

A 49-Receiver Installation

Let us now suppose that 49 receivers are to be fed from the antenna system.

The main transmission line would be dropped through the conduit to the starting point of the distribution system where seven quarter-wavelength transmission lines would branch off, each terminating in seven twinax cables of the same impedance, to feed 49 apartment terminal boxes. The only critical lengths of transmission lines involved are the quarter-wave feeders from the main line to the branch lines. For experimental purposes, the point at which these seven feeders are located should be available so that the feeders could be changed in case the tuning selection of any of the dipoles is changed.

Each of the selected apartments where a receiver would be installed would have four twinax lines installed, one from each of the four dipoles. A group of 49 selector boxes would have to be installed at the terminations in the apartments, providing a switch which would select the desired channel and at the same time terminate the other lines in their characteristic impedance. A single transmission line would connect the output of these terminal boxes to the receivers, which could include on the selector switch assembly a remote-control activator to select the channel to which the receiver was tuned. All other receivers would require, it is true, under this system, that the operator perform two operations in tuning in his receiver: (*1*)—Select the proper antenna channel; and (*2*), select the receiver channel.

Inputs Needed

The terminal boxes with remote-controlled selection would not be necessary provided all television receivers were equipped with an extra switch section on the selector assembly and with four or more inputs to connect with four or more incoming transmission lines from separate dipole installations on the apartment house roof.

It is possible that a special apartment house model may be made available. With such a specially designed receiver, no remote control mechanism would be required, since switching from one channel to another would automatically select the proper antenna line by manual means.

At the outset for the experimental

(*Continued on page* 34)

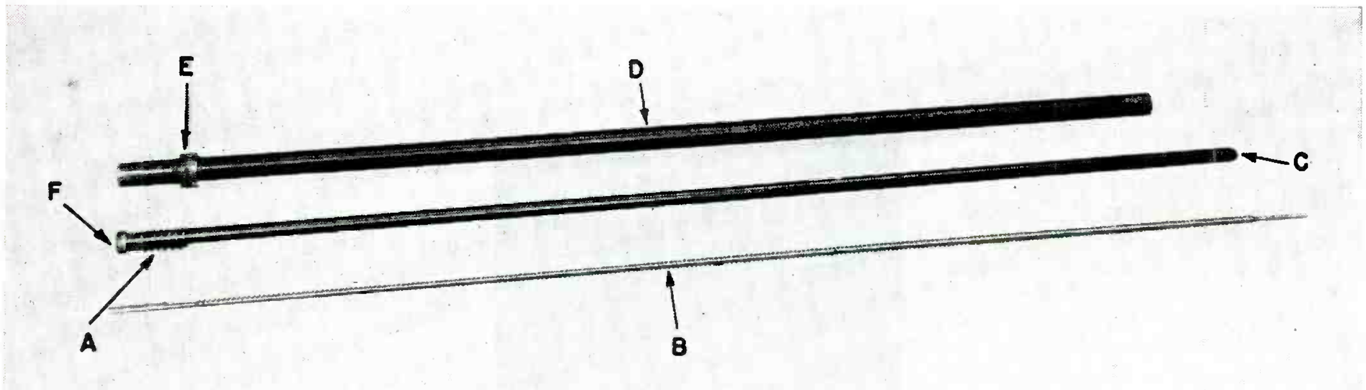


Fig. 6. Arm details. *A*, safety spring; *B*, threaded drive rod that extends arm; *C*, extensible antenna arm; *D*, stationary antenna arm; *E*, collar that connects antenna leads; *F*, threaded nut and bushing combined, also a guide to prevent rotation.

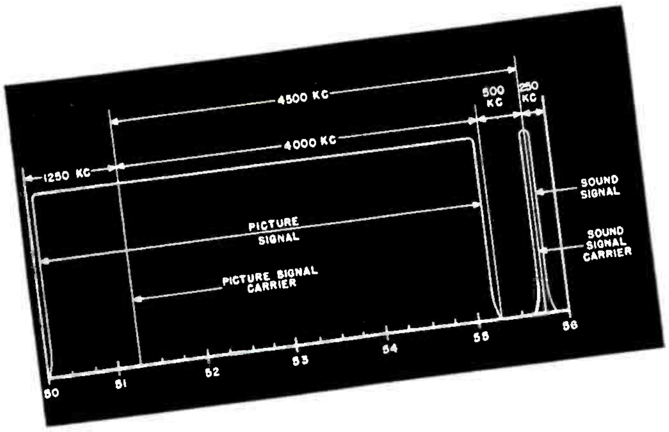


Fig. 1. Makeup of the television signal channel. Both video and audio signals are transmitted within this channel, and received at the receiver as a combined signal. The receiver then selects the proper audio and video components for the appropriate channel.

THE TELEVISION SIGNAL

An Analysis of Its Composition

by R. B. CARWOOD

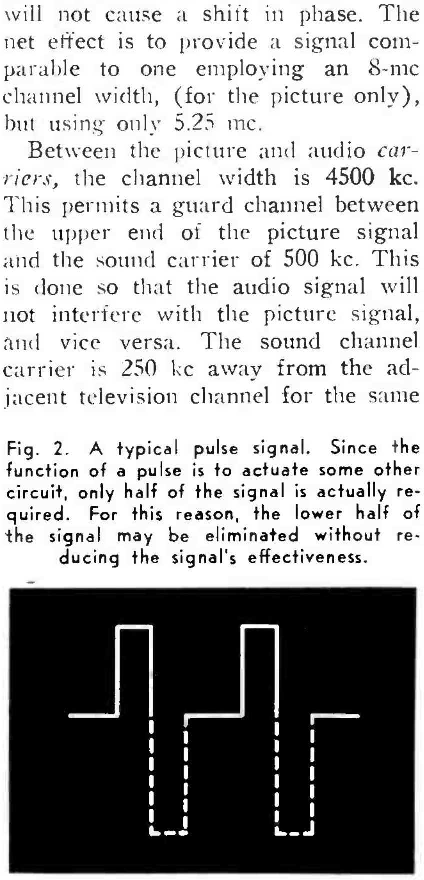
THE television signal is a complicated combination of modulating components each of which serves a definite purpose in the final delineation of both picture and sound transmissions.

Because of the numerous functions served by the television signal, a very wide band of frequency transmission is required. The present bandwidth is six megacycles wide, which permits transmission of not only the picture and sound elements, but also includes the necessary guard bands, so that adjoining channels will not interfere with each other. Fig. 1 illustrates the channel makeup, given in terms of kilocycles, so that the Service Man can readily compare it with broadcast frequencies.

The picture, or video signal, has a total band width of 5250 kc. However, it will be noted that the center frequency of the video carrier is unbalanced, with a band width of 1250 kc on the lower frequency side, and 4000 kc on the upper. This type of transmission is known as vestigial side band, and serves a very definite purpose. Since the picture signal is a series of various type pulses, the transmission of the signal in both directions serves no purpose, since the lower signal would merely be a repetition of the signal on the upper half. In other words, since an electrical impulse is going to be translated into a visual action, only one half of the cycle is necessary, Fig. 2. A perfect method of transmission would then be one which transmits only the upper, or lower half of the signal. However, technical difficulties prevent the realization of this system. Removal of the entire lower half of the signal would introduce phase shifts in the video signal which would ruin the picture. Therefore, it is necessary to remove that portion of the lower signal which will not cause a shift in phase. The net effect is to provide a signal comparable to one employing an 8-mc channel width, (for the picture only), but using only 5.25 mc.

Between the picture and audio *carriers,* the channel width is 4500 kc. This permits a guard channel between the upper end of the picture signal and the sound carrier of 500 kc. This is done so that the audio signal will not interfere with the picture signal, and vice versa. The sound channel carrier is 250 kc away from the adjacent television channel for the same purpose. Since the greater danger is from audio interference on the video signal, due to the smaller bandwidth of the audio channel, and since the portion of the transmitted video signal which the audio channel adjoins is not used, the channel width between the adjacent television channels does not have to be as wide. Frequency allocation channels are jealousy guarded, and every kilocycle possible is put to some use. This accounts for the acute debates about guard channels, etc.

Fig. 2. A typical pulse signal. Since the function of a pulse is to actuate some other circuit, only half of the signal is actually required. For this reason, the lower half of the signal may be eliminated without reducing the signal's effectiveness.



As outlined in last month's discussion, the present television channel allocations are in two bands, 44 to 88 mc and 174 to 216 mc. At these frequencies, known as very high frequencies (v-h-f), the nature of the signal differs radically from those characteristics it displays at broadcast frequencies. Signals in the v-h-f band can be received effectively only within close ranges, on the order of a 40-mile radius from the transmitting antenna. The actual distance is a function of the height of the transmitting and receiving antennas, and for a rough estimate can be considered as line of sight. For this reason, receiving antennas should be erected as high as possible.

Another characteristic of v-h-f signals is that they are reflected by buildings, or other high masses, very much like light. For this reason, a signal may arrive at the receiving antenna from two different directions. Since the distance traveled by each signal will be a function of the paths they follow, and since the time of arrival at the receiving antenna will be a function

(*Continued on page* 35)

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by FRANK C. KEENE

WHAT *is the best procedure to follow in checking power supplies?—M. L. Wheeler.*

The most effective check is one which determines the specific voltages in a receiver. For example, the high-voltage winding should be checked under operating conditions to see if both rectifier plates are at the same potential above ground. This requires the use of an a-c voltmeter. If there is more than a 5% voltage difference between plates, this is indicative of shorted turns in the secondary.

While a check of the power consumption of the receiver is indicative of the condition of the receiver, actually, this check gives no information other than that the receiver drain is abnormally high or abnormally low.

Filament voltages should always read at least 6 volts at normal line voltages. Before blaming the trouble on the power transformer, it is necessary to check each tube across the filament supply by removing each tube momentarily and noting the voltage rise. It is impossible to predict the specific voltage rise, since it will be a function of the number of tubes across the particular supply. However, in general, the rise should be less than ½ volt per tube, except output tubes which draw over .3 ampere. At any rate, this is more a check of the tube than the supply, since a shorted filament turn will usually smoke, or indicate a reduced filament voltage of 1 volt or more. The same procedure is followed for the rectifier filament.

Where wet electrolytic capacitors are used in the filter network, the physical position of the receiver must be watched during a test. That is, it may be necessary to remove the filter capacitors with extended leads, so that they may be placed in an upright position, while the set is inverted. If the wet filters are inverted, chances are that the electrolyte will not conduct properly, particularly if they have been in use for any length of time. The wet electrolytics may be replaced with dry types, if they are suspected of being defective.

To check filter capacitors for leakage, a milliameter should be inserted at point *A* in Fig. 1, and the reading compared with that obtained at points *B* and *C*. All readings should be identical. A 100-ohm, 20-watt resistor is inserted in series with the *B* lead to determine if the second filter capacitor is leaky. At the same time, it should be noted if the current drain is within the rating of the rectifier tube. An abnormally high current drain is indicative of a short after the rectifier.

Leakage at the rectifier socket is difficult to check. However, removing one filament lead, and then checking the rectified plate voltage with the lead intermittently touching the socket connection may show this up. Another method is to use an external d-c supply of 300 volts, and after removing the rectifier tube and associated load, applying this high voltage to the filament and plate terminals on the socket. The connections from the power transformer to the socket should first be removed. If arcing or sparks are observed, the socket should be replaced. For another check, a voltmeter can be connected across the external power supply. This will denote if any load is being imposed by the suspected socket.

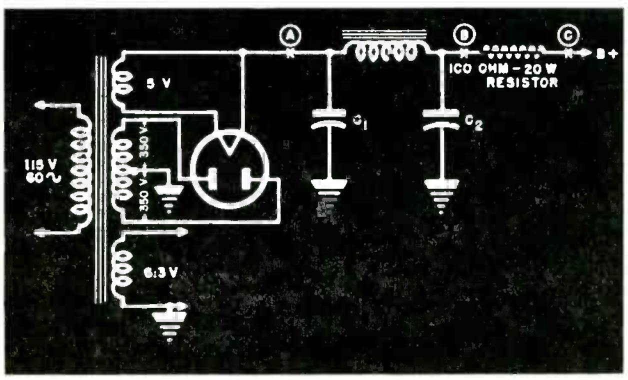


Fig. 1. Typical circuit of a receiver power supply. Voltage values will vary, depending on manufacturer, and type and number of tubes used. Points *A*, *B* and *C* denote places for inserting milliammeter to check for filter capacitor condition. All readings should be identical. The resistor should have at least a 100-ohm and 20-watt rating, and is inserted to permit checking C_2 for leakage.

•

WHAT *are the possible causes of distortion in the first audio stage of battery type portable receivers? (When checking with headphones, the quality is good at the volume control, yet bad at the plate.)—J. L. Hancock.*

Let us study the detector and first audio circuit of a typical battery type portable receiver, Fada model P22,-P28A; Fig. 2. Since the signal is good across the volume control, the trouble must necessarily be in either the control grid, or the plate circuit of the 1H5GT. The first possibility is that the .01-mfd coupling capacitor from the volume control to control grid, is defective. If this capacitor is replaced and the trouble persists, the next check should be the resistance of the grid resistor. It is suggested that the 2-megohm resistor be replaced with a 1-megohm resistor to reduce the possibility of distortion.

If this is not the cause, the next check should be the plate resistor. This resistor may be checked by shunting with a 1-megohm resistor. The .00025-mfd plate bypass should also be checked by removing and replacing with a similar value capacitor. The same procedure should be used to check the audio coupling capacitor between the 1H5 plate and the output control grid.

Too much emphasis cannot be placed on the proper method for checking capacitors. They should always be dis-

C1	TWO GANG VARIABLE	
C2	.01 MFD.	200V
C3	.05 MFD.	200V
C4	.0001 MFD	600V
C5	.05 MFD	400V
C6	.5 MFD.	200V
C7	.01 MFD.	400V
C8	.004 MFD.	600V
C9	.04 MFD.	600V
C10	500MFD. ELECTROLYTIC	15V
C11	15MFD. ELECTROLYTIC	250V
C12	15MFD. ELECTROLYTIC	250V
C13	10MFD. ELECTROLYTIC	250V
R1	470M OHM	1/4W
R2	100M OHM	1/4W
R3	68M OHM	1/4W
R4	1000 OHM	1/4W
R5	220M OHM	1/4W
R6	3.9 MEGOHM	1/4W
R7	47M OHM	1/4W
R8	VOLUME CONTROL	
R9	15 MEGOHM	1/4W
R10	1 MEGOHM	1/4W
R11	2.2 MEGOHM	1/4W
R12	90 OHM WIREWOUND	1W
R13	100 OHM	1/4W
R14	100 OHM	1/4W
R15	1000 OHM	1/2W
R16	7 OHM	1/2W

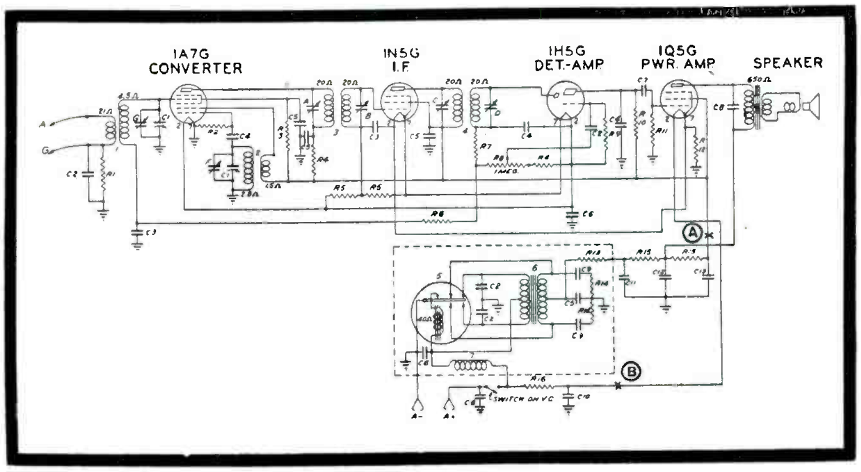


Fig. 3. Zenith 4B15 vibrator model discussed in Mr. Hancock's inquiry about vibrator hash. Checking at points *A* and *B* with separate power supply will reveal if trouble is due to direct radiation. (Parts list for receiver at left.)

connected when checking with a new one, and never shunted.

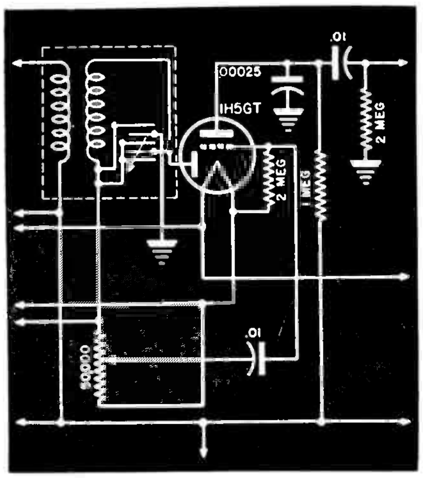
Of course, the foregoing should be tried only after we are sure that the tube is not responsible for the distortion. Quite often, a tube checker does not duplicate operating conditions, and therefore is not too reliable a check. Thus tube replacement should be tried.

•

HOW CAN vibrator hash in battery portables, such as the Zenith 5F134 and 4B515, be minimized? —*F. L.* **Hancock.**

In receivers of this type, (model 4B515, Fig 3) vibrator hash may be communicated to the receiver in three ways. The first is by direct radiation. A quick check may be made to determine if radiation is the cause by supplying filament and plate voltages to the receiver from an external source, at the same time running the vibrator from its own source. The two points where the disconnection is made is shown as points *A* and *B* in the diagram. If, after applying the external voltages, the hash is still present, radiation is the cause. The necessary cures can then be applied while running the receiver with the external hookup. The only effective methods for reducing radiation hash is shielding of the vibrator and associated components. Some ingenuity may have to be brought into play to accomplish the necessary shielding. Sometimes, the addition of a shield over a shield is necessary.

Fig. 2. Detector and first a-f stage of a battery portable, Fada P22, analyzed for causes of distortion.



Two other possible sources of hash injection remain. One of the these is the filament circuit. To check if this portion of the circuit is responsible, the filament circuit should be disconnected at point *A*, supplying the *B* power from the vibrator. An external battery should be used for the filament supply. If the noise is gone, the trouble lies in the filament-supply filter network. An additional r-f choke may effect the cure, or it may be necessary to replace the high value capacitor. Incidentally, the old capacitor should be disconnected, and not shunted when checking the filter circuit. This also applies to *B* filters.

The same method can be used to check the *B* filter network. The *B* circuit should be disconnected at point *A* and *B* voltage introduced from an external source. If the noise disappears, the trouble is in the filter section. Higher value filter capacitors may sometimes prove effective.

It is important to remember that the bias voltages for the audio stages are obtained from the filament supply by returning the control grids at the appropriate points. Since only a slight ripple at the control grid of the first a-f tube will be amplified to an objectionable level, a good method for curing this trouble is to return the control to ground through a bias cell. Since the bias on the first audio tube is usually on the order of 1½ volts, a single bias cell is sufficient. This would obviate the necessity of replacing the filter capacitor in the filament circuit.

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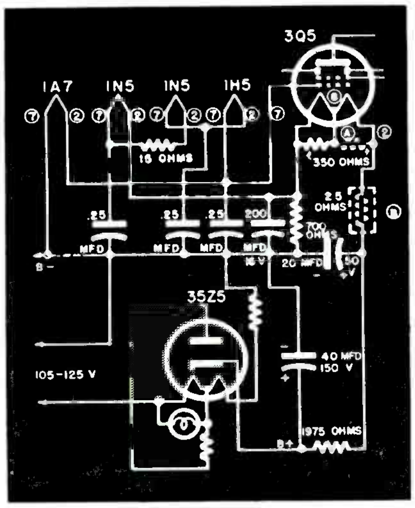
WHAT causes the unshunted portion of the 3Q5 in a Montgomery-Ward model 14 BR-684A to burn out? (This trouble occurs intermittently after 2 to 30 days of operation.)—Gordon Bellah.

This trouble may be caused by any one of several conditions. From Fig. 4,

(*Continued on page* 36)

Fig. 4. Circuit of the Ward 14BR-684A, showing the filament and *B* circuit analyzed for G. Bellah, who inquired about 3Q5 burnouts. Burnout of the 3Q5 filament is probably due to a defective 200-mfd filament bypass capacitor. The best service approach would be a replacement of the filter capacitor assembly, since the trouble may usually be traced to this source. Other possible causes are also shown, with their cures at *A* and *B*.



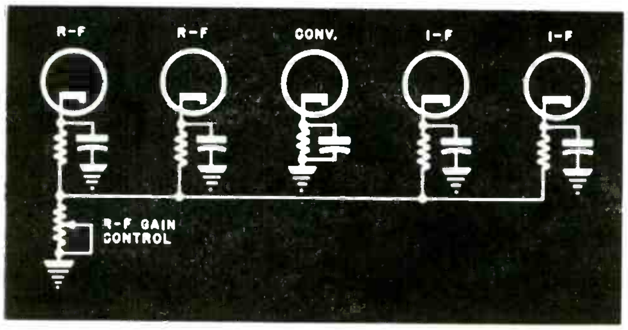


Fig. 1. A simple form of r-f gain control. Varying the control introduces resistance into the cathode circuit of the r-f tubes, reducing the gain in the r-f portion of the receiver.

COMMUNICATIONS RECEIVERS

Design and Use of R-F Gain Controls . . . S and R Meters . . . Band Spreading . . . Variable Selectivity I-F Stages . . .

by THOMAS T. DONALD

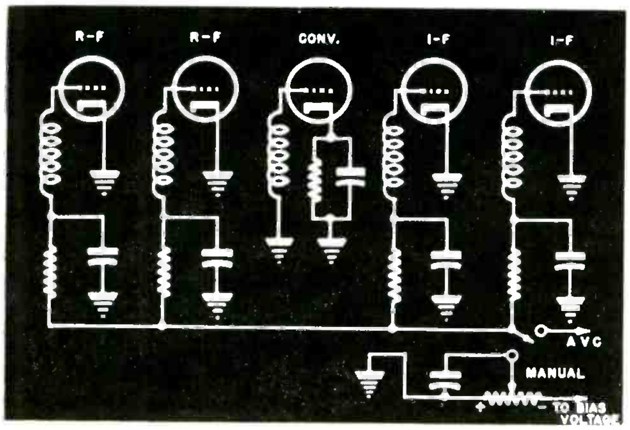


Fig. 2. A second method of r-f gain control, using the avc system after the detector stage. By applying a portion of the fixed bias voltage from the power supply to the grids of the r-f section of the receiver, the gain is reduced.

Nearly all communications type receivers feature an r-f gain control, in addition to an a-f gain control.

The r-f gain control is necessary in communication receivers because an on-off switch is used for the avc system. When tuning in distant stations, the full sensitivity of the receiver is desired, to pick up very weak signals. For this reason, the avc system must be grounded, since its action reduces the absolute sensitivity of the receiver. When the receiver is operated without avc, strong signals would tend to overload the receiver. The r-f gain control provides a manual substitute for the avc system, thereby permitting hand operation of the r-f gain.

Fig. 1 shows a typical manual r-f control system. Service Men will recognize this circuit as the old method of volume control before the days of *avc*. In effect, the circuit is a manual equivalent of the avc system. By varying the value of cathode resistance in the r-f portion of the receiver, the bias on the tubes is increased, and the stage gain thereby decreased.

A second method is shown in Fig. 2. The end effect of this type of circuit is identical to that of Fig. 1, except that the bias potential is applied to the control grids of the r-f tubes from a fixed source, usually the bias voltage obtained from the power supply system. This system has the advantage of applying manual control to the avc system after the detector voltage has been isolated.

Hallicrafters SX18

Some version of these two systems is usually used in manual r-f gain control systems in communications receivers. The method employed in the Hallicrafters SX18 is shown in Fig. 3. Here, a fixed voltage is derived for the cathode bias of the r-f tubes from a bleeder network across the *B* circuit. When the control is set for maximum sensitivity, the bias voltage for the cathodes is that developed across the 250-ohm resistor or 5 volts. Advancing the control increases the effective voltage between cathode and ground. This voltage is not only created by the current flow in the cathode circuits of the r-f tubes, but is augmented by the current flow due to the circuit connection to the *B* supply. At the same time, the sensitivity of the r-f section is further reduced by the increase in screen grid voltage, since the screen grid voltage supply is connected to a tap on the bleeder circuit. The inclusion of the control resistance at the return end of the bleeder system increases the voltage at the screen-grid voltage tap.

National NHU

Fig. 4 shows the r-f gain control

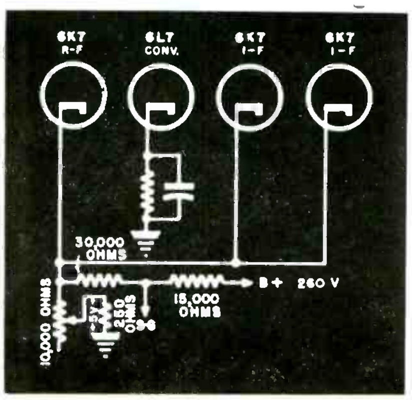


Fig. 3. R-f gain control system as used in the Hallicrafters SX18. Here, the normal current from the r-f cathodes is supplemented by the current from a bleeder network connected to the high voltage. Increasing the volume control also increases the screen grid voltage, thereby further reducing stage gain.

circuit of the National NHU. It should be noted that the control is applied to the first, second and third i-f stages only. Since the signal voltage applied to the antenna input would rarely create excessive grid voltage at the input to the mixer stage, no control is applied to the r-f or mixer stages. However, when the avc is used voltage is applied to these stages. The avc voltage is applied, since the action is automatic. This reduces the problem of applying sufficient bias voltage to the i-f section to reduce the possibility of overloading. The circuit is conventional, and is identical to that of Fig. 1.

S and R Meters

Better type communications receivers feature tuning meters, variously called *S* meters or *R* meters. These tuning aids indicate the exact point of resonance, or center, of the received signal, and are actuated by the avc voltage. Typical tuning meter circuits are shown in Fig. 5. In *a*, a pentode is used to amplify the avc voltage. In this respect, the tube is used as a d-c amplifier, with the plate current responding to the increases or decreases in avc voltage. The static plate current creates a voltage drop across the plate load resistor, which is in shunt with the meter. In series with the meter is an adjustable rheostat which permits the setting of the meter for maximum deflection when no signal is being received. This point of maximum meter deflection now represents zero signal. Upon receipt of a signal, an avc voltage is created. This voltage in turn increases the bias on the meter amplifier tube grid, reducing the plate current. Therefore less current flows through the meter, causing the needle to return toward meter zero. The stronger the signal, the greater will be the meter deviation from maximum. Thus, the meter is indicative of the signal strength. Meters are calibrated in terms of signal by an ascending scale. Thus, an S5 signal is stronger than an S2 signal. The meter, therefore can also be used to compare the strength of two different signals. It should be noted that the meter action is inverse to the signal strength in this system. That is, maximum meter reading is minimum signal reading, and vice versa.

Fig. 5*b* shows a similar system, with the meter in the cathode circuit of the meter amplifier. This circuit has the advantage of placing the meter at ground potential, thereby protecting it against shorts in the circuit.

Another method is shown in Fig. 6. In this system (National NHU), the

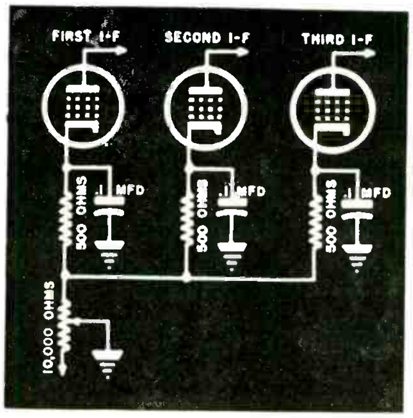
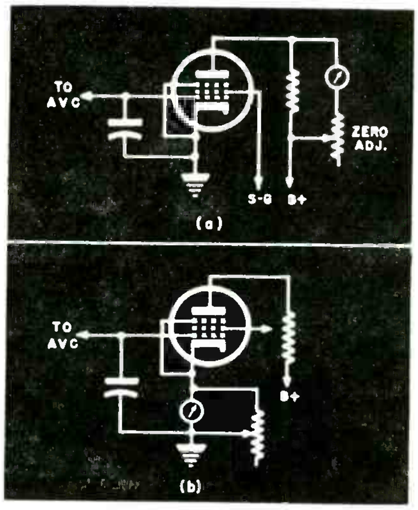
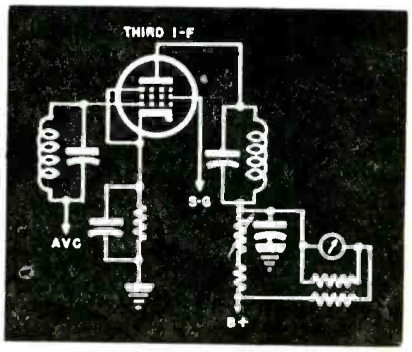


Fig. 4. National NHU r-f gain control system. It is only used in the first, second and third i-f stages. However, avc action is applied to the r-g stages as well to create a smoother action.



Figs. 5 (above) and 6 (below). Fig. 5. Two methods of supplying the actuating voltage to an indicating signal meter. In *a*, the meter is in shunt with the plate resistor of a pentode amplifier tube actuated by the avc voltage. In *b*, the meter has been placed in the cathode circuit to protect it from shorts. Fig. 6 shows the *S* meter circuit of the National NHU. The third i-f stage has been used as the meter amplifier in this receiver. Avc action will reduce the plate current, which in turn registers on the meter.



third stage performs the function of the pentode tube of Fig. 5*a*. Any increase in bias on the third i-f stage through the application of avc voltage will decrease the plate current. Since the meter is connected across the load resistor feeding the plate of the tube, this variation in current will be reflected in the meter reading.

RME 41-43

Figs. 7 *a*, *b* and *c* show a cathode version of Fig. 5, used in the RME 41-43. This system is a plug-in type, which supplies filament voltage to a pilot light inside the meter case. A bucking voltage is also supplied to the meter by the speaker field-winding circuit. This meter operates in reverse to the meters previously discussed, in that meter zero is also signal zero. When no signal is present, the bucking voltage from the speaker field is so adjusted that the meter reads zero. The indicating voltage is supplied by the cathode circuit of the second i-f stage. An increase in signal increases the avc voltage, which, in turn, reduces the cathode current in the second i-f stage. This causes the current from the speaker field to flow through the meter circuit, the amplitude of this current depending on the amplitude of the cathode current drop. Fig. 7*b* shows the same circuit simplified. In effect, a parallel path exists, through which the speaker field current may flow to ground. In Fig. 7*c*, we note that when the cathode current through R_1 is equal to the field current through R_2, a null condition is created at the two meter terminals, where the current at both sides of the meter is equal. The meter therefore will indicate zero. When the cathode current decreases, a portion of the field current will then flow through the parallel path of the meter side of the circuit, thereby causing the meter needle to indicate the signal strength responsible for the loss in cathode current.

Since indicating meters are dependent on the avc system for their actuating voltage, they are inactive when the receiver is switched to manual control. Adjustments for setting meter zero are usually found on the rear of the chassis, in the vicinity of the antenna terminals.

Band Spreading

Many communications receivers also feature band-spreading controls. Those receivers which feature a crystal i-f filter usually incorporate band spreading as a necessary adjunct. Since the bandwidth of a coded signal is very narrow, on the order of 100 cycles or less, it is very easy to slide over the signal when using the conventional dial, particularly when the i-f is set at crystal sharpness. The band-spreading dial is connected to a three-plate tuning capacitor which is part of the main

(*Continued on page* 24)

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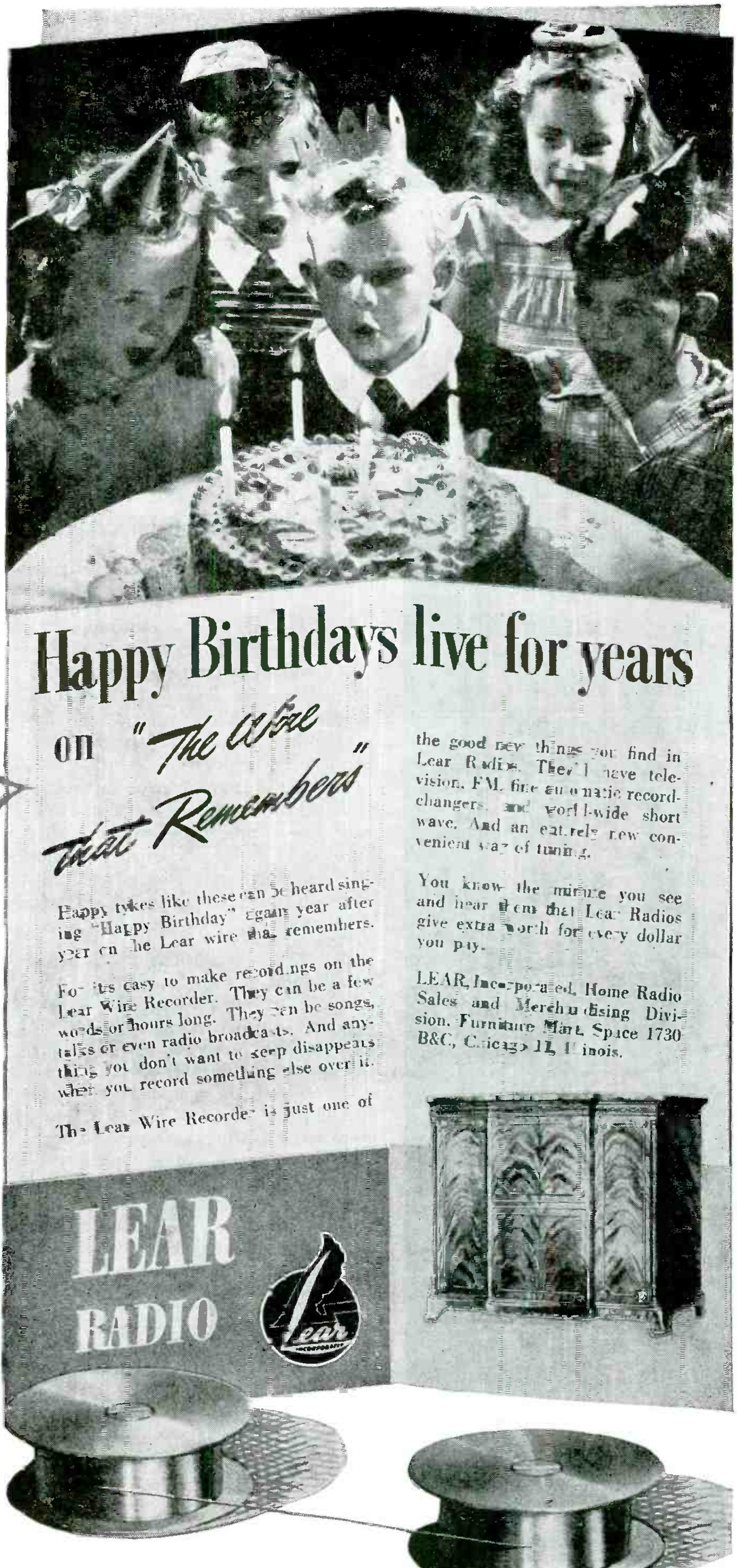
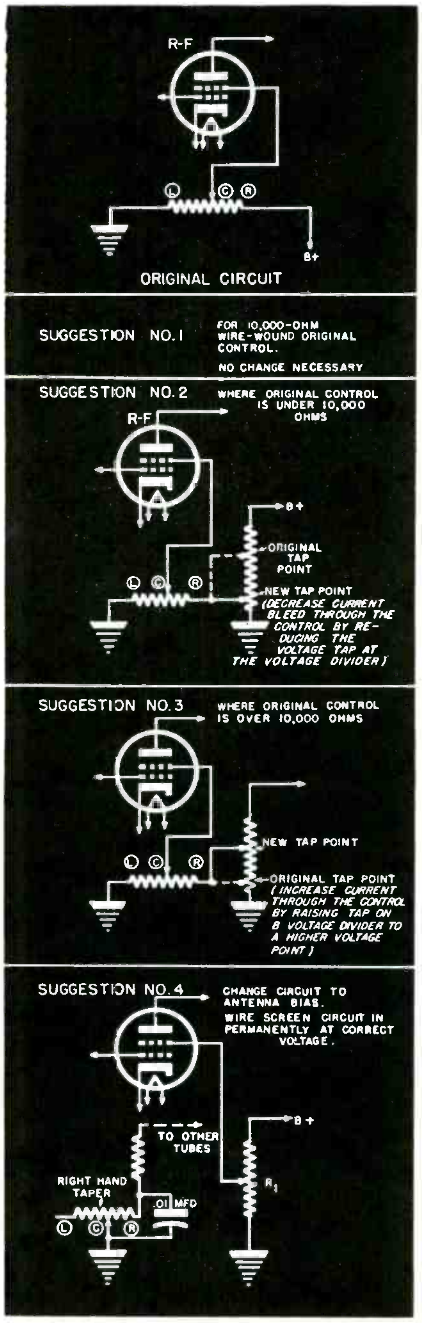


VOLUME AND TONE CONTROL RESISTORS

Repairing, Reconditioning and Circuit Substitutions



[Part Twelve of a Series]

by ALFRED A. GHIRARDI

Advisory Editor

AS explained previously noisy carbon controls often may be quieted (usually only temporarily) by merely rotating the shaft back and forth repeatedly while the entire unit is immersed in a grease solvent such as carbon tet., Energine, white gasoline, etc., or by introducing the solvent at the terminal lugs and shaft bushing. However, these procedures are not sure cures in all cases, nor do they provide the important replacement of the lubricant on the metal-to-metal rubbing surfaces.

It is better practice to first remove the attachable switch or dust cover from the back of the unit so as to expose the vital parts, and then carefully examine the carbon-coated resistance element and all metal-to-metal rubbing surfaces. If the resistance element does not show signs of excessive wear, cracking, or pitting, a simple, thorough cleaning with one of the previously specified cleaning fluids carefully applied with a small paint brush, will usually be satisfactory. Then all the metal-to-metal rubbing surfaces in the unit should also be cleaned in the same manner.

The contacting device is particularly important. Various types are employed—all are designed to minimize wear of the thin carbon resistance coating. Some types (Allen-Bradley, IRC) employ a sliding wiper contact. Others use a flat, flexible plated-bronze spring in the form of a ring slightly smaller in diameter than the outer edge of the resistance element. This is normally held clear of the element by spring tension, but is pressed down to make pressure-contact along the element by the action of a pad on the end of a rotor arm. Still another type employs a contact arm carrying a small roller. This presses a thin flexible, circular metal contact band or *track* into intimate contact with the resistance element only at the point where the roller happens to be at the moment.[2]

The contact surface of whichever type of contacting device is employed should be cleaned by the previously described procedure. In the case of the flexible ring or band type contactor, this should be followed, when dry, by a small spot of Lube-Rex (or one of the other lubricants previously specified) applied *only* on the metal-to-metal, contact-arm rubbing surface of the contact element. The lubricant should be applied very sparingly so that it will *not* find its way on to the surface of the carbon resistance element later, thereby effectively insulating it from the contacting device.

Then a small amount of the lubricant should be applied to all the other metal-to-metal rubbing surfaces. Here again, oil or graphite grease should never be used.

While the unit is open, it is advisable to inspect all rivets which fasten members that are part of the *electrical* circuit within the control. When doing this, it should be remembered that as a rule the contacting device in carbon-element controls is insulated from the rotating shaft and mounting bushing, since this element is often the terminating point of a sensitive circuit which would be affected by body capacitance through the control knob and the shaft. Various methods are employed to achieve this insulated construction, depending upon the manu-

Fig. 6. Suggested changes and substitutions for sample screen circuit type volume controls. See page 19 for circuit analysis.

[2]Part 6, August 1945, SERVICE.

facturer's particular design. Usually, the arrangement comprises a slip ring and wiper contact on the contact shoe, which is mounted on an insulating bakelite section that is turned by the shaft and knob.

If rivets in any part of the internal electrical circuit are loose or corroded, noisy or intermittent operation will result. Such rivets should be tightened carefully if possible, both sides of the rivet should be soldered to the metal members it is holding together, using as little solder as necessary and carefully cleaning away excess flux.

2. ***Touching-up the Carbon Element:*** If the carbon-coated resistance element shows signs of pitting, cracking, or wearing in spots, such spots can be *touched up* by carefully applying to them one of the special commercial carbon liquid compounds made for this purpose. Carbon-X,* a graphitic compound, is useful, and is easily applied over such bad spots. It is marketed in convenient 1- and 2-ounce bottles. It does not adhere well to carbon elements that have absorbed oil, or which were of water-resistant nature when made. For such elements, the old practice of carefully filling these worn or pitted spots with carbon from an ordinary soft lead pencil is frequently employed.

Repairing Attachable Switches on Volume Controls

Occasionally, the attachable switch fastened to the back of a volume control goes bad. The most frequent trouble is weakening of the coil spring and resultant failure of the bakelite-ring contact carrier to close the contacts firmly. Of course, the best policy is to replace the switch with a new one if possible, for such switches are very inexpensive and it does not pay to attempt to repair them unless it is absolutely necessary. However, there are instances when a repair must be effected.

Since the switch mechanism is usually enclosed in a plastic case which is riveted to a metal back plate, these rivets must be filed off and removed in order to take the switch apart. (New ones of the same size should be available.) The compression coil spring should be removed and stretched somewhat so it will provide more compression when it is put back. The contacts may require cleaning. If they are pitted, they may have to be dressed down with a fine file and then bent slightly to make perfect contact. The unit should be operated and checked with a continuity tester to make sure that it works properly, before riveting it on to the back plate.

Switches on faulty controls that are to be junked will frequently be found to be in excellent operating condition. Some Service Men make a practice of saving them for use as replacements for similar defective switches on good controls.

Control and Circuit Substitutions and Improvements

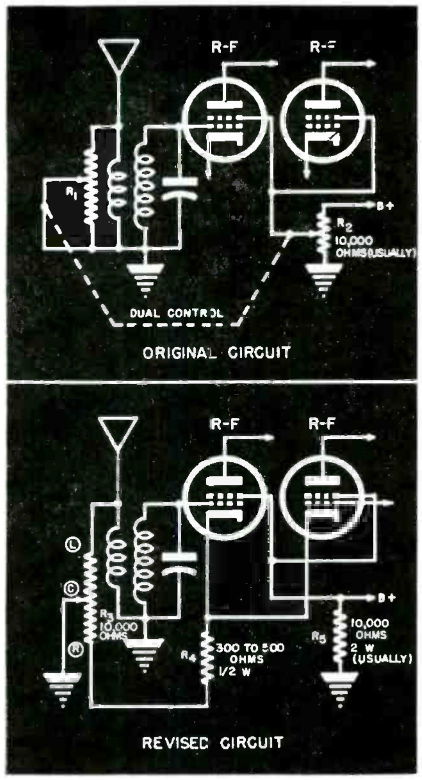
The modern Service Man should possess a good working knowledge of the actions and peculiarities of the many different types of volume and tone control circuits employed in both the older and the current types of receivers.[3] This will enable him to actually improve some of the known unsatisfactory control arrangements when he finds them in receivers that are brought to him with volume or tone control troubles. He should also be familiar with certain well-known control circuit changes that many Service Men often make when they are called upon to service a receiver containing a faulty control and are unable to either repair the unit or obtain a suitable replacement unit that matches the value and taper of the original control. Such knowledge is extremely useful and valuable especially to those Service Men who are located at points distant from sources of replacement parts.

Screen Circuit Control Changes and Substitutions

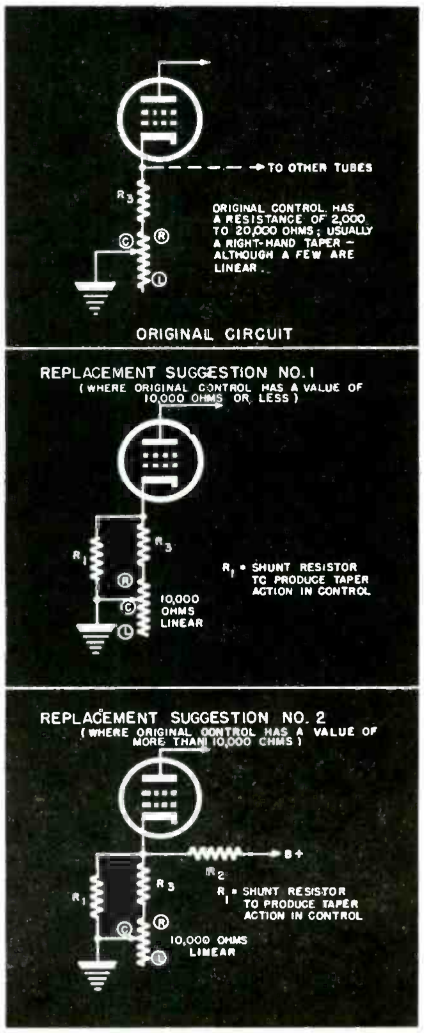
(1) Simple Screen Circuit Control: In many of the older type receivers, the method used to control the volume was that of varying the screen-grid voltage applied to the r-f tubes, as illustrated at the top of Fig. 6. The action of the control is similar in most respects to the action obtained by controlling the grid bias of the tube. The mutual conductance (plate current to grid voltage transconductance) of the tube varies with the screen voltage. This circuit properly takes a control having a left-hand taper that is rather sharp. Because of the small screen current drawn by only one or two tubes, and because of the necessity of a sharp taper, a carbon control is best suited for the purpose.

Varying the screen voltage to control the r-f tube is now practically an

(*Continued on page* 21)

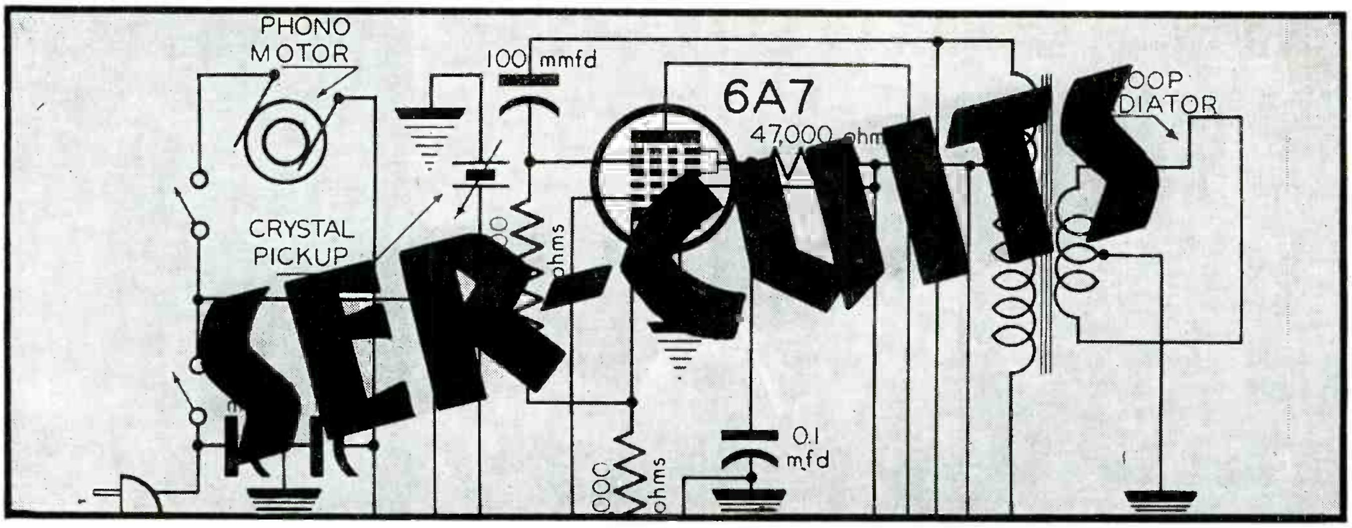


Figs 7. (above) and 8 (below). Fig. 7. Suggested change for volume control employing dual control in screen and antenna circuit. Fig. 8 shows suggested changes for bias-type control circuit when a standard 10,000-ohm linear replacement control must be used.



*General Cement Mfg. Co.

[3]For a comprehensive explanation of volume and tone control circuits employed in receivers see *Volume Control Circuits* by Robert L. Martin, June and July 1945, SERVICE.



by **HENRY HOWARD**

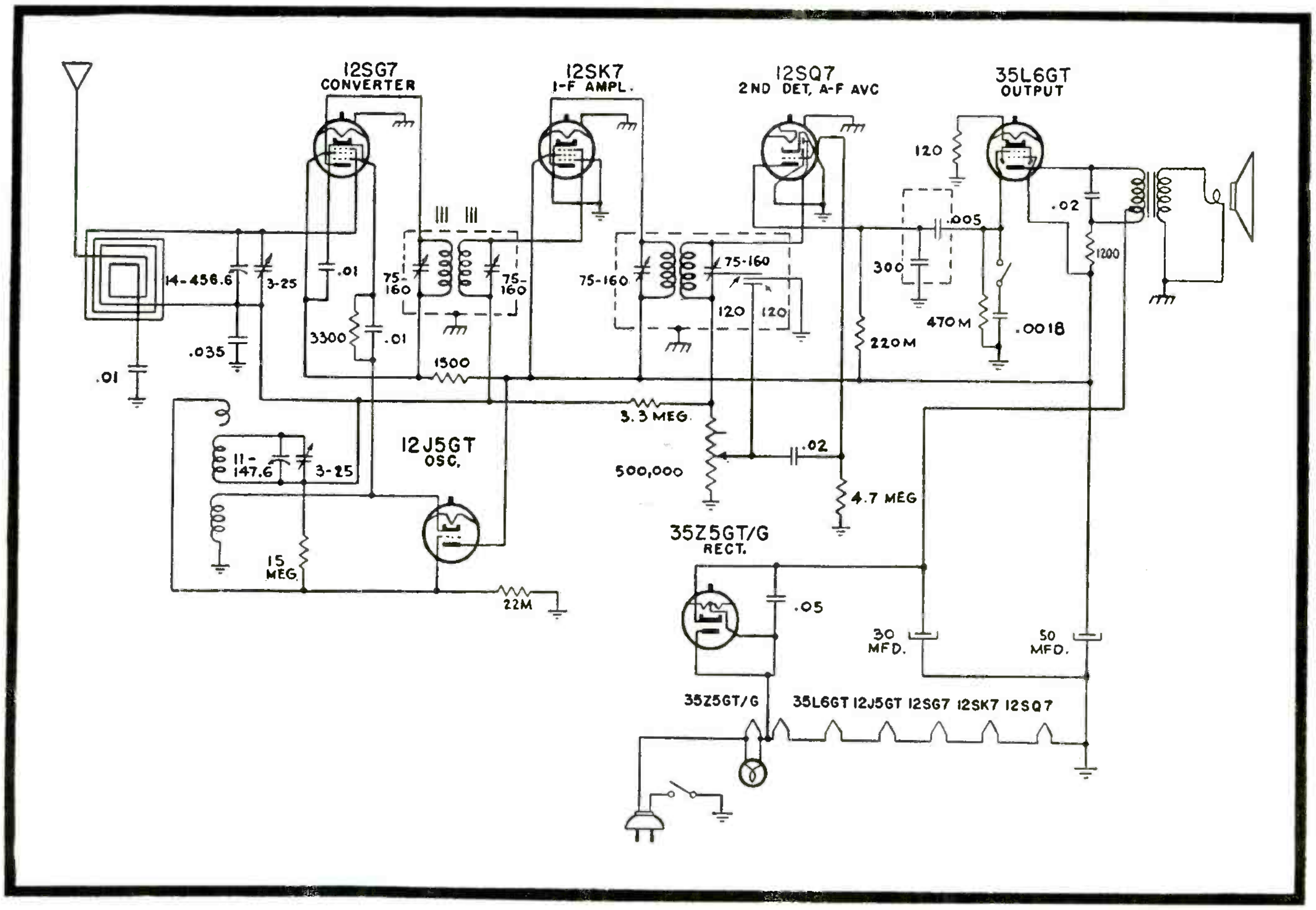
THE past few weeks have seen the release of quite a few post-war models, with many circuit developments. The RCA receivers, for instance, feature a high gain 6SG7-12SG7 as an r-f amplifier or converter in place of the more common 6SK7-12SK7 remote cutoff pentode. The SG series has about double the transconductance of the SK series, making it possible to secure a 50% increased gain. All a-c/d-c models of the RCA group have the speaker voice coils, as well as all shields of metal tubes, grounded to the chassis. Chassis are connected to *B-* through a 0.1-mfd capacitor shunted by 220,000 ohms. This keeps the chassis at an r-f ground potential and prevents the building up of a static potential between chassis and ground.

RCA 56X, 56X2, 56X3

In Fig. 1 we have the RCA Victor compact models 56X, 56X2, 56X3 with a 12SG7 converter, 12J5GT separate oscillator, 12SK7 i-f, 12SQ7 detector/avc/audio and 35L6 beam output to either an e-m or p-m speaker. The oscillator is unusual. It consists of a cathode feedback circuit with the plate grounded to r-f, directly connected to *B+*. A grid capacity winding on the oscillator coil serves as a grid capacitor. Oscillator voltage is injected to the converter by a cathode-to-cathode connection through a 3,300-ohm bias resistor and .01-mfd bypass capacitor. The oscillator tuning capacitor across the grid coil is tied to the avc bus. A

(*Continued on page* 22)

Fig. 1. Postwar 5-tube and rectifier a-c/d-c RCA compact receiver, type 56X, 56X2, 56X3.



(*Continued from page* 19)

obsolete practice, but when a receiver using this control arrangement is encountered and you are unable to match the value and taper of the original control, any of the four suggestions proposed by P. R. Mallory & Co., Inc., and illustrated in Fig. 6 can be used. In most cases, if the proper control unit can be obtained, it is best to change the circuit to the more modern method of volume control suggested in *4*. The tapped fixed resistor R_1 is wired in as a voltage divider to supply the proper fixed voltage for the screen operation.

(2) Dual Control in Screen and Antenna Circuit: The original circuit of a typical control arrangement of this type is illustrated at the top of Fig. 7. If you are unable to match the value and taper of the original dual control, you should change to the simple antenna-shunt plus grid-bias single-control (*IRC*) circuit shown. This may be accomplished by removing the old control and replacing the screen section, R_2, with a fixed 2-watt screen resistor, R_6, whose resistance is equal to the value of that section in ohms (usually 10,000 ohms). The dual control should be replaced with a single midget 10,000-ohm control, R_3, and either a built-in, or external, 300- to 500-ohm ½-watt *C*-bias fixed resistor, R_4, for the two tubes, as shown. The midget control, R_3, should have a right-hand taper of the type best suited for antenna-shunt plus grid-bias control.

Bias Type Control Changes and Substitutions

(1) Single Bias Control: With the advent of *super-control* tubes, the grid bias type of volume control circuit was widely adopted. This makes use of the variation of bias voltage applied to one or more r-f tubes to control the volume of the receiver. Several variations of this circuit have been used, such as grid return to the negative *B* potential, cathode connection to voltage divider tap, etc. However, the most popular was the single variable resistor usually connected in the cathode return of the r-f stage or stage as illustrated by the top circuit in Fig. 8. In each of the circuits illustrated in Fig. 8, R_3 is the minimum-bias resistor.

The middle and lower diagrams in Fig. 8 illustrate two suggested circuit revisions, proposed by P. R. Mallory & Co., Inc., to be used whenever only

(*Continued on page* 32)

SER-CUITS

(*Continued from page* 20)

15-megohm resistor is connected between the bus and oscillator grid, providing a negative bias on the bus when no signal is coming through. This bias varies somewhat with frequency, the grid voltage being -7.5 at the low frequency end and -6 at the high end.

A 1,500-ohm resistor is used to isolate the converter screen grid and plate from *B*+. The .01-mfd filter is returned directly to cathode. This *RC* filter attenuates hum and prevents common coupling to other stages (particularly to the i-f amplifier) through the *B* supply.

The 12SK7 and 12SQ7 stages are quite conventional. It will be noted however that the ½-megohm volume control has a stop at 50,000 ohms which prevents the control from being turned up to maximum position. This prevents distortion due to overloading of the detector, representing a sacrifice of quantity for quality. A tone control switch places a .0018-mfd capacitor across the 35L6 input.

Hum neutralizing is obtained in the output transformer by feeding the *B* supply to a tap on the primary. Hum current going in one direction (toward the plate) is neutralized, or cancelled, by the hum current in the opposite direction to the screen of the 35L6 and all other tubes. A filter consisting of 1,200 ohms and 50 mfd eliminates the audio voltage and hum, preventing modulation of the screen and *B*+ bus. With this type of hum neutralizing the power tube may be fed directly from the rectifier output, as in a push-pull amplifier. The power output is 1.5 watts maximum, 1.0 watt undistorted.

When an electromagnetic speaker replaces a p-m, the filter and output circuits are changed, with the field being used as a filter choke. Since smaller electrolytics are permissible and there is no need for hum neutralizing, the full winding is used as a primary load for the 35L6. The tap on the transformer is taped.

RCA 56X5

RCA model 56X5 has a 12SG7 r-f amplifier and a peaked, untuned first detector handling a short-wave band of 8.9 to 12 mc. The s-w transformer secondary functions as a loading coil for the loop on b-c. The tuning capacitor is connected to a tap allowing bandspread on s-w, but with little effect on b-c. The first detector is coupled to the 12SG7 across a 1,200-ohm plate resistor and 220,000-ohm grid leak. A 1.5-ohm peaking coil and 150-mmfd blocking capacitor is tuned for a maximum gain near the center of the band. A decoupling filter, 120 ohms and 0.1 mfd, is used in the plate supply circuit. The 12SA7 oscillator section operates with a grounded cathode and screen plate tickler. As in Fig. 1, a 15-megohm resistor connects grid to avc bus across a 22,000-ohm grid leak. The grid potential is –8 volts at 540 kc, –10 at 1,600 kc,– 6 at 8.9 mc and –7.5 at 12 mc.

A 3-position waveband switch covers b-c with maximum highs; b-c with a .0018-mfd capacitor across the first audio output and s-w with the same capacitor. This minimizes extraneous noise and heterodynes, although it sacrifices some treble. The oscillator has a dual coil, the sections being in series for b-c, the top coil only for s-w. A tap is provided for bandspread. On s-w, a .005-mfd capacitor shorts the b-c tickler while a .01-mfd capacitor shorts the grid coil. An iron core i-f transformer is used for input; air core for output.

RCA 56X11

The RCA 56X11 2-band receiver is similar to the 56X5, with the same tube lineup but with different antenna and oscillator circuits. The s-w antenna transformer primary acts as a b-c antenna loading coil. Bandspread is obtained by inserting capacitors in series with the tuning capacitors. The oscillator uses plate cathode feedback with screen at r-f ground potential.

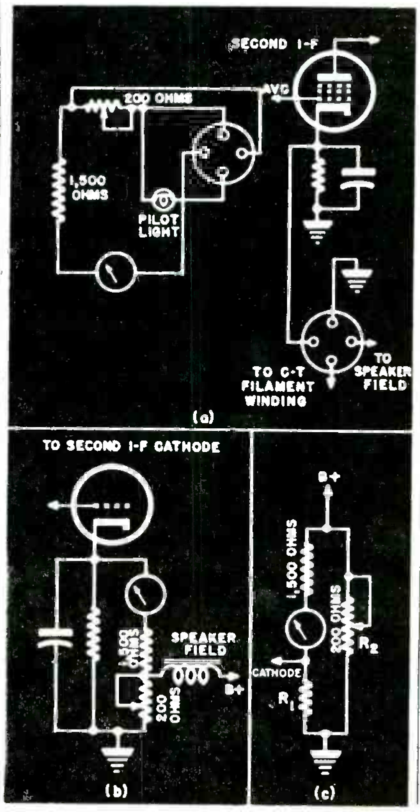
List of parts for Stewart-Warner 9000-B, 5-tube and rectifier a-c/d-c 2-band model described and illustrated in last month's *Ser-Cuits* discussion, page 46.

	CONDENSERS
3	Condenser—trimmer; 25 to 100 Mmfd..
5A-5B-5C	Condenser—variable gang (with drum).
9	Condenser—315 Mmfd. 500 volt.........
11	Condenser—mica—50 Mmfd. 500 volt...
12	Condenser—.1 Mfd. 200 volt............
13	Condenser—.2 Mfd. 200 volt............
14	Condenser—trimmer; 25 to 100 Mmfd....
18	Condenser—.25 Mfd. 200 volt...........
26	Condenser—.0008 Mfd. 400 volt..........
27	Condenser—.002 Mfd. 400 volt..........
28	Condenser—mica—110 Mmfd. 500 volt..
32	Condenser—mica—110 Mmfd. 500 volt..
33	Condenser—.05 Mfd. 200 volt...........
34	Condenser—.004 Mfd. 400 volt..........
39	Condenser—.01 Mfd. 400 volt...........
40A-40B	Condenser—electrolytic A-40 Mfd. 150 volt B-20 Mfd. 150 volt ....
43	Condenser—.02 Mfd. 400 volt...........
46	Condenser—.05 Mfd. 400 volt...........
	RESISTORS
6	Resistor—carbon 390 ohms ¼ watt......
10	Resistor—carbon 22,000 ohms ¼ watt..
15	Resistor—carbon 220,000 ohms ¼ watt..
19	Resistor—carbon 4700 ohms ¼ watt.....
21	Resistor—carbon 3.3 Meg. ¼ watt......
22	Resistor—carbon 47 ohms ¼ watt......
24	Resistor—carbon 47,000 ohms ¼ watt...
25A-25B	Volume control 500,000 ohms (with switch)
29	Resistor—carbon 10 Meg. ¼ watt.......
30	Resistor—carbon 2200 ohms ¼ watt....
31	Resistor—carbon 2.2 Meg. ¼ watt......
35-36	Resistor—carbon 220,000 ohms ¼ watt..
37	Resistor—carbon 470,000 ohms ¼ watt..
38	Resistor—carbon 130 ohms ¼ watt.....
42	Resistor—carbon 1500 ohms 1 watt...
48	Resistor—carbon 33 ohms ½ watt..

(*Continued from page 16*)

tuning capacitor, but which appears as a separate tuning control and dial. This dial is calibrated so that it can be used to determine the particular frequency within a band. By rotating the band-spread dial, an entire band is then covered. Thus, a full dial rotation is used to cover a portion of the main dial calibration. It is important to reset the band spread to its zero point before using the main dial for tuning purposes. Otherwise the scale reading of the main dial will be incorrect. This must also be checked when aligning the receiver. The stator plates of some band-spread capacitors are mounted on the main tuning capacitor assembly, and the rotor revolved from a separate shaft. The band-spread capacitor may therefore be considered in the same category as a trimmer. For this

Fig. 7. Circuit diagram of the metering circuit of the RME 41-43. The meter is a plug-in type. Circuits in *b* and *c* are presented to clarify the action of the tuning meter. Meter zero in this system is also signal zero.



reason, the band-spread capacitor must be reset to full mesh before the main dial will read correctly.

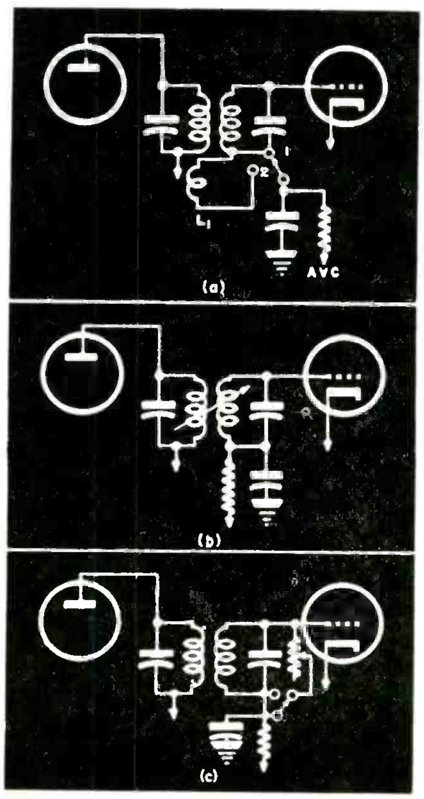
Variable Selectivity

Variable selectivity in the i-f stages is another feature of some communications receivers. These systems are similar to some of those featured in the better type of ham receivers. Variable i-f selectivity is particularly necessary in communications receivers, because of their varied uses. Since most receivers tune to broadcast frequencies, a wide-band response is necessary for high fidelity. On the short waves, the narrower bands are used so as improve intelligibility in the presence of noise. The crystal filter and its accompanying selectivity is used primarily for coded signal work, its selectivity being too sharp for voice signals.

Fig. 8 shows three methods for varying the selectivity of an i-f stage. In *a*, the coupling between primary and secondary of the i-f transformer is varied by including or excluding the close coupling coil L_1. This coil consists of a small number of turns connected to the secondary of the transformer, and closely coupled to the primary of the same i-f transformer. In position *1*, the close coupling coil is

(*Continued on page* 37)

Fig. 8. Three methods of producing wide band acceptance in an i-f amplifier. In *a*, switching in L_1 into the grid circuit increases the coupling between primary and secondary. In *b*, coupling between primary and secondary is varied mechanically. In *c*, varying the resistor across the grid input circuit reduces its *Q*, and the corresponding selectivity.



Simplified Analysis of OHM'S LAW

[*Part II*]

by L. A. MOHR

WHEREVER current and voltage are present, energy is being dissipated. This energy dissipation is usually evidenced as either heat, light, or motion. Another way of stating this fact is to say that work is being done, or that power is being consumed. In electricity, the power consumed is a function of the current flow and the voltage used to induce that current flow. Simply stated, power is equal to current x voltage, or $P = E \times I$, where P = power in watts, E = volts, I = current in amperes.

The same formula may also be expressed in terms of voltage or current. Therefore:

$$E = \frac{P}{I}, \text{ or } I = \frac{P}{E}$$

The formula is quite simple to apply. As an example suppose a light bulb is connected across a source of voltage measuring 110 volts. The current in the circuit is 1 ampere. What is the wattage dissipated, or consumed in the light bulb?

$$P = E \times I, \text{ or } P = 110 \times 1.$$

Therefore $P = 110$ watts.

Now let us suppose we had a 60-watt bulb connected across a voltage source of 120 volts, and we wanted to know what current will flow in the circuit.

$$I = \frac{P}{E}, \text{ or } I = \frac{60}{120}.$$

Therefore $I = .5$ ampere.

Suppose now we wanted to find out the line voltage, with a 100-watt bulb in the circuit and the current of .8 ampere.

$$E = \frac{P}{I}, \text{ or } E = \frac{100}{.8}.$$

Therefore $E = 125$ volts.

As we can see from the above examples, if two factors are known, the third can be computed.

Practical Applications

Unless very high accuracy is necessary, as in laboratory work, certain aspects of average E-I-R hook-ups are either taken for granted, or we can mentally account for them. Two of these factors are energy source, and wire size to be used in circuit connection.

In electrical work associated with radio, three common sources of voltage are used. These are the electric line or house electrical system, radio power supply, and battery. In determining the proper size wire to use for connections in electrical circuits involving any of these sources, wide latitude of judgment is permitted. It is desirable not to waste energy in the connections involved in joining electrical circuits, since this energy performs no useful work. On the other hand, it is wasteful to use wire sizes for connections that are in excess of what is actually necessary, since wire cost increases rapidly with wire size. For this reason, standards have been set for appropriate wire sizes for various types of electrical connection. The size of wire to be used is determined by the current flowing in the circuit. To standardize procedure, maximum current capacity for various diameter wires has been established. As previously stated, one form of dissipated electrical energy is evidenced as heat. The *safe* current carrying capacity of a wire is therefore determined by its ability to carry a current without undue heating. The chart shown in Fig. 4 gives the current carrying capacity for various sizes of wire.

Standard Wire Sizes

House wiring systems are usually

(*Continued on page 28*)

Gage (B. & S.)	Diameter (Inches)	Carrying Capacity: Rubber Insulation	Varnished Cloth	Other Insulation	Resistance (Ohms Per Foot)
10	.1019	25	30	35	.0009989
12	.08081	20	25	30	.001588
14	.06408	15	18	20	.002525
16	.05082	6	..	10	.004016
18	.0403	3	..	6	.006385
20	.03196	1.5	..	3	.01015
22	.02535	1	..	2	.01614

Fig. 4. A chart showing influence of wire size on current carrying capacity and wire resistance. Note the influence that the wire covering exerts on current carrying capacity.

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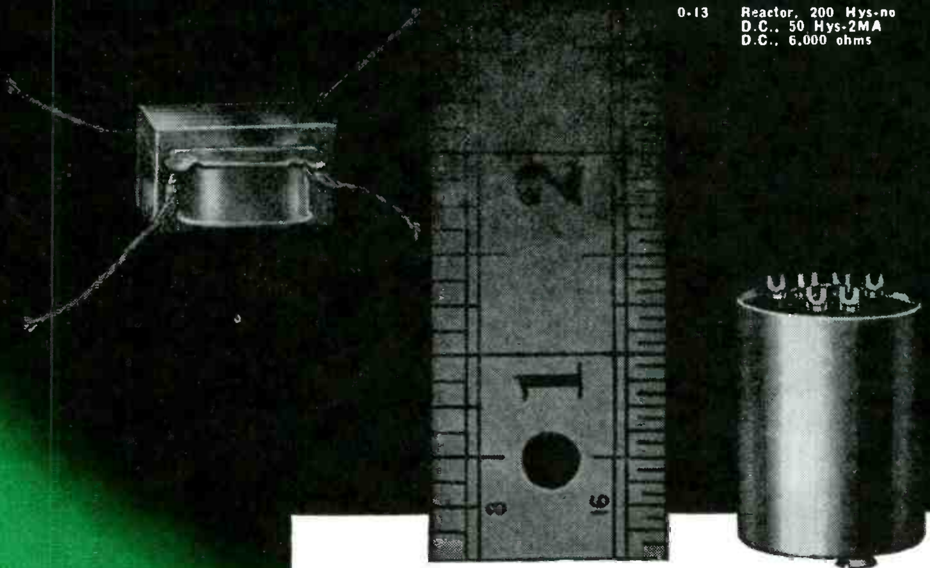
UTC Sub-Ouncer units are 9/16" x 5/8" x 7/8" and weigh only 1/3 ounce. Through unique construction, however, these miniature units have performance and dependability characteristics far superior to any other comparable items. The coil is uniform layer wound of Formex wire . . . On a molded nylon bobbin . . . insulation is of cellulose acetate . . . leads mechanically anchored (no tape) . . . core material Hipermalloy . . . entire unit triple (waterproof) sealed. The frequency response of these standard items is ± 3 DB from 200 to 5,000 cycles.

Type	Application	Level	Pri. Imp.	D.C. in Pri.	Sec. Imp.	List Price
SO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	$5.00
SO-2	Interstage/3:1	+ 4 V.U.	10,000	0	90,000	5.00
SO-3	Plate to Line	+ 23 V.U.	10,000 25,000	3/1.5 mil.	200 500	5.00
SO-4	Output	+ 20 V.U.	30,000	1.0 mil.	50	5.00
SO-5	Reactor 50 HY at 1 mil. D.C. 3000 ohms D.C. Res.					4.50

UTC OUNCER SERIES

The standard of the industry for seven years. The overall dimensions are 7/8" diameter by 1-3/16" height including lugs. Mounting is effected by two screws, opposite the terminal board side, spaced 11/16". Weight approximately one ounce. Units not carrying D.C. have high fidelity characteristics being uniform from 40 to 15,000 cycles. Items with D.C. in pri. are for voice frequencies from 150 to 8000 cycles.

Type	Application	Pri. Imp.	Sec. Imp.	List Price
0-1	Mike pickup or line to 1 grid	50, 200, 500	50,000	$11.60
0-4	Single plate to 1 grid	8,000 to 15,000	60,000	$ 9.25
0-5	Single plate to 1 grid, D.C. in Pri.	8,000 to 15,000	60,000	$ 9.25
0-6	Single plate to 2 grids	8,000 to 15,000	95,000	$10.45
0-8	Single plate to line	8,000 to 15,000	50, 200, 500	$11.60
0-9	Single plate to line, D.C. in Pri.	8,000 to 15,000	50, 200, 500	$11.60
0-12	Mixing and matching	50, 200	50, 200, 500	$10.45
0-13	Reactor, 200 Hys-no D.C., 50 Hys-2MA D.C., 6,000 ohms			$ 8.10



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OHM'S LAW

(Continued from page 26)

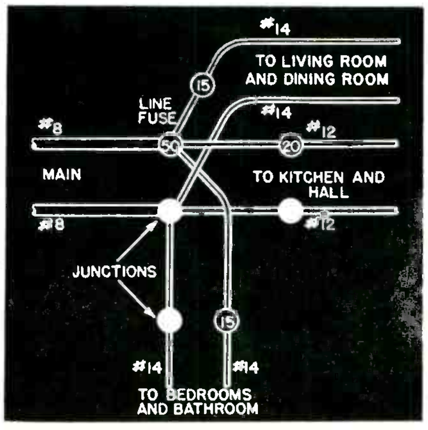
12 or *14* gage. Lamp wires are generally *16* or *18*. Electric cords for irons or toasters run about *14* or *16*. Radio set wiring runs from *16* for filament circuits to *22* for set wiring. The use of the proper size wire insures a minimum of power loss in the connections.

The source of power is another limiting factor in matching E, I, and R. Electrical work involves currents rated in amperes, whereas in radio receivers, values of current are only a fraction of an ampere, or milliamperes. A milliampere is a thousandth of an ampere, and is written as either 1 *ma* or .001 ampere; 10 ma or .01 ampere; or 100 ma or .1 ampere.

House lighting systems are supplied by very large generators capable of supplying thousands of amperes. However, currents in excess of 15 amperes in individual circuits are ordinarily not used, since the wire size in the house wiring system is rated at this value, Fig. 5. In radio receivers the situation is reversed. That is, the wire is not the limiting factor, since the proper size can easily be used, but the source of voltage is a factor. Since the source voltage for a receiver is a function of tubes and transformers, these parts have definite ratings of power output, which are not to be exceeded. An analogy would be a truck capable of carrying two tons of material. Loads in excess of this value would probably shorten the life of the truck, or break it down. In the same sense, a power transformer or tube rated at 100 watts output should not have loads imposed in excess of this rating.

The same reasoning applies to bat-

Fig. 5. A typical wiring system for an apartment. The main leads which carry the entire current for the house system are represented by heavy wires with a high ampere fuse. The branch leads use small size wire, and correspondingly smaller fuses. Wire size is determined by the current which lines are expected to carry.



teries. Batteries are very limited sources of power. Within their current ratings, batteries will deliver this current at their designated voltage. However, once this current is exceeded, the voltage of the battery will drop. This drop in voltage is due to the excessive current drain creating a voltage drop across the internal resistance of the battery. The action is similar to that of a motor which will maintain a constant speed at rated loads, but whose speed will be reduced when the load is excessive.

Voltage Distribution

Ohm's law defines the action of voltage current, and resistance for any combination of these three electrical elements. However, electrical and radio circuits involve numerous combinations of these three elements, resulting in complicated distribution systems.

In Fig. 6*a* is shown the voltage distribution system of a typical midget receiver. Although all tube elements and associated resistors are shown as simple resistive paths, the computation of current and voltage for any point of the circuit is evidently a difficult task, even with a complete knowledge of Ohm's law. Evidently, the resistor values vary, depending on the current and voltage desired at a particular point. Here again the water analogy may be used in explanation.

In the construction of a building the size of pipe used to feed the various water services would be determined by the needs, insofar as pressure and amount of water required by the particular service, Fig. 6*b*. For example, the water main in the street, which is to supply several houses, would have the largest diameter, say 6". The feed line into the house would be 3". The feed line for the kitchen would be ¾" diameter, and the one for the bathroom would probably require a 1" diameter pipe. The pipe feeding the bathtub would be of a larger diameter than that feeding the kitchen sink, for two reasons. First, greater pressure could be used in the bathtub so as to fill the tub faster, whereas the same pressure on the kitchen sink faucet would only result in splashed walls. Again, a greater amount of water flow is desired for the bathtub, so as to fill it up faster.

In a similar manner, the resistor in the electrical circuit has its size and value determined by the voltage and current demanded at its far end. Because of the numerous voltages and currents demanded in a radio receiver, the distribution system becomes quite complicated. Yet two simple laws

(*Continued on page* 30)

OHM'S LAW

(*Continued from page 29*)

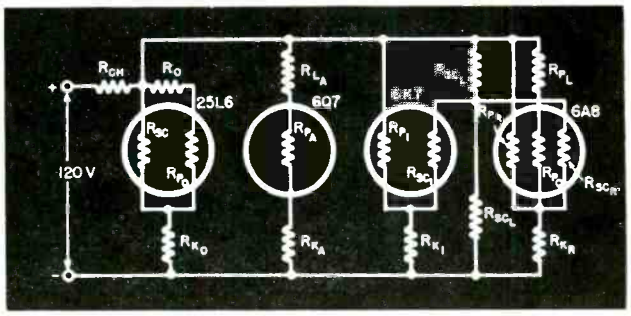


Fig. 6*a*. Voltage distribution system of a typical midget receiver. All tube elements and associated resistors are shown as simple resistive paths.

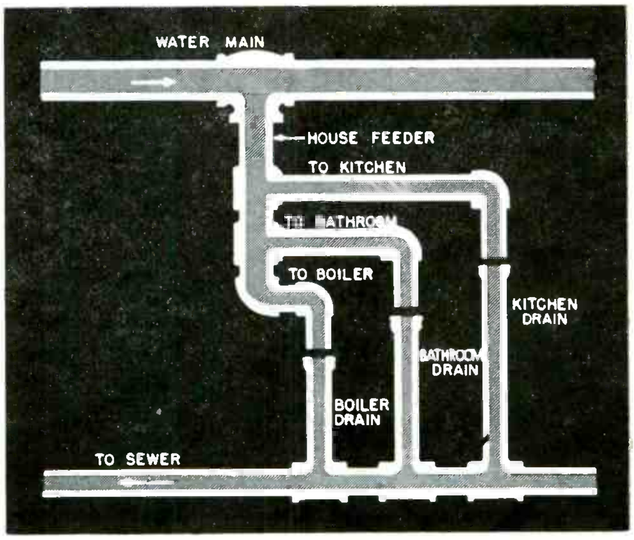


Fig. 6*b*. Water supply analogy to illustrate water and current flow control. Large diameter pipes permit greater water flow for increased pressure demands at output: size and value of resistor in electrical circuit controls current and voltage demanded at far end of circuit.

govern the action of all electrical distribution systems, and the application of Ohm's law. These two laws are known as *Kirchhoff's laws.*

The first law states: *At any point in an electrical circuit, there is as much current flowing into that section of the circuits, as is flowing away from it.*

The second law states: *The voltage drop between any two points of a circuit is the same, no matter what paths are used to connect these two points.*

Although these two laws are simple, and self-evident, the difficulty in determining where a circuit begins or ends usually results in confusion, when attempting to apply them. Because of their importance in any work in radio, it is important that this phase of electricity be thoroughly understood.

The water analogy may be used to further explain these two laws. In Fig. 7 is shown two pipes, coming out of a common source, and feeding a common pipe. Naturally, the amount of water drained from the tank by both pipes, regardless of their size, must wind up in the common pipe. Therefore, as much water flows in the common pipe as is being fed into the two pipes from the tank. This principle seems so simple that it would appear unnecessary to go to such lengths in explanation. Yet the most common error made in computing resistor size is usually due to neglecting possible current paths, their sources and their end points.

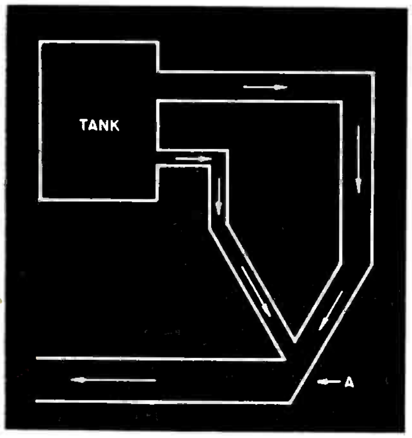
The second law may be explained by the same illustration. It is apparent that no matter which path the water took, the small pipe or the large one, the water pressure at the point where the two meet would be the same, and consequently the drop in pressure in either pipe, as measured between source and outlet, would be identical. In electrical or radio circuits, two resistors may be physically distant from each other and connected by wires. Yet their source and outlet may be common. Therefore, the voltage drop across either resistor will be the same.

In using the water analogy, one pitfall must be avoided. A *large* pipe is used to designate a pipe of large diameter, which implies one that is capable of carrying a large amount of water. In electrical terminology, a large resistor denotes its ability to carry current without undue overheating. In other words, its wattage rating. On the other hand, the *value* of a resistor is denoted in ohms, and would be equivalent to the resistance against water flow introduced by the length of a pipe. The physical length of a resistor is not the determining factor of its resistance value. This condition may be compared to a spiral pipe, whose resistance to water flow is high, even though it occupies a small physical space, Fig. 8. In the same manner, a small diameter wire may be wound on a form so as to occupy a small space, yet display a high resistance. Most resistors used in radio are a carbon type, in which the resistance value is determined by the composition of the carbon used. For carbon resistors, the physical size of the resistor determines its current carrying ability, and not its resistance. Resistors of the same current rating are usually the same size, regardless of resistance value.

Fig. 9 shows three simple combina-

(*Continued on page* 38)

Fig. 7. Water analogy to illustrate Kirchoff's laws.



VOLUME AND TONE CONTROLS

(*Continued from page* 21)

a 10,000-ohm *linear* replacement control (either carbon or wire-wound type) is available.

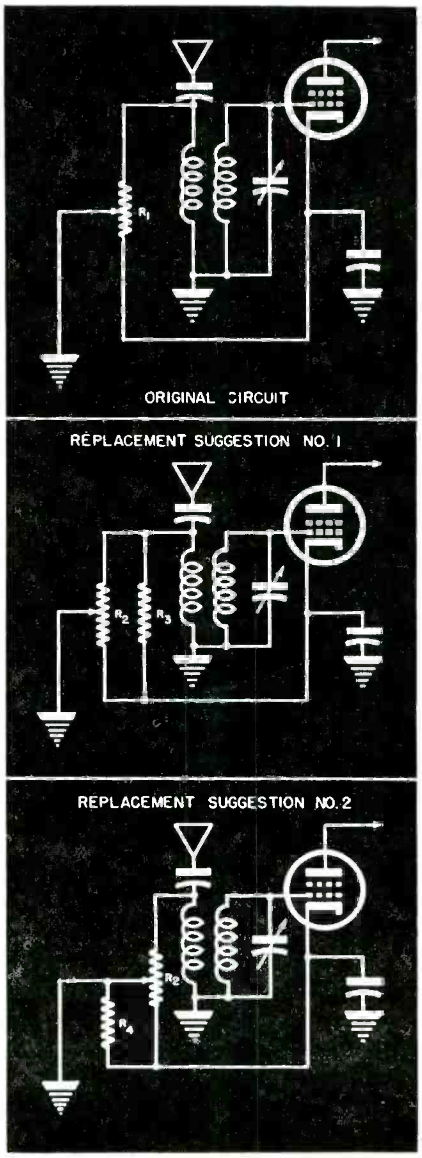
Where the original control has a value of 10,000 ohms or less, suggested circuit *1* in Fig. 8 should be employed. The shunt resistor R_1 is installed to produce a taper action in the control. The proper resistance value to employ is such as will compensate (by its shunting action) the use of a 10,000-ohm volume control in place of the original control of lower value.

Where the original control has a value of more than 10,000 ohms, suggested circuit *2* should be employed. Resistor R_2 should be of such resistance value that it bleeds the proper value of current through the 10,000-ohm volume control to duplicate the voltage drop that existed when the original volume control of value over 10,000 ohms was used. It is important to keep the voltage drop across the volume control resistor low enough so that it is operating within its power rating.

In either case, care should be exercised with installations of the carbon type control in cases where two or more stages are controlled through the unit, or where a considerable bleed current is to be carried by it.

(2) Antenna-Shunt Plus Grid-Bias Control: The diagram at the top of Fig. 9 illustrates the popular antenna-shunt plus grid-bias volume control circuit that is widely used in the majority of a-c/d-c t-r-f receivers. In this, the function of the volume control, R_1, is to serve as a dual-purpose unit. When turned in the reduced-volume direction, it serves to cut down the actual signal input and simultaneously increases the grid bias applied to the tube so as to reduce the gain of the stage involved. This circuit may control the cathode voltage of more than one tube, and may or may not carry a bleed current. Many receivers using

Fig. 9. Suggested changes for antenna shunt plus bias volume control circuit when a replacement control of higher resistance than the original unit must be used.



this circuit are equipped with a wire-wound control because the comparatively high cathode current that must pass through it would, in time, be destructive to a carbon control.

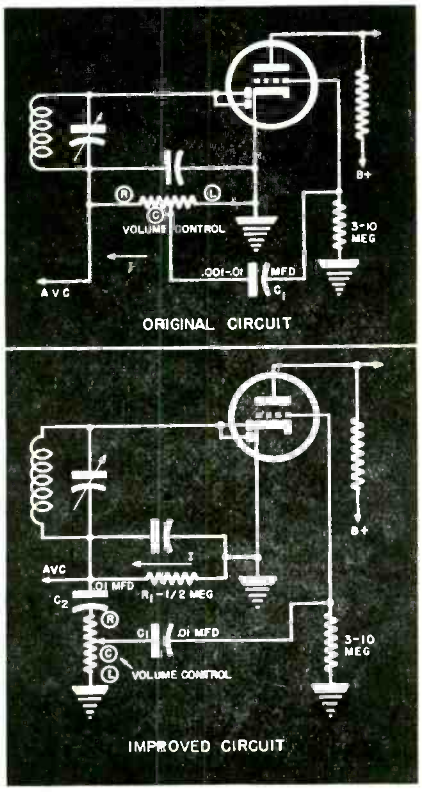
If the volume control in a circuit of this type is to be replaced, and a replacement unit is not obtainable but one of higher resistance is available, the entire higher-resistance control, R_2, may be shunted by a fixed resistor, R_3, of suitable value as illustrated in the center diagram of Fig. 9. Or the portion of it that develops the grid bias for the tube may be shunted by a fixed resistor, R_4, of suitable value as illustrated in the lower diagram.

Diode-Circuit Type Control Circuit Changes

The top circuit in Fig. 10 illustrates the popular audio volume control arrangement in which the volume-control resistor also functions as the diode plate-load resistor. It will be noted that the volume control is in the diode circuit, where the rectified signal voltage is applied across the control. Consequently, the diode current flows steadily through the resistance element and the contact of the carbon-element type control. A recommended circuit change is shown on the bottom of Fig. 10.

[*To Be Continued*]

Fig. 10. Suggested change of circuit to keep d-c out of carbon volume control in diode-circuit type controls.



TELEVISION ANTENNAS

(*Continued from page* 9)

installation, it would be necessary only to supply a few receivers to various apartment owners. The installations in other apartments could be terminated by resistors housed in a suitable form of plug-in dummy terminal box, which could be removed for substitution of a remote-controlled terminal box when the tenant purchased a television receiver.

It is of course realized that this apartment house installation limits the tenant to the use of four television channels. At a future date, however, four additional dipoles could be provided on additional masts located at the midpoint of the four roof ledges. In making the additional installation of the dipoles it would be wise to provide conduits large enough to accommodate four extra transmission lines in case the apartment house owner decided to install additional receiving antennas. It is believed that for the next ten years eight television channels should be sufficient for satisfactory service in the New York area, and that four such channels will give satisfactory service during the coming five years.

The proposed installation would require four dipoles, four transmission line feeders and conduits, four branch feeder junction boxes, 196 transmission line branches and conduits, five terminal boxes, 44 dummy terminal boxes; cost would be in the neighborhood of $26,000.

To facilitate orientation and tuning, two types of remote-control systems have been developed by our research engineers.

Both have two motors in the case, one for orientation and one for tuning. Four push buttons on a control board allow for the operator of the television receiver to rotate the antenna clockwise and counterclockwise, through + or —190° and to increase and decrease the frequency of resonance. Although only 180° is needed, an overlap of 10° is provided. An automatic stop limits the angle so that the antenna cable will not be twisted.

In one system there is a three-section arm extension with a frequency range of 2½ to 1, from 46½ to 117 megacycles. It has three sections of telescopic tubes which form the extensible members of the tunable dipole. The length of each half of the dipole is controllable from 26″ to 66″ as measured from the midpoint, Fig. 2.

In the other antenna system, the smaller of the two, the antenna has two sections of telescoping tubes, with a frequency range of 1.8 to 1, from 46½ megacycles at the bottom end, when extended, to 85 megacycles at the top end when retracted. The length of this antenna is 36″ when closed and 66″ when open, measured on either side from center, Fig. 4.

Inasmuch as the tuning feature greatly complicates the mechanism, without corresponding benefits to reception except in special cases, a more practical robot antenna is one equipped for remote control of orientation alone.

A robot dipole which is for orientation alone is now being developed.

Dipoles and Ghosts

One solution to the ghost problem consists in providing a dipole antenna which can be oriented (and tuned) by remote control as mentioned previously. Orientation (and tuning) may be interconnected with the television receiver's channel-selector, so that when a particular channel has been selected the antenna is automatically oriented to the optimum position for reception of the primary wave and rejection of the secondary, reflected waves. Further refinement in reception is obtained by actual tuning of the antenna to the desired channel frequency, although this latter feature is not nearly so effective as orientation. Only in very special cases is the tuning feature of any particular significance. One of these occurs when there is an adverse orientation relative to the transmitting antenna for eliminating *ghosts*.

In one of the experiments designed to prove the efficiency of this new development, an antenna was set up on the ground floor of the Hotel Astor ballroom, in New York City. The Astor, as is well known, is a steel structure surrounded by many other steel buildings, and therefore normally subject to poor television reception. With this receiving dipole antenna a highly satisfactory video signal was obtained and the shadows or ghosts were practically eliminated.

[*Additional data on television antenna systems and installation methods will be presented in the March issue.*]

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THE TELEVISION SIGNAL

(*Continued from page* 10)

of the distance, an interference pattern will be set up in the receiver, similar to the echo of audio signals. This is reflected on the screen of the television receiver as a double image. The distance between the two images will then be a function of the paths followed by the two signals. When the reflecting surface is close to the receiving antenna, a blurred signal will result. If the reflecting surface is distant, the second image, or ghost, will be separated from the original by a definite space. This condition complicates the installation of the receiving antenna, particularly if it is to be used to pick up television signals from a number of directions, depending on the location of each television transmitter.

To remove ghosts, directive arrays are used. These are so arranged that the antenna is capable of picking up signals from one direction only. This may lead to a very complicated antenna setup, where an individual antenna would be required for each channel, so arranged that each antenna would pick up only the signal of the particular channel to which it is tuned and directed. This may not be necessary for all installations, but may be required in a small minority.

The antenna problem is being studied by many, and thus far several effective solutions have been offered. In the paper by Paul Schwehn in this issue, page 7, one such solution is discussed.

filament. It should be noted that all the other filaments are shunted by a resistor, 700-ohms, and that the other half of the 3Q5 filament is also shunted. Therefore, any excessive filament voltage would probably burn out this filament before the others.

•

WHY are resistors and capacitors of .2 megohm and .1 mfd value respectively, used between chassis and B— in many a-c/d-c receivers?—B. Benz.

Many a-c/d-c receivers use this method to keep either leg of the a-c line from being accidently shorted to ground through the chassis. Sometimes, receivers are placed on radiators, or other grounded surfaces. If B— is connected to the chassis, then one side of the house system is on this side; Fig. 5. If the a-c plug happens to be connected so the *high* side of the a-c main goes to chassis, shorting the chassis to a radiator (this contact may be made accidently through the chassis bolts underneath the cabinet) will short the a-c main. To prevent this, the *RC* network is used. This network places the chassis at r-f ground through the .1-mfd capacitor, and at the same time, the resistor limits the a-c supply which will be passed when the chassis is grounded. If the resistor is open, the set may stop playing, or even die out, depending on how many circuits are grounded to chassis. An open capacitor may do the same, but is usually not as critical. At any rate, both parts should be checked to see if they are in good shape.

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SERVICING HELPS

(*Continued from page* 13)

we note that the most likely cause of filament burn-out of the unshunted portion of the 3Q5 would be a shorted 200-mfd capacitor. The shorting of this capacitor would put the entire filament voltage across the 3Q5 filament and the burnout would most logically occur across the unshunted portion, rather than the shunted portion.

A second possibility is an intermittently shorting .25-mfd capacitor from the control grid return of the 3Q5. This would short out the bias as well as part of the filament voltage, causing excessive plate current as well as excessive filament voltage.

A third, but remote possibility is voltage surge due to filter capacitors or slow heating filaments. This can be cured by inserting a 25-ohm resistor in series with the filament circuit, reducing the voltage drop across the tube filaments, and adding a 350-ohm shunt resistor between terminals 2 and 8 of the 3Q5 as added insurance.

A fourth possibility is leakage between capacitors in the electrolytic container, which, in this receiver, houses all the filter capacitors. This would possibly cause the trouble by applying excessive voltage to the 3Q5

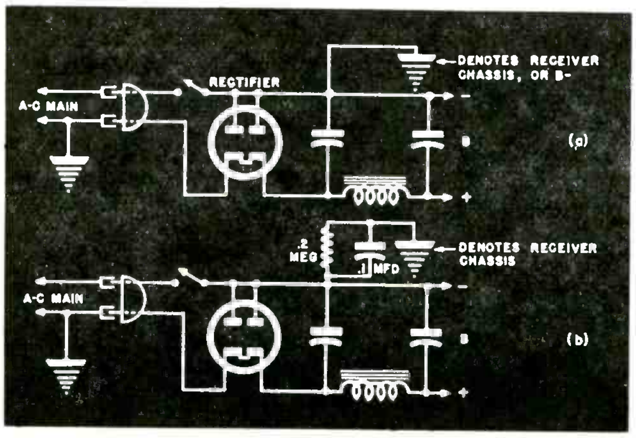
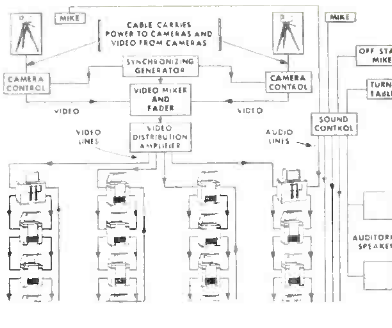


Fig. 5. In *a* and *b* appear two methods used in midget receivers for establishing a *B*-point. In *a*, where the chassis is used for *B*—, one side of the a-c line is returned to chassis. This may be the *hot* side of the a-c main. Should the chassis be accidentally grounded, a line short results. This condition is avoided in *b* by use of the *RC* filter. This places the set chassis at r-f ground, yet the receiver may be grounded without affecting the a-c main.

INTRA-STORE TELEVISION



Equipment and hookup used by RCA Victor for the intra-store television system used in Gimbels-Philadelphia department store. Two television cameras were operated on a stage in the store's auditorium, transmitting 10-minute programs every half-hour during regular store hours to twenty television receivers located on seven floors of the store. Three of the receivers were large-screen projection type.

COMMUNICATIONS RECEIVERS

(*Continued from page* 25)

not in the circuit. In position *2*, the grid is returned to avc through this coil. This tends to overcouple the transformer, reducing its selectivity, and thereby broadening its response. We note that the coupling coil is not in the tuned circuit of the transformer, and thus the detuning effect of its inclusion is minimized.

The same result may be accomplished mechanically. That is, the coupling between primary and secondary is varied by means of a mechanical arrangement so that the physical distance between the primary and secondary is increased or decreased. This method is similar to the mechanical control of r-f coupling used in some of the old Majestics and Colonials; Fig. 8*b*.

The third method, shown in Fig. 8*c*, should be familiar to Service Men who have serviced television receivers. Here, a resistance has been added across the i-f transformer to broaden its response. The addition of the resistor reduces the *Q*, or figure of merit of the circuit, thereby reducing its selectivity. The lower the value of resistor, the broader will be the circuit response.

All systems of broadening i-f response are accompanied by a reduction in volume. This condition may be more apparent on some signals than on others, depending on the avc action, and its ability to compensate for a reduction in r-f signal level. Again, when aligning receivers with variable i-f systems, the receiver should always be switched to its sharp i-f position before proceeding.

Since the overall selectivity of a receiver is a function of the selectivity of its individual stages, the broadening system is not always used in all i-f stages. Sometimes, the system is only used in one stage.

[*To Be Continued*]

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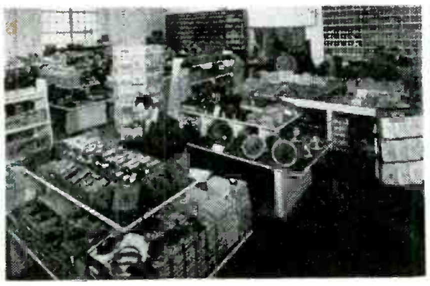
SELF-SERVICE SYSTEM



The self-service parts department recently installed by the Radio Television Supply Company, Los Angeles, California.

OHM'S LAW

(*Continued from page* 31)

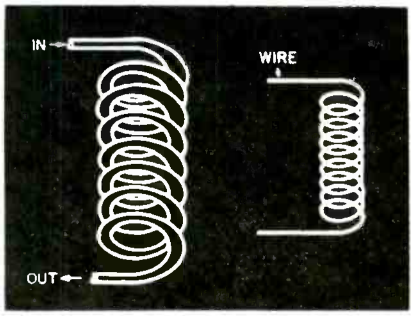
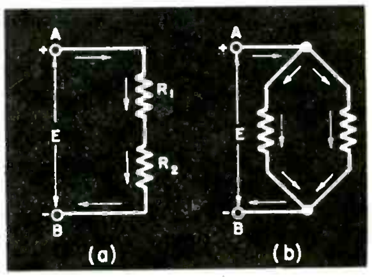


Fig. 8. Comparison of spiral water pipe with a high resistance to water flow and small diameter wire coil that may also display a high resistance.

tion circuits, in which more than one resistor is used for a current path. In Fig. 9*a* we have two resistors connected in *series* across a voltage source. Fig. 9*b* shows the same two resistors in *parallel* across the same voltage source. *A* and *B* designate the two points of the circuit from which all measurements will be made. In *a*, applying Kirchhoff's first law, the current flowing through R_1 and R_2 is the same, insofar as points *A* and *B* are concerned. In *b* the current flowing through R_1 must be added to the current flowing through R_2 to determine the total current flowing between *A* to *B*. Fig. 9*b* also serves to illustrate Kirchhoff's second law; the voltage drop across both resistors is identical. In *c*, a third resistor is introduced into the circuit. Again, Kirchhoff's laws are followed, in that the current flowing through R_1 and R_2 combine to flow through R_3 and eventually back to point *B*. The voltage drop across either R_1 or R_2 is the same.

[*To be continued*]



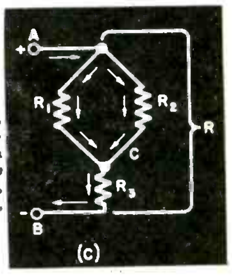
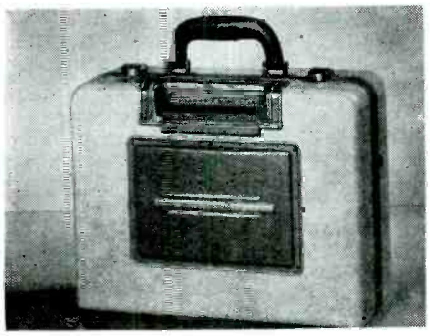
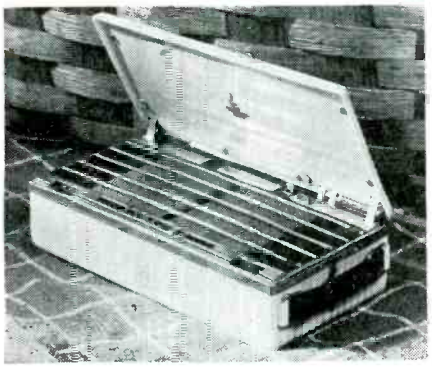


Fig. 9. Three circuits, where one or more resistors are used for a current path. In *a*, we have a series link; *b*, parallel connection; *c*, series-parallel setup.

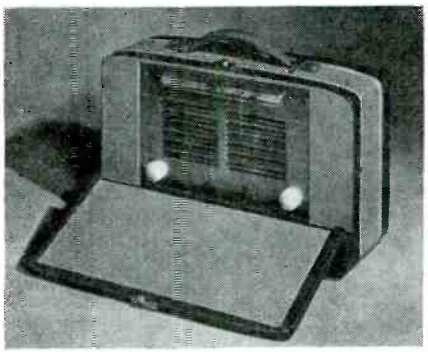
POSTWAR RECEIVERS



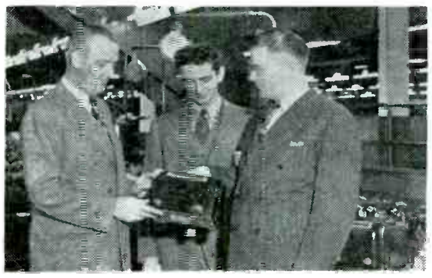
Above, Belmont 5-tube a-c/d-c battery portable, 5P19. Below, Emerson pocket type battery model.



Below, Garod 6-tube 3-way portable, 6E1. Removable loop in rear of case. Has an r-f stage.



L. C. Truesdell (left), general sales manager of radio and television at Bendix Radio, showing one of the first postwar Bendix table models to W. P. Hilliard, general manager, and E. K. Foster, production manager at Bendix Baltimore plant.



NEWS

SPECIAL N. Y. C. TRAIN FOR N. Y. GROUP GOING TO PARTS SHOW

The New York Central will run a special train for those going to the Radio Parts and Electronic Equipment Show, to be held at the Stevens Hotel, Chicago, May 13 to 16. The train will leave at 4:15 P. M., Sunday, May 12.

This train will only carry men affiliated with the radio industry. Dinner, midnight supper and breakfast, and taxicab transportation will be furnished.

Arrangements were made by Perry Saftler, 53 Park Place, N. Y. City.

* * *

JOHNSON REJOINS SYLVANIA

Lt. Henry C. L. Johnson has returned to Sylvania Electric Products, Inc., after three years of service in the United States Navy. He will resume his position as advertising manager of the radio division, and in addition, he will direct the advertising and sales promotion of the industrial electronics and international divisions.

* * *

TACO CATALOG

A catalog describing and illustrating noise-reducing and multiple antenna systems, store-demonstrating antenna system, transmission lines, couplers, and dipoles, has been published by Technical Appliance Corp., 46-06 De Long Street, Flushing, N. Y.

* * *

G. E. PROMOTIONS

R. C. Longfellow has been named engineer of the G.E. electronics specialty division. His headquarters will be at the Wolf Street Plant in Syracuse, N. Y.

Philip G. Caldwell has been appointed sales manager of television equipment in the transmitter division of the G.E. electronics department. He will continue to have his headquarters at the G.E. Schenectady plant until the commercial group of the transmitter division is moved to Syracuse.

Ewing Lawrence, Jr., has become sales manager of G.E. marine electronic equipment for the transmitter division. Mr. Lawrence will be stationed at the Schenectady, N. Y. plant.

* * *

GARRARD RECORD CHANGER DATA

A 4-page brochure, No. 45, describing automatic record changers, is now available from Garrard Sales Corporation, 401 Broadway, New York 13, N. Y.

* * *

FREED COMPARISON/LIMIT BRIDGE BULLETIN

A 4-page folder describing a comparison and limit bridge has been released by

(*Continued on page* 42)

OLD TIMER'S CORNER

by SERVICER

WHILE passing down Main Street a few weeks ago I was hailed in a rather jolly way by my friend Joe. I say—rather jolly—for Joe was usually mild-mannered. But it seems as if he was jovial that night about something.

"Come on down to the shop," he said, "I want you to take a look at my latest . . . well you come down and you see for yourself."

So we walked down to his shop, and he soon pointed to a bright-orange truck.

"That's it," he said.

"What's it?" I asked.

"That truck is it! Come inside and I'll tell you about that truck."

So we stepped inside where Joe overflowed into a chair and I perched myself on the repair bench.

"Now what's doing?" I asked.

"Going to build me a sound truck," Joe started.

"Seems like there aren't enough of them in this town, and I mean to increase the population of the sound trucks by at least an even one, if not more. If this goes over I'll have two or three later on," he continued.

"As you know, this will be the first spring or summer of *no war* for quite a spell, and folks are going to take advantage with picnics and outdoor meets. And later in the summer there'll be political campaigns. I figure that there is room for a few sound trucks. This truck will be called—*Sound Truck No. 1.*

"I am going to install a complete sound system from microphone through to converters in the truck, and in addition I am also going to add a few wrinkles of my own.

"For the amplifier I will use a good 15-watt job for medium coverage. For the outdoor meets I will have a 50-watt rig.

"For music I will use three turntables, two at 78 rpm and one at 33⅓ rpm for transcriptions. To hold the speed constant I will use frequency control on all the converters. Such a converter is on the market, but in case you don't know how it is done, I'll explain. There's a heavy rheostat in the field coil circuit of the dynamotors which control the field coil strength. That in turn controls the frequency of the output and will hold it fairly constant at 60 cycles per second. Yes, and all the converters are 110-volt a-c jobs.

"I plan to use several microphones and will carry plenty of cordage so that they can be used at a considerable distance from the truck. And I won't be partial to ribbon mikes either. They are hard to handle on a windy location. So I will have a few crystals and at least a dynamic or two.

"One of the things that annoy folks at large outdoor affairs is light failure. I intend to furnish real service to my clients by having a string of lights which can be powered from the converters and which can be used for the very time when you need a light.

"Figuring out the best method of getting all that power from converters, I discovered that it would be foolhardy to expect the car battery to furnish the juice. So I have reconverted a small gasoline engine and will use that to drive a dynamotor which I purchased from the surplus boys. The dynamotor runs about a kilowatt of 110-volt a-c, and that ought to give me good regulation as well as ample power for everything."

"Well, won't you be sort of doing something foolish if you run that big rig for the 15-watt job?" I asked.

"I figured on that one," said Joe. "I'm going to use the car battery, converted, for the 15-watt job and plan to keep the engine running so that the car battery won't go too low. I find that I will have to get about 120 watts of power from the dynamotor and that means about 150 watts from the battery. Converting that to volts and amps, it means that I will draw about 25 amperes at 6 volts. Since that's a heavy drain, it will be necessary to run the car motor while using that particular amplifier.

"As for the truck, it is a second-hand affair. I know that it won't run very

(*Continued on page* 42)

OLD TIMER'S CORNER

(*Continued from page* 41)

good, but I don't expect to take it on trips except in the city here. For that it should serve very well, even if it burns gasoline and oil in about even proportions. It will more than pay for itself in no time at all."

"How do you expect to get the business, Joe? You know that that has been tied up by *Sound Service Sales* for the last few years. They have the equipment and they have the trucks, and, what's more importance, they have the acceptance!" I said.

"There's always room for one more. Besides, the 'triple S' outfit for the last years has been associated with one political party. In addition to that they have been with the same clients year in and year out. They have the trucks, that's true. But they don't give particular service the way I see it. I was at the meeting of our lodge last fall where they furnished the outfit. To use the microphone, the boys had to sit in the cab of the truck. And both speech and music quality were quite bad. When I asked the driver why they didn't clean up the sound and furnish a lot of cord, he answered that they had neither the time nor the inclination. Besides, he said, they had all the business that they wanted, and if the lodge didn't like the sound, they could do without it next year.

"Well, that reply set me thinking on my project. Sure its hard to get parts and still harder to get service. But things are rapidly changing and the fellow with the smile will once more be able to get the business. So I figure that even if I can't be the biggest fish in the pond of sound trucks, I can still be a small one and make myself a few dollars as well.

"And from the point of getting contacts and prospects for the store, the sound truck is such a great advertisement that I am sure that even if I only break even on the costs I will be doing me and the store a lot of good. After all, I can't afford to hire a sound truck to go around the town and to the picnics and to the political rallies carrying my name on its sides. That would be too expensive. But I surely can afford to have *my own truck* go to those places especially when the traffic is paid for by a client.

"Even if the client wants to put a sign on the side of the truck—and I have thought of that too—there will still be an obstructed view of the store's name and address, as well as the phone number. That's what counts," Joe concluded.

NEWS

(*Continued from page* 40)

the Freed Transformer Company, 72 Spring St., New York 12, N. Y.

Data presented covers resistor, capacitor and inductance ranges, and applications.

* * *

JACK MOORE JOINS C. L. PUGH

Jack Moore has joined C. L. Pugh Company, 1670 Doone Road, Columbus 8, Ohio, as a manufacturer's representative.

* * *

ELECTRICAL REACTANCE CAPACITOR BULLETIN

A 4-page bulletin describing Hi-Q silver electrode capacitors has been published by the Electrical Reactance Cor-

(*Continued on page* 43)

NEWS

(*Continued from page 42*)

poration, Franklinville, N. Y. This bulletin covers the CI Type of capacitor with axial leads.

* * *

WOLIN BECOMES SALES PROMOTION MANAGER OF SOLAR COMPANIES

Sylvan A. Wolin, formerly sales manager of the Solar Capacitor Sales Corp., has been appointed sales promotion manager of both the Solar Manufacturing Corp. and the Solar Capacitor Sales Corp.

George Jephson succeeds Mr. Wolin as sales manager of Solar Capacitor Sales.

S. A. Wolin

G. Jephson

* * *

ED COHEN JOINS PERLMUTH ON WEST COAST

Edward J. Cohen has resigned as vice president and general manager of the Insuline Corporation of America and joined J. J. Perlmuth & Associates of Los Angeles, manufacturers' sales representatives, as a co-partner.

Prior to joining I. C. A., Mr. Cohen was eastern sales manager for the Franco Battery Company, and before that was vice president of the Baltimore Radio Corporation.

* * *

FELIX SIMON APPOINTED JFD SALES REFRESENTATIVE

Felix Simon of Denver, Colorado, has been appointed sales representative for JFD Manufacturing Company of Brooklyn, N. Y. He will cover Montana, Wyoming, Colorado, Utah and New Mexico.

* * *

NEWS OF THE REPRESENTATIVES

Sidney N. Spector, 116 Montgomery Street, San Francisco, has joined the California chapter. Percy D. Terwilliger, 27 West 85th Street, Kansas City 5, Mo., and Maury E. Bettis of 400 B. M. A. Bldg., Kansas City, Mo., have become members of the Missouri Valley chapter.

The Dixie chapter elected E. L. Hollingsworth president for 1946. William E. Hopper and L. C. Still were named vice president and secretary-treasurer, respectively. Henry Burwell and James Millar were designated as delegates to the national convention next May.

The new officers of the California chapter are: president, Russ Hines; secretary-treasurer, Les Logan. Arnold A. Sinai, D. Rudat and A. J. Hitt are delegates.

* * *

LEE R. KEMBERLING JOINS LIFETIME SOUND

Lee R. Kemberling has joined The Lifetime Sound Equipment Company, 911-13 Jefferson Avenue, Toledo, Ohio, and will be in charge of the amateur radio equipment division.

* * *

D. L. WARNER RESUMES DIRECTION OF ALLIED'S AMATEUR DIVISION

Capt. D. L. Warner, W9IBC, has returned to his former post as director of amateur equipment and sales division of Allied Radio Corp., 833 West Jackson Boulevard, Chicago.

* * *

REIG, DAVIDSON AND CALDWELL OPEN SERVICE SHOP

Ray Reig, Ray Davidson and Henry Caldwell have opened a service shop to be known as Central Electronic Service No. 4, at 9304 Santa Monica Blvd., Beverly Hills, Cal.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 52 Vanderbilt Ave., New York 17, N. Y., giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

NEW PRODUCTS

ELECTRO-VOICE CARDIOID CRYSTAL MICROPHONE

A cardioid unidirectional crystal microphone, Cardax model 950, with dual frequency response selection, has been announced by Electro-Voice, Inc., 1239 South Bend Ave., South Bend, Indiana.

Operating on a *Mechanophase* principle of unidirectivity the microphone is said to have wide angle front pickup, and be dead at rear; stops feedback, substantially reduces pickup of background noise and reverberation.

Die-cast case finished in satin chrome. Built-in cable connector. Supplied with standard 5/8″-27 thread for stand mounting; 20′ shielded cable.

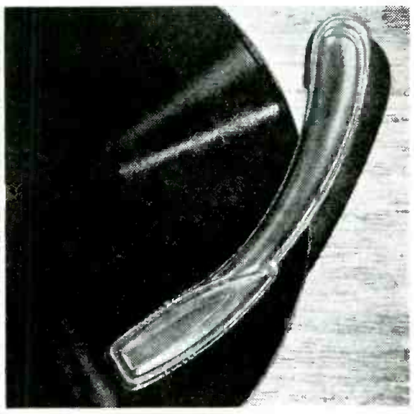
* * *

SHURE GLIDER PICKUP

A crystal phonograph pickup, the Glider, featuring a lever-type cartridge and a low-mass tone arm, has been developed by Shure Brothers, Chicago, Ill.

Has an adjustable swivel screw that is said to prevent needle from striking the turntable if the arm is dropped.

No springs or counterweights are used. Standard output voltage is 1.6.



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CLIPPARD VOLT-OHMMETER

An electronic volt-ohmmeter, type 406, has been announced by Clippard Instrument Laboratory, 1440 Chase Avenue, Cincinnati 23, Ohio.

A-c voltages are measured with a high-impedance pen-type dual-diode probe on a 36″ detachable shielded cable. A ground terminal near the end of the probe is said

(*Continued on page* 46)

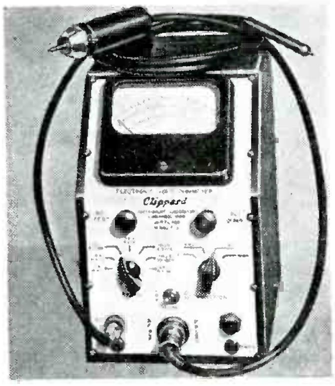
NEW PRODUCTS

(*Continued from page 44*)

to provide minimum lead length for maximum accuracy of a-c measurements in all frequency ranges.

A-c and d-c scales read: 0-1, 0-3, 0-10, 0-100, 0-300 and 0-1,000. 0-1,000 megohm scale in seven ranges. Db scale of –20 to + 51 provided through square faced D'Arsonval type meter of 200 microampere sensitivity.

Uses a 6X5GT rectifier, two 6SN7GTs, one 6AL5 dual diode in shielded probe.



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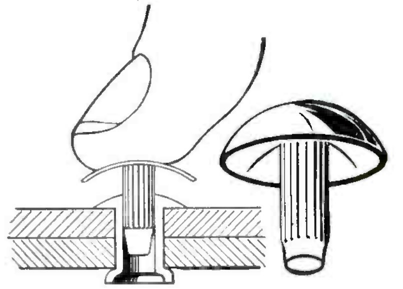
CHERRY RIVET UMBRELLA PLUG

An *umbrella plug* that fits into the center of hollow type Cherry rivets and furnishes smooth cap covering for the head of a rivet, has been announced by the Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California. These plugs, which are available in aluminum, copper or plastic, can be colored to match or harmonize with the surrounding surface.

The shank of the plug is knurled and tapered. The pointed end of the shank is inserted into the installed rivet, and the plug is pushed in by hand.

Umbrella plugs may be used in hollow type Cherry rivets of 1/8", 5/32", 3/16" and 1/4" diameters.



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MARION COLORED FLANGE METERS

Interchangeable colored flanges for meters have been announced by Marion Electrical Instrument Company of Manchester, N. H.

Flanges are offered in round or square shapes, in blue, red, green, silver, gold, etc.

* * *

RCP VOLT-OHM-MILLIAMMETER

A volt-ohm-milliammeter, Model 424, has been announced by Radio City Products Co., 127 West 26th St., New York.

Instrument uses a 3" meter with a sensitivity of 2,500 ohms-per-volt and a movement of 400 microamperes. Milliammeter range is ten megohms with a center to full-scale ratio of 125. Low ohm scale reads 5 ohms at center and 0.1 ohm at each of the first ten divisions.

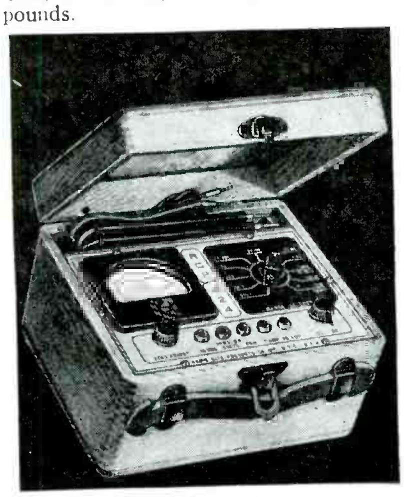
Suppressor-type copper oxide rectifier is used for a-c measurements.

Ranges are: d-c voltmeter, 0-2.5-10-50-250-1,000; a-c voltmeter, 0-10-50-250-1,000; d-c milliammeter, 0-10-50-250-1,000 ma; ohmmeter, 0-500-100,000 ohms . . . 1-10 megohms; decibel meter, –10 to +15, –4 to +29, –18 to +43, –30 to +55 db.

Db range is calibrated for a line of 500-ohm impedance.

Size, 7½" x 5¾" x 3¾"; weight, 2 pounds.

Portable type, 424P, also available. Size, 8" x 6¾" x 4⅝"; weight, 3½ pounds.



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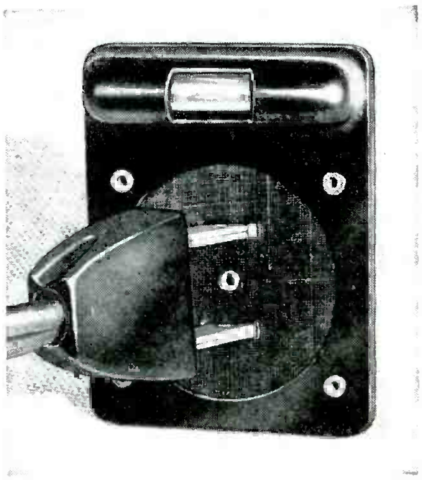
INDUSTRIAL DEVICE PLUG-IN PILOT LIGHT

A neon-light glow indicator for use on 110 v a-c or d-c has been announced by Industrial Devices, Inc., 22 State Road, Edgewater, N. J.



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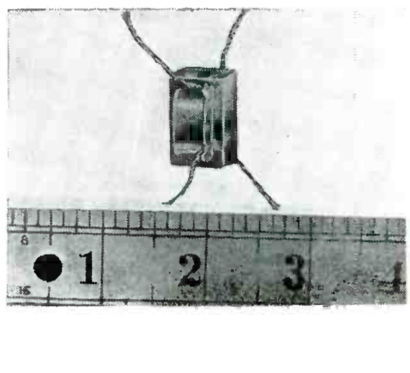
UTC SUB-OUNCERS

Sub-ouncer (⅓ ounce) transformers, 9/16" x ⅝" x ⅞", have been announced by the United Transformer Corporation, 150 Varick Street, New York 13, N. Y.

The coil is layer-wound of Formex wire, on a molded nylon bobbin. Insulation is of cellulose acetate. Core material is Hipermalloy.

Five standard items are available. Frequency response is said to ± 3 db from 200 to 5000 cycles.



POSTWAR MODEL WITH IRON CORE I-F'S

(See Front Cover)

THE trend toward iron-core i-f transformers, indicated in many prewar designs, is now being emphasized in postwar receivers. The new G.E. 100 series, for instance (100, 101, 103, 105), shown on the cover, are featuring iron-core i-f's. The high gain 12SG7 is used in the i-f stage.

Other receiver features include an antenna resistor for preventing sharp resonance, a 10-megohm avc biasing resistor from the oscillator grid, cathode feedback 12SA7 oscillator, i-f plate supply filter, isolated volume control handling no d-c and a bass boost arrangement with feedback from the 50L6 cathode to the low end of the volume control. The feedback voltage is delivered across 1,000 ohms through a 0.1 mfd capacitor. A cathode equalizer of 39 ohms in series with 40 mfd is placed across the 150-ohm bias resistor.

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BOOK REVIEW . . .

INSIDE THE VACUUM TUBE

By John F. Rider, Lt. Col. U. S. Signal Corps, (Ret.) . . . 424 pp. . . . New York: John F. Rider Publisher, Inc. . . . $4.50

A thorough knowledge of the function and operation of the vacuum tube is a prime requisite in servicing. This interesting volume provides such information with a simplified analysis of all types of tubes. Tube operation, for instance, is portrayed through the use of animated diagrams and anaglyphs. The latter are dual colored diagrams, which, when viewed through red and blue spectacles supplied with the book, give a stereoscopic effect, with the figure assuming three dimensions.

Another innovation is the duplication of diagrams and graphs where the accompanying text extends beyond the page on which the original diagram is shown. This method of illustration facilitates reading and interpretation of the text.

Fourteen chapters cover: The electron; electron emission; movement of charges; space charge and plate current; fundamentals of tube characteristics; the diode; the triode; static characteristics of triodes; triode dynamic characteristics and load lines; dynamic transfer characteristics; voltage amplification; the tetrode and pentode vacuum tubes; the cathode circuit; power amplifiers; and miscellaneous vacuum tubes. An appendix includes typical plate current characteristic curves and a glossary of letter symbols used in the book.

The author has adopted the new important concept of current flow. Old conventions are not used, and all circuits are analyzed in accordance with the latest electronic conventions.

Here's a book that should prove invaluable to the Service Man.

JOTS AND FLASHES

FINAL decision of the FCC places the f-m broadcasting bands on the 88-108 mc channels. It appeared for a time that the 44- to 50-mc bands might be used as an allied channel, but the FCC has said no. Perhaps next year after propagation tests have been completed, there may be a channel extension. . . . J. K. Poff has become service manager of the jobbers division of the Astatic Corp. at Conneaut, Ohio. Ira Kaplan is now sales manager for Emerson-New York. . . . F. Price Merrels has joined the staff of the Henry P. Segel Company, 143 Newbury Street, Boston, Mass. . . . Cooper-Di Blasi, 259 West 14th Street, N. Y. City, will represent the American Transformer Company of Newark, N. J., in the metropolitan New York and lower New York State area. . . . Hallicrafters is now manufacturing a converter to adapt prewar f-m receivers to the new f-m bands. . . . The RMA membership has risen to 307. . . . Ray T. Schottenberg, sales manager of the jobber division of Astatic, visited eastern New York State recently. . . . Vic Mucher has been elected president of Clarostat Mfg. Co., Inc., Brooklyn, New York. William Mucher is treasurer, and George Mucher, chief engineer, has become vice president, too. . . . Walker-Jimieson, 311 South Western Avenue, Chicago, Ill., have published their 1946 radio and electronic reference book and buyer's guide. . . . Lifetime Sound Equipment Co., Toledo, Ohio, is now in the distributor business exclusively. They manufactured sound equipment previously. William Manoff is general manager. . . . F. Theodore Hegeman has become sales manager of the distributor division of the Electronic Laboratories of Indianapolis, Ind. . . . H. E. Osmun has resigned as director of Centralab sales, because of unsatisfactory health. W. S. Parson succeeds Mr. Osmun. . . . Cornell-Dubilier has published a booklet describing the V-T radio proximity fuze, and the role C-D capacitors played in their construction. . . . Walter Addison Watson has been named advertising manager of the Hoffman Radio Corporation, 3430 South Hill Street, Los Angeles 7, California. . . . Grady L. Roark is now sales manager of Musaphonic receivers for G. E. . . . E. R. Taylor has been named advertising director of the Zenith Radio Corporation. . . . Vertrod Corporation, 17 Williams Avenue, Brooklyn, N. Y., have opened a sales office at 60 East 42d Street, New York 17, N. Y.

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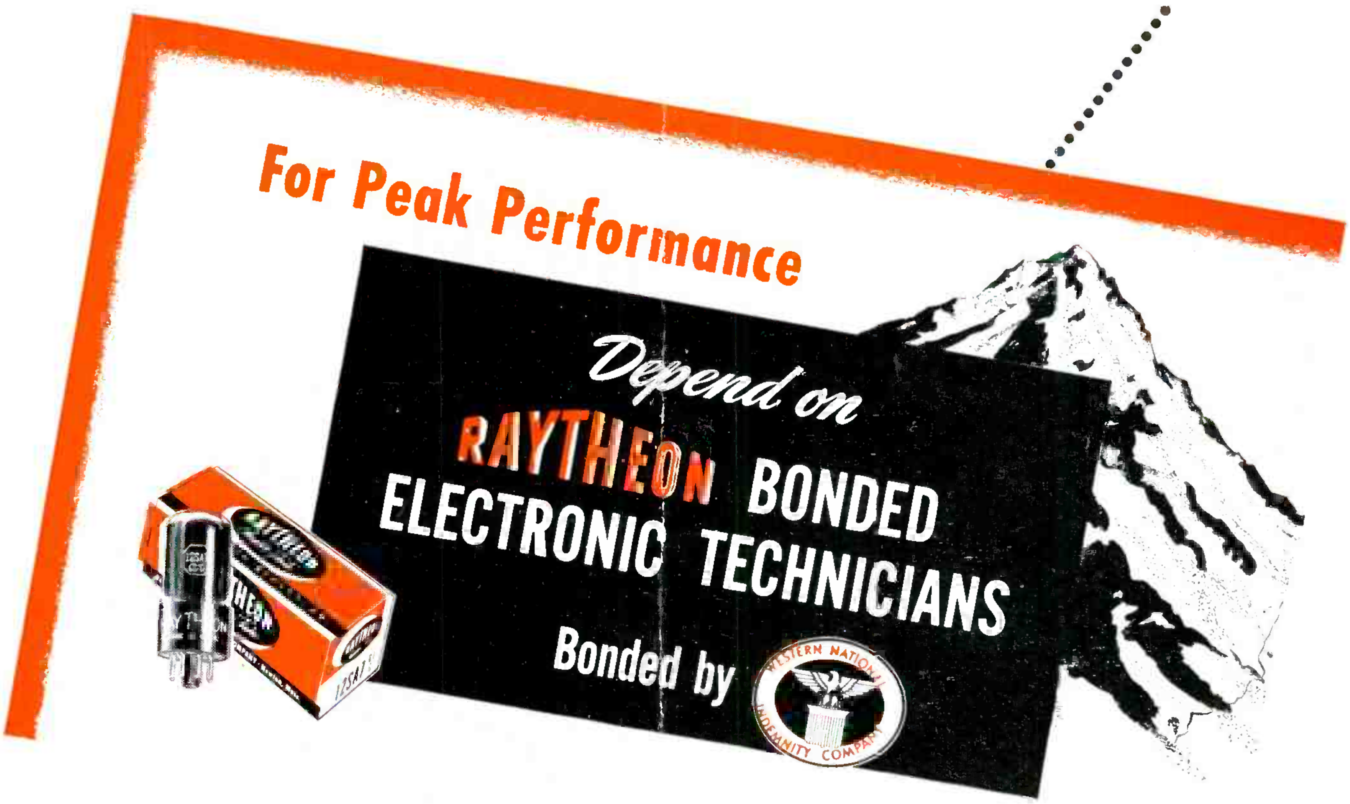

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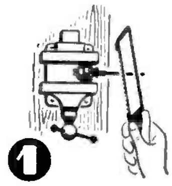

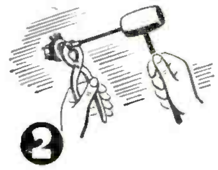

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