JULY 1948

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RADIO MAINTENANCE

OHM'S LAW IN RADIO SERVICING.

INTERFERENCE, PART III

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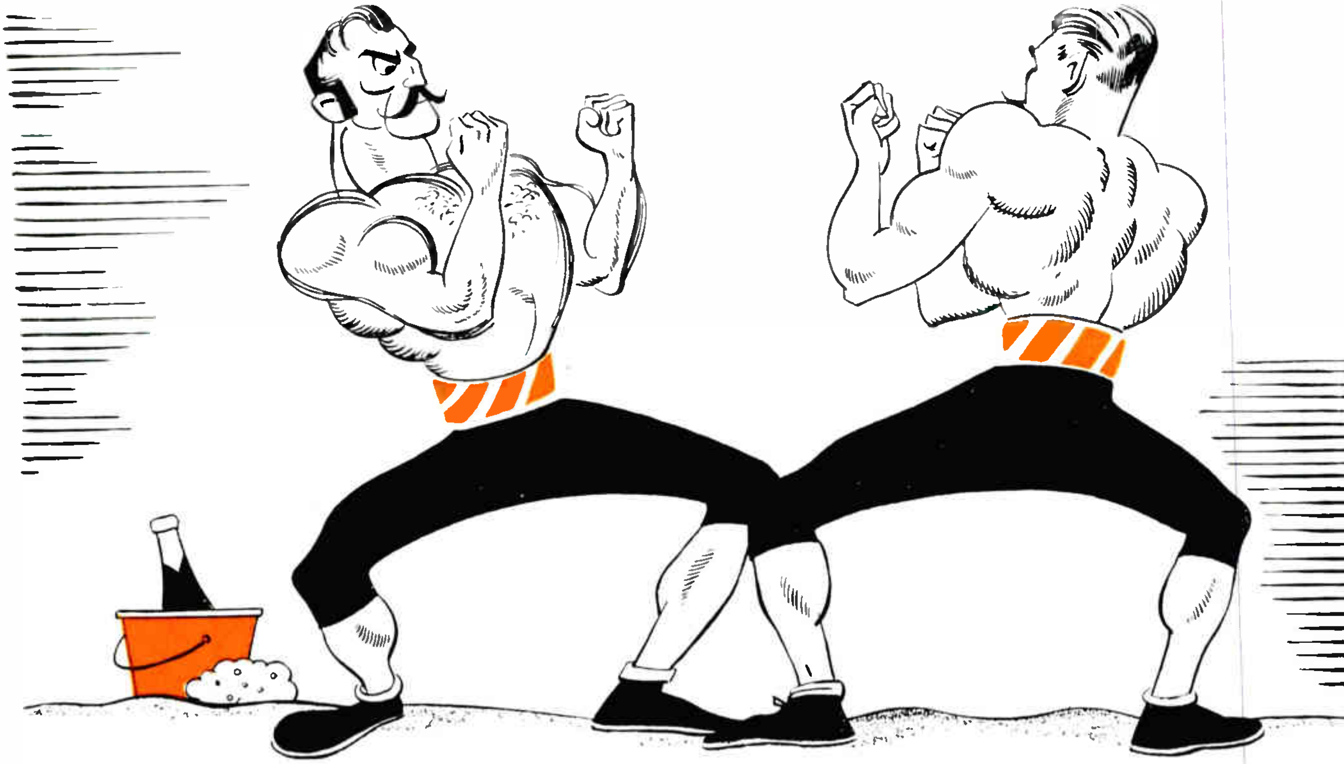

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OFF OUR CHEST

From the letters that come in to us from time to time, it would seem that some of our readers have a legitimate gripe against their fellow radio service technicians.

These readers complain that they very often are confronted with a set that has been previously repaired by a service technician who has left no record of his repairs. This makes it very difficult for the next man who has to repair the set to make his tests and checks. Very often, we are afraid, it makes that service technician determine not to mark his repairs in turn, "just to get even." It is easy to see what sort of situation this can lead to.

For his own convenience and protection, the radio service technician should always mark all repairs he makes, or he too will soon be getting unmarked sets to repair. He should note all changes in wiring, all tubes tested and how they seemed, and he should mark the value of each part replaced.

One reader makes the very sensible suggestion that a small notebook be placed inside each set, when it is brought in for repair. Into this notebook would go all notes on changes and repairs. Thus each set would carry its own record, making it much easier for the next man to judge what is wrong with the set this time. Very often this "next man" will be the man who serviced the set originally, so that he will actually be helping himself.

Consideration for the "next man" is a very practical thing, as the next man will eventually be you. Thus, consideration, or the lack of it, makes a full circle, and is soon felt by the one practicing it.

WANTED . . .

Technical writers capable of doing articles on assignment for Radio Maintenance. These writers must have experience in this type of writing and an understanding of the problems facing the radio service technician. Write direct to the editors of this magazine stating your qualifications and past experience, and, if possible, send us samples of your previous work.

RADIO MAINTENANCE

INCLUDING ELECTRONIC MAINTENANCE

Volume 4 JULY 1948 Number 7

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Midwestern Office
228 No. La Salle St.
Chicago 1, Ill.
Dearborn 3507

Eastern Office
460 Bloomfield Avenue
Montclair, N. J.
Montclair 2-7101

West Coast
Swain Associates
639 So. Wilton Place
Los Angeles 5, Calif.
Dunkirk 8-2248

Radio Maintenance is published monthly by Boland & Boyce, Inc., at 34 No. Crystal St., East Stroudsburg, Pa., U.S.A.; Executive and Editorial Office, 460 Bloomfield Ave., Montclair, N. J. Subscription Rates: In U. S., Mexico, South and Central America, and U. S. possessions, $3.00 for 1 year, $5.00 for two years, single copies 35 cents; in Canada, $3.50 for 1 year, $6.00 for 2 years, single copies 40 cents; in British Empire, $4.00 for 1 year, $7.00 for 2 years, single copies 50 cents; all other foreign countries, $5.00 for 1 year.
Entered as Second Class matter July 18, 1946, at Post Office East Stroudsburg, Pa., under Act of March 3, 1879.

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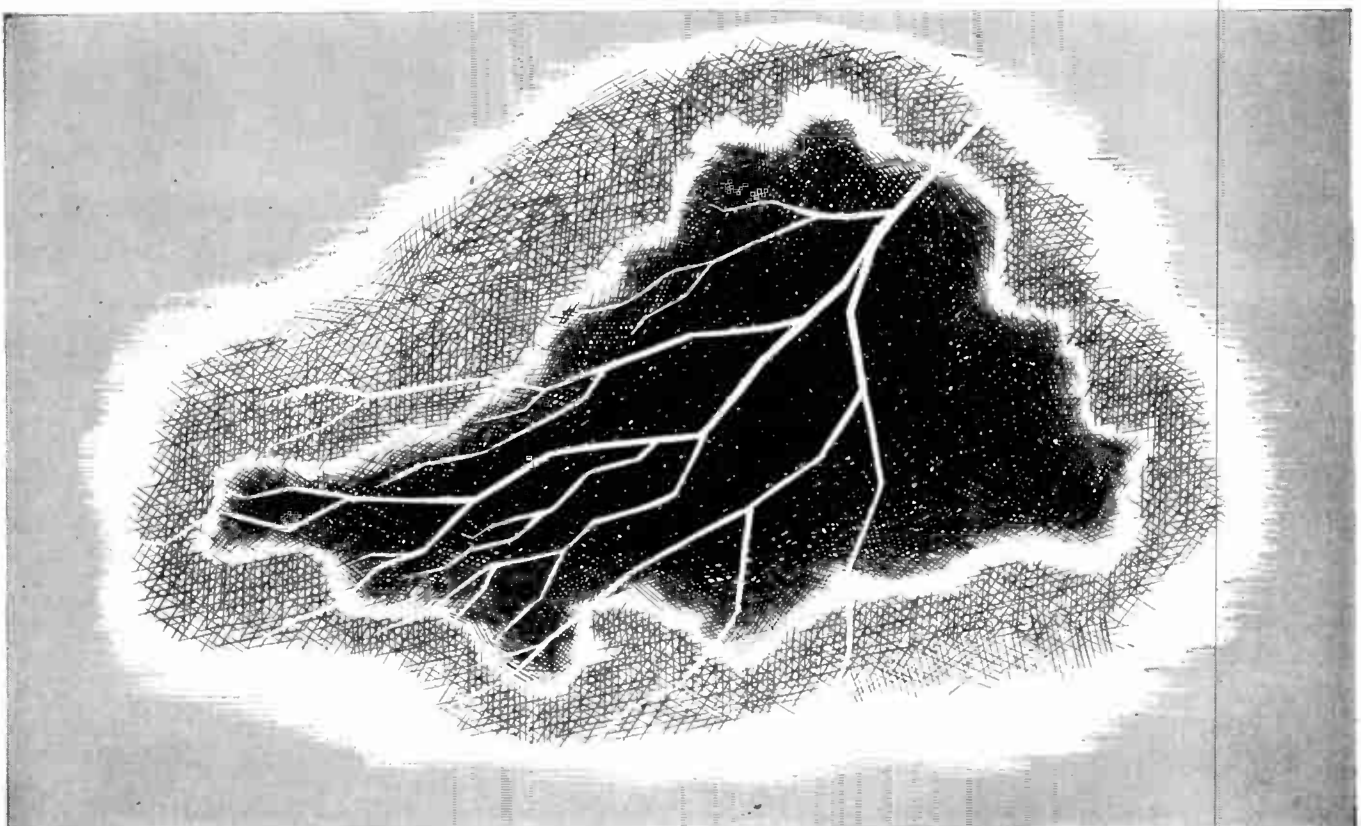

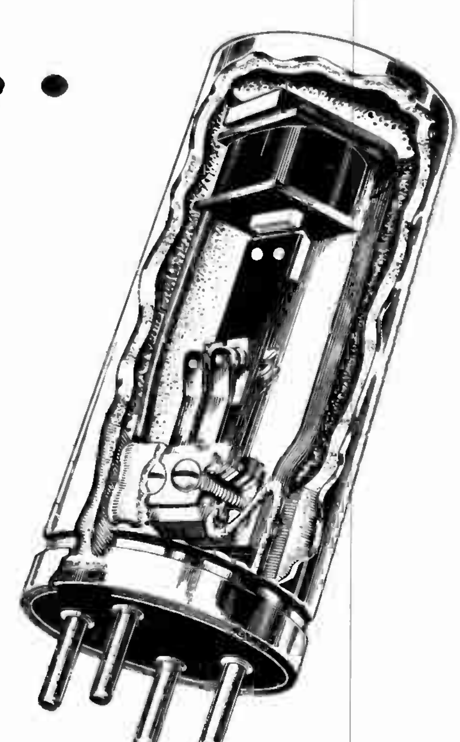

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Yes, you are in good company if you instinctively associate V-R tubes with Hytron. Army, Navy, Air Force, AEC, famous university research laboratories — as well as industrial leaders — repeatedly order Hytron V-R tubes. Pick either the standard OC3/VR105 and OD3/VR150 or the space-saving OB2 and OA2; you, too, will prefer Hytron. That goes double, if you're "from Missouri." Find out for yourself why so many turn automatically to Hytron.

CONGRATULATIONS RADIO SERVICEMEN!

Hats off to you servicemen! Entries in your Hytron Contest are pouring in—and are they ingenious and practicable! You have really started something worth while to all. We are proud of you. Keep it up. Don't stop at one entry. Double—triple your chances to win. Watch for results of May contest.

Not received an entry blank yet? See your Hytron jobber, or write us. Briefly, six monthly contests—May through October—seek ideas for shop tools from bona fide radio servicemen. Many prizes still left. *Right now* you may have a winning idea at work in your shop. It's easy. Get an official entry blank today.

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JULY Hickok Model 156A Indicating Traceometer.

AUG. McMurdo Silver Model 900A "Vomax" Electronic Volt-Ohm-Milliammeter; Model 904 Condenser/Resistor Tester; and Model 905A "Sparx" Dynamic Signal Tracer/Test Speaker.

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OCT. Weston Model 769 High Frequency Electronic Analyzer.

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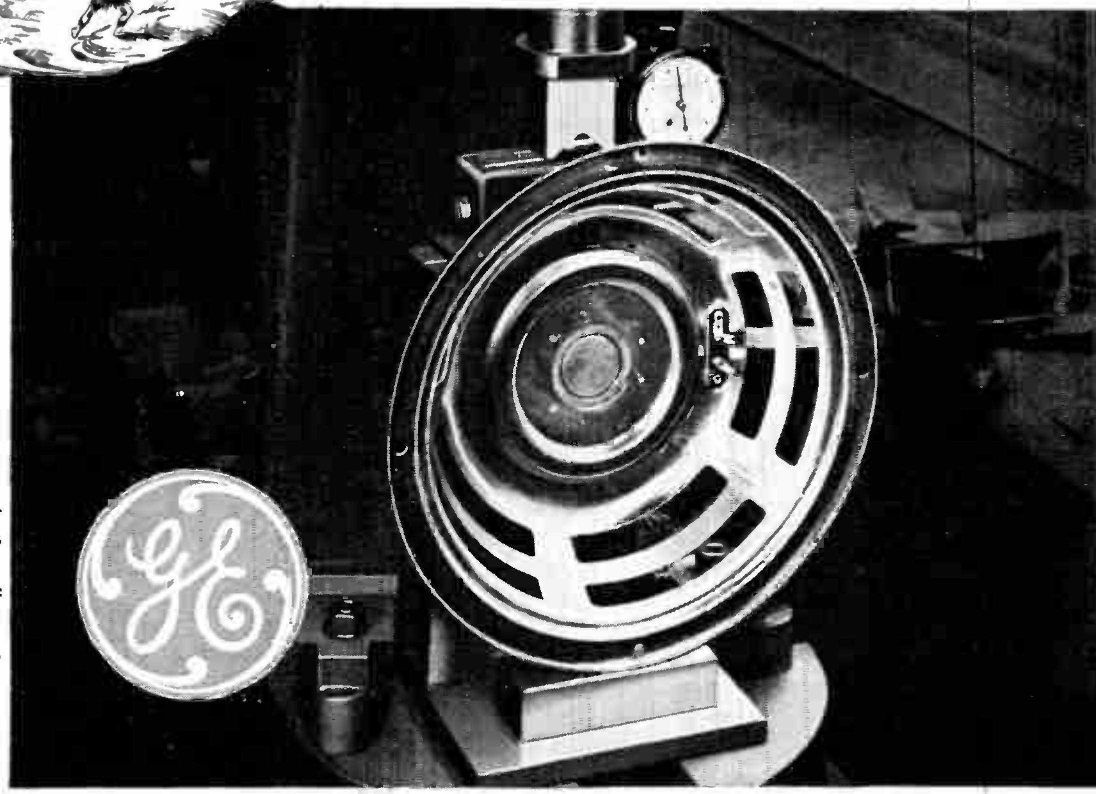

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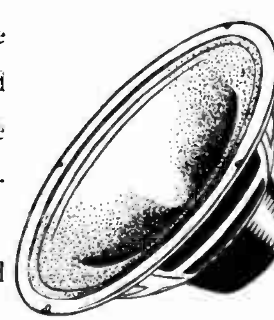

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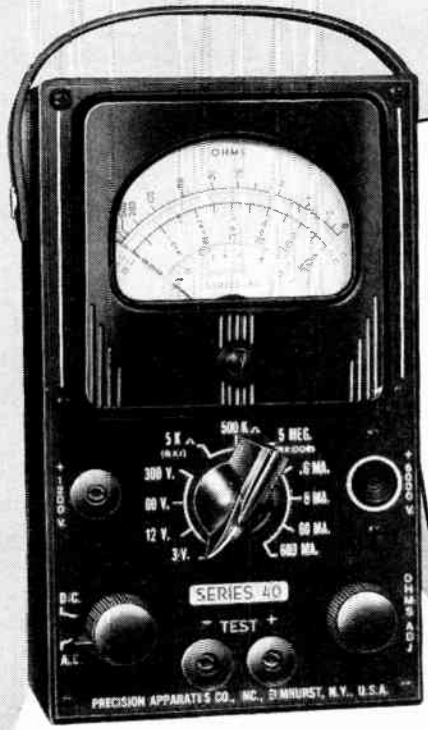

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HOW TO USE OHM'S LAW IN RADIO SERVICING

by Willard Moody

Ohm's Law is a simple but effective aid to the service technician. Here are some of its common applications.

OHM'S Law is at once one of the simplest and most useful of all electrical laws applicable in servicing. No advanced knowledge of mathematics is required for its employment. For example, an ordinary filament circuit is shown in Fig. 1. The set might be one of those nameless wonders made in a back room somewhere. The ballast tube is "gone" and a replacement must be made. To determine the type of tube necessary and the resistance value of it, or to determine the values of a shunt resistor across the pilot lamp and of a series resistor between the lamp and the high side of the line, we may put Ohm's Law to work. From a tube chart, the filament current of the 25L6 is found to be .3 ampere. Bearing in mind the principle that the current is the same in all parts of a series circuit, the current in the other filaments will also be .3 ampere. A common mistake that beginners and early technical students make is to add the currents in the series circuit.

The tube chart or tube manual also gives the filament voltages. They are, for the various tubes:

TUBE	FILAMENT VOLTS
6SJ7	6
6SK7	6
25L6	25
25Z6	25

Any experienced serviceman would recognize the tubes and filament voltages at a glance. The voltage across the pilot lamp is 6 volts. The current through the lamp under normal working conditions for a brown bead type would be .15 ampere. Six volts divided by .15 gives 40 ohms as the "hot" resistance of the lamp and, for an equal division of current (.15 in the lamp and .15 in its associated shunt) we may use a 40 ohm resistor across the pilot light.

The two 25 volt filaments are easily added, giving 50 volts. We see at a glance that three six volt filaments will equal 18 volts. This, added to 50, gives 68. Adding the 6 volt lamp drop, we have a 72 volt drop in the circuit without reaching for a pencil and scratch paper at all. The voltage drop across R2 must be 115 minus 72 or 43 volts. Next, multiply 43 by 10, simply moving the decimal point one place to the right. Divide 430 by 3 to get the value of R2. It is about 143 ohms, obtained without a slide rule or any great effort of the mind.

The power in R2 is 43 x .3, or 12.9 watts. A resistor having a rating of about 25 or 30 watts would be satisfactory. It is good practice to use a heavy duty unit which will not overheat. When there is plenty of room in the chassis and cabinet, the resistor may be used; otherwise the use of a line cord having the proper resistance value is indicated. One having a resistance as close as possible to the calculated value should be used. However, the value

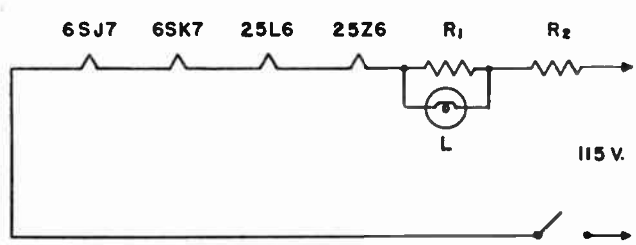

FIGURE 1

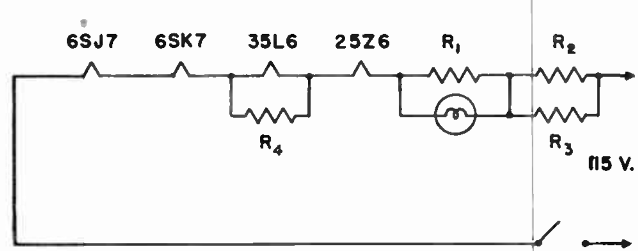

FIGURE 2

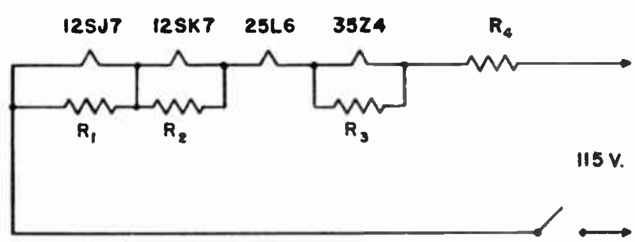

FIGURE 3

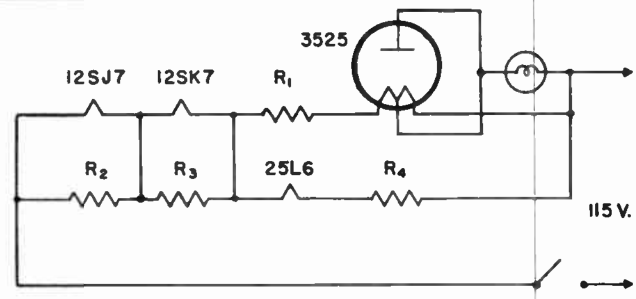

FIGURE 4

is not extremely critical.

The resistor, if it is used, may often be mounted vertically. This is done by some men in the New York area who convert sets from a.c. to d.c. or a.c.-d.c. operation. A hole is drilled in the chassis, asbestos washers used for insulation at the top and bottom of the resistor and a long machine screw is threaded through the vitreous enamel unit for mounting purposes.

Circuit changes

Due to scarcity of tubes, it may sometimes be necessary to make a slight change in the circuit. If a 35L6GT is available, it can be used in place of the 25L6. The circuit arrangement is shown in Fig. 2. Here, R1 would be a 40 ohm 5 watt type. R2 could be changed to a new resistor or shunted to decrease its value. This would not be practical for a line cord but if a built-in resistor is used it can often be done. First, R4 may be figured. You know that there is 35 volts across this resistor, since the 35L6 has a 35 volt filament, and the shunt current is .15 amp., equal to the 35L6 current. The total is .3 amp. through the combination. Then, 35 divided by .15 equals 233 ohms, and a 230 or 235 ohm resistor could be used. The power in it would be 35 x .15 or 5.25 watts, and a 10 or 20 watt unit could be used. The total drop in the circuit is now 78 volts. The drop across R3 and R2 must be 115 minus 78, or 37 volts. The net resistance in the circuit must be 37 divided by .3, or approximately 123 ohms for the R3-R4 combination. Then,

$$\frac{1}{123} = \frac{1}{R3} + \frac{1}{R2} = \frac{1}{R3} + \frac{1}{143}$$

$$\frac{1}{123} - \frac{1}{143} = \frac{1}{R3}$$

$$.008 - .007 = \frac{1}{R3} = .001$$

$$R3 = \frac{1}{.001} = 1000 \text{ ohms}$$

The power in R3 is simply,

$$P = \frac{E^2}{R3} = \frac{37^2}{1000} = 1.37 \text{ watts}$$

A 3 to 5 watt rating could be used.

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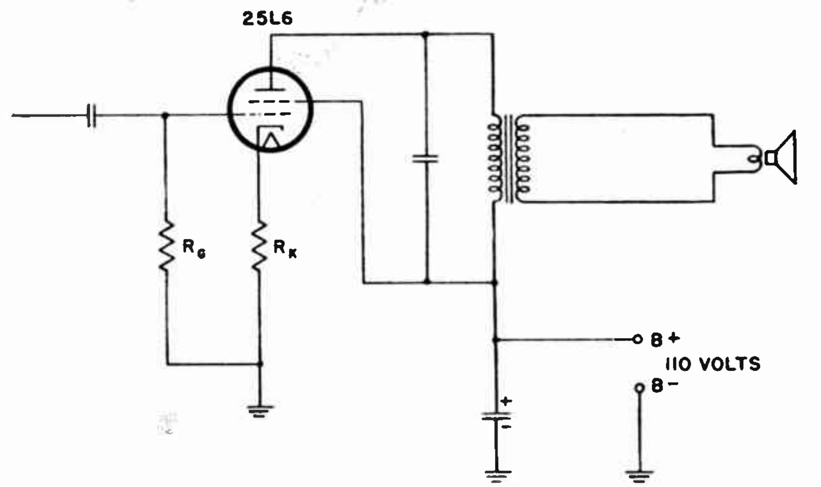


FIGURE 5

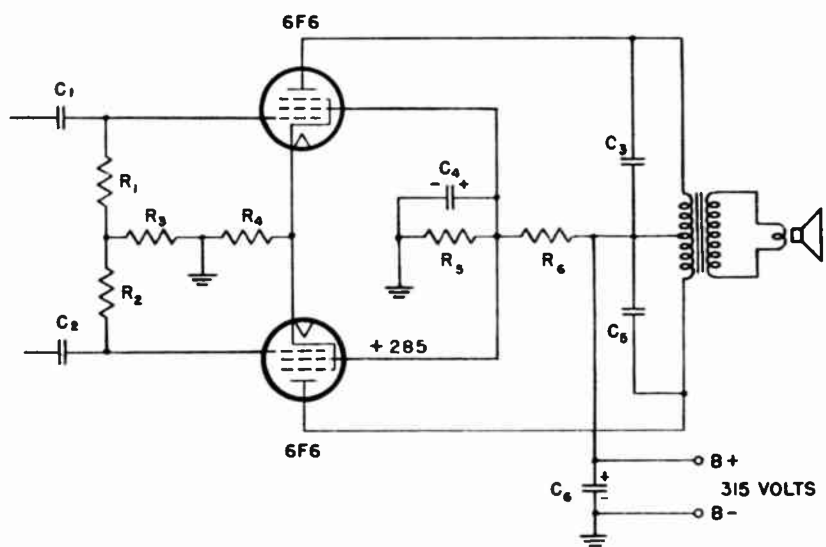


FIGURE 6

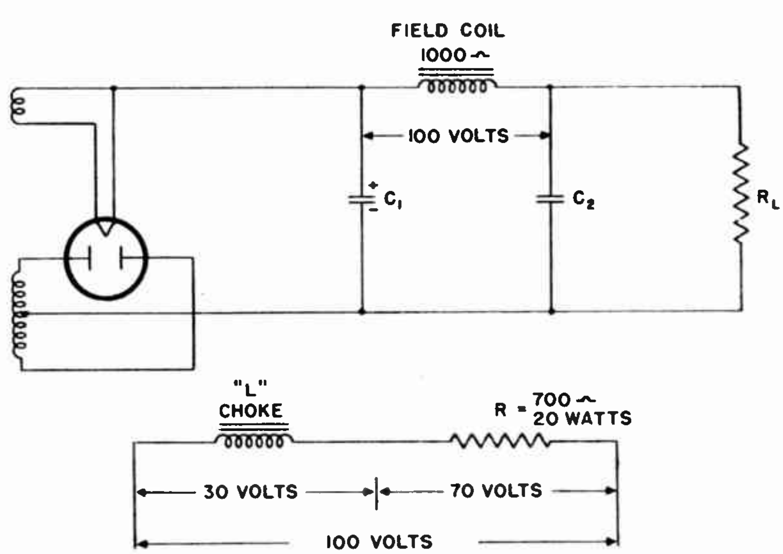
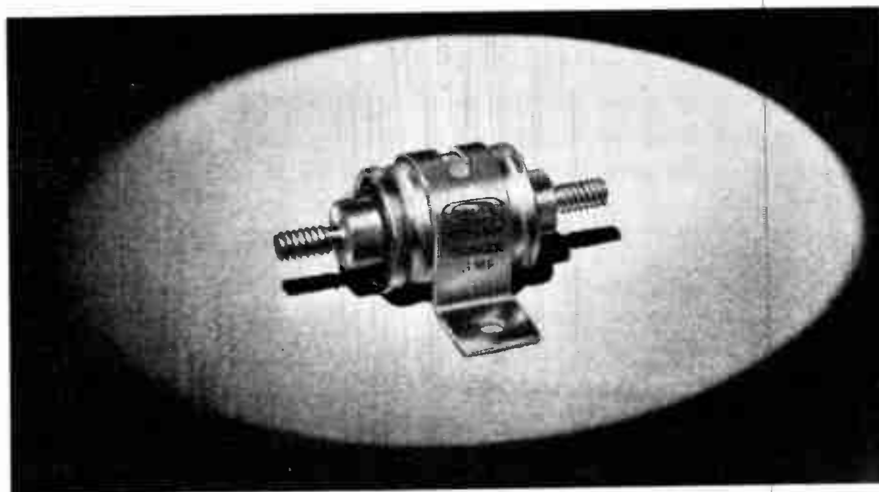


FIGURE 7

INTERFERENCE



PART III

by Paul M. Miller

The "noise specialist" will find plenty of jobs waiting for him in offices, apartment houses, and private homes. All he needs is an understanding of the nature of interference, and how to use wavetraps, filters and noise-limiters to eliminate it.

A SIMPLE wavetrap consists of a coil and condenser in a parallel resonant circuit. In some traps the condenser is variable; in others, the inductance is variable. The circuit is designed to tune over a small range of frequencies. Figure 1 shows how the action of a wavetrap rejects certain frequencies and permits others to pass with little or no attenuation. This trap is designed to be resonant at about 435 kilocycles. This point is maximum impedance to this particular frequency. On both sides of this frequency, for about 35 kc, it also has large impedance to the incoming signal, but above 475 kcs, and below 400 kcs, the impedance is small enough to present only circuit resistance to the incoming signals. Thus an interfering signal appearing in the antenna has a great attenuation through the trap, while the signal of the station being tuned has very little resistance in its path.

The signal to noise ratio is increased, often to a point where station signal has sufficient volume to "drown out" the interfering signal. Most wavetraps are enclosed in shielded cans that are similar to I.F. cans, and have screwdriver or knob adjustments on the top. Some are slug tuned. The wavetrap of Figure 1 can be compared to the primary or secondary of an I.F. transformer of 465 kc, in a sense.

While aligning a superheterodyne receiver with 465 kc I.F. transformers, the adjustments are made for greatest output as indicated on an output meter, while the transformers have a signal of 465 kcs being fed into the input. At resonance, the circuit of the transformer has little impedance, and the voltage output is at maximum. If the circuit is out of alignment and thus not in resonance, the signal is attenuated. That is the action of a series resonant circuit. Suppose the I.F. transformers are in perfect alignment and the signal output is maximum. If we were to take the transformer out and install it in the antenna lead, *in parallel*, and connect the signal generator (still set at 465 kcs) to the antenna, hardly any voltage would get through, because the attenuation of the resonant circuit, when used in parallel, is maximum. We are using only one "tank" of the transformer—either primary or secondary. It is now a wavetrap and transfering a minimum of energy, instead of a maximum. In this circuit perhaps "anti-resonance" would be a more descriptive word.

Some wavetraps are constructed

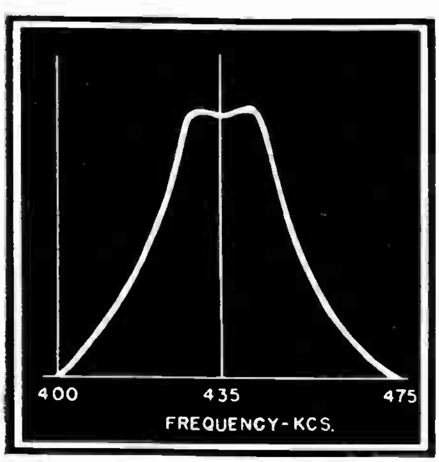


Fig. 1 A wavetrap rejects certain frequencies and allows others to pass with little atenuation.

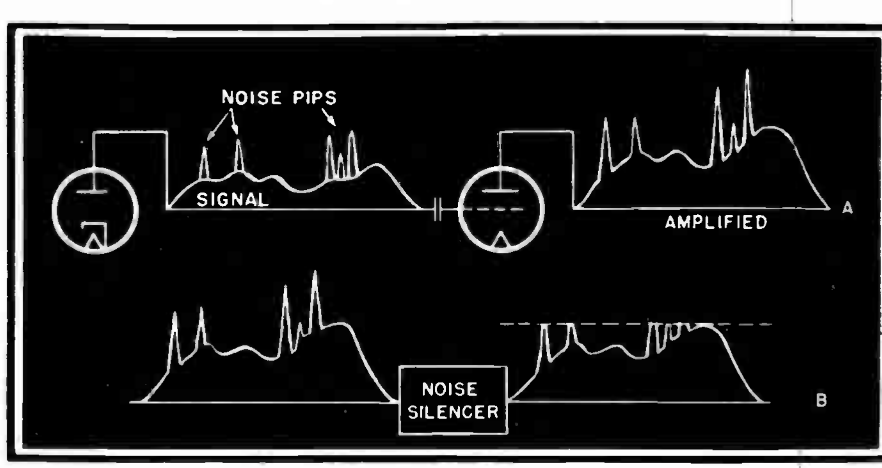


Fig. 2 Man-made static becomes part of the audio signal and is amplified along with it. The noise silencer actually merely performs a limiting action, reducing noise pips to the level of the signal. Here they are not objectionable.

with both series and parallel resonant circuits, for greater selectivity of the frequency to be suppressed. The series part of the trap permits the parallel portion to have a much sharper characteristic.

Installing the wavetrap

Wavetraps are especially efficient in radios that have no RF stage, where the signal comes directly into the mixer tube as in small table model sets. A wavetrap may be purchased for just about any frequency or range of frequencies that are common sources of trouble and interference. Well-designed traps are so reasonably priced that it is not worthwhile for the serviceman to make his own. If there is no room on the chassis for the trap, it may be mounted inside the cabinet. If it is of the unshielded type, it can easily be placed under the chassis.

On most of the common wavetraps, the antenna connects directly to the trap, goes through the trap and to the antenna terminal post on the receiver. The ground is similarly connected.

The type of interference which reaches a receiver through its antenna or I.F. section is a little more difficult to cope with, but satisfactory results can be obtained in a majority of cases with a representative stock of the following devices.

Meissner, Millen, RCA, and the other manufacturers of "Ham" equipment are specialists in designing traps to reduce or eliminate interference or unwanted signals. If the Meissner line of components seem to be accentuated here it is because Meissner products are of reasonably good quality and can be found on most jobbers' shelves. Although other manufacturers make almost identical products, they are not as likely to be found at your jobbers at all times.

In the wavetrap "department" of our kit, we will start with the:

RCA External Antenna Coupler for loop sets. This unit is very useful for installations where it is desirable to connect an external antenna to a receiver loop, thus improving the sensitivity and signal to noise ratio. The range is 500 to 1750 kilocycles. It is easy to install and easy to adjust. The unit is also very useful as a fixed-tuned substitute for any standard loop to aid in aligning loop receivers. It has adjustments for each band.

Meissner DeLuxe Dual Universal Wavetrap. This will prove to be a popular addition to the kit, for it can handle code signals as well as broadcast interference, right down to the low frequency police bands. It tunes from 400 to 475 kilocycles to prevent code and other signals from entering the receiver through the I.F. circuit. It also tunes 550 to 1950 for interfering signals in the broadcast and police bands. It has a ferrocart iron core for greater efficiency.

Meissner Dual Ham Band Wavetrap. If the interfering code signals can be identified as being in the allotted ham bands, this trap will eliminate them on two bands simultaneously: either the 40 and 80 meter bands, or the 40 and 160 meter bands.

Meissner Standard Single Wavetraps. These are each designed for a specific frequency coverage for use where the interfering signals can be identified as to their exact frequency or band. Air core with screwdriver adjustment, they can be purchased shielded or unshielded. For low and medium frequencies, wavetraps do not necessarily require shields, especially if they can be tucked away in some corner of the chassis.

The standard single wavetraps tune from 400-700 kcs, 650-1000 kcs, 950-1600 kcs, 20-40-80-160 meter and police bands, and 465 kcs.

Millen Company manufactures a **Dual Wavetrap** that is very well designed and very efficient in operation. It consists of a series of parallel resonant circuits to provide almost infinite attenuation and a sharp resonance curve for minimum attenuation of other frequencies. **Millen** type 813 BC #1 and #2. The #1 tunes 900 to 1600, and #2 from 500 to 900 kilocycles.

For the short-wave bands, the James Millen Co. also makes wave-

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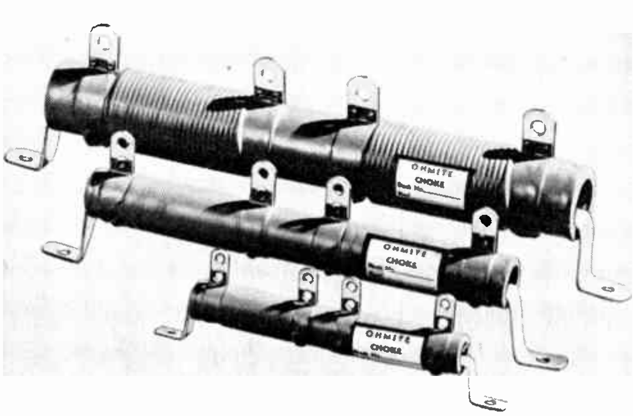
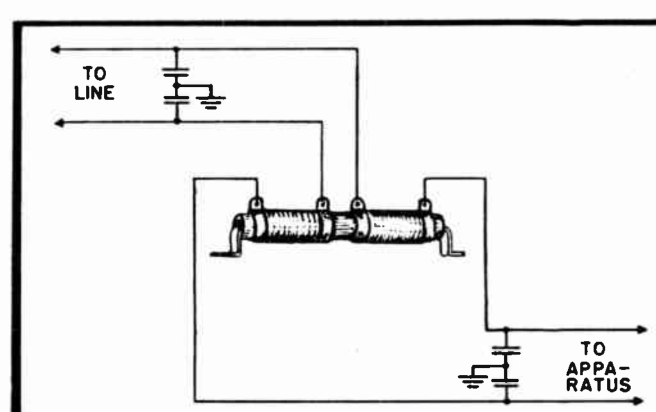
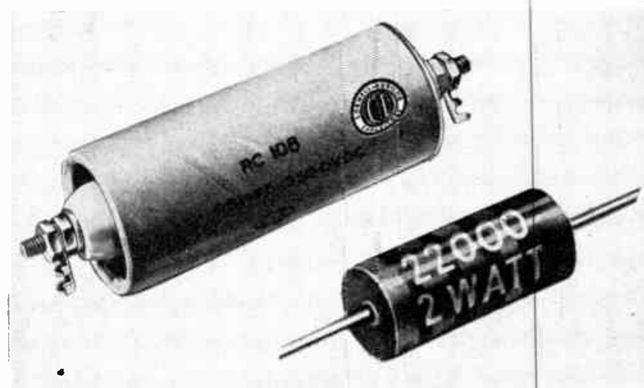
To check noise from home appliances at the source, many types of special filters are available. The one above is designed for use with electric shavers and other portable appliances with insulated cases.





For preventing interference from high-frequency emissions of nearby amateur transmitters or therapeutic machines, filters like those above are available. Filters should be installed in the 110 volt lines of interfering machine or transmitter as shown.

SERVICING RC FILTERS



by Irving Dlugatch

Here is some practical information that will help you in selecting original and replacement components for RC filters.

THERE are very few electronic circuits that do not make some use of a combination of resistance and capacitance. In every case, R and C are carefully chosen on the basis of the needs of the circuit and the fundamental principles involved. Although a great deal has been written on the subject of time constants and their uses, very little information is available of a practical nature. The technician needs facts that will help him select original and replacement components intelligently.

A brief review of some important mathematical relations is necessary here. A resistor, when placed in series with a capacitor, will delay its charging or discharging. The quantity of capacity will also determine the time to charge or discharge. The product of the capacity in farads and the series resistance in ohms is called the time constant of the circuit. It is convenient for comparison with other circuits. The larger the value of RC, the longer the condenser takes to charge or discharge. Some useful formulas based on the time constant follow.

1. T = 5RC where T is the time in seconds for the condenser to be fully charged or discharged.

2. $F = \frac{1.59}{RC}$ where F is the cut-off frequency in cycles of any resistance-capacity type filter.

The reader is referred to any basic textbook for the derivation of these formulas. The cutoff frequency mentioned is one whose duration is such that the condenser voltage will be 50% of the maximum value. Both of the formulas apply only to sine waves.

Power supply

The circuit of Fig. 1 is the first to be analyzed. It is the power supply of a typical six-tube superheterodyne. The plate circuits of the tubes have been replaced by the equivalent resistor, R1. Its value can be found by Ohm's Law from the total current of 80 ma. and the supply voltage of 125 volts. R1 is calculated to be 1562 ohms. The charging circuit for C1 includes:

1. The transformer or generator supplying the electric power.

2. The pilot light in parallel with a portion of the 35Z5 filament. When cold, these have a very low resistance.

3. R3. This is an extremely important resistor. It limits the peak value of current flowing during the charging of the capacitors. Without it, the series impedance will be insufficient to prevent damage to the tube. It is omitted only when C1 is made small enough so that the pilot light circuit will provide the minimum plate impedance.

4. Tube plate resistance. This varies with the tube used and the operating conditions.

All of these add up to an extremely small value of series R. As an example, for typical operation of a 35Z5 on a 117 volt line, tube manuals list a minimum required imped-

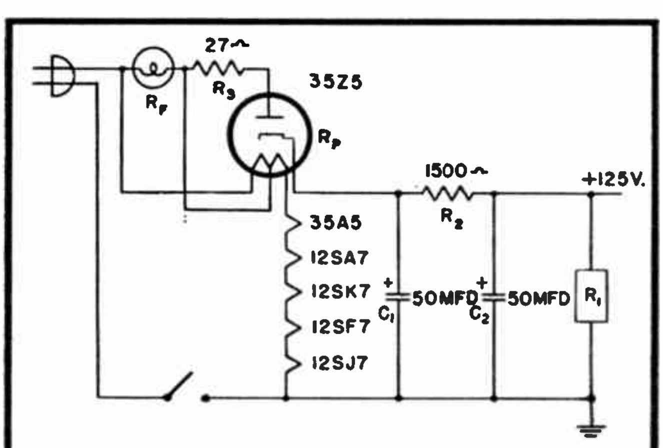


Fig. 1 Power supply of a typical six-tube superheterodyne.

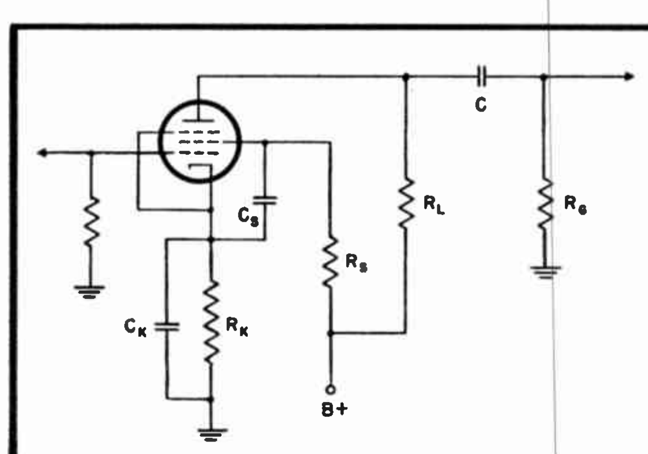


Fig. 2 Conventional pentode resistance-coupled amplifier.

ance of 15 ohms when C1 is less than 40 mf. As a result, the charging time constant for this capacitor is very short. It will charge to very nearly the peak value of the 60 cycle wave.

C1 discharges through R2 and R1, a total of 3062 ohms. Therefore, it will take longer to get rid of its voltage. The larger the value of R1, the more charge will remain on C1. As a result, the average value of the voltage on C1 is entirely dependent on the resistance of R2 and R1.

As for C2, its charge time constant is more complex. It charges not only through the impedances listed for C1 but also through a resistance equal to R1 and R2 in parallel. Its initial voltage is slightly lower than that of C1. It discharges faster than C1 because it discharges through R1 alone.

To sum up for this circuit.

1. For any selected values of C1 and C2, the ratio R1/R2 should be as large as possible for maximum output voltage.
2. For any particular values of R1 and R2, C1 is more important than C2 in determining the d.c. voltage. Lowering of its capacity reduces the output voltage.
3. C2 provides a low impedance path for R.F. Reduction of its capacity will result in motorboating, squeals and howls.
4. The life of rectifiers can often be lengthened by the addition of a small resistor in series with the tubes.

It must be remembered that the primary purpose of the filter is the removal of ripple. It is a low-pass filter since high frequencies will be bypassed by the capacitors. Its cutoff frequency should be well below the ripple frequency. Equation 2 can be used to check this. To avoid involved calculations, a rough approximation may be obtained by using for RC the product of C1 and the sum of R1 and R2. It is important to determine whether C2 is capable of properly bypassing R2. C2 and R2 in combination should form a low-pass filter whose cutoff frequency is not more than that of the lowest audio frequency to be amplified. The same formula can be used.

The next circuit, shown in Fig. 2, is that of a conventional pentode resistance coupled amplifier. It con-

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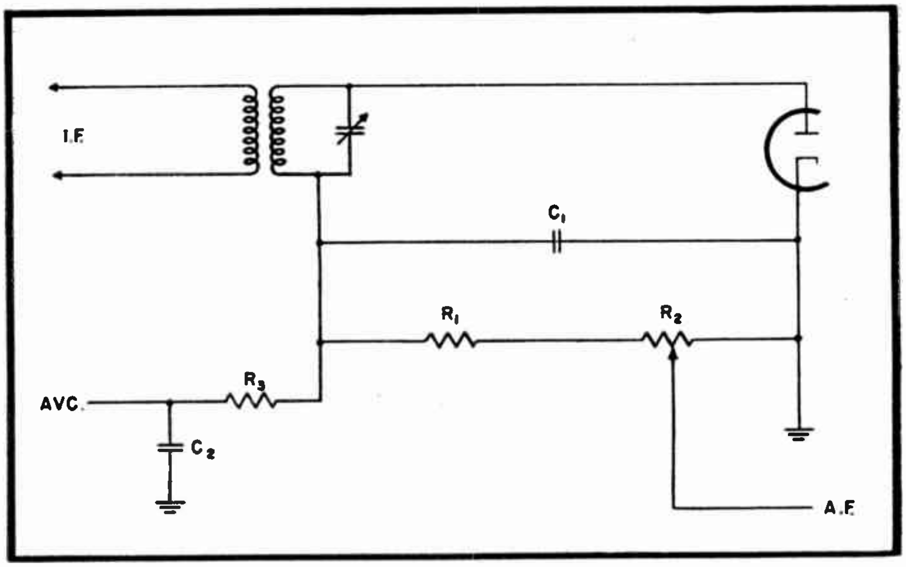

Fig. 3 An A.V.C. circuit.

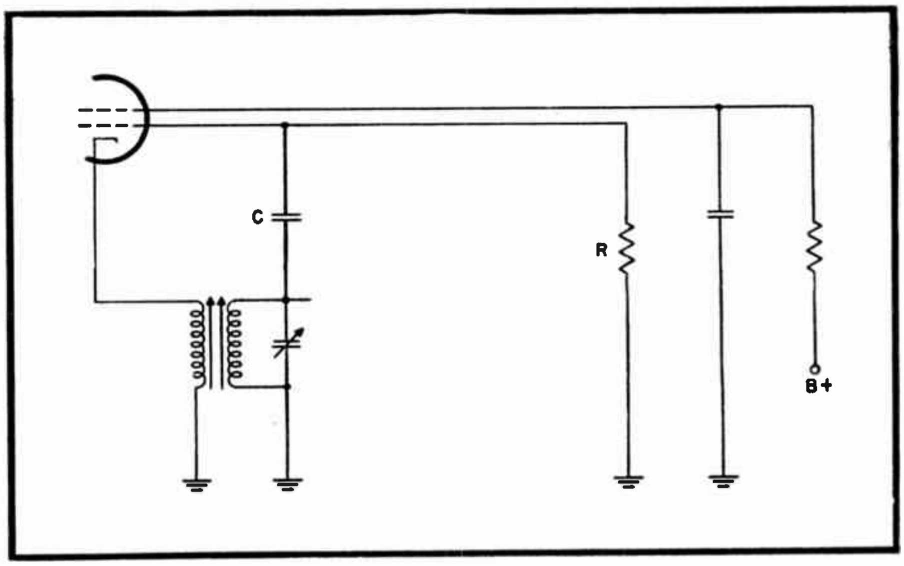

Fig. 4 The Oscillator portion of a superheterodyne receiver.

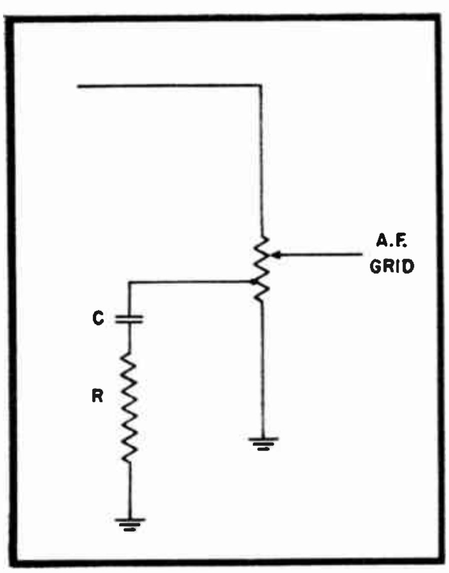

Fig. 5 A volume control.

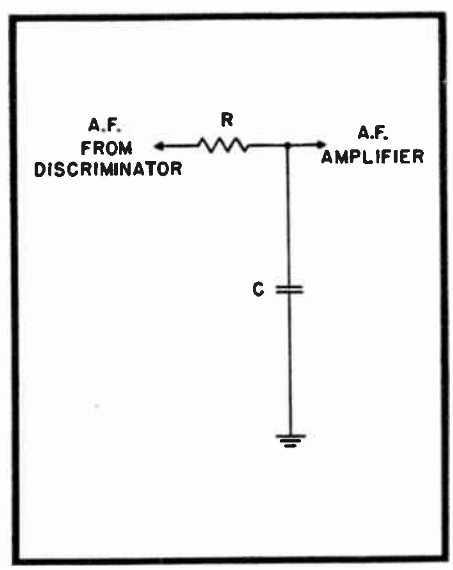

Fig. 6 A low-pass filter.

WHY DO WE NEED F. M. ANTENNAS?

by J. Richard Johnson

This is the question your customers will ask. They didn't need an outdoor antenna for their AM set, and want to know why they need one with FM. Be prepared to answer this question and you'll also be prepared to do a better job of setting up their FM antennas.

IF you haven't already been faced with it you soon will. I mean that classic customer-to-serviceman question, "Does my F.M. receiver really need one of those *things* up on the roof?"

You must be ready with a clear and uncompromising answer. You must be able to explain just why the antenna on the roof means the difference between receiving the full benefits of F.M. and just "getting by." This is a difficult thing to do, of course. But if we have a clear understanding of the reason ourselves, it will be much easier to pass it along to our customers, and we will also find it easier to put up their antennas properly.

Important Fundamentals

The purpose of a receiving antenna is to intercept a desired radio wave. The interception must be such that a satisfactory signal voltage is applied to the receiver's input circuit.

The radio signals which permeate the space around us are rated according to their intensity. This intensity is expressed as so many volts per unit length. The most used unit is microvolts per meter. In other words, the signal voltage between two points varies with the distance between them. Suppose a signal has an intensity (called "field strength") of 100 microvolts per meter. This means there is a signal potential of 100 microvolts between two points one meter apart, 200 microvolts between points two meters apart, and so on. With our points separated 10,000 meters, there would be a 1 volt signal between them. A long antenna therefore intercepts more of the wave than a short one. Greater antenna current is induced in the long one, and we receive better with it. That's a good rule, but it is modified by one other important consideration.

Resonance Effect

If the actual length of the radio wave front were the only consideration, we could say "The longer the antenna, the more signal voltage we'll have at the receiver." But another factor alters the whole picture. The factor is the phenomenon of resonance. A quarter wave length of wire, or any multiple thereof, acts like a resonant circuit. By adjusting it to this exact length we tone it to the desired signal frequency. At resonance, an antenna has a very low impedance, and the field intensity voltage surrounding it induces a relatively large signal current in it. This current is larger than the current induced in a non-resonant piece of wire many times as long.

Fig. 1 illustrates an experiment which shows antenna resonance effect. The experiment is conducted in an area in which there is a certain very strong signal. This signal has a frequency "f" and a corresponding wave length "λ" (called "lambda" and used to indicate wave length in meters).

We start with a piece of wire three sixteenth of a wave length long and connect an RF meter between one end and ground as shown. The meter shows the RF current induced in the wire by our strong signal. We now gradually lengthen the wire, taking meter readings as we proceed. We find that at a quarter wave length the current reaches its highest value. Further lengthening of the wire causes the current in the meter to decrease. The decrease takes place in spite of the fact that increasing the length of the wire intercepts more wave front.

In other words, *the resonance effect is many times as great as the effect of non-resonant wire length.* In the vicinity of resonant length the latter effect is not noticeable.

Non-resonant wire length is still important, however, because a low frequency resonant antenna, being longer, inherently produces more signal voltage than a high frequency resonant antenna. The resonance effect is the same at both frequencies, but the greater length of the low frequency antenna makes it more sensitive.

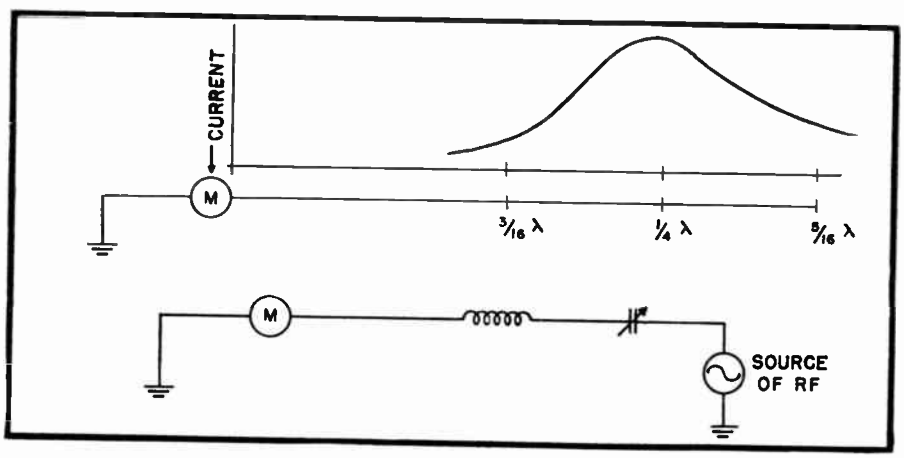

Fig. 1 An experiment illustrating antenna resonance effect. The resonance effect is many times as great as the effect of non-resonant wire length.

Dipole Antenna

A typical quarter wave resonant antenna and feeder connection are

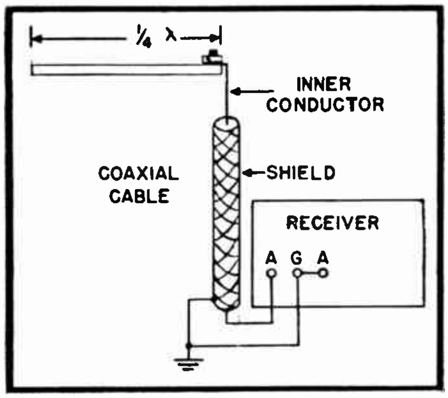

Fig. 2 A quarter wave resonant antenna and the feeder connection.

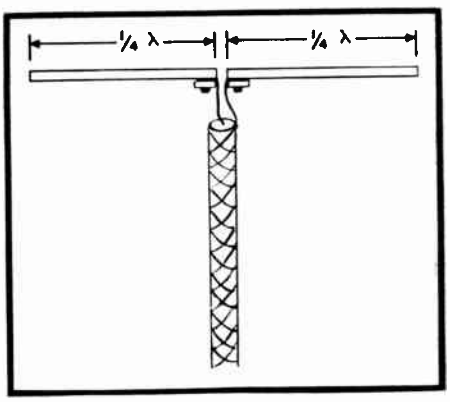

Fig. 3 Two quarter wave antenna sections are joined to form a "dipole".

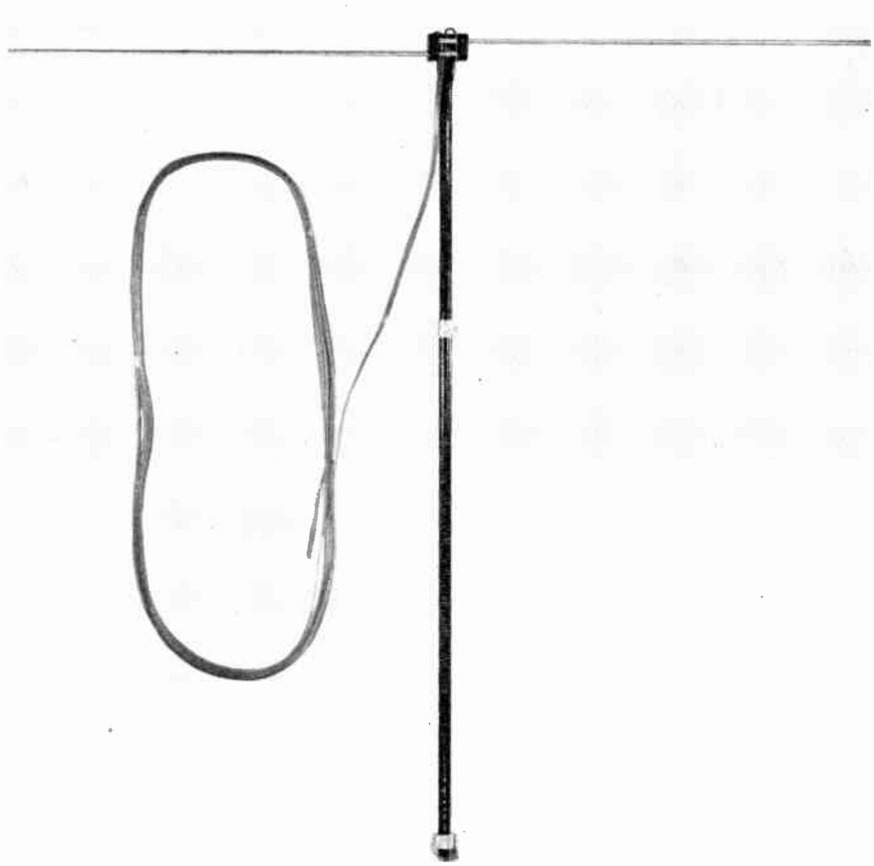

Fig. 4 Typical dipole. The dipole is the most popular F.M. antenna.

shown in Fig. 2. The antenna feeds current through the load (the receiver) to ground. The transmission line provides the interconnection. The shield of the transmission line is grounded to form what is known as an "unbalanced" line.

To obtain a "balanced" line, we can take two quarter wave antenna sections like that shown in Fig. 2 and place them in line with each other as shown in Fig. 3. This forms what is known as a "dipole." Dipoles are the most popular of F.M. antennas. A typical dipole for F.M. reception is shown in Fig. 4.

Dipoles can be fed with either a balanced or an unbalanced line. An example of each arrangement is shown in Fig. 5. The choice of the type of line to be used is influenced by many factors and will be discussed in detail in our next F.M. article.

Antenna elimination in A.M. sets

Most of the A.M. broadcast receivers we handle today don't need an external antenna. The question which naturally arises is "Why is an F.M. antenna so much more necessary than an A.M. antenna?"

Let's consider some of the factors involved in this situation.

1. *Sensitivity and Losses.* At present it is not possible to make receivers operating in the F.M. frequency range nearly as sensitive as the A.M. broadcast type of competitive quality. "Sensitivity," which is the response of a receiver to a certain voltage at its input terminals, should not be confused with "range," which takes into account antennas, propagation, transmitter efficiency, etc. Although the range of F.M. signals is often better, the sensitivity of an F.M. receiver is considerably poorer than that of the A.M.

This is due to losses, which are very much greater at the higher frequencies. Resistance of coils and wires, dielectric losses in condensers, input conductance of vacuum tubes and resulting gain per amplifier stage, will become much worse at 100 ms than at lower frequencies.

These losses can be, and are, more than nullified by better propagation (transmission from transmitter to receiver) and more efficient antennas on both ends. But they are a definite reason for the greater need for a receiving antenna in the F.M. range.

2. *Size of the Antenna for Resonance.* Because of the great length of A.M. broadcast waves a resonant antenna would have to be from 300 to 750 feet long (half wave dipole) Naturally this is impractical. However, many broadcast receivers use a "folded-up" resonant antenna known as a *loop antenna.* A loop antenna of this kind is simply the result of "blowing up" the tuned grid coil of the RF or mixer (first) stage. (Often an unshielded antenna coil of standard size provides enough pickup to give good reception on the A.-M. broadcast band. This explains why some A.M. receivers work without any external antenna or loop. The internal loop can intercept more wave front and thus improve reception. (See Fig. 6).

The loop and "coil pickup" phenomena are not noticeably effective at F.M. frequencies. First of all, the DF amplifier coil must be carefully placed and shielded. Secondly, it has so few turns to resonate properly

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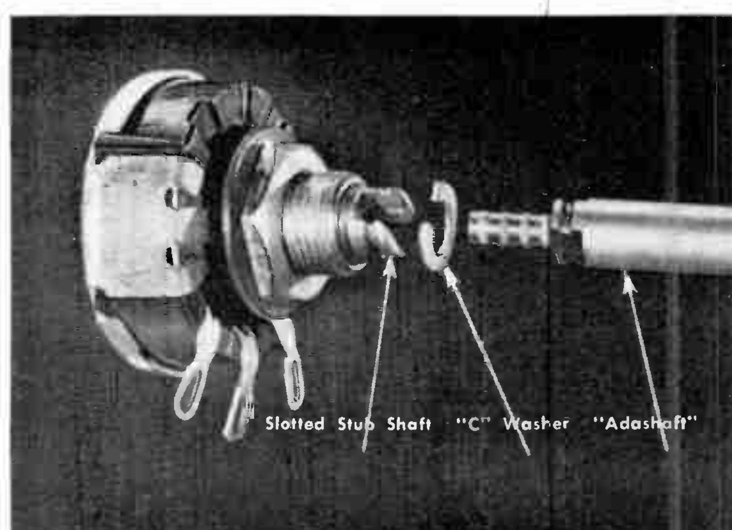
See how Centralab



Capacitors: CRL line of ceramic By-pass and Coupling Capacitors gives you ceramic dependability and permanence at a new low price! Packaged in a convenient envelope. *Hi-Kaps* are clean, easy to stock and handle. Wide range from .000050 to .010000 mfd. Rating — 600 WVDC, 1000 V. flash tested. Just out! New ceramic *Hi-Vo-Kaps* for television and high voltage use!

Controls: With CRL's improved *Adashaft* Radiohms you can carry a small stock of controls, yet be ready to handle almost any kind of control replacement problem. No wiggle, no wobble, no slip. Just insert shaft pilot in hole provided in control stub shaft, and slip "C" washer into place. Available in all sizes for all Model "M" volume control applications. Six types of shafts.

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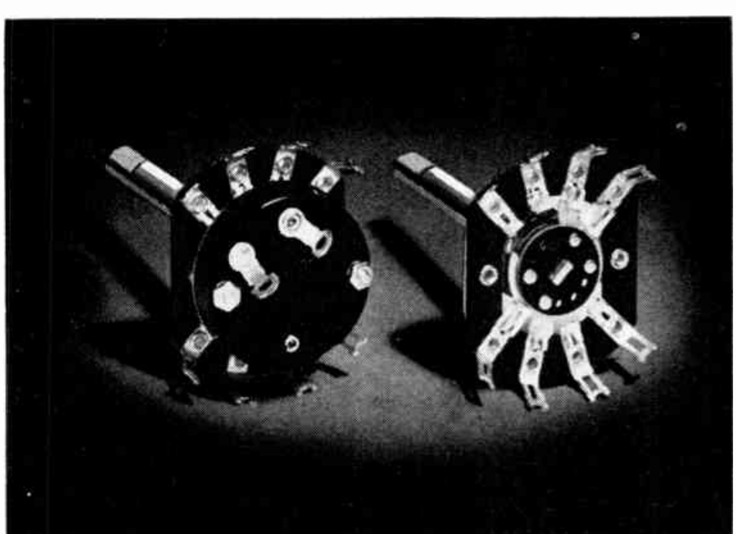
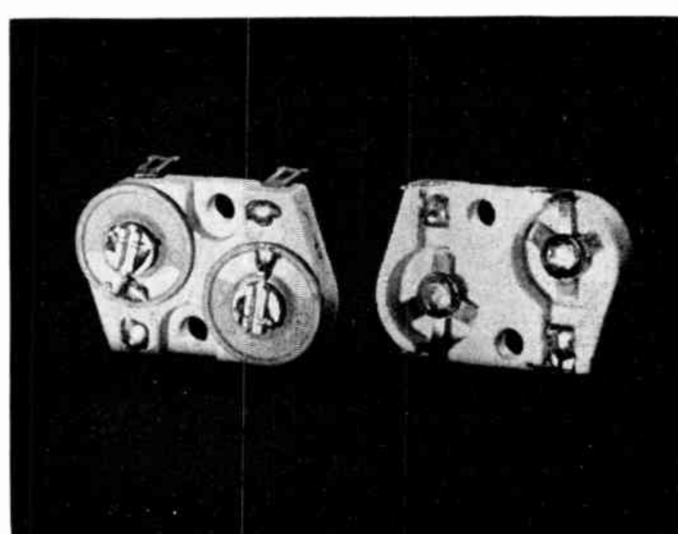
Want to speed up service and repairs? Want to simplify inventory and draw more customers? One look at Centralab's line of service components gives you the key to these important service problems. Compare quality . . . compare performance . . . compare price, and you'll see why radio servicemen everywhere use CRL parts to increase the efficiency of their shops and give their customers fast, dependable service. Yes, new Centralab research and development points the way to easier, faster service and repair . . . improved customer satisfaction! For the complete story on the Centralab line, get in touch with your Centralab Distributor.

— "Centralab's ceramic *Hi-Kap* capacitors are way ahead on performance and cost", says Earl Meyers, service manager at Erv's Radio & Appliance Store, Milwaukee. "They're easy to stock, easy to use, and you can be sure they won't let you down."

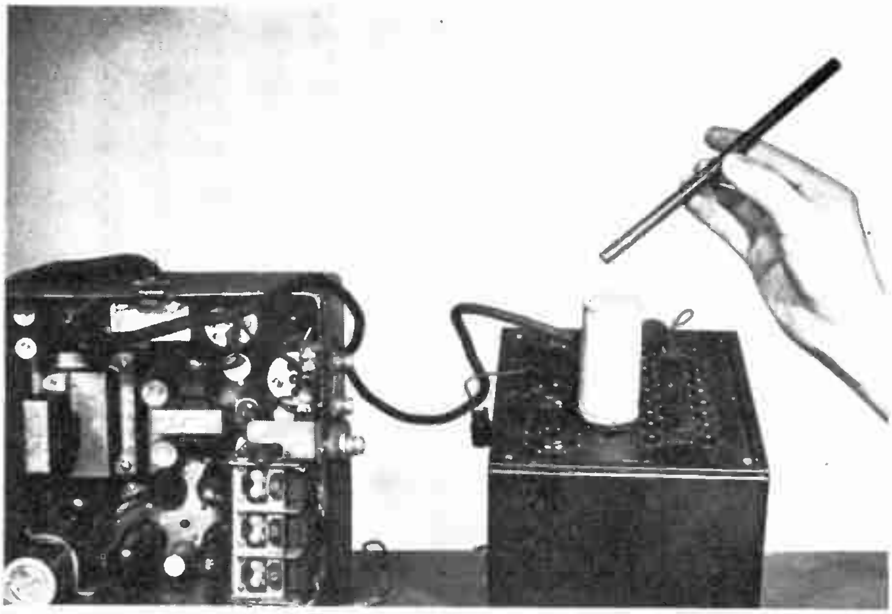
Centralab
Division of GLOBE-UNION INC., Milwaukee





Switches: Centralab offers you a complete line of Tone, Rotary Selector, Lever Action and Medium Duty Power Switches, which features a wide variety in both laminated phenolic and steatite insulation. Available with shorting or non-shorting contacts. See your Centralab Distributor for further information, or write direct for Catalog 722.

Trimmers: CRL's Ceramic Trimmers are made in four basic types with full capacity change within 120° rotation. Working voltages, 500 DC. Flash test, 1100 volts DC. Type 820—3 ranges from 2.6 to 35 mmf. Type 822—7 ranges from 2 to 50 mmf. Type 823 — 8 ranges from 5 to 125 mmf. Type 824 — 5 ranges from 1½ to 31 mmf. Spring pressure maintains constant rotor balance.



TIME

PLUG-IN ADAPTER

Adapters used to measure voltages and currents of tubes by plugging a cable-connected plug in place of the tube and locating the tube outside the set, were in common use a short time ago and many such outfits are no doubt gathering dust on shop shelves. These adapters may be put to good use in checking auto sets, and if not available could easily be assembled in a simplified form for the purposes illustrated.

As shown in photo #1, the vibrator is placed in the adapter where it may be tapped with a fiber rod to determine if intermittent operation is due to the vibrator. If such tapping is done with the vibrator in the chassis, it is difficult to determine whether the fault is in the vibrator or some nearby part. While some noise will be heard due to the connecting cable with this arrangement, the purpose of localizing the trouble may be realized.

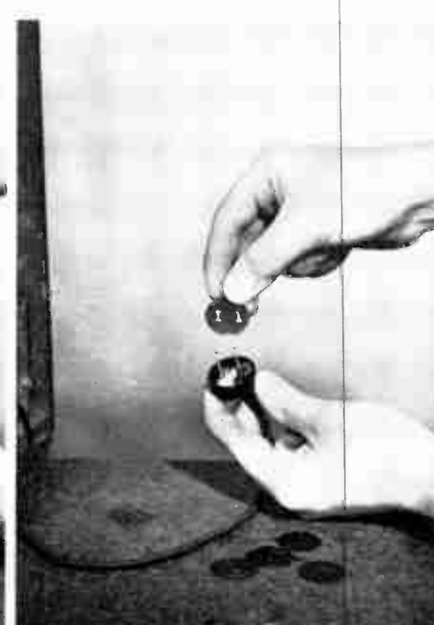
In photo #2 the adapter is used to extend the speaker cable and permit freedom of moving the chassis without pulling on or damaging speaker connections.

LINE PLUGS AND CORDS

The line cords and plugs on most customers' sets are in need of some minor repair. Such repairs may in most cases be easily noted by the radio owner and will be appreciated more than repairs which are out of sight under the chassis.

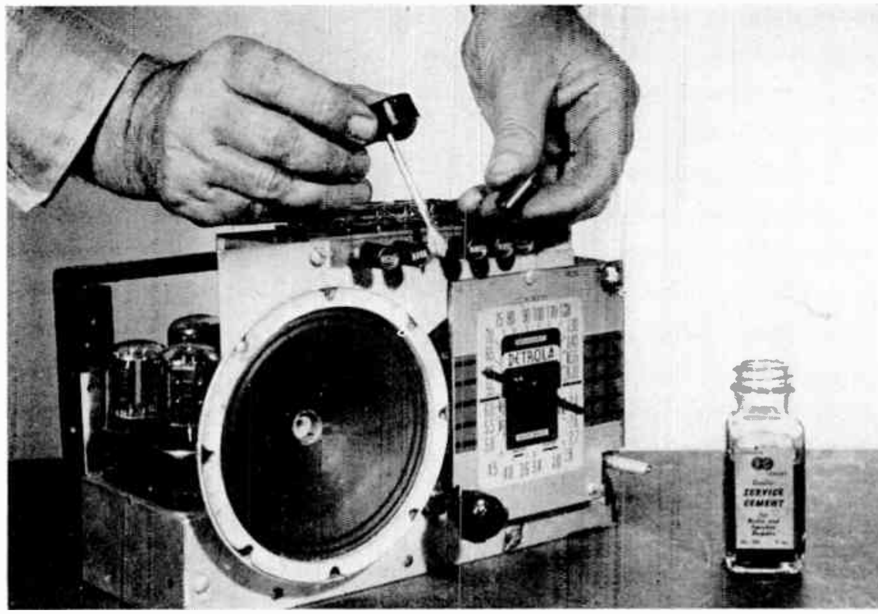
Plugs of the type shown usually have frayed wires which should be trimmed free, screws tightened and a piece of tape forced between the terminals. (See Photo #1)

A few fiber covers which slip on over the plug prongs should be on hand to complete the plug repair. (See Photo #2)



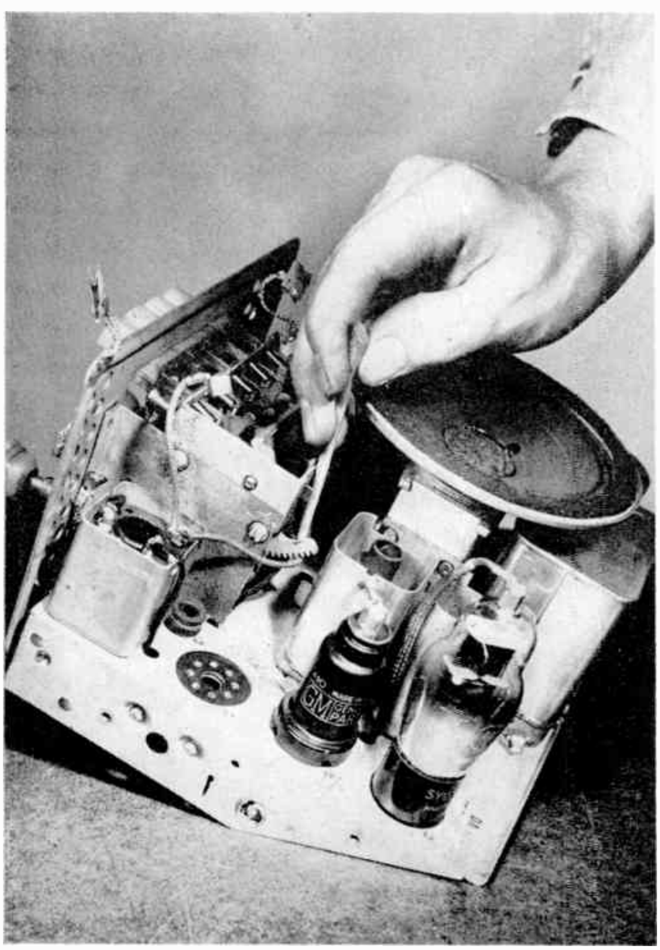
SAVERS

by H. Leeper



CEMENT FOR PUSH BUTTONS

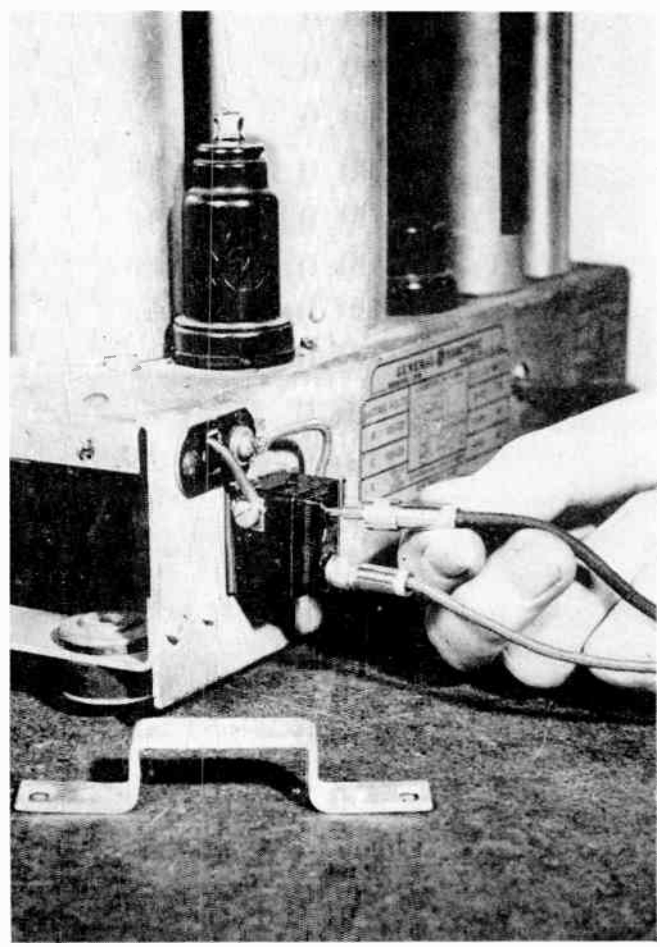
Fibre insulating push buttons of the type shown often become loose and slip off the metal plungers or rods. An application of service cement, as used for speaker repairs and similar work, will hold these buttons in place.



AUTO RADIO RECEPTION

Condenser tuning gears or cams in some auto radios extend some distance back of the condenser assembly at certain tuned positions. These cams may strike the coil-to-condenser wire as in the illustration, causing noise, and later a complete circuit break.

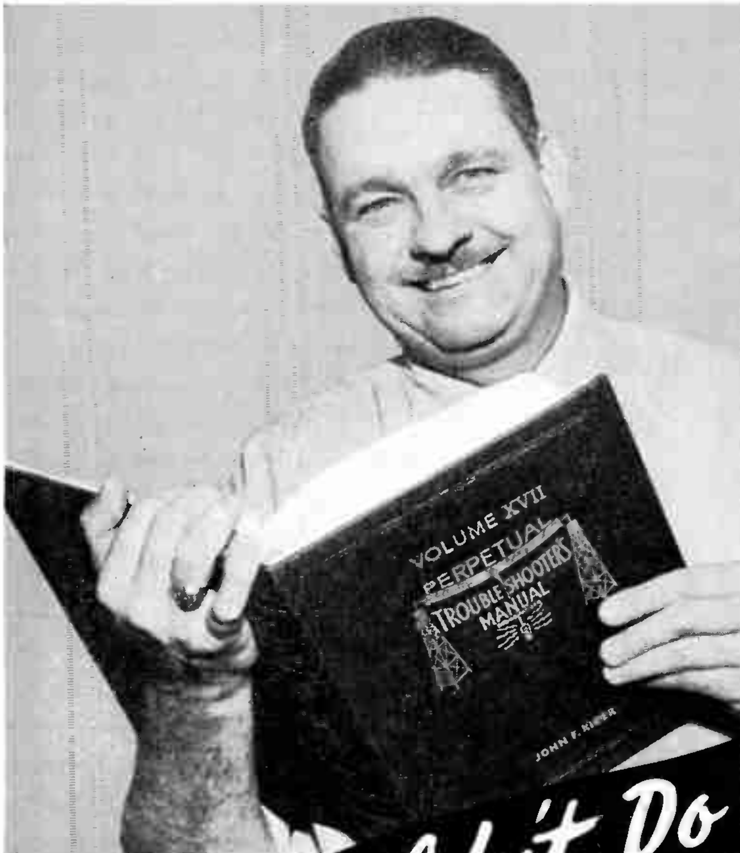
The wire lead should be taped to a rigid part in such a manner that the gear will clear it at all positions.



ANT-GROUND OUTLET

A broken aerial terminal is often difficult to repair.

An improvement over the original arrangement may be made by installing an "Ant-Ground" Outlet on the back of the chassis as shown. The metal strap is not used and the fiber outlet is held to the chassis by means of a bolt through the chassis. The original Ant-Ground wires are attached to the fiber outlet's proper terminals.



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This month, we add to the list of Rider "firsts" with the publication of Volume 1—Rider Television Manual.

We also announce another Rider first which will be out soon, the Rider PA Manual. (Publication date this summer.)

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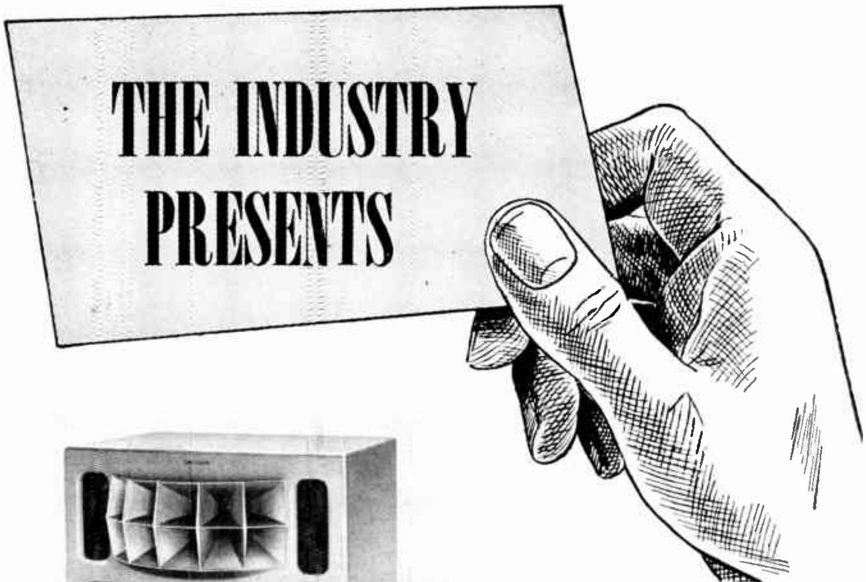
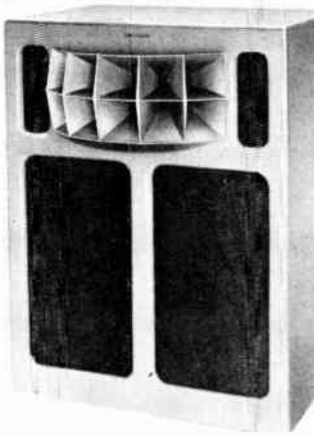




SPEAKER SYSTEM

Designed for installation in the home and described as featuring the same components, engineering standards and configuration of acoustic baffling, as used in commercial theater equipment is the Tru-Sonic Model P-63HF 2-Way Speaker System recently introduced by Stephens Manufacturing Corporation, Los Angeles. Shown installed in the Tru-Sonic 65U Utility Cabinet, the P-63HF is also available in the Model 63SD DeLuxe Period Cabinet.

Information on the complete Tru-Sonic line is contained in Bulletin #109, copies of which may be had by writing Stephens Manufacturing Corporation, 10416 National Boulevard, Los Angeles 34, California.

ULTRA-SENSITIVE MICROAMMETER

Harrison, N. J.—A new ultra-sensitive electronic microammeter capable of accurately measuring d.c. currents down to one-billionth of an ampere, has been announced by the RCA Tube department.

The new RCA microammeter is a portable, battery-operated, vacuum-tube meter, of moderate price whose usefulness extends to all fields — chemical, medical, mechanical, electronics, and radiation—where the measurements of extremely small currents is involved. It is expected to be of special value to recently intensified work in television, atomic research, facsimile and similar projects. Applications in these fields include weak-current measurements in iconoscopes, image orthicons, and electron multipliers, and such critical measurements as vacuum-tube grid currents and anode currents of photo tubes.

WIRE RECORDER

Webster-Chicago has announced their Model 78 Wire Recorder. The unit is especially adaptable for home use in connection with a radio receiver or with a high fidelity public address type amplifier and speaker. Compact in design with simple push button controls, the Model 78 adequately meets the needs of both the professional and amateur recording enthusiast. Model 78 comes complete with necessary cords, plugs, microphone, 15 minute spool of wire, and full instructions for easy connection. Head phones may also be used for quiet, private play back of a recording.

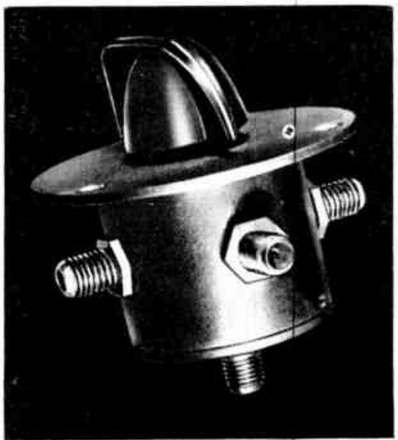
For further information write to the Webster-Chicago Corporation, 5610 West Bloomingdale Ave., Chicago 39, Illinois.

SIGNAL TRACER AND UNIVERSAL TEST SPEAKER

The McMurdo Silver Co., Inc., Hartford, Conn., has announced two new laboratory caliber electronic test instruments.

The first is Model 905A "SPARX", a super-sensitive aural dynamic signal tracer incorporating 18 watt universal output transformer and test speaker which may be used separately. Employing new vacuum tube hand-size probe on extra-flexible 4 ft. cable, the probe is provided with switchable tip to permit of either r.f./i.f. or a.f. signal tracing without usual single-probe distortion. Frequency range of probe and cabinet-contained 2 stage a.f. amplifier is 20 cycles thru 200 megacycles for a.m., f.m. and TV signal tracing. Amplification is so great that loud signals are had from built-in 6" PM speaker on local stations when probe is contacted to small midget loop antennas. Undistorted power output is 3.4 watts. Power supply employs mains-insulating power transformer. Two panel switches and chart establish any one of 30 desired transformer primary impedances from 325 thru 70,000 ohms, single and push-pull.

Model 910 is identical to 905A in its universal test speaker functions and applications, differing from 905A "SPARX" only in not including signal tracing functions.

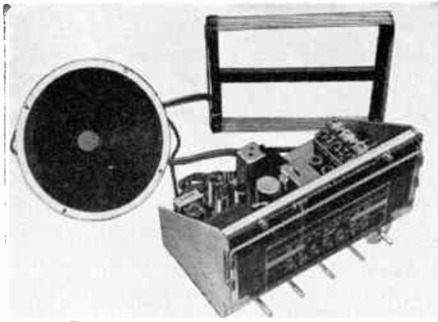


COAXIAL SWITCH

television channel to another utilizing the new Workshop Television Receiving System. The unit provides for switching conveniently any one of four antennas of a receiver.

In addition to the above, this new switch is the answer to the television sales demonstration problem. By using additional switches, any number of television sets can be demonstrated from one convenient location. The switch maintains a low standing wave ratio.

For further information write to The Workshop Associates, Inc., 66 Nedham St., Newton Highlands 61, Massachusetts.



CUSTOM CHASSIS

Rounding out their line of custom-built chassis units, the Espey Manufacturing Company has added the model 511 AM/FM receiver.

The Model 511, an AM/FM superheterodyne receiver employing twelve tubes plus an electron tuning indicator tube and a rectifier, is designed to operate on 105-125 volts a.c., 50-60 cycles. The unit covers the broadcast band from 535 kc. to 1720 kc., and from 88 mc. to 108 mc. on the f.m. band. This receiver features a.v.c. on both The Workshop Associates has developed a a.m. and f.m., separate full range bass and new coaxial switch for RG-59/U coaxial cable. This unit is used to switch from one treble tone controls. 13 watt push-pull audio output and provision for phonograph operation controllable from the front panel.

The chassis is 13½" x 8" x 9". A loop antenna for a.m. and folded dipole for f.m., a 10" speaker and all necessary hardware are included.

Details on their entire custom installation line of radio chassis will be furnished by the Espey Manufacturing Company, Inc., 528 East 72nd Street, New York 21, N. Y.

BANTAL TUBES

The Radio Receiving Tube Division of Raytheon Manufacturing Company, Newton, Mass., has announced the introduction of the new Raytheon Bantal Tubes, featuring advanced type of construction and greatly improved performance. Among the construction advantages of the Raytheon Bantal is its ruggedness and structural strength, afforded through the use of an 8-pillar support construction. The advanced Bantal design, while providing the strength, performance and reliability of the older and larger size tube, has at the same time retained the compactness and space-saving features of the modern GT construction.

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ELECTRONICALLY SPEAKING

On Thursday evening, May 20, 1948, during a regular meeting of the New York Servicemen's Association at Manhattan Center, New York City, John F. Rider, publisher. was presented with a silver plaque by Max Liebowitz, President of the Associated Radio Servicemen of New York. The hall, accommodating 1700, was packed to capacity for the occasion. Before handing Mr. Rider the plaque, Mr. Liebowitz read the inscription to the assemblage: "Associated Radio Servicemen of New York, Inc., Awarded to John F. Rider, In grateful appreciation of his meritorious achievements in behalf of the radio service industry (during the years) 1921-1948."

Mr. Rider, in accepting the testimonial, took advantage of the opportunity to congratulate the recently organized Association on its progress and the acceptance it has received from the public, the press and judiciary. He envisioned a big future for it. He also expressed the belief that it would serve as a model for servicemen in other localities who could similarly enjoy the benefits flowing from a well-organized local group equipped to further the interests of the individual serviceman and protect the industry as a whole from the damage of unfair practices and discriminatory legislation.

John F. Rider is presented with a silver plaque by Max Liebowitz, President of the Associated Radio Servicemen of New York.

The first in a nation-wide series of forums on television antenna installations and servicing was held Monday, May 3rd, at the Hotel Sheraton, Newark. It was sponsored by the JFD Manufacturing Co., Brooklyn, New York, in cooperation with the R.A.D.A. of Northern New Jersey. The JFD Forum was attended by 350 radio parts distributors and servicemen, in addition to all local JFD Television and FM antenna distributors.

Mr. George Duvall, of the Duvall Radio Service, was the first guest speaker. Mr. Duvall, who founded Television Technicians in 1939, discussed the growth of problems in television installation from the very first to the latest found in today's complex situations. The second guest speaker of the evening was Mr. Martin Bettan, Chief Engineer of the Colonial Television Company. Mr. Bettan, who is considered the leading specialist in Theatre Television Projection, spoke about the difficulties arising from the installation of such units.

Mr. Albert J. Friedman, JFD Chief Antenna Development Engineer, analyzed practical and theoretical television installation practices. He also spoke on impedance matching and phasing of complex arrays, and the use of various antennas with regard to specific locations. Following the three speeches, a question period ensued in which the serviceman present learned various solutions to their own specific installation problems.

Other television antenna forums will be held in various cities in the East in the near future. All servicemen are advised to keep in contact with their local distributors for further information as to the JFD Forums to be held in their locality.

"Ceramic Developments in the Electronic Field" was the subject of a talk given in New York recently by Dr. Bennett S. Ellefson, director of the Central Engineering Laboratories of Sylvania Electric Products, Inc. before members of the New York Section of the American Ceramic Society. He discussed some of the industry-wide developments contributing to the trend toward more compact radio and electronic devices operating at the higher frequencies.

Stating that new trends in electronic engineering call for improved materials and design in circuit components as well as vacuum tubes, Mr. Ellefson cited the development of synthetic mica, ceramic-metal seals for high temperature operation, new magnetic materials for tuning coils, the development of titanates as a dielectric material and the cataphoretic method of making tube heaters as outstanding contributions of science and industry.

The development of subminiature tubes, he continued, has made it necessary to revolutionize tube production by the design of far more precise parts and assembly. This includes tiny emitter wires which much maintain dimensional stability at relatively high temperatures. It has been accomplished by the application of the cataphoretic method which permits exact coatings on filamentary of the proper physical characteristics. Improved ceramic-metal seals, he said, offer a possible solution to the problems encountered in tubes where operating temperatures are high.

Over half the equipment needed for the Rural Radio Network has been shipped, General Electric has announced. The Rural Radio Network is a chain of six FM radio stations which will serve 118,000 farms in 40 counties in upper New York State.

Complete studio equipment and a transmitter for station WVFC at Ithaca, N. Y., central station in the six-station network, has been sent along with two transmitters for other sites. The network, which expects to be in operation early this summer, is also using two-way radio equipment to conduct FM tests and facilitate construction on the elevated transmitting sites in the radio link. When completed, the Rural Radio Network will program news and weather broadcasts, market reports, farm talks, nostalgic and religious music, and programs in keeping with the character of farm interests.

Plans call for operating the six stations as a network, with each station simultaneously receiving and transmitting particular programs. Any station in the chain may originate program material but all will broadcast the same programs during most of the program day. Stations will be located at Ithaca, DeRuyter, Cherry Valley, Turin, Bristol Center, and Wethersfield, N. Y.

A total of 162,181 television receivers were shipped to 21 states and the District of Columbia during 1947, the Radio Manufacturers Association revealed today in the first authoritative industry report on the distribution of TV sets. About half

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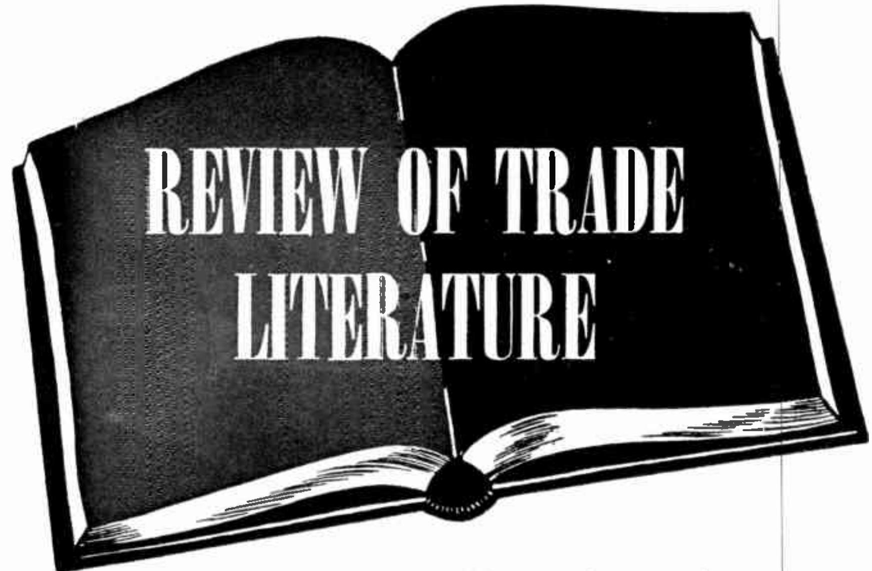

REVIEW OF TRADE LITERATURE

To avoid delay when writing to the manufacturer give issue and page number

A revised four-page catalog of the Camco "Featherlite" Television and FM Antennas is now available. It is attractively designed and illustrated, featuring the new line of 13 to 1 All Channel Television Antennas. It is completely descriptive and functional, making it easier to choose the correct antenna for a location and condition.

To secure a copy write to Camburn, Inc., 32-40 57th Street, Woodside, N. Y.

The McGraw-Hill Book Company has just published *Microwave Transmission Design Data.* This 248 page book was written by Theodore Moreno, Project Engineer of Sperry Gyroscope Company, and Research Associate of the Massachusetts Institute of Technology. It is a practical handbook of specific design data for the use of engineers engaged in the design of microwave equipment of all kinds. It discusses transmission line theory from the high frequency point of view, coaxial lines and transmission line structure, hollow pipe wave guides, properties of dielectrics at high frequency, cavity resonators, etc. Emphasis throughout is on the practical applications of this data in design and construction work.

This text sells for $4.00. ✔ ✔ ✔

It may be obtained from McGraw-Hill Book Company, Inc., 330 West 42nd St., New York City 18, New York.

Concord Radio Corporation has issued its 1948 catalog (No. 9-47). This 160 page catalog lists the available Concord items, such as radios, radio parts, amplifiers, test instruments, television, and related electronic equipment. A large section is tronic equipment. This catalog is divided into a number of sections, each section listing items of the same general category. A special yellow-page section lists special values on all sorts of items. A large section is devoted to condensers, resistors, volume controls, switches, transformers, and other types of small parts. Each item is described and priced, and most of them are shown in photographs or drawings. Information is included on the company and how it operates.

To obtain this catalog, write to the Concord Radio Corporation, at either 901 W. Jackson Blvd., Chicago 7, Ill., or 265 Peachtree Street, Atlanta 3, Ga., depending on your location.

American Radio Hardware Company has released its new catalog (Catalog 48). This nineteen-page booklet lists the company's available parts for radio, television, sound, high frequency, microwaves, and radar. There are descriptions, illustrations, and prices of such parts as plugs, sockets, wrenches, screwdrivers, prods, switches, fuse mounts, jacks, grid caps, binding posts, strips, and terminals.

This catalog is available from American Radio Hardware Company, Inc., 152 MacQuesten Parkway, Mt. Vernon, N. Y.

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Industry Presents

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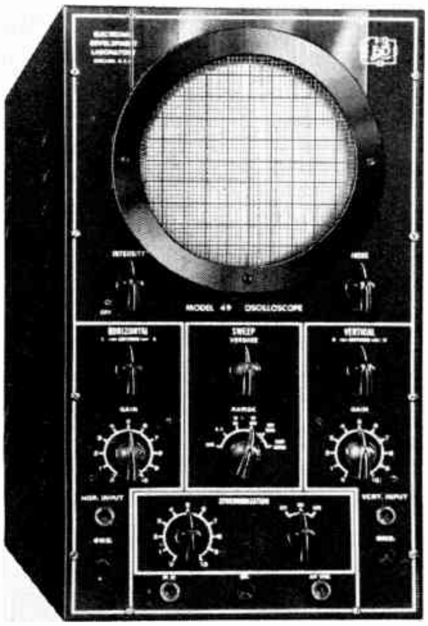
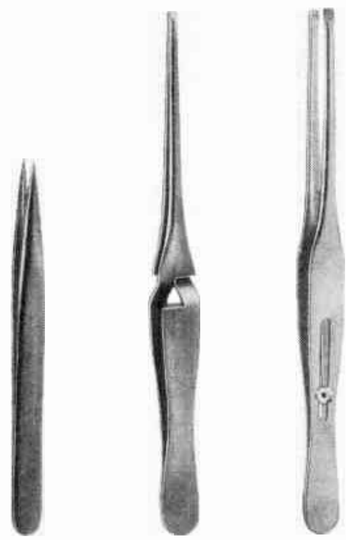


NEW OSCILLOSCOPE

Electronic Development Laboratory, 2655 W. 19th Street, Chicago, Illinois, has announced two new oscilloscopes. First is the new Model 75 wide range oscilloscope which permits direct observation of composite video signal. It embodies many recent developments. Vertical amplifier response is ± 2 DB from 10 cycles to 5 MC—permitting study of television signals and all waveforms with high harmonic contents. An extremely desirable feature of this versatile instrument is a self contained voltage calibrator with an accuracy of ±5%. Test probe has shielded cable to eliminate stray pickup. Electronic Development Laboratory's Model 49-A 5-inch Cathode Ray Oscilloscope has amplifiers compensated to give high frequency sine and square wave response, wide range linear sweep and is free from "hum" effects.

ULTRA-SHORT PULSE GENERATOR

In announcing its new ultra-short pulse generator, the Mega-Pulser, Kay Electric Company believes it to be the first commercially available instrument of its kind. It provides a pulse with a spectrum which more than covers the present video frequency range. Its features are: Pulse width, 0.025, 0.05, 0.1, and 0.25 micro seconds Pulse Amplitude 100 volts at 50 ohm impedance, pulse shape, flat top pulses 0.05 microseconds and greater, pulse rise and pulse fall time less than 0.01 microseconds. It also triggers from an internally or externally provided pulse. Provides positive or negative pulse. Output pulse is delayed approximately 0.25 microseconds to allow observation on an oscilloscope. It can be used for such purposes as: Testing Video Amplifiers, cable testing by echo observation, testing Radar systems and components, transient response study of electrical networks, testing television systems and components, a pulse modulating source for high frequencies, and as university laboratory equipment for student instruction in pulse techniques. Operates on 117 volt 60 cycles. Has self-contained power supply. Weighs 25 pounds. For further information write to the company, at Pine Brook, N. J.



TWEEZERS

The Walter L. Schott Co. of Beverly Hills, California, has added a new line of service tweezers to their regular line of tools and service aids for the radio technician that will substantialy reduce time lost on these difficult repair jobs. These tweezers are made of fine spring steel, are polished nickel plated, and have numerous uses in the shop and laboratory, such as holding wires and small parts together when soldering, clamping cemented items, installing dial cord and record changer springs, looping and untying knots in dial cord, etc.

INVERTERS

American Television & Radio Co., 300 East

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With this issue *The Notebook* combines with *Case Histories* to form one department. This department will consist of readers' ideas and suggestions for kinks and gadgets which have proved helpful to them, plus case histories of some of the tough ones we have all come across. Tell us about the problems you have encountered with certain sets and how you have solved them. With the case histories give us a clear and brief an explanation as possible stating the symptoms, the cause, and the remedy; give the make, model number, and if possible, the year. Of particular interest are those receivers manufactured from 1937 to the present. Keep your suggestions for useful gadgets and twists both simple and practical. Radio Maintenance will pay $2.00 for each item published in this department.

CHINA-MARKING PENCIL

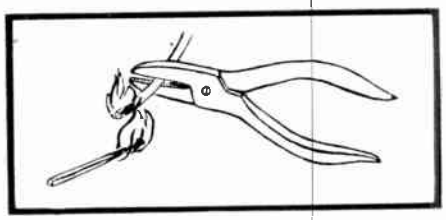
A useful item to always have on hand near the service bench is a china-marking pencil. Often a radio comes into the shop for repairs, and the service technician finds that the chassis and tubes are not properly marked. These markings wear off in time and, while gummed labels can be used to remark them, they have a habit of coming off too easily. A china-marking pencil is excellent for marking tube types on the sockets and tubes. It is also useful for writing installation notes, or other data, directly on the tubes.

Albert Loisch
Darby, Pennsylvania.

COMMON GROUND

When a number of leads are to be grounded, a neat job can be made by using a common post consisting of soldering lugs mounted in staggered positions on a long bolt grounded to chassis. The wires are then easily removable one at a time if necessary. If an insulated post is desired, the bolt may be mounted in a piece of fibre which is attached on the chassis.

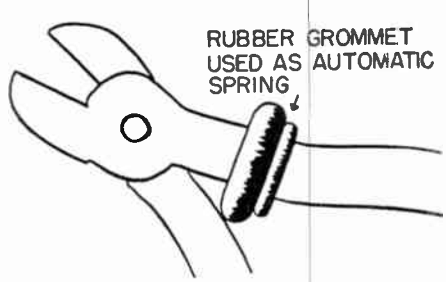
Marion L. Rhodes,
Knightstown, Indiana.



REMOVING STUBBORN INSULATION

Whenever I run into some tough insulation that is hard to remove quickly, I simply set it on fire with a match or cigarette lighter, and let it burn off. The insulation is pinched with a pair of pliers, as shown, and the flame burns to the pliers and goes out. The burnt insulation is then removed and the bare wire scraped clean with a knife.

Arthur Trauffer,
Council Bluffs, Iowa.



DIAGONAL CUTTING PLIERS

In using the diagonal cutting pliers, I found that by placing a large size rubber grommet on one of the pliers arms the grommet will act as an automatic spring and the jaws will open and remain thus after a cut has been open and ready for use.

James W. Graham
Jamaica, L. I., N. Y.

A.C.-D.C. TUBE BURNOUTS

For the serviceman who guarantees his work, here is a practice that will increase customer satisfaction and save money in the long run. Whenever an a.c.-d.c. set using a 35Z5GT rectifier comes into the shop, replace the 47 dial light regardless of its condition; a few cents expense may prevent the embarrassment of a dual burnout.

When replacing a burned out tube in an a.c.-d.c. set, check all filament voltages; a low resistance filament may cause future burnouts.

Sterling's Radio &
Television Service
Sterling K. Berberian
(No address)

IRON HEAT CONTROL

The following method keeps your soldering iron temperature from running too high. Connect a 100-watt bulb in series with the power line for your iron. The SPST switch is connected across the bulb. When the iron is not being used much, you can open the switch and let it idle. When more heat is required, close the switch and thus apply full power. You will find that reduction in oxidation and tip corrosion is well worth the trouble.

Clay Seidel
Neighborhood Radio Service
Camden, N. J.

MOPAR AUTO RADIO MODEL 802 (1946)

Dead on Broadcast

This set played good on all push-buttons, but dead on broadcast. The trouble was found to be the padder condenser marked dial, which was shorted. This padder condenser is located on the bottom of the front part of the chassis. The trouble can be taken care of by removing and replacing condenser, or by putting new mica between plates.

Vern Preston,
Long Beach, Calif.

GENERAL ELECTRIC MODEL HJ 1205

Poor Reception

Reception is poor because IF's are out of line but cannot be aligned to proper frequency. The IF's in this set are permability tuned and the terminal connections at the base have fixed trimmers made of mica, silver plated. The trouble lies in the silver falling off the mica. Use a sharp knife to cut these out. Put good mica or ceramic condensers of 175 or 200 mmfd. across the terminals in their place. Realign. Be sure to completely remove the old trimmers, as they still have some capacity and will continue to charge if left in.

Frank Markovich,
Marks Radio Service.

EMERSON MODEL 522

Severe Hum

Severe hum was present in this model when the volume control was set for minimum volume. The tubes were checked first, and found to be in good condition. Filter condenser could not cause the trouble, because the hum would then be loudest at the *maximum* setting of the volume control. By tapping all connections and parts in the set, a high resistance joint was located at the cathode pin of the 12AT6 socket. A small heater-to-cathode leakage will develop a voltage across such a faulty connection, thus varying the grid-bias on the tube. Resoldering the faulty connection cured this trouble.

Albert Loisch,
Darby, Pennsylvania.

PHILCO 37-11

Distorted Phono Pick-up Signal

A phono pick-up was connected to this receiver in the customary manner, but the signal that came through was very distorted when the volume was cut down to a satisfactory level. There seemed to be a stronger signal feeding into the receiver than the volume control could adequately handle. A 3.5 meg. resistor connected between the phono input to the receiver and the volume control took care of the difficulty very well.

H. M. Spurling,
St. Louis, Mo.

OVER THE BENCH

by John T. Frye

THE letters I receive convince me that, next to the question of how much to charge, the two most bothersome problems for beginning servicemen are "credit" and "guarantees." Both of these are almost certain to rear their ugly heads in the first week or so of shop operation; so let us take a good long look at them.

If you care to take my advice on the subject of credit, I can dispose of that hobgoblin very quickly and very bluntly: Just don't give any!

There are some customers who will try to make you feel that you are a mean, suspicious, miserly hard-hearted John because you refuse them credit; but just remember this: a radio is a luxury item. No one is going hungry or naked or cold because you insist on cash on the barrel-head. Remember, too, that most of your bills will be for amounts too small to warrant court action for their collection. If the customer does not want to pay you, he does not have to do so. He can feel fairly certain that you are not going to file a mechanic's lien for a three or four-dollar bill.

The extending of credit is quite similar to the drug habit: once started, it is hard, if not impossible, to stop. What is worse, it spreads like dandelions. If you let Friend Bill have his radio on time, can you deny the same privilege to Acquaintance Jim?

Yes, if you start giving credit, you have to keep it up, and you will be surprised how much this will complicate your bookkeeping. Ironically, it will also complicate the amount of "kick-backs" you get. For some strange reason, a radio that is not paid for when it is serviced seldom works as satisfactorily as one whose service bill is paid. When you delicately hint to a customer that it has been several months since he took his radio out of your shop, promising, "I'll see you Saturday," you are very likely to be met with:

"Oh that thing didn't work two days. I took it to Blank's shop, and he said that condenser you put in was no good."

Where does that leave you? Tha-a-a-a-ts right: holding the bag!

Any banker will tell you that the extension of credit is one of the chief causes of failure of small businesses. He will also tell you that you will lose very little worthwhile business by insisting on cash. Make up your mind to operate on a cash basis, *without a single exception*, and stick to it. Display this business rule where all may read, and if any case-hardened customer still asks for credit, explain:

You have no provision in your bookkeeping system for the handling of credit. You do all of your buying on a cash basis; consequently you have to receive cash for your work. You have given a solemn promise to your "backer"—that may be yourself or your wife—that you will not make a single, solitary exception to your rule of "Cash Only." If he still insists, pretend to have a fit or do something else to change the subject.

The giving of a guarantee is not quite so simply handled. The customer has a right to expect you to stand behind your work. At the same time, you should not be expected to make good the failure of a component that you did not place in the set. Right there is the nub of the whole matter of guarantee: you must make crystal-clear to the customer, at the time you do this work, that you are willing to guarantee your work but not that of the manufacturer.

Point out to him that the average radio has some 2,000 parts in it. Give him an itemized bill showing exactly what parts you replaced. Tell him that if one of these parts—let us say they are three—fails in a specified length of time, you will cheerfully replace it without any charge whatsoever; *but* — and this should be emphasized—if any of the other 1,997 parts suffers a failure, that is a horse of another hue. This is a hard thing to handle, for the customer seldom has a chance to see the parts that go bad. He more or less has to take your word for it that it was or was not the parts you put in that failed. Marking parts that you install with a certain color of paint is not a bad idea, both for your sake and that of the customer.

The length of time for which you guarantee your work is another knotty problem. The time should not be too long, or you will find yourself keeping very busy and taking in no money.

At the same time, your guarantee must compare favorably with that of your competitors, or it is going to seem that you do not have much faith in your own work. Personally, I install parts on a full year-guarantee. To do this, I put in nothing but 600 volt or higher by-pass condensers and only transformers, coils, filter condensers, etc., that well-known manufacturers guarantee *to me*. Tubes are guaranteed against failure of any kind, including burn-outs, for six months. Were it not for the a-c — d-c receivers, I would be perfectly willing to guarantee tubes for a full year, too; but this is not good business with these little fellows.

I have had to make good on some of those guarantees, too; but I have found that I can actually *be* cheerful about this. (I always try to *seem* so.) Invariably the customer feels so good about getting something for nothing, and he feels so sorry for you for having to lose money on his radio, that he gives you several dollars' worth of free advertising!

In conclusion, then, I say: do good work; use good parts; stand squarely and honestly behind what you do; take care of your guarantees promptly and cheerfully; and never, never, never forget the wise words:

"Ah, take the Cash, and let the Credit go . . ."

Industry Presents

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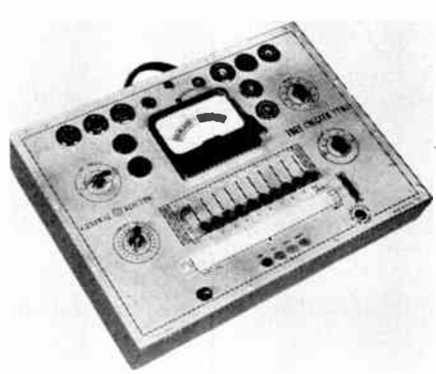
Fourth St., St. Paul 1, Minnesota, announces a complete new line of DC-AC Inverters, operating on DC input voltages ranging from 6 volts DC to 220 volts DC, delivering an output of 110 volts, 60 cycles, AC at output capacities ranging from 75 watts to 500 watts. These inverters are specially designed for operating AC radios, public address systems, television sets, amplifiers, small AC motors, and electrical appliances from DC voltage sources. Featured in the line is an automatic switching unit for use as an auxiliary unit with 32 volt and 110 volt DC input inverters, permitting the automatic start and stop of these units as the load is turned on and off. The ATR Inverter Line includes more than 33 different standard types. Complete descriptive literature is available, free of charge, by writing the factory.

TELEVISION BOOSTER

Jerrold Electronics' new booster boosts the entire band width of all thirteen television channels. Through the use of a newly invented tuned-grid tuned-plate circuit, there is a minimum boost of 25 d.b. over the entire 6 megacycle band width. Highs of fifty d.b. and over have been measured on some channels. The new booster greatly extends television reception in the fringe areas, for the high amplification of incoming TV signals promises steady reception in areas where television presently cannot be seen. The new booster works with any television set, home built, custom or popular make. It works with any television antenna. The booster is manufactured by Jerrold Electronics, Inc. of 121 N. Broad Street, Philadelphia, Penna.



TUBE CHECKER

A new tube checker, Type YTW-1, featuring rapid, easy-to-read checking of receiving tubes, has been announced by the Specialty Division of the General Electric Company's Electronics Department. A large degree of flexibility is attained in the new device with

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Home Calls—Do They Pay?

→ From page 11

ing and you are immediately greeted with a story like this: "I paid $300 for this radio just six weeks ago and now it has gone bad already. Why, for *that* price it should last longer than that! What's the matter, aren't these sets any good?" Your first impulse is to say, "I'll fix it, Mrs. Brown." Then pick up the set and hustle it off to the shop where you can work without her standing over you. This might be your first impulse, but, if you are to satisfy customers instead of just fix radios, you would never accomplish your purpose that way.

Here is the way I handled that very case: I had some preliminary information before I ever went out. I knew the make and model of the radio. I knew the set was dead—both radio and phonograph. This narrowed it down to audio or power supply. I also knew Mrs. Brown was worried because she had called four times, so I determined to fix the set right there if possible. It would probably be a tube, so I took the audio tubes and rectifier. Now I was prepared to meet Mrs. Brown and the battery of questions which I knew she had ready. After she had run down and stopped for breath, I told her, "I'm sure it's something very simple. This may have happened to any set, even one that cost $600. That is the reason radios are guaranteed—so that you will be protected against minor defects that may show up." I had her remove all of the vases, pictures, etc., from the top, then I pulled the set away from the wall and started to work on it. She continued to ask questions and I answered them while I replaced the tubes one by one. It wasn't a tube, and I would ordinarily have pulled the chassis and speaker and taken them to the shop, but she was still worried, so I was determined to try to locate the trouble there. I pulled the chassis and went to work right on her living room flor. A voltage check revealed no screen voltage on the first audio tube, but normal voltage on the supply side of the screen resistor. I disconnected the shorted bypass condenser and explained to her that this one little part had failed and would have to be replaced. At last she was releived. We had found the trouble and her $300 radio wasn't a "lemon." The fault was just a 30 cent condenser. I didn't have one in my tool box, but she had no objection to letting me take the chassis to the shop to put a new one in. I was back in a few minutes and she was happy that her radio was playing just like the one she bought 6 weeks ago. She knew what had happened and didn't have to wory about it any more.

It took about ½ hour longer to make Mrs. Brown a satisfied customer, than it would have done to just fix her radio. Was it worth it? Time and time again customers who have had trouble and thought they had made a mistake in buying, have been resold by a service call. And they have sold their friends and relatives on their type of radio and our store. A radio customer is a potential customer for major appliances, phonograph records or any other items you may sell including future service. The way you handle the customer in the hour of distress when service is needed, speaks louder than anything else when it comes to keeping or losing that customer's future business.

In Mrs. Brown's case there was a definite defect in the radio. In many cases there is nothing wrong with the radio—nothing that you can fix without rebuilding the whole thing, including the cabinet. When a person putters along for years with an old "klunker," he gets used to the interference, the noises, and no reception at all on distant stations. When he buys a new radio, he expects perfection. A.M. is expected to be as clear and noise-free as the advertisements say F.M. is F.M. is expected to pick up distant stations. The A.M. set is more sensitive that the set traded in, consequently, it can get more stations, but those stations don't come in like locals. Why don't they? Didn't the customer pay $400 for this radio? In some cases there is even interference on stations only 30 miles away—there was before, but it is now noticed, and you are supposed to correct it. In cases like this, it is hard to keep the customer happy. You have to let him down easy—let the air out of the dream bubble without breaking it.

Do Home Service Calls Pay? It all depends on how you look at it, and how you handle them. If you try to do major repairs in the home, you will lose both money and customers good-will, because you can't do a thorough and efficient job in the home. But, if customer satisfaction and repeat business mean anything to you, home service calls will pay big dividends even if you take the set back to the shop with you, or just explain its limitations without doing anything at all to the radio itself.

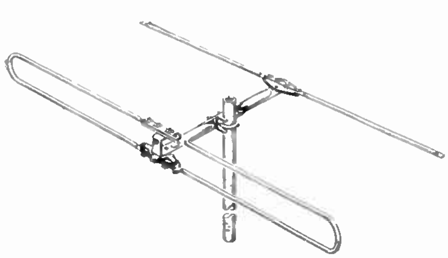
Industry Presents

→ From page 35

each tube element having its own individual circuit switch. It tests 4, 5, 6, 7, and 8 pin standard, 5 pin small, 7 and 9 pin miniature, and lockin tubes, as well as pilot bulbs and batteries. The new checker tests for filament continuity, heater cathode, open elements, shorted elements, and quality of emission. In order to speed up the test of a tube, the circuit of the YTW-1 is designed to immediately expose a tube with an open filament without the usual warm-up period. The device is portable, weighing 15 pounds and operating from standard a-c power source. Further information on the new tube checker is available from the G-E Specialty Division at Electronics Park, Syracuse, New York.

WIRE RECORDER

Fidelity which surpasses that of acetate disc recording, and a built-in radio and phonograph are among the exclusive features of the Wiremaster, a new wire recorder produced by Precision Audio Products, Inc., 1133 Broadway, New York 10, N. Y. The Wiremaster has 13 tubes, and records and reproduces a frequency response of 40-10,000 cycles, twice the usual response of wire recorders. It plays through a Jensen High Fidelity 8" PM speaker, housed in a separate cabinet to avoid vibration and acoustical feedback. All controls are located on the front panel, and plainly marked for simple, fool proof operation. A Speaker Monitoring control on the Wiremaster enables the user to adjust the listening volume to his own liking when recording, without effecting the recording volume, which is accomplished with separate bass and treble controls for boost and attenuation. The unit has two microphone channels.



QUIK-RIG TV ANTENNAS

The JFD Manufacturing Co., Inc., 4117 Fort Hamilton Parkway, Brooklyn 19, New York, has placed in production their new *Quik-Rig* television antenna line. As simple to open as an umbrella, the *Quik-Rig* antenna can be made ready for immediate operation in less than 30 seconds. This ease and simplicity of assembly reduces installation time and costs to the barest minimum. In the disassembled state, the JFD *Quik-Rig* antenna forms one complete, compact unit free of all loose elements and hardware. The dipoles and reflectors, which are neatly folded up against the side of the crossarm, are simply swung out into position and tightened by means of attached wing nuts.

An outstanding feature of this versatile antenna is a specially engineered mast arrangement which permits rapid on-the-job enlarging and stacking of arrays to suit local conditions. Conversion to a wide variety of such multi-stacked arrays is made possible by means of eight JFD conversion kits. Another salient feature is a heavy-duty U-Bolt Clamp for use in attaching securely the *Quik-Rig* antennas to any size masts up to $1\frac{1}{2}$" o.d. This clamp also provides $\frac{1}{8}$, $\frac{1}{4}$, or $\frac{1}{2}$ wavelength spacing of any number of bays on the array and allows each bay to be independently oriented. A bulletin describing and illustrating the Super-Beam *Quik-Rig* line is available upon request from the manufacturer.

TUBE GUARD

Two-way support is offered by the Mini-Spring Tube Guard, produced by the Staver Manufacturing Company, 254 Atlantic Ave., Brooklyn 2, N. Y. It consists of a hard steel, cadmium plated post and an alloy coated, hard drawn steel wire spring. Designed to provide top efficiency of tubes regardless of the way they are mounted, Mini-Spring exerts a steady, axial pressure toward the chassis and at the same time prevents lateral motion by keeping the tube perpendicular to the chassis. This assures solid contact of all prongs and prevents tube breakage, whether the tubes are mounted vertically, horizontally or on an inclined chassis. One of the outstanding features of the Staver Mini-Spring Tube Guard is the ease of mounting. It is fastened by one of the socket rivets or eyelets, which holds it rigidly in place. No extra piercing of the chassis is required.

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Ohm's Law

→ From page 13

A value of 1.37 would be found on a slide rule and twice that would be approximately 2.6.

If the correct tube were obtained later on, it would be a simple matter to remove R4 and R3. If the shoe is on the other foot and we should want to replace the 35L6 with a 25L6, the circuit of Fig. 3 could be used. The advantage of using individual resistors across each filament except the 25L6 is in the reduction of power handled by each unit, making smaller size resistors practical. The value of R1 is 12 volts divided by .15 amp., or 80 ohms. A 5 watt rating could be used. R2 in Fig. 3 would be the same as R1.

Alternate method

An alternative method of doing the job is shown in Fig. 4. In Fig. 3, the value of R3 would be 35 divided by .15, or 233 ohms. The value of R4 would be obtained by adding up the voltage drops and making the necessary calculation as previously described. It would be about 103 ohms.

In Fig. 4 a 35Z5 rather than a 35Z4 is shown for the sake of variety and also because this type circuit is quite common in servicing. R2 and R3 are 80 ohm, 5 watt units on the basis of previous calculations. The drop across the 35Z5 is normally 35 volts in the filament circuit and this value added to the voltage drops across R2 and R3 which are 12 volts each, gives the total drop in the circuit.

$$12 + 12 + 35 = 59 \text{ volts}$$

The drop across R1 must be,

$$115 - 59 = 56 \text{ volts}$$

As the current in R1 is .15 amp., 56 divided by .15 gives 373 ohms. The power is 56 x .15 or 8.4 watts, and a 20 watt resistor could be used. The drop across R4 is,

$$115 - (12 + 12 + 25) = 66 \text{ volts}$$

and as the current in R4 is .3 amp., the resistance is 66 divided by .3, or 330 ohms. The power is 66 x .3, or 19.8. A 40 watt resistor could be used.

Figuring a bias resistor

Ohm's Law may be used, of course, in figuring a bias resistor. Suppose, for example, that the tube is a 25L6 as shown in Fig. 5. In the RCA Tube Manual, the plate current with no input signal is 49 ma. and the screen current is 4 ma.; therefore the cathode current is 49 plus 4 or 53 ma., equal to .053 ampere. Then,

$$R_K = \frac{E_K}{I_K} = \frac{7.5}{.053} = 141 \text{ ohms}$$

where R_K = cathode resistor value in ohms

E_K = drop across R_K in volts (bias)

I_K = cathode current in amperes

The value is not critical and a 150 ohm resistor rated at 1 to 2 watts may be used, but a conservative rating is best and a 3 or 5 watt type should be used.

In Fig 6, a push-pull stage is shown. The tubes may be operated with about 315 volts on the plates and 285 volts on the screens. In the tube manual, the signal plate currents are .062 amp., and screen .012, making I_K equal to .062 plus .012, or .074 amp. For a bias of 24 volts,

$$R_K = \frac{E_K}{I_K} = \frac{24}{.074} = 324 \text{ ohms}$$

A 5 to 10 watt resistor could be used.

The screen current is .012 amp. Assuming a bleeder current through R5 of 2 ma. and 2 ma. of leakage in C4, the total is

$$I_{R6} = I_{C4} + I_{R5} + I_S$$
$$= .002 + .002 + .012 = 0.16 \text{ amp.}$$

The value of R_6 is,

$$R_6 = \frac{E_{R6}}{I_{R6}} = \frac{315 - 285}{.016} = 1875 \text{ ohms}$$

The value of R5 is,

$$R_5 = \frac{285}{.002} = 142{,}500$$

Actually, in some receivers, the value of R5 would be much lower since this value might represent the other tubes in the set with reference to plate and screen demand of current for those tubes.

To take another example, suppose we have a receiver or amplifier with a loudspeaker that is equipped with a 1000 ohm field. Checking the voltage across the field under working conditions, 100 volts is measured. If a p-m loudspeaker is to be used as a replacement, what equivalent combination of resistance and inductance can be used? As the voltage and resistance are known

$$I_F = \frac{E_F}{R_F} = \frac{100}{1000} = .1 \text{ ampere}$$

where I_F = field current

E_F = field voltage

R_F = field resistance

Using a 300 ohm choke rated at 150 ma. and 20 henries, in series with a resistor rated at 700 ohms will bring up the total resistance to 1000 ohms to equal the original field circuit resistance. The voltage drop across the choke is,

$$E_L = I_L \; R = .1 \times 300 = 30 \text{ volts}$$

The rating in d.c. is .15 amp., so the choke can carry the .1 amp. current safely without overheating or saturating. The 700 ohm resistor dissipates a power of 70 x .1 or 7 watts and a rating of 20 watts could be used.

Many other useful applications of the simple but effective Ohm's Law will arise often in your work. A little thought given to it will be well worth the effort.

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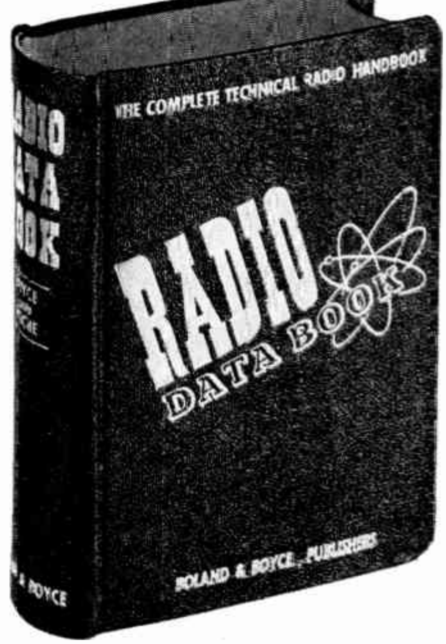

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This section presents complete information on all antennas, transmitting and receiving. Completely illustrated, showing various types of antennas, their construction and wave patterns. The twenty or so different types of television antennas now on the market are illustrated and discussed. Loading, impedence, polarization, directivity, etc., are explained and diagrammatically illustrated. The entire function of antennas is explained in detail—from the theory of wave propagation, radiation and reception—through the design of various types of antennas and their selection and installation for various requirements—to the tuning and feeding of antennas. All this information is presented in non-mathematical style for all to understand and for quick reference.

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The planning, selection of equipment and the assembling and combining of various components in complete PA installations. Every type of unit used is described and analyzed in detail. There tables and charts giving proper power output needed for any given area—rooms, halls, ball parks, etc. There are charts on power outputs of the various units used, and patterns of microphones and speakers. Complete installations are illustrated and described. Complete instructions for wiring and placements of components and controls. And in addition, the proper maintenance of P.A. systems is thoroughly explained.

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Here is a unique and valuable list of books for anyone desiring further details on any subject in Radio. Here books of the highest rating are listed and a description of their contents is included. You can instantly determine which is the book you want.

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F.M. Antennas

→ From page 19

that it can't intercept much of the radio wave.

3. *Limiting and Distortion Effects.* A good F.M. receiver can provide excellent reception with fairly weak signals. On any receiver, however, very weak signals below a certain "threshold" level sound distorted because of improper limiter and detector action. A.M. receivers under equivalent conditions are very noisy, but distortion is not present. Thus an A.M. receiver's output is undistorted (except for noise) on very weak signals, whereas an F.M. receiver doesn't give any idea of its quality potentialities at all. With antennas on both, the F.M. performance is superior.

Part of the Receiver

It becomes apparent that, although the antenna of an A.M. receiver is something more or less external and separate, the F.M. antenna is essential to the F.M. receiver. *The F.M. antenna must be considered as a component of the receiver itself.* Its selection and installation should be given the same care and attention as the replacement of an IF coil, a power transformer or a bypass condenser.

Some F.M. receivers come equipped with "built in" antennas. These are designed to give the best possible reception in areas of high signal intensity near the transmitting station. There is seldom a case, however, in which a marked improvement is not realized by the addition of an outside antenna. This problem will be discussed further in the next article.

Essential Points

In this article we have reached the following conclusions:

1. Basically, longer antennas intercept more wave front and therefore are more sensitive to a given signal.
2. A resonant antenna (quarter wave or a multiple) is a tremendously sensitive to a signal of the resonant frequency. The resonant effect is far greater than the lengthening effect described above.
3. Antennas are necessary in F.-M. reception because of the lower sensitivity of F.M. receivers and the relative size of a resonant antenna.

In our next F.M. article, we'll use these facts and some others in discussing the actual choice and installation of antennas and transmission lines. ✓ ✓ ✓

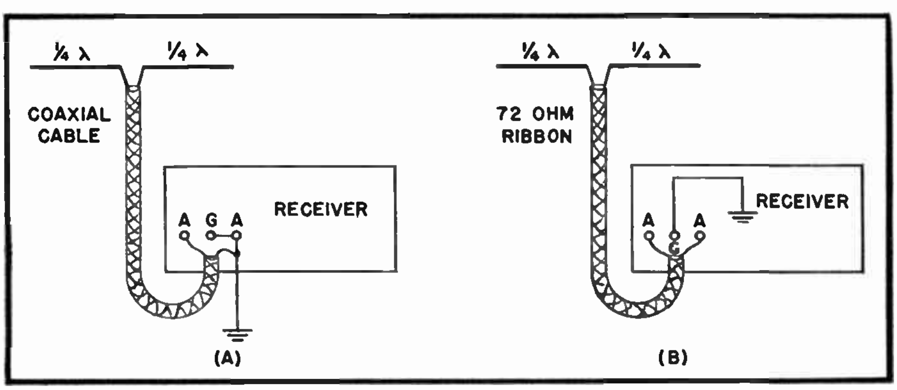


Fig. 5 Dipole can be fed with either a balanced or an unbalanced line, as shown above.

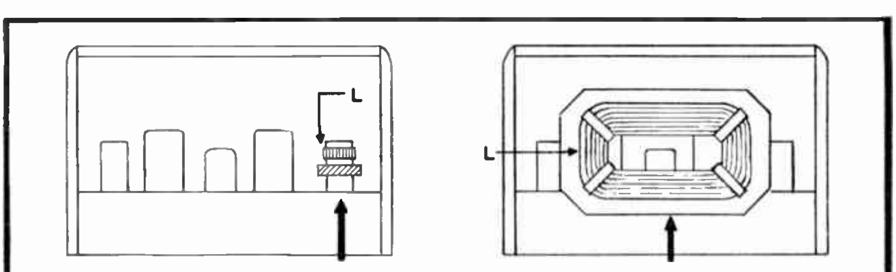


Fig. 6 Above are shown the "coil pickup" and "loop" types of antennas, which can be used with A.M. receivers, but not F.M.

Electronically Speaking

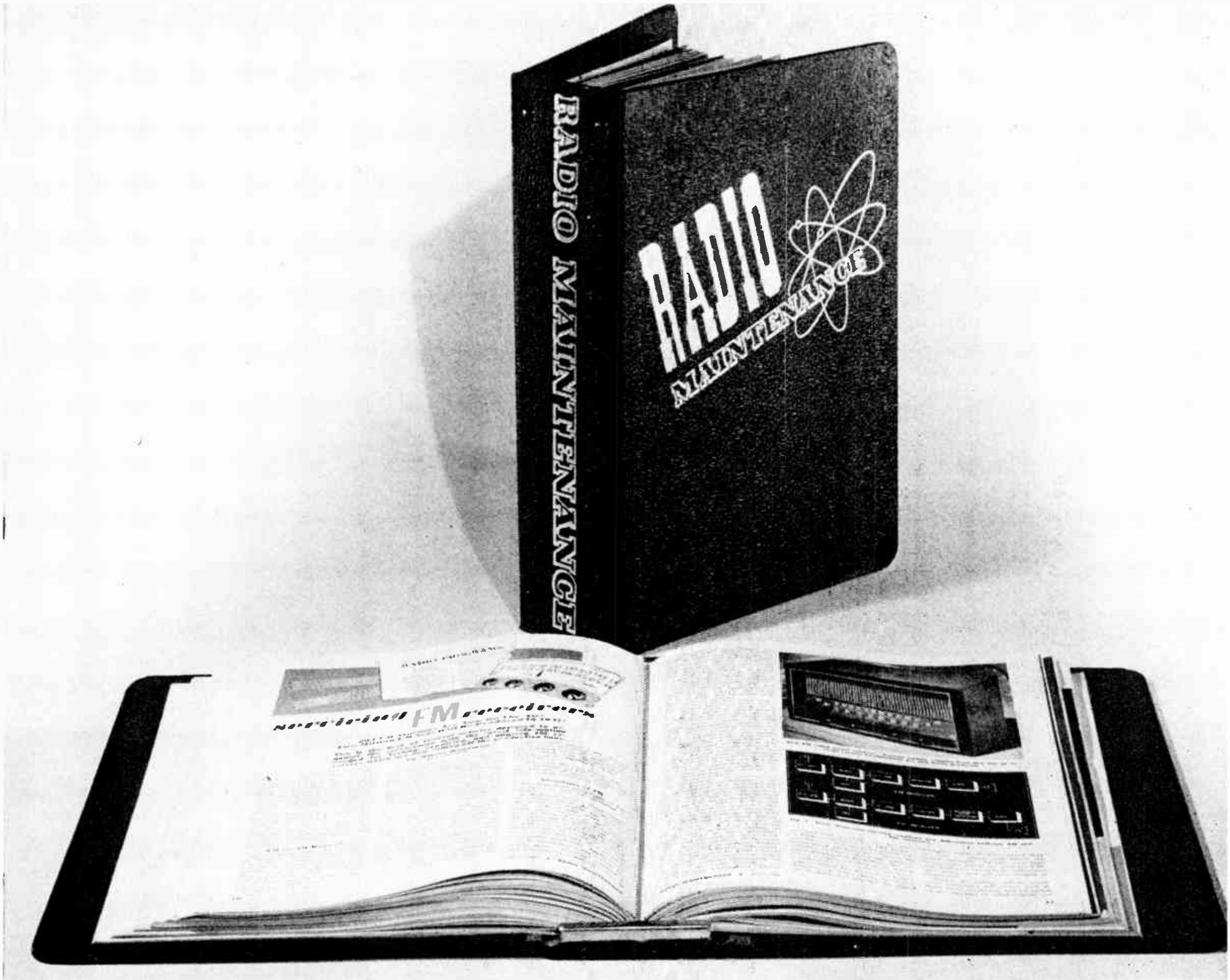
→ From page 29

of these TV sets were shipped to the NewYork-Newark area, including suburban communities. New York City received 56,645 and Newark 22,158 to rank first and second on the list of cities to which RMA manufacturers shipped sets. Philadelphia came third with 18,923 receivers, and Chicago was fourth with 13,723.

RMA intends to issue quarterly reports on television set distribution during 1948. During the first quarter of this year 118,027 TV sets were manufactured by RMA member-companies, bringing the total production since the war to more than 300,000 as of April 1. Only 6,476 TV sets were made in 1946.

The Presto Recording Corporation has completed the moving of factory, laboratories and general offices from New York City to their recently completed plant at Paramus, New Jersey. Mail must be addressed P.O. Box 500, Hackensack, N. J. An efficient system of moving assembly sections as units was developed to maintain maximum production of Presto equipment. Some equipment begun in New York received its final work and testing in the new plant at Paramus. The new plant, employing approximately 250 people, is adjacent to Presto's other factory that is used exclusively for the production of Presto Recording Discs.

A site for a new television receiver plant was announced today by Dr. Allen B. DuMont, President of Allen B. DuMont Laboratories, Inc. It is the south building of the former Wright Aeronautical Plant in East Paterson, N. J. Annexation of the new plant is expected to triple DuMont's present 3,000 receivers a month production by the end of 1948. The eventual goal is 20,000 receivers monthly. ✓ ✓ ✓



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Servicing RC Filters

→ From page 17

tains three low-pass filters that are basically alike. C_kR_k, C_sR_s and CR_g should each result in a cut-off frequency equal to the lowest audio frequency to be amplified. The equation

$$F = \frac{1.59}{RC}$$

is used. However, the selection of the resistors and condensers differs slightly. The voltage drop across R_k supplies the grid bias for the tube. Therefore, its value is chosen to give the necessary bias on the basis of the current flowing through it. For example, if the plate current is 5 ma. and the screen grid current is 1.5 ma., the total current through R_k is 6.5 ma. If the bias needed is 3 volts, $R_k = \frac{3}{.0065} = 461$ ohms. If the lowest frequency to be amplified is 100 cycles, C_k can be found from $C = \frac{1.59}{461 \times 100} = 34$ mf. Stock parts such as a 500 ohm resistor and a 40 mf. condenser could be used. If this were an RF amplifier, the frequency used in the calculations would be the lowest frequency to which the amplifier will be tuned.

R_s drops the supply voltage down to the value of screen voltage needed. This voltage drop occurs due to the screen grid current flowing through R_s. Once R_s has been determined from this information, C_s can be computed from the cutoff frequency formula .

R_g is selected from information given in the tube manuals. For most tubes, we are given a maximum value to use in the grid circuit. This limit is placed to prevent tube damage due to positive bias developed in the resistor by grid gas current. (An exception is in the case of high mu tubes whose control grids are close to the cathodes. With these tubes, as much as 15 megohms may be used to develop "contact bias." An action similar to that of a thermocouple takes place, causing current to flow from the grid to the cathode. The resultant voltage drop makes the grid negative with respect to the cathode. The bias developed is rarely more than 1 volt.) R_g is made as large as possible to get maximum voltage on the grid of the tube. Then C can be calculated from the cutoff frequency formula. However, the tube may block if too large a value of capacity is used. The capacitor should be between .01 and .05 mf.

Slightly low values of C_k or C_s will result in loss of low frequencies. Large losses in capacity will reduce the gain of the stage, permit hum and squeals to occur. Increasing these capacities will have no effect when their original values are correct. As for C, too low a capacity will affect the low frequency response. Too high, it will make the next tube block because electrons cannot leak off fast enough through R_g. Excessive leakage in C_k will reduce the bias voltage. In C_s, it will lower the screen voltage. In C, it will mean the application of a positive voltage to the grid of the next tube. This will give distortion and reduced volume. Incidentally, it should have a voltage rating of at least 400 volts because it requires a high leakage resistance. It is the condenser most likely to be the cause of intermittent receivers.

AVC circuit

In Fig. 3 we have an a.v.c. circuit. R_1 added to R_2 is the load resistor for the detector. Through them flows a pulsating current composed of (1) D.C. whose average value depends on the amplitudes of the signal, and (2) A.F. modulation.

C_1 carries the radio frequency currents. Again we are dealing with a low-pass filter. However, now the cut-off frequency is made much higher (approximately 10,000 to 20,000 cycles). Using a 100 mmf. condenser for C_1 will provide satisfactory operation.

R_3 and C_2 make up the a.v.c. filter. Their purpose is to prevent audio frequency variations from affecting the gain of the a.v.c. controlled stages. Yet they must permit changes due to fading signals. Obviously, this filter can change the frequency response of the receiver. The a.v.c. filter used in a short wave receiver cannot be good in a high fidelity receiver. Typical time constants are:

High fidelity receivers	.3 second.
Short wave receivers	.1 second.

R_3 provides decoupling and should not be less than 100,000 ohms. Its maximum value is limited by the tube manual ratings as described in connection with R_g of Fig. 2. In any case, it shouldn't be larger than 3 megohms. C_2 will be between .05 and .25 mf.

Theoretically, if C_1 opens considerable RF will be fed back through the a.v.c. system, reducing the output of the receiver. However, the wiring capacity may be sufficient to bypass the RF across R_1 and R_2. Any leakage in C_1 will produce distortion due to shunting effects. If C_2 is open or low in value, AF will get to the RF stages in the form of inverse feedback. This will result in either distortion or, in extreme cases, low volume. Leakage or a short in C_2 will stop the a.v.c. This will show up in the form of blasting from the speaker or lack of volume control.

Oscillator

Fig. 4 presents the oscillator portion of a superheterodyne receiver. C and R are not readily calculated in this circuit. R is found by experiment. It is adjusted to give the required oscillator output voltage. This is approximately 10 volts for most receivers. A value can be found that will give fairly uniform output over the entire band to be tuned. The size of the resistor varies considerably with the type of tubes used. In a.c. and a.c.-d.c. receivers, R is usually from 20,000 to 50,000 ohms. With battery operated portables, about 100,000 ohms is normal.

Actually this is not a filter in the true sense of the word. C is present only because some means must be provided for preventing the coil's low d.c. resistance from short-circuiting R. On the other hand, R, in turn may load down the tank circuit. Making C small will improve the Q. It should have a value between 50 and 100 mmf.

If C is open circuited, no R.F. gets to the grid of the oscillator. Oscillations will stop. A shorted C will also stop oscillations since it prevents the bias from building up.

Tone controls are RC filters but do not lend themselves readily to simplified analyses like the others. The values of the components depend on many things, among them:

1. Frequency response of the receiver.
2. Type of circuits used.
3. Expensiveness of tone control.
4. Size of cabinet.
5. Size and type of speaker.
6. Personal tastes.

Special networks

Other RC tone compensation systems not controlled by the user of the receiver involve inverse feedback and special networks. One example is illustrated in Fig. 5. Most frequency response curves (such as for a resistance coupled amplifier, the human ear, etc.) tend to droop at both the low and high frequency ends. Suppose then that the volume control of Fig. 5 were set at reduced volume which is at the grounded end of the control. Obviously all frequencies would have their amplitudes reduced. But the small receivers cannot reproduce the lows well. Also, our ears need greater amplitude for the low frequencies than for the highs, to give the same apparent volume. Therefore, at the low level setting of the control, the high frequencies will seem to disappear. The RC filter will reduce the high frequencies and make the low frequencies sound louder by comparison. R may be 100,000 ohms and C, .01 mfd. A change in the value of C will alter the tone of the receiver. This may not be noticed except by an expert listener. A shorted C will result in the tinny sound expected without such a filter.

Very few service notes have been provided here for troubles due to defective resistors. This is because they will in most cases change the distribution of the direct currents in the receiver. They are, therefore, readily detected. In any case, resistors can be easily tested with an ohmmeter while condenser checking is more difficult.

In FM receivers, we meet an RC filter that resembles the tone compensation circuits of the AM receivers. It is called a de-emphasis circuit. Insufficient modulation at high frequencies occurs at the transmitter, unless the highs are artificially boosted. At the receiver, we do not hear exactly what the studio microphone heard unless the emphasis on the high frequencies is removed. This is done by a low-pass filter such as Fig. 6.

The time constant for this circuit has been set by the Federal Communications Commission as 75 microseconds. A typical set of values would be .015 megohms for R and .005 microfarads for C. With such a filter, attenuation of 50% is obtained at approximately 18,000 cycles, the top end of the audio frequency band. The attentuation tapers off as the frequency is lowered. Wrong values for R and C would give poor frequency response. Again, this may not be objectionable to many people and unbearable to others. The serviceman should listen to an FM receiver with and without the de-emphasis circuit to determine its effect. He will then be able to recognize when C is open. A shorted condenser can be located by signal tracing methods since it would cut out the signal completely as would an open resistor. A shorted resistor would change the frequency response

Television RC filters are used with voltages that are not sine waves. This complicates any study of their operation so that these circuits cannot be included here.

Interference

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traps (for less than a dollar each) that tune from the 14 megacycle band, 7 mc., 1.7 mc., 3.5 mc.

10 Kilocycle Audio Filters. The FCC broadcast station allocations are 10 kilocycles apart, and sometimes a broad band, sensitive receiver has difficulty distinguishing between stations on the same frequency, or on nearby frequencies, and a whistle or squeal occurs. This squeal can easily be removed with one of these filters. Both Meissner and Millen make excellent quality 10 kilocycle Audio Filters. Take your choice. They are resonant filters used in the plate circuit of triode amplifiers or in the diode load circuit. The Meissner has two tuned circuits which provide maximum attenuation of the 10 kc audio note. It comes with complete instructions and diagrams and operates with any of the standard power output tubes. The current-carrying capacity is 75 mils. The coils are universally wound and the unit is shielded and accurately pre-tuned at the factory. The **Millen** unit consists of a high inductance iron core winding, shunted by a variable trimmer condenser operating at about 85 uuf. The attenuation to 10,000 cycles is approximately 30 db.

Don't forget that several wave-traps can be connected in series to eliminate several different sources of interference.

Noise Silencers

One common type of noise silencer or noise limiter will be described here. Although "silencer" is the word used, it really does not eliminate the noise altogether, but merely reduces it to a level which is no longer objectionable or noticeable. Most noise limiters can be attached to any radio (with 456 or 465 kc. I.F.) with little trouble.

Man-made static changes both in amplitude and frequency, and the amplitude is usually of much greater height than the signal. It is amplified right along with the signal and comes out of the speaker in loud bursts and crackles. Figure 2(a) shows how static superimposes itself on the audio modulation envelope.

A portion of the audio signal is changed for a fraction of a second. This static becomes *part* of the audio signal and is detected and amplified as such. So you can readily see that it is important to prevent this static from entering the receiver in the first place, if at all possible. Installing tone controls or condensers in the plate circuit of the output tubes may reduce the noise, but at the same time the higher audio frequencies suffer, and fidelity is lost.

Figure 2(b) shows the action of a noise limiter on the "pips" of noise. It reduces them to the same level as the signal, and at this point they are no longer objectionable. The circuit of the silencer will not be reproduced here as most servicemen do not have the time to do construction work, but prefer to sell the customer a known make and install it for him. A brief description of how it works follows.

In sets using a diode detector, the output of the detector is fed to a tube that is used for furnishing bias to the audio amplifier. As long as the signal is of average value, the silencer is inoperative. When a burst of static enters the set and is detected, the "silencer tube" draws a large plate current, due to the higher voltage of the static. This plate current causes the bias voltage of the audio amplifier to increase to a point beyond cutoff, and the tube stops amplifying temporarily.

The time interval of non-conductance by the amplifier tube is so short that it is hardly noticeable to the human ear.

The noise level may be adjusted to fit the requirements of the receiver being serviced, or the location of the set, or may be adjusted by the customer to suit his desires of the moment. There is a known adjustment for controlling this level.

In high-noise areas where it is not practical to attempt to eliminate all of the interference or the sources of the noise, the most practical and efficient method of satisfying the customer is selling and installing a noise silencer.

Meissner makes a unit that eliminates 90% of the noise in any set using 456 or 465 kilocycle intermediate frequency system.

It reduces static peaks and man-made static to an acceptable level. It permits good short-wave reception in high-noise districts. The unit operates on 110 volts AC or DC, has four tubes, one each—6K7, 6J7, 6L7, 6H6. The connections to any receiver are very simple and are explained in the diagram and instructions that come with the unit. The noise level control is located at one end of the chassis and it has a 110 volt outlet on the other end. The noise silencer adapter unit is available in kit form or wired at the factory. It just is not worthwhile for the busy serviceman to buy the kit, and spend time on construction and working out the "bugs," to save a couple of dollars. The adapter unit sells for $10.00, and the kit (if you must) is $7.75. It is worth every cent of this to the customer, as the results are very noticeable and he is certain to be satisfied.

Application & installation

A practical application of a noise limiter unit, for instance, would be in a doctor's office in a large office building. Here the problem is with the doctor's personal radio or the reception room radio.

Usually there is noise from a hundred different sources in a location such as this: office machines, medical machines, the heating system (if electrically controlled), air conditioning, elevators, and countless small motors and appliances throughout the building.

It should not be difficult to sell the doctor on a noise silencer. Your only work will be to install the unit, adjust it properly—and collect the bill. The offices of doctors, dentists, lawyers, and other professional men offer a lucrative market for the noise suppression specialist.

The portable equipment of the noise specialist enables him to analyze and diagnose interference on the spot, and that is where the work must be done. The interference that the customer complains about usually cannot be found in the serviceman's place of business.

Incidentally, it is an excellent policy to take the noise out of the service shop first. Picture the customer as he calls for his radio that has been repaired. The serviceman turns it on for him to show him that it works—and the customer is greeted with a conglomeration of noises and static almost as loud as the signal itself. Confidence in the serviceman's ability goes down a notch. Instead of apologetically telling the customer "It's noisy around here" or "We have a lot of interference in this location," he should get busy and remove it. He should install filters in his fluorescent lighting fixtures, analyze and correct the noise coming in the power lines, install a good, sturdy antenna with a shielded lead-in for the AM sets, and put in a good dipole with a coaxial cable lead-in for the FM sets.

Suppose a customer brings in a receiver for servicing, complaining of "static" or "noise." You put it on the bench, turn it on—and the "noise" is not present. Undoubtedly the interference is confined to the usual location of the receiver. This means a trip to the customer's home to analyze and correct the interference. But before you go, take a minute to check a few things in the set. Check the alignment, RF, IF, and oscillator circuits, not just by ear, but with a signal generator, for alignment at 465 or 456 or whatever frequency the manufacturer specifies. Do not assume that alignment is correct after checking by ear. They may be peaked at 480 or 445 or some other odd frequency by some amateur repairman or tinkerer. Intermediate frequency transformers are designed for maximum efficiency at a particular frequency and this efficiency and gain is reduced at any other setting. Detuned I.F. frequency stages also invite image whistles.

If the set has Automatic Frequency Control, check for proper adjustment. See that all tube shields are present and have good connection to ground.

When you arrive at the customer's home, check the antenna and lead-in, and if noise is coming in through this point, consider whether or not changing the length, type, or location, might help reduce it. Check the ground system, if there is one, and if there is not, explain to the customer the advantages of a good ground system. Observe the tuning habits of the customer. Does he (or she) tune in the station "on the button," or turn the volume up and then tune to the desired volume by tuning to either side of the station. Naturally this practice will decrease the signal-noise ratio. It is popular with some housewives whom the au-

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Industry presents

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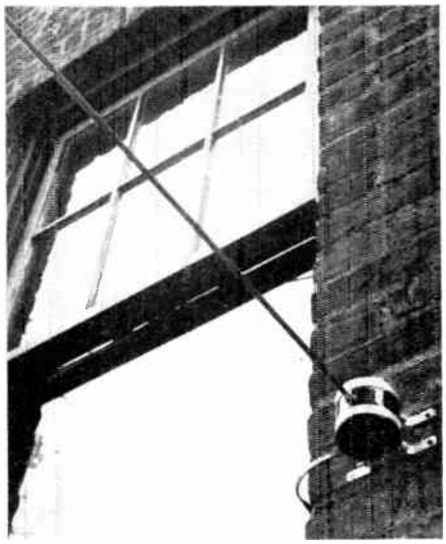


ROD ANTENNAS

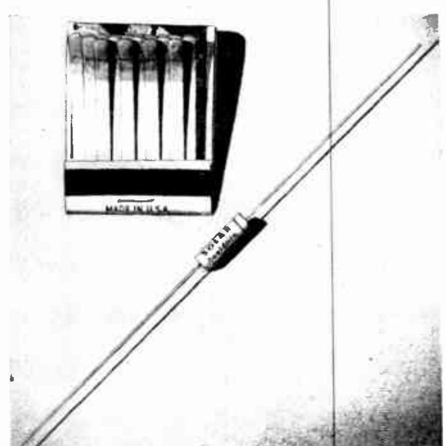
Vertrod Corporation, 11 Park Place, New York 7, N. Y., announces the development and production of a new series of window mounted rod type television, FM and AM antennas. The rod type of antenna for television is a departure from the regularly accepted theory of television and FM dipole antennas and is based on the patent applications assigned to Vertrod Corporation by Ira Kamen, leading television antenna authority. These antennas mount on the outside of a window of either an apartment house or private dwelling and project not more than 45 inches for television and FM reception. The rods are designed to make simple, low-cost and yet highly efficient window installations. The series consists of three models to cover the TV and FM, FM and AM, and TV, FM and AM bands. All units are circuited for 300 ohm balanced transmission line. An adaptor can be supplied to match the 300 ohm line to a 70 ohm input type of television receiver.

RECORD CHANGER

A new Garrard automatic record changer is available for moderately priced sets or custom installations. The new RC70 stresses simplicity of construction combined with the same standards found in the more expensive Garrard instruments. It plays 10-10" or 10-12" records and automatically switches off after the last record has been played. There is a separate platform for 10" and 12" records, controlled by a lever on the mounting plate. The turntable of the RC70 is weighted for fly-wheel action and driven by means of a drum on the inside. This results in high torque and at the same time reduces turntable rumble to a minimum. The center spindle, a new Garrard design, is removable. Single records can easily be played without the main spindle. The tone arm can be handled or stopped during any part of its cycle without loosening its adjustment. The motor will immediately regain speed without stalling.

COMBINATION RADIO & INTERCALL

Setchell Carlson, Inc., of 2233 University Ave., St. Paul 4, Minnesota, has introduced a combination radio and intercall system. Designed for home, office, factory, and warehouse, it is instantly ready for use as a radio or intercall. The Radio Dor-A-fone, Model 458 RD, as pictured above has three possible uses. First, it can be used as a regular radio. Second, it can be used as a radio with the reception from the extension unit. Third, it is a two-way intercall system. Quick-heating tubes permit instant use.



SMALLEST MOLDED PAPER CAPACITOR

Tubular molded paper capacitors, 3/16" in diameter x 5/8" long, are the latest development in miniaturization of electronic components. Identified as Type TST "Tiny Sealdtites", electronic components. Identified as Typt TST "Tiny Sealdtites", these new capacitors are now in mass production by Solar Manufacturing Corp., 1445 Hudson Blvd., North Bergen, N. J. Solar "Tiny Sealdtite" capacitors are molded in Hi-Temp plastic compound for satisfactory operation under the high operating temperatures found in miniaturized electronic equipment and personal radios. Unlike conventional thermo-setting molding materials, the Hi-Temp plastic compound housing will withstand extremes of humidity cycling. Complete details of Solar Type TST capacitors are given in a new catalog.

FM CONVERTER

The Howard "482" is built to convert any radio to receive FM stations on the 88 to 108 M.C. band. The addition of the Howard "482" to present radio equipment does not affect the present functions of radio or record changer in any way. THE HOWARD "482" CAN BE INSTALLED INSIDE THE RECORD COMPARTMENT ON CONSOLE COMINATIONS. A special mounting bracket is supplied as standard equipment, so Converter may be mounted on either left or right side of compartment. This arrangement may be preferable to having unit placed on top of cabinet. See photo illustrating this arrangement. The cabinet is designed to fit with most surroundings. Available in standard mahogany and blonde finish. Built of solid hardwoods, blonde model is built of select hard, blonde maple. It has SEVEN TUBES, INCLUDING RECTIFIER.

POCKET-SIZE TESTER

The Model 770 Pocket-size Volt-Ohm-Milliammeter uses a rugged 2% accurate, 1 Mil. meter. It measures A.C. and D.C. voltage, current and resistance on radios, electrical appliances, motors, etc. Its sensitivity is 1000 ohms per volt. Extremely compact, measuring only $3\frac{1}{8}$" x $5\frac{7}{8}$" x $2\frac{1}{4}$". Available complete with self-contained batteries, test leads and all operating instructions. Manufactured by Superior Instruments Co., 227 Fulton Street, New York 7, N. Y.

Interference

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thor has visited (and then they complain about the "static").

Diathermy machines and dental machinery are sources of a particularly annoying type of noise, and should be removed at the source whenever possible, as this will eliminate the noise from many receivers in the vicinity. The serviceman should use tact and diplomacy in approaching the owners of these offending machines. The problem should be explained to them as clearly as possible and it should be suggested that it is their responsibility to pay for the work done. In cases where the owner simply will not cooperate, the local office of the Federal Communications Commission should be notified about the nature of the interference, the location of the device, and why you have taken the trouble of notifying them.

If telephone dials cause noise in the radio, notify the telephone company. They are usually very cooperative about this.

Advertise yourself as a noise specialist. There are many who are waiting to see such an advertisement. You can increase the scope and amount of your business merely by having the know-how of correcting interference and the courage to go out after the business. ✓ ✓ ✓

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