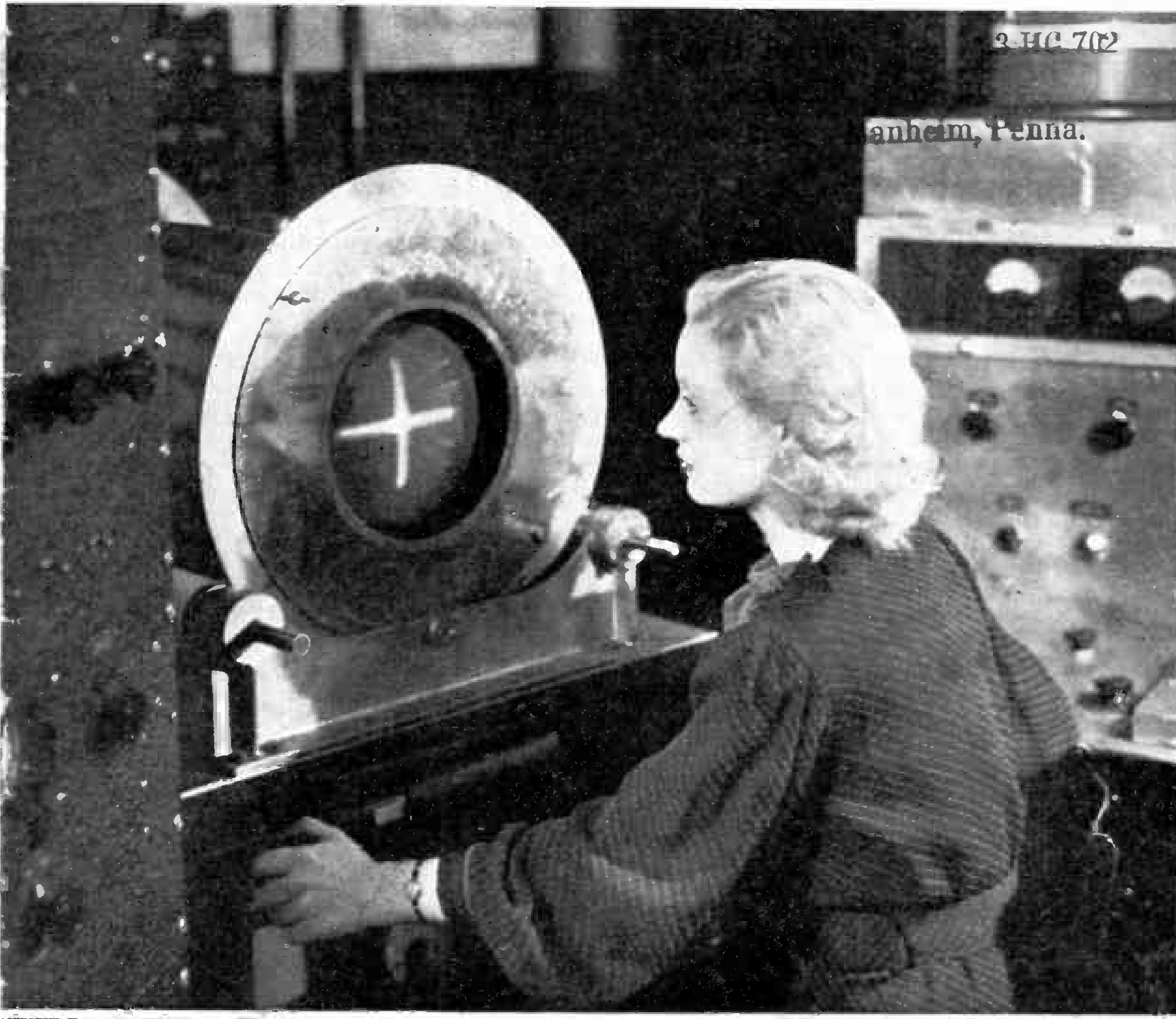
NATIONAL RADIO NEWS



IN THIS ISSUE

Sightseeing In A Cathode Ray Tube Factory
Equalizing A. F. Amplifiers
Alumni Association News

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Stick-- and You'll Win!

"How can *I* make a success?" is a question often asked the successful man. The simplest answer to that question is "finish whatever you start."

"But suppose I change my mind, discover I made a mistake, that the thing I started on isn't going to be what I thought it was at all?" is the usual come-back. Right there is where the most vital point of all is overlooked: that until success *is* attained the individual tasks confronting you are relatively unimportant in themselves; that the really important thing is their effect upon you, what you *learn* from them, the *practice in succeeding* that you acquire in accomplishing them. Most of the jobs given you or that you wish on yourself probably aren't worth a stack of hayseeds—but *you are.*

Sure, we can always find plenty of reasons for quitting, more reasons than for going ahead. But what do you accomplish, what do you learn, by quitting? Only how to quit; more about how to fail.

No truer words were ever spoken than "there is no such thing as failure; there is only the ceasing of effort." Obviously if success in any undertaking is dependent upon effort (and we all agree that it is) then the more effort we make, the greater our success. This does not mean that you can trace the success present in every effort but it is there just the same. It's a case of cause and effect; you cannot have one without the other, but if you have one you've *got* to have the other, whether you can find it or not. You don't attain success all at once, in one jump. You succeed by degrees and the degree of success is in exact proportion to the degree of effort expended.

"Nothing succeeds like success." Think about this age-old saying for a moment. What does it mean? Simply that each success paves the way for further success. How? Why? Only because the habit of succeeding has been unalterably fixed; because he who succeeds is determined to finish everything given him to do and will not quit until he does finish. He can't fail because failure is merely a "ceasing of effort" and he just won't quit trying until he's won.

The successful man is not a success primarily because of what he has *done* but because of what he *is.* And he is what he has made himself by pushing through to success whatever jobs were given him. It is not the jobs in themselves that made him; it's what he did with them.

E. R. HAAS,
Vice President and Director.

EQUALIZING A. F. AMPLIFIERS

By PAUL H. THOMSEN
N. R. I. Consultant

PAUL H. THOMSEN

EQUALIZATION of an audio frequency amplifier involves the introduction, into the amplifier circuits, of certain electrical components which change the frequency response of the amplifier. There are two distinct reasons for equalizing an amplifier: 1, to obtain a flat electrical frequency response; 2, to obtain a flat acoustical frequency response. Flat electrical frequency response means that the gain of the amplifier is the same for all frequencies in the range being handled. Flat acoustical frequency response means that all frequencies in the reproduced sounds have the same volume relation to each other as do the sound frequencies at the pick-up point; this is accomplished by making the amplifier itself compensate for deficiencies in the frequency response of the sound pick-up device and the reproducer, and also take into account the acoustical qualities of the location of the system.

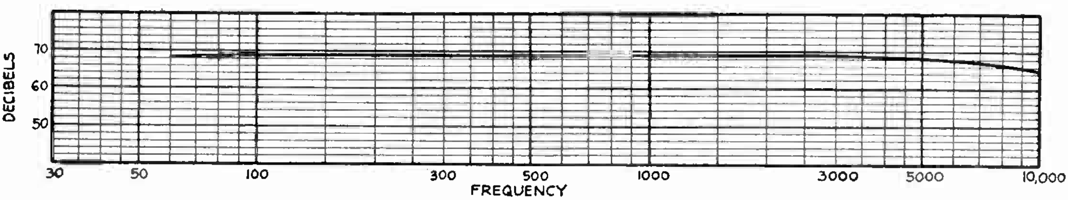

Fig. 1. Representative frequency response curve of an A. F. amplifier.

The *frequency response* of an A.F. amplifier is a measure of its ability to amplify at various frequencies in its range; when this information is plotted in the form of the curve shown in Fig. 1, we have the *frequency response curve* of the amplifier. This curve indicates the frequency response of the high fidelity transformer-coupled A.F. amplifier of which a simplified circuit diagram is presented in Fig. 2; a type 56 tube feeds two type 56 tubes in push-pull, and these in turn feed two type 2A3 tubes operating in push-pull as class A amplifiers and delivering an undistorted power output of 15 watts. From the frequency response curve in Fig. 1 you can see that the amplifier has a uniform gain of 69 db for all frequencies between 100 and 3,000 cycles (has a flat electrical response over this frequency range), dropping about .7 db at 60 cycles and dropping about 4 db at 10,000 cycles.

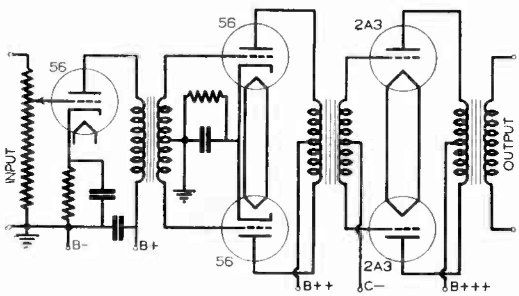

Fig. 2. Simplified circuit diagram of a representative A. F. amplifier.

When one of the transformers, tubes, by-pass condensers or resistors in the amplifier circuit in Fig. 2 becomes defective, the replacement part used should have exactly the same characteristics as the original part or else the frequency response of the amplifier will be changed. This applies to these same parts in any other A.F. amplifier used in radio receivers or transmitters, in public address systems, electric phonographs or theatre sound systems.

There are occasions, however, when an exact replacement transformer, choke or tube cannot be secured; in cases like this it is necessary

(Page 4, please)

Equalizing A. F. Amplifiers (Continued from page 3)

to duplicate the part as closely as possible then make a check of the frequency response. If the original frequency response is not obtained, then the amplifier will have to be equalized by inserting in it certain special equalizing circuits and adjusting them until the original frequency response is secured.

Although equalization is most often carried out after some part of an amplifier is replaced, it is also utilized to improve the frequency response characteristic of an amplifier or to give a flat electrical response to amplifier stages which are being added to an already equalized amplifier. Since equalization which results in flat acoustical response is too lengthy a process to be described in this short article, only equalization which results in a flat electrical response will be considered here. The procedure to be described can be used equally as well to duplicate any frequency response curve, even though not flat, provided the original curve is at hand.
The frequency response curve of an amplifier, or sufficient data to indicate the relative responses at various audio frequencies, is generally given in the instruction manual or in literature supplied by the manufacturer; this curve serves as a guide during the equalization process.

Test Equipment Required. Suitable measuring equipment must be available in order to determine the effectiveness of any equalization introduced into an amplifier circuit. The equipment consists of an audio frequency signal generator (A.F.S.G.) and two vacuum tube voltmeters (or two copper oxide voltmeters which are free from frequency discrimination over a range at least as wide as 15 cycles to 15,000 cycles). The A.F.S.G. should be capable of producing a sine wave signal of any frequency between 30 and 15,000 cycles and delivering a voltage of approximately 1.5 volts across a 5,000 ohm load with very little harmonic distortion. The voltmeters should have low voltage scales, preferably reading from 0 and 3 volts. Multipliers should be at hand so that any voltages between 0 and 250 volts can be measured with the pointer near mid-scale to secure maximum accuracy.

Connection of Test Equipment to A.F. Amplifiers. Since the values of the terminating connections to an amplifier affect its frequency response and gain, it is important that impedance matches be secured at the amplifier input and at its output. Data is generally available regarding the input and output impedances of factory-built equipment, but there will be cases where this information may have to be secured by actual measurements.

How to Determine the Input Impedance of an A.F. Amplifier. The input terminals of an A.F. amplifier are often connected directly to the output of the device which is producing the A.F. signal. When this type of A.F. amplifier is at hand, we may consider its input impedance to be equal to 1 megohm.

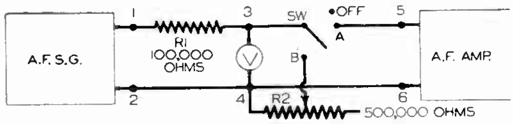

Fig. 3. Circuit for determining the input impedance of an A. F. amplifier.

If the input circuit of an A.F. amplifier consists of some coupling device such as a volume control, transformer, or a special pad, then the *substitution method* of determining the input impedance of the amplifier should be used. The A.F. amplifier in this case is turned off, disconnected from its signal source and connected into the circuit shown in Fig. 3. The A.F.S.G. is set to either a 400 cycle or 1,000 cycle reference frequency and its voltage output is adjusted for its maximum value, which may be several volts. Resistor R1, having a resistance of 100,000 ohms, is used to divide the A.F.S.G. voltage between the A.F. amplifier and rheostat R2, which has a resistance of 500,000 ohms. With switch SW at position A, there will be a certain voltage between points 3 and 4. This voltage will be indicated by V, a vacuum tube voltmeter or copper-oxide rectifier type voltmeter. The switch is changed to position B and R2 is adjusted until V reads the same value as before; the ohmic value of R2, as measured with an ohmmeter connected between points 4 and B when switch SW is in its "off" position, is now exactly equal to the input impedance of the A.F. amplifier in ohms.

How to Determine the Output Impedance of an A.F. Amplifier. When a single output tube of an A.F. amplifier stage feeds into an unknown load, as is the case in Figs. 4A and 4B, we can assume that the plate load impedance in ohms is equal to the plate load resistance of the tube used (this being the condition at which maximum power output is obtained). The correct operating plate load impedance can here be determined from a tube chart.

Oftentimes an A.F. amplifier will have an output transformer as is the case in the circuits of Figs. 4C and 4D. The impedance between points 1 and 2 in each case can be measured by the substitution method shown in Fig. 3. The amplifier is turned off, a resistance (2 watt rat-

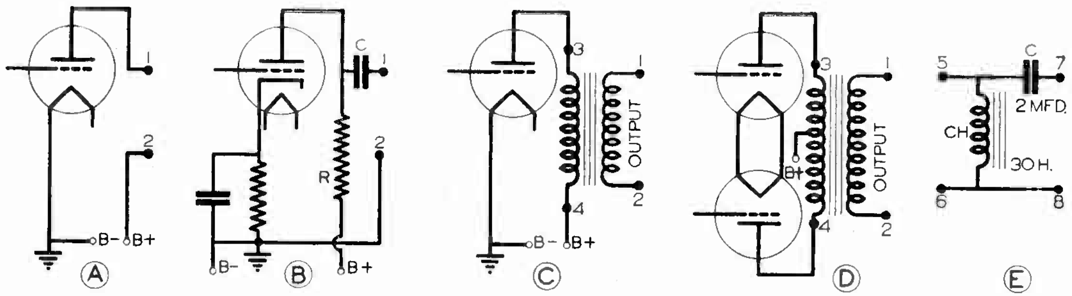

Fig. 4. Types of A. F. amplifier output circuits.

ing) equal to the plate load resistance of the last tube is connected between points 3 and 4, and the circuit in Fig. 3, consisting of the A.F.S.G., R1, R2, V and SW, is connected to terminals 1 and 2. The value of R2 which makes the meter V read the same for switch settings A and B is then the output impedance of the amplifier. (In the case of a push-pull amplifier the value of the resistor connected between points 3 and 4 would have to be twice the plate load resistance recommended for one tube.) After the output impedance has been determined, be sure to remove the resistor which was connected to points 3 and 4.

Amplifier Output Connections for Equalizing. Certain precautions must be observed when connecting the vacuum tube voltmeter to measure the output of an amplifier being equalized, depending upon the type of output circuit.

In the amplifier output circuits of the type shown in Fig. 4A, the plate voltage must not be lowered by the resistance load which is connected in place of the usual amplifier load during the equalization process. It is therefore necessary to connect between the load resistor and the amplifier output a choke and condenser circuit like that in Fig. 4E. Choke CH must have an inductance of at least 30 henries when normal D.C. plate current flows through, yet must have a very low D.C. resistance so it will not drop the plate voltage too much. Condenser C is of the paper type, at least 2 mfd. in size and having a voltage rating equal to about twice the plate voltage of the stage. The load resistor, having an ohmic value equal to the plate load impedance of the stage, is connected to points 7 and 8.

With a circuit like that in Fig. 4B, the required load resistor can be connected directly to points 1 and 2 of the amplifier during the equalizing process.

With circuits like those in Figs. 4C and 4D, the required value of load resistor is connected directly to output terminals 1 and 2.

In each case the power-handling rating of the load resistor must be at least equal to the power output value of the output stage. The voltmeter used to measure the output voltage is, of course, connected directly across the load resistor terminals.

Matching the A.F.S.G. to the Input of the A.F. Amplifier. The amplifier input connections for equalizing are given in Fig. 5; the voltage divider or pad consisting of the resistors R1, R2 and R3 is necessary to match the input impedance of the amplifier with the output impedance of the A.F.S.G. When resistor R3 has a resistance equal to 90% and R2 a resistance equal to 10% of the *input impedance* of the amplifier under test, satisfactory matching will be accomplished. Resistor R1 should be *at least* five times the value of R2, so that the shunting effects of the output of the A.F.S.G. will not materially affect the value of resistor R2. Resistors R1, R2 and R3 may be 1 or 2-watt carbon or metallized resistors.

The voltmeter V indicates the voltages between points 1 and 2 at the output of the A.F.S.G.; knowing this voltage and the values of R1 and R2, in Fig. 5, we can calculate the voltage between points 3 and 4, which is the amplifier input voltage, by multiplying the voltmeter reading by the ratio of R2 to the total resistance across the meter (R1 + R2).

Let us consider a typical example: If the A.F. amplifier has an input impedance of 500,000 ohms, R3 will be nine-tenths (90%) of this value or 450,000 ohms and R2 will be 50,000 ohms. The minimum value for R1 is then five

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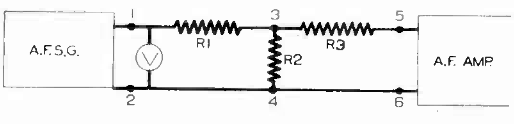


Fig. 5. Matching circuit.

times 50,000 ohms, or 250,000 ohms. The total resistance across V (R1 + R2) is then 250,000 + 50,000 or 300,000 ohms, and 50,000 ÷ 300,000 or 1/6 is the value by which we must multiply each reading of V to get amplifier input voltages. The input voltage may be reduced to any desired value by increasing the ohmic value of R1. This simple method of reducing the input voltage applied to the A.F. amplifier without changing the output voltage of the A.F.S.G. makes it possible to select the most suitable voltage for measurement purposes when checking very sensitive A.F. amplifiers; the readings of V are thus sufficiently high to be read with ease and accuracy.

Adjusting the Amplifier Input Voltage for Equalizing. The first step in the actual equalizing process is to determine the frequency at which maximum amplification is obtained. Swing the A.F.S.G. over its entire frequency range several times while watching the output voltmeter (which is, of course, set at the proper voltage range) until you have found the frequency at which a maximum voltage reading is obtained.

Now calculate the correct output voltage for rated power output by dividing rated power output in watts by the load resistor value in ohms, then taking the square root of the result. If the maximum output voltage which you measured is higher than the correct value for rated power, reduce the input voltage either by increasing the value of R1 in the input circuit or by reducing the output of the A.F.S.G. With this input voltage value, then, the rated power output value of the amplifier will never be exceeded while equalizing.

Getting a Frequency Response Curve. In order to determine how much equalizing, if any, and what type of equalizing is necessary for the amplifier in question, a frequency response curve must be plotted on paper (or pictured mentally) after data for it has been secured by actual measurements. If the voltmeter which is used to measure output voltages also has a db scale and you know how to interpret its readings, the problem is simple. Simply take readings of gain in db, with the apparatus set up as previously described in 10 cycle steps up to 100 cycles, in 100 cycle steps from 100 cycles to 1,000 cycles, and in 1,000 cycle steps for all higher frequencies, and plot these values against frequency or logarithmic graph paper exactly as was done in Fig. 1. If the resulting response curve does not meet requirements, then one of the equalizer circuits hereafter described must be introduced into the amplifier and adjusted until the desired frequency response is obtained.* Several test curves may be necessary.

Equalizer Circuits. Regardless of the method of equalization introduced, those signal frequencies which are excessively amplified must *be reduced* to the intensity of the weakest signal frequency if we want flat electrical response. In other words, if the output voltage of an amplifier is 100 volts at 1,000 cycles and but 40 volts at 60 cycles, the 1,000 cycle signal intensity must be lowered to the 40 volt level for equal response at these two frequencies. This naturally means that the amplification of the amplifier is reduced at the 1,000 cycle frequency. If the over-all amplification after equalization is not enough for satisfactory operation, more amplification must be introduced, but distortion due to over-loading of a particular stage in an amplifier must not be permitted. This means there is a limit to the amount of equalization which can economically be introduced into an amplifier circuit.

Since most of the equalizing problems encountered in the field will require either the raising or lowering of the lower or higher range of audio frequencies amplified, the simpler types of

*If the output voltmeter used does not indicate gain directly in db, you will have to record the output voltage readings at each frequency setting of the A.F.S.G. and convert these voltage values to db values by means of the following formula:

$$\text{Gain in db} = 6.02 + 20 \log \frac{V2}{V1} + 10 \log \frac{r}{R}$$

Here V2 is the A F. amplifier output voltage in volts, V1 is the A.F. amplifier input voltage in volts, r is the input impedance of the amplifier in ohms and R is the ohmic value of the load resistor.

(Page 9, please)

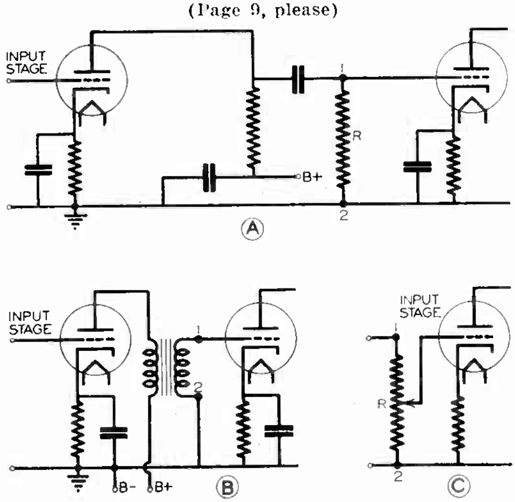


Fig. 6. Positions for equalizer circuits.

The Laboratory Page

By GEORGE J. ROHRICH

The purpose of this department is to furnish supplemental experiments to students who have completed their Home Laboratory Course, but who wish additional laboratory experience. You are not required to perform these experiments, but you will gain increased knowledge by doing so. Most of the material required will be that received as part of the Laboratory Course. Any other material necessary can be purchased very reasonably and will constitute an investment rather than an expense, as it will serve as replacements in service work or be useful in your shop later.

George J. Rohrich, Engineer in Charge N. R. I. Laboratory

EXPERIMENT NO. 57

Object: To study the voltage, current and resistance distribution in a circuit.

Apparatus Required: 0-50 voltmeter (item No. 12); 0-5 milliammeter (item No. 1; test prods; one 45 volt battery, tapped at 22 volts.

Experimental Procedure: 1. Connect the test prods to the 0-50 voltmeter and test the voltage of the battery at both the 22 and 45 volt terminals. 2. Remove the test prods and connect the two meters in series as shown in Fig. 85 on page 8. Connect across the 22 volt section of the battery.

Observations: 1. Voltage tests with the 0-50 voltmeter will show readings between 40 and 50 volts for the battery if it is in useful condition. A new battery often tests between 45 and 50 volts although the value printed on the battery is only 45 volts. This is due to the fact that the battery consists of thirty cells in series, each having slightly more than 1.6 volts. This voltage value drops gradually with age and use. The meter is therefore not necessarily inaccurate if it reads a higher or lower voltage than 45 volts. Many factories place a date on the batteries so that fresh batteries having at least 45 volts available may be obtained when purchased.

When testing across half of the battery you test the voltage of fifteen cells normally giving about 22 volts. However, even if the reading is different from the expected value of 22 volts, the battery may not be at fault. This variation could be caused by the fact that meters cannot be made which are accurate over the entire scale, unless the meter is calibrated by hand. This is done only for special (and very expensive) laboratory meters.

Manufacturers of radio parts such as resistors, condensers and the more inexpensive meters are permitted a tolerance of plus or minus 10%. Special parts and higher grade meters are obtainable with closer tolerances, such as 2% or 5%. It is important to remember that highly accurate voltage, current and resistance measurements are seldom necessary. In mathematics numbers are considered to be exact. On the contrary, a physical measurement is always an approximation.

2. The resistance of the voltmeter is 3300 ohms. The milliammeter has a resistance value of 2000 ohms. We can now regard the parts of Fig. 85 as being the circuit shown in Fig. 86. The total resistance is 2000 plus 3300 ohms, or 5300 ohms. By Ohm's Law the current will then be 22.5 volts divided by 5300 ohms, which equals .0042 ampere (4.2 milliamperes). Your milliammeter reading should approximate this value.

As the voltmeter indicates 14 volts and we have available 22.5 volts, reasoning will indicate that 8.5 volts must exist across the milliammeter. Ohm's Law will check this also. Multiplying the current by the resistance of the milliammeter (.0042 times 2000) gives a value of 8.4 volts, which is a value within our ability to read the meter scale. This indicates that the milliammeter is also usable as a voltmeter. By multiplying any current value indicated by 2, the voltage across the meter is given. The 0-5 milliammeter is therefore also a 0-10 voltmeter.

(Page 8, please)

The Laboratory Page (Continued from page 7)

Theory of Operation: A meter, regardless of calibration, is a current operated device. The movement of the hand is caused by a magnetic flux, caused by a current flow through a coil of wire. Meters differ only in sensitivity, calibration and resistance, both internal and additional resistances being considered.

The resistance of a meter sometimes is an important factor in making the best use of it as an ammeter or a voltmeter. In general a low resistance meter is used as an ammeter and a high resistance meter is used as a voltmeter. A meter having a moderate amount of resistance can be used as a voltmeter in low voltage circuits while it can also be used as an ammeter in a high voltage circuit. Still, this meter of moderate resistance makes a poor ammeter in a low voltage circuit and it makes a poor voltmeter in a high voltage circuit.

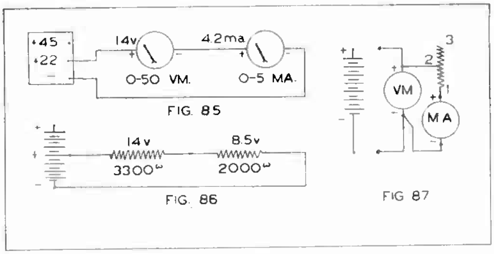


FIG. 85
FIG. 86
FIG 87

From the above explanation it would appear that the milliammeter cannot be used for accurately measuring the amount of current flowing in any circuit. However, in a high voltage circuit which contains high resistance, this meter can be connected in series to measure the current without changing the value of original current to any large extent.

Let us take an example to illustrate the case. Let us take 50,000 ohms and connect it into a 100 volt circuit. By Ohm's Law we know that the current will be .002 ampere or 2 ma. Now if we include the 2,000 ohm meter into the circuit, the total resistance will be 52,000 ohms. By Ohm's Law we find that the current will be .00192 ampere or 1.92 ma. The addition of the meter changed the original current only by eight-hundredths part of one milliampere and, therefore, the error is not noticeable.

EXPERIMENT NO. 58

Objects: To show how meters may be compared and to extend the range of a meter.

Apparatus Required: The same as the previous experiment with the addition of the potentiometer (item No. 13).

Experimental Procedure: 1. Connect the voltmeter across the 45 volt battery and note the reading. 2. Connect the potentiometer to the milliammeter as shown in Fig. 87. Rotate the dial to 100 and connect the combination across the 45 volt battery. Now rotate the dial of the potentiometer until a comparative reading is obtained on the milliammeter. In other words, if the voltmeter indicates 42 volts, adjust the potentiometer until a reading of 4.2 is obtained on the milliammeter.

Observations: The potentiometer serves as a current limiting resistor, reducing the current to a value which may be indicated by the milliammeter. The proper setting for a comparative reading will normally be obtained at about 80 on the potentiometer dial. When the setting has been found, the milliammeter will be a 0-50 voltmeter as long as the potentiometer is unchanged. All readings obtained on the milliammeter may now be multiplied by 10 and read as volts.

Theory of Operation: Adding resistance in series with a meter will extend the range of the meter. All good meters utilize this principle. The fundamental meter has low resistance, multipliers being added in series to furnish the necessary resistance to limit the current, considering the voltage range to be employed. The meter is then calibrated in volts by comparing the readings obtained when connected to a standard voltage source along with a standard meter. We are using the 0-50 voltmeter as our standard, which means we cannot obtain a higher degree of accuracy than the original rating, plus or minus 10%.

However, if we employ a laboratory meter for comparing readings, higher degrees of accuracy may be obtained. By using several voltage sources, we may calibrate our meter for every degree on the scale, if such accuracy is desired.

Equalizing A. F. Amplifiers (Continued from page 6)

equalizer circuits will be considered first. These types of equalizers employ a combination of resistors, condensers and tuned circuits which act as voltage dividers, dividing the circuit voltage in a different manner for each frequency, or serve to shunt the input circuit of an amplifier stage a different amount for each frequency.

Location of Equalizer Circuits. Equalizer circuits may be introduced between any two stages and 6B, points 1 and 2 in each case are connected together, and the grid connection for the following tube is changed over to point 3 of the equalizer circuit.

Since resistors R1 and R2 in Fig. 7B are connected in series, with the grid of the next tube going to their common point (3), there will be a division of the signal voltage which varies with frequency because the reactance of C

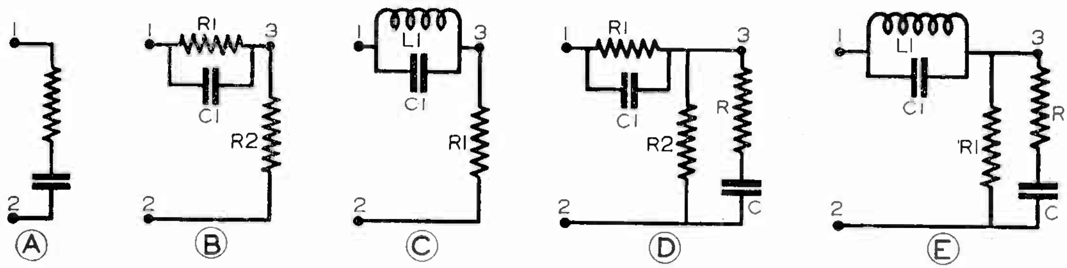


Fig. 7. Equalizer circuits.

of an A.F. amplifier, as at points 1 and 2 in Figs. 6A and 6B, or at the input of the first stage of the amplifier, as at points 1 and 2 in Fig. 6C. As a general rule, place the equalizer circuits as close as possible to the amplifier input, for this lessens the possibility of overloading any of the stages at certain frequencies.

Cutting Down the High Frequency Response. The equalizer circuit shown in Fig. 7A, consisting of a resistor R and condenser C in series, will serve to cut down gradually the response of an amplifier to high frequencies; points 1 and 2 of this circuit are connected to points 1 and 2 of the amplifier circuits in Fig. 6. R can be a 250,000 ohm variable resistor, so you can adjust its value to get the desired amount of equalization; C should have a value somewhere between .0001 mfd. and .05 mfd. The larger the value of C and the smaller the value of R, the more will the high frequencies be cut down.

The circuits in Fig. 7B and 7C also serve to cut down the highs when points 1 and 2 on them are connected to points 1 and 2 in the circuits of Fig. 6, but the effect is more gradual, with even the lowest frequencies being cut a small amount.

Cutting Down the Low Frequency Response. The intensities of the low audio frequencies being handled can be cut down gradually, with the lowest frequencies attenuated the most by using the circuit in Fig. 7B as a voltage divider. For amplifier circuits like those in Figs. 6A varies with frequency. At high audio frequencies condenser C1 acts as a short-circuit path across R1, and full signal voltage exists across R2 for application to the next stage. At low frequencies the reactance of C increases, with the result that there is a voltage drop across R1 and C1 and less voltage is applied to the grid. The values of R1 and R2 depend upon the amount of equalization required; in any event their total series resistance should not be more than 2 megohms. The best value for C1 can be found by first using a .0005 mfd. variable air condenser; the greater the value of C1 in microfarads the more will the low frequencies be cut down and the less will the medium low frequencies be cut down. With a circuit like Fig. 6C, however, the grid connection to its potentiometer R is left unchanged, and the upper end of the potentiometer is connected to points 3 in Fig. 7B.

Introducing Peaked Response. It is sometimes desirable to raise the response at a certain group of frequencies, giving what is called *peaked response*. This may be accomplished by using a resonant circuit such as L1-C1 in Fig. 7C. When the resonant circuit is connected in series with R1 and in shunt with the input of an amplifier stage, the grid connection of the stage being left unchanged, there will be maximum impedance between points 1 and 2 at the resonant frequency of L1-C1, and this resonant frequency will be amplified to a greater extent than other frequencies. The amount of peaked

(Page 10, please)

 (Continued from page 9)

response introduced will be controlled by the resistance of R1. Use a variable resistor for R1 until you have secured the desired amount of equalization, then substitute a fixed resistor.

The circuit shown in Fig. 7C may also be used to cause a decrease in amplification at the resonant frequency of the tuned circuit, by connecting the grid (or the upper end of potentiometer R in the case of Fig. 6C) to point 3 instead of point 1. The amount of reduction in gain will be dependent upon the value of R1; the lower the value of R1, the greater will be the attenuation of resonant frequency signals.

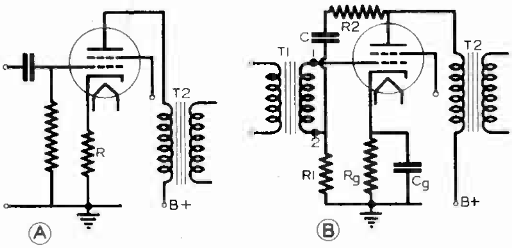


Fig. 8. Inverse feed-back circuits.

Combinations of Equalizer Circuits. It is possible to combine the circuits of Figs. 7A and 7B to cut down the medium frequencies with a fair degree of efficiency. Figure 7D shows the resulting equalizer network; it is connected in the usual manner between points 1 and 2 of the A.F. amplifier, with the grid of the A.F. amplifier tube (or the upper end of R in Fig. 6C) connected to point 3. The values of the resistors and condensers employed will be essentially the same as in the individual circuits. One equalizer circuit will tend to compensate for the effects of the other, but under normal circumstances it is possible to obtain the effect of a rise of at least 5 db in the amplification at the highest and at the lowest signal frequencies.

The arrangement shown in Fig. 7E is a combination of the circuits in Figs. 7A and 7C. With the grid of the amplifier tube connected to point 1, it is possible to secure attenuation of the high frequencies and peak response at the resonant frequency of L1-C1. With the grid (or the upper end of R in Fig. 6C) connected to point 3, the resonant frequency (and adjacent frequencies) as well as the higher frequencies will be attenuated.

Use of Inverse Feed-Back Circuits for Equalization. It is possible to introduce inverse feed-back at frequencies where the response of an A.F. amplifier is too great, in order to lower the actual gain in a stage of A.F. amplification and obtain a flatter frequency response. This type of feed-back is called inverse feed-back because it is degenerative; that is, it decreases the intensity of the signal, whereas ordinary regenerative feed-back builds up the signal intensity.

The simplest circuit which may be used to obtain inverse feed-back or degeneration is that shown in Fig. 8A. You will note that the by-pass condenser usually connected across the cathode resistor R is eliminated; the elimination of this condenser causes degeneration at all frequencies being amplified. The amount of degeneration introduced will be dependent upon the value of resistor R. Since R is also used to obtain automatic C bias, its value cannot be varied to control the amount of feed-back; the inverse feed-back voltage is thus definitely limited.

To overcome the deficiencies of this simple circuit, the arrangement shown in Fig. 8B is often employed, where C and R2 are introduced for the specific purpose of providing inverse feed-back. In this circuit the purpose of resistor R_g is to supply the proper operating C bias automatically, while condenser C_g prevents degenerative effects in this part of the circuit at all audio frequencies. Condenser C_g has a high capacity and therefore provides a low reactance path for signal currents.

The relative values of R1, R2, and C affect the frequency response of the amplifier stage in Fig. 8B. The larger the capacitance of C, the more will the lower audio frequencies be attenuated.

Resistor R1 can be shunted by a condenser; the reactance of this condenser decreases at higher frequencies with the result that there is more inverse feed-back voltage across R1 at the lower frequencies than at higher frequencies, and the attenuation of low frequency signals will be increased. Placing a coil instead of a condenser across R1 reverses the effect, giving more feed-back voltage across R1 at high frequencies and consequent increased attenuation of the "highs."

The introduction of any inverse feed-back method involves a loss of gain; in addition, if the inverse feed-back voltage is too great, the stage may go into oscillation or become unstable. There is, therefore, a limit to the amount of equalization which may be secured with this method.

This article is intended to give you only a general idea—a sort of bird's-eye-view—of the process of equalizing A. F. amplifiers to secure uniform electrical or acoustical response at audio frequencies. The many little details of the process will clear up automatically as you acquire more knowledge of radio principles, and actual equalization experience with A. F. amplifiers.

WANTED: YOUR RADIO BUSINESS-GETTING IDEAS

How do you advertise your Radio servicing business? Do you use newspaper ads, telephone directory ads, postcards, letters, or signs to bring in business, or have you some entirely original scheme of your own that gets results? We'd like to know what you are doing along this line—in fact, we want to secure complete data on your best ideas, for reproduction in future issues of NATIONAL RADIO NEWS.

PRIZES

1st PRIZE: $10.00 CASH.
2nd PRIZE: $5.00 CASH.
TEN THIRD PRIZES: Set of high quality socket wrenches designed especially for Radio servicing work.

We know that most of you will be glad to swap your successful ideas, through the pages of this magazine, with fellow-students and Radio-Tricians who are so widely scattered throughout the world that they cannot possibly be considered competitors, but as an added inducement for you to send those ideas in, we're offering a number of cash awards and valuable prizes for those ideas which are considered the simplest, most effective and most original.

We want only those business-getting ideas which have been tried out in actual practice. For example, if you have been depending upon government postcards to bring in the new business, using a different message on each group of cards mailed, send in one card from each group, together with a few notes on how many cards you send out each time, their total cost, how you address them, where you get the names of prospects to whom cards are mailed, and an estimate of the results obtained. In other words, your entry should contain a complete description of your idea, how you used it, an estimate of the results secured, and most important of all, samples of the cards, letters, ads, calendars, blotters, etc., which you used.

Large mail-order businesses consider a two percent return on a mailing (two replies from every hundred cards or letters sent out) to be very good, so don't hold back your ideas because the results appeared poor to you. Remember that results from your mailings may trickle in for six months or even a year; there are some Radio receivers which stubbornly persist in working perfectly for years and years, if fed with a new tube occasionally, and the lucky owners of these sets will stick your card in back of the Radio until they need service.

Glance over the contest rules and see how simple they are. Notice especially that you can send in as many entries as you like, in one envelope or separately, as you prefer; each entry will stand an equal chance of being published and winning one of the prizes.

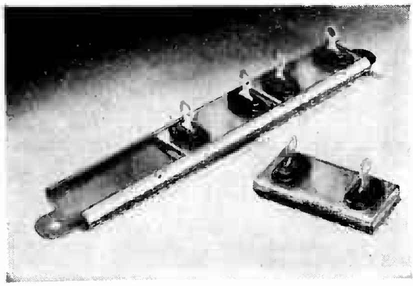
Ideas for the part-time serviceman are wanted just as much as those for the man who has a shop, hence N. R. I. students who have progressed sufficiently with the Course to do a little part time servicing and who have advertised their work can enter. Send those ideas in now—before you forget.

CONTEST RULES

1. This contest is open to all students and graduates of National Radio Institute, but not to N.R.I. employees.
2. Each entry shall consist of one business-getting idea *which has actually been tried out* and proved successful in either a part-time or full-time Radio servicing business. The entry shall consist of one sample of the literature used if it be a postcard, letter, handbill, business card or an especially effective letterhead; if an advertisement, send one clipping of it; if a window display, sign or poster, send a clear snapshot or sketch of it; if a business-getting contest, send the contest entry blank.
3. Include with your entry a description of how your idea was used, the results secured, and all data which would be of help to someone else who wanted to try your idea.
4. You may send in as many entries as you like; number them Entry No. 1, Entry No. 2, etc., for identification purposes, placing name, address and student number on each. Each entry will be considered separately by the judges.
5. The following prizes will be awarded on the basis of the effectiveness, originality and simplicity of the idea presented: First prize—$10.00; second prize—$5.00; ten third prizes, each consisting of a set of socket wrenches.
6. Judges will be members of the technical department of National Radio Institute and the editor of NATIONAL RADIO NEWS. The opinions of the judges will be final; in case of ties, duplicate prizes will be awarded. An entry will not be returned unless specific request is made directly on the entry that it be returned.
7. National Radio Institute reserves the right to reproduce a part or all of any entry in NATIONAL RADIO NEWS, in instructional material, and in promotional material.
8. Entries must be postmarked before midnight, AUGUST 31, 1937 to receive consideration in this contest. Winners will be announced in a future issue of NATIONAL RADIO NEWS. Get your entry in early, so you won't forget about it.
9. Address your entries to: CONTEST EDITOR. NATIONAL RADIO NEWS, 16th and YOU STS., N. W., WASHINGTON, D. C.

Build-Your-Own Voltage Dividers

By means of handy sectional units and a mounting base of the required length to accommodate them, it now becomes possible to build or rather assemble one's own voltage divider to meet any individual need. The new Clarostat Series BYO or Build-Your-Own Resistor Network is a development of the Clarostat Mfg. Co., Inc., 285-7 N. Sixth Street, Brooklyn, N. Y., and is now made available in sectional units of the necessary resistance values, together with mountings to take care of from one to six units.



Build-Your-Own Voltage Dividers showing sectional construction.

Each sectional unit is a complete molded-seal metal-clad resistor with two terminals of the required ohmage for that section. Bakelite—encased winding construction is used. Units slide into and fit snugly in the base mounting strip which takes the requisite number of units. Excellent conduction of heat from winding to mounting base, and metal mounting surface, provides for maximum wattage ratings. Adjacent terminals are connected together to form a single resistance network of all the sections. Or the sections may be used individually since they are normally insulated from one another.

———*n r i*———

New Shure 1938 Catalog

A new, completely revised six page catalog of Microphones and Acoustic Devices has just been published by Shure Brothers, 225 W. Huron Street, Chicago.

Among the new items described in the catalog are the "Tri-Polar" Controlled-Direction Crystal Microphone, providing switch-controlled unidirectional, bi-directional and non-directional response in one unit, "Military-Type" Hand microphones, designed to fit in the hand, improved "Communications-Type" microphones, "Transcriptions" Record Reproducers, and Vibration Pickups.

Copies of the catalog are available on request to the manufacturer.

Complete Line of IRC Exact Duplicate Replacement Controls Announced

A complete line of IRC Metallized Volume Controls in exact duplicate replacement types, including dual and other special units, is now in production and will be available by September 1, according to a recent announcement of the International Resistance Company, Philadelphia, Pa. Complete guide listings of these new controls will be prepared to enable complete coverage in fall jobber catalogs.

Previously IRC Metallized Controls have been made in thirty-five standard types. The present expansion comes as a result of the popularity of these units and the demand for a complete line of exact duplicate types for the wide variety of receivers on which servicemen are called upon to make control replacements.

———*n r i*———

Porcelain-Case High-Voltage Mica Capacitors

Appreciative of the high voltages and high frequencies to which mica capacitors are subjected in Radio transmitters and certain electronic applications, a line of porcelain-case mica capacitors is announced by Aerovox Corporation, 70 Washington St., Brooklyn, N. Y.

New Aerovox Porcelain-Case Mica Capacitor.

Each new unit is housed in a glazed porcelain case and provided with heavy brass terminal studs and lock nuts. There is the widest choice of capacities from .00005 to .1 mfd., as well as D.C. test voltages from 2000 to 12,500. The maximum r.f. current that can be handled is indicated on the label of each unit.

Sightseeing in a Cathode Ray Tube Factory

By J. A. DOWIE
N.R.I. Chief Instructor

and

L. J. MARKUS
N.R.I. Technical Editor

To RCA Manufacturing Co., Inc., and particularly to Mr. Linwood G. Lessig of the RCA Radiotron Division, we wish to express our appreciation and thanks for the cooperation given in the preparation of this feature article and for the many excellent photographs showing actual manufacturing operations in the RCA cathode ray tube factory.

WOULD you like to know how a cathode ray tube is made? Would you be interested in seeing the actual machines used for assembling the electron gun, mounting the gun in its funnel shaped glass envelope, and testing the finished tubes? Then join us in this photographically-illustrated sightseeing trip through that section of the great RCA Radiotron tube factory which is devoted to the manufacture of cathode ray tubes.

First of all, let us look over a few of the completed tubes, ready for installation in the cathode ray oscillographs used by radio servicemen or even in experimental television receivers. The heart of these tubes is an electron gun, an ingenious combination of electrodes which pulls electrons out of a heated cathode and crowds or focuses them into a narrow beam. Some tubes use two pairs of electrostatic deflecting plates to sweep this electron beam over the fluorescent screen at the widest end of the tube, while in other tubes the deflecting plates are absent and external electro-magnetic coils are used to give the required control over the beam.

The fluorescent screen glows wherever it is hit by the electron beam; the glow can be made to fade out immediately or last for a few seconds after the electron beam has moved to a new spot. Lines and pictures can be formed on the screen if the beam is made to trace a definite pattern over and over again. If this pattern is produced oftener than about twenty times per second, the human eye sees a continuous pattern or scene with little flicker, just as in the case of movies.

Tube *A* (in Fig. *1*) is a high vacuum cathode ray tube which is widely used in oscillographs built for radio servicemen. It has a three-inch diameter fluorescent screen at the large end of the glass envelope, and is provided with two sets of electrostatic deflecting plates which are mounted on the outer end of the electron gun and connected to prongs on the tube base.

Tube *B* in Fig. *1* has a five-inch screen and therefore requires slightly higher electrode voltages

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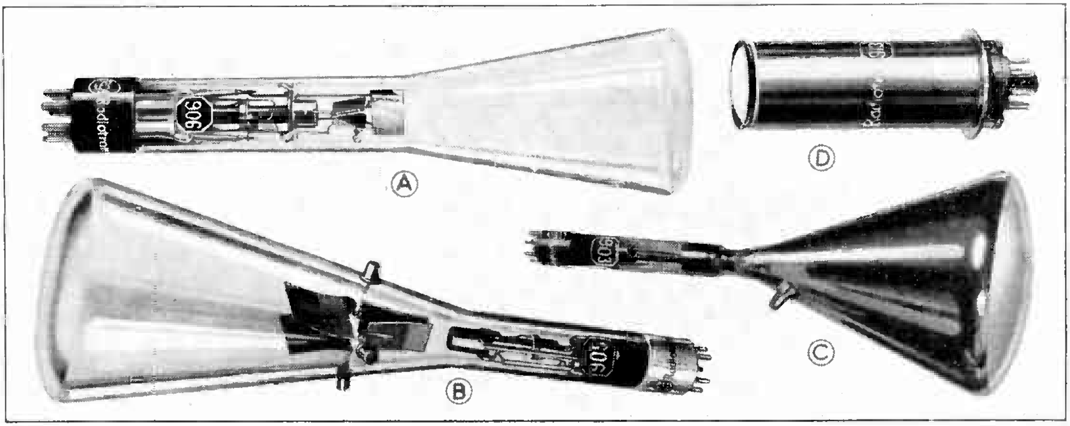


Fig. 1. This article tells how these four representative types of cathode ray tubes are made.

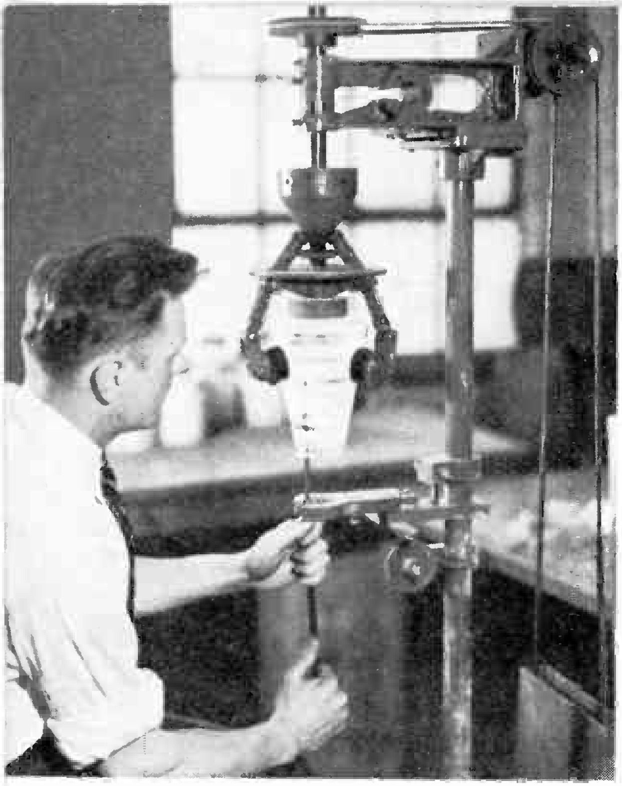
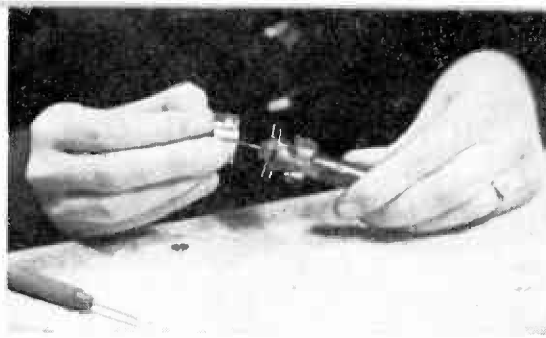


Fig. 2. Removing surplus screen material.



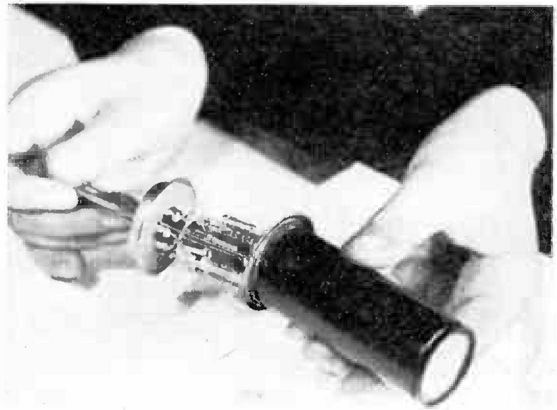


Fig. 3. (above) Assembling an electron gun.
Fig. 4. (below) Assembling a type 913 tube.

(a maximum of 2000 volts D.C. on the high-voltage anode). Notice that the deflecting plates are here connected to terminal caps which are sealed into the side walls of the glass envelope; this lessens the number of prongs on the tube base, simplifies construction of the electron gun and gives much better results at high frequencies.

Tube *C* is one of the largest made for commercial apparatus, having a screen which is nine inches in diameter. There are no deflecting plates; four electromagnetic coils connected together in pairs must be placed at the narrowest part of the neck of the tube (where the funnel meets the neck) to deflect the electron beam.

A conducting layer of graphite, sprayed on the inside of the funnel portion of the tube and on a part of the neck comprises the high voltage electrode (anode No. 2) of tube C; contact is made to this electrode by means of a wire fused into the side wall of the funnel. Since this electrode is often operated at 7,000 volts D.C., you can see that it is decidedly not healthy to come in contact with parts of the tube circuit while the tube is in operation. This same precaution holds true for all cathode ray tubes; even the smallest one made can give you a 500-volt "bite."

Finally, there is the type 913 tube, smallest of them all; it appears at *D* in Fig. *1*. It has a tubular metal shell much like that used for the 6L6 all-metal tube, except that a convex glass screen is hermetically sealed into the end of the metal tube. The electrostatic deflecting plates are mounted on the electron gun and connected to the 8-prong octal base.

And now let us start our sightseeing trip through this great factory. Logically we enter the glass-blowing room first, and there see the many different sizes of tubes being blown in molds. Envelopes for the smaller tubes are made in one section, while those for the larger tubes may be made in several sections which are fused together just before the tube is evacuated. Cathode ray tubes are high-vacuum tubes, and hence these glass envelopes must be designed to withstand great pressures; for example, atmospheric pressure exerts a total force of over 960 pounds on the screen of a nine-inch tube. One reason for making the end of the envelope convex rather than flat is to give added strength; it has been calculated that glass over one-half inch thick would be required for the end of one of these large tubes if it were flat, whereas the glass is only about one-thirty-second of an inch thick in

Fig. 5. Checking electrode alignment.

Fig. 6. Welding electrodes to base.

most of the cathode ray tubes being made today.

Over here, in the chemistry laboratory, we see how the luminescent materials which form the fluorescent screen are prepared, applied to the inside of the glass envelope, and allowed to harden. The nature of these materials varies with the color, intensity and duration of the glow desired. Synthetic willemite, containing crystalline zinc orthosilicate and a small amount of manganese, is perhaps the best known of the chemicals used for screens; it gives a green glow on the screen which remains visible for about one-fifteenth of a second after the electron beam has passed. After the screen material has hardened, any surplus chemical on the side walls of the envelope is trimmed off with a brush while the envelope is slowly rotating; Fig. 2 shows this operation. Special padded jaws replace the chuck of the drill press, gripping the fragile glass envelope tenderly yet firmly.

The assembly of the electron gun, illustrated in Fig. 3, is a delicate process requiring great accuracy. Special jigs are used to hold the parts in the proper relation to each other while they are spot-welded together. These jigs are carefully checked at regular intervals by the tool-making department to maintain their accuracy. Throughout the plant we notice that women have almost a complete monopoly upon the delicate assembly operations, which require nimble but steady fingers. In almost every manufacturing plant you will find this same evidence of the superiority of women for the more intricate mass-production processes.

Inspection of another group of complex machines shows us that the bases and stems of RCA cathode-ray tubes are manufactured in much the same way as corresponding parts of glass and metal receiving tubes. The large tubes use glass stems into which special connecting and support wires are sealed under intensely hot gas flames. In the case of the one-inch tube, which has a metal base, the lead wires are sealed into glass beads which are in turn fused to special metal eyelets in the base.

The electron gun, containing the heater, the cathode, the control electrode, the focusing electrode, the accelerating electrode and in some cases the deflecting plates, is welded to the stem supports as a single unit; in Fig. 6 you can see the welding machine being used for this purpose

(Page 18, please)

COSTLY LATHE WHIRLS GIANT TUBE THRU FLAMES

in connection with the one-inch tube. The two wires which are to be joined are placed between the terminals of the welder, and the operator presses a foot lever to send a very high current across the junction of the wires, heating them to the fusing point and thus producing a perfect weld.

After the welding operations have been completed, another young lady checks the electrode spacing with a microscope, as you can see in Fig. *5*. The five apertures (openings) in the electron gun, through which the electron beam passes, must be aligned with an accuracy of better than four-thousandths of an inch. The edges of these apertures are finished so finely that they are microscopically clean, in order to insure a clearly defined spot on the screen. Actually, as much care is used in constructing an electron gun as in making a high grade optical lens system, for the same principles apply to the focusing of electron beams and light beams.

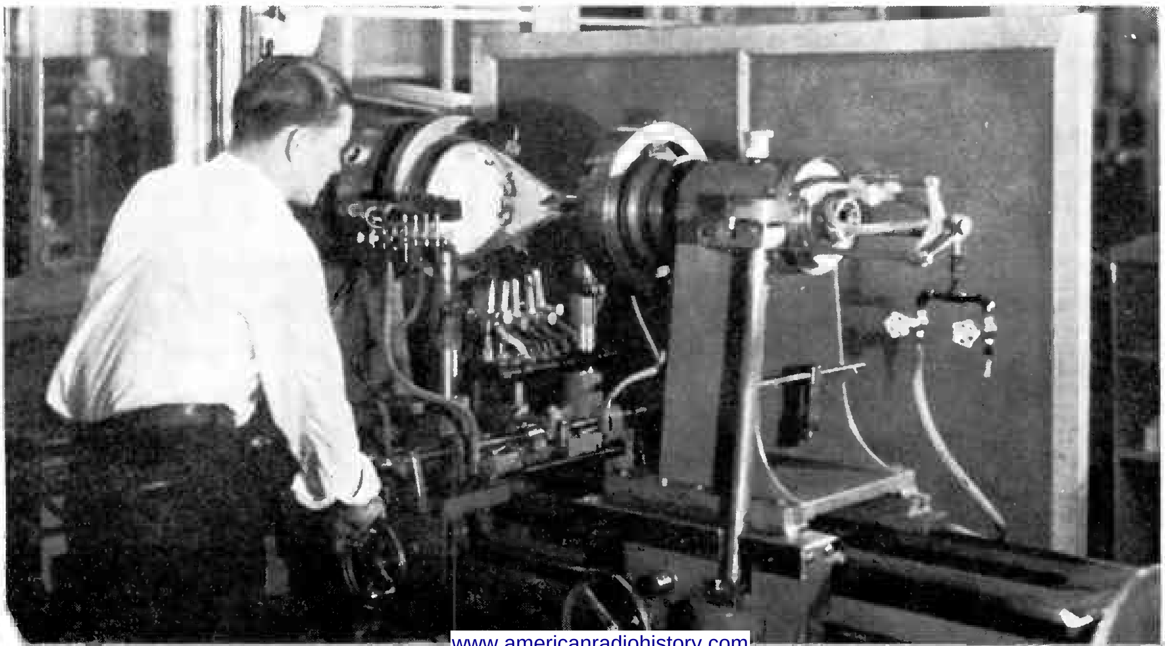
The final assembly of the one-inch cathode ray tube (Fig. *4*) is no different from the assembly of an all-metal tube. Base and envelope are welded together with a current of about 75,000 amperes, and the tube is then evacuated and sealed off. There remains only the attaching of the octal base, soldering of the leads to the prong tips, and the final testing before this midget of cathode ray tubes is ready for use in inexpensive but none-the-less accurate and efficient oscillographs.

Even better than the most expert glassblowers are some of the machines which we watch; this giant lathe, for example, can fuse together two sections of the envelope of a large cathode ray tube so perfectly that you can scarcely notice the joint after the job is done. There's a photograph of this lathe in Fig. 7; notice how both the head and tail chucks are gear-driven, so each revolves at exactly the same speed and no strain is placed upon the glass envelope. Rows of gas torches are directed on the tube as it rotates slowly in the lathe under the watchful eye of the operator. This particular lathe is also used for fusing the deflecting plates into the side walls. Precision of alignment of all parts being extremely important, we see a large number of costly machines like this in our trip through the factory.

When all the electrodes of a tube are in position and the stem is fused to the envelope, the tube is evacuated (all air is pumped out); during this process the metal parts of the tube are heated by induction to drive out all gases. The tube is then sealed off and taken to the machine shown in Fig. *8*: here the tube base is attached with a cement which hardens when subjected to heat. Notice how a sponge rubber pad surrounded by wood guide blocks holds the large end of the

(Page 21, please)

Fig. 7. Fusing together sections of envelope for large cathode ray tube.



Sightseeing in a Cathode Ray Tube Factory (Continued from page 18)

tube in position. In such a long tube, the base must be exactly in line with the axis of the tube; even slight errors would place a strain on the glass when the tube was plugged into its socket and clamped in position. The base must always have the same relation to the screen pattern formed by a given set of deflecting plates, for all tubes must produce identical patterns under given conditions.

After manufacture of a cathode ray tube has been completed, there comes a long series of electrical tests and inspections. There must be no loose particles inside a tube, for this would scratch the delicate screen while the tube was being handled.

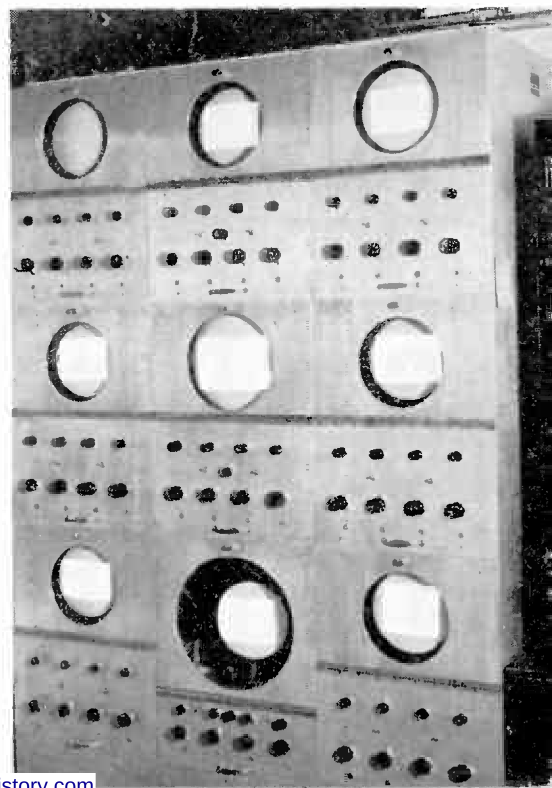
The final electrical test of a cathode ray tube is made in the piece of apparatus illustrated on the front cover of this issue. The tube is shielded from the magnetic effects of nearby apparatus and from the effects of the earth's magnetic field by the massive metal housing. The operator can be seen checking the relationships of the two pairs of deflecting plates in a large cathode ray tube.

One of the many electrical test panels which we see in this factory is illustrated in Fig. *9*; here life tests are being made of representative tubes taken from production and operated under various conditions. Each tube is checked regularly during this test period; the life of a tube is considered ended when its characteristics fall below the established high standards.

In this short time we obviously have secured only a bird's-eye view of the processes by which cathode ray tubes are made, but isn't that all the average radio man need know about manufacturing problems? At least we'll all agree that it takes a great deal of intricate and costly machinery, as well as costly materials, skilled workers and elaborate inspections to produce one of those "picture-making" tubes about which we have read so much and perhaps even seen several times.

Fig. 8. Cementing base to tube.

Fig. 9. Life test panel.



Novel Radio Items

—BY L. J. MARKUS—

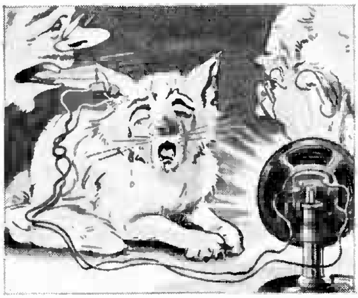
Army Has Radio Interference-Maker!

Tests of an invention which will create enough interference to stop all short-wave radio reception are being made at West Point. It can be used to blanket radio communication facilities at strategic times during a war.

—n r i—

Transmitter Spies On Stratosphere!

An ultra short-wave radio transmitter developed at the National Bureau of Standards for weather forecasting purposes can, as it is carried high into the stratosphere by a small gas balloon, send back to earth reports on temperature, barometric pressure and humidity at regular intervals. The entire unit, batteries and all, weighs less than 2 pounds.



KITTY'S EAR SERVES AS "MIKE"! The ear of a cat was made to serve as a microphone in a recent demonstration at Harvard Medical School. It is presumed that electrical impulses created inside the ear by the sounds were picked up with needle-point probes and fed into an A.F. amplifier. Kitty was none the worse after the adventure with science.

—n r i—

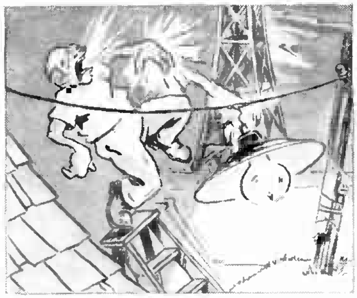
Will Condensers Be Called Tubes?

Electrolytic condensers which plug into octal tube sockets just like metal tubes are now on the market. If housings resembling the envelopes of metal tubes are used, they'll also look alike.

—n r i—

Coronation Is Televised in Rain!

Despite a downpour of rain, the coronation procession of King George VI of England was successfully televised by the British Broadcasting Co., using equipment similar to the R. C. A. system in this country. Thousands of people as far as 30 miles away from London watched as well as listened to this epic event.



MAN GETS FREE POWER FROM AIR! Across the road from the transmitter of WBZ (Boston, Mass.) is an experimentally inclined gentleman who illuminates the front lawn of his home with a 1000-watt bulb connected to an antenna system which he tunes with a pair of pie plates. Burns and shocks do not seem to deter him from experimenting with this "stolen" radio power.

—n r i—

50,000 Bees Broadcast in Boston!

Two hives of bees buzzed merrily before the mike for a special program put out by WEEI, Boston. Half an hour later there was tacked to the studio door this hastily-scribbled note: "Warning—bees loose—do not enter." State Apiarist John Van de Poele had stumbled while carrying out one hive, and 10,000 bees lost their lives in the resulting 24-hour melee. Despite use of vacuum cleaners and brooms, Van de Poele was stung 300 times.

RADIO CALMS NERVES OF HENS! Radio receivers operate all day long in the poultry houses of one Long Island farmer, since he discovered that chickens which become accustomed to radio programs lose all fear of strange noises. It is a recognized fact that egg-laying drops off when chickens are frightened.

N.R.I. ALUMNI NEWS

Business Problems in Radio Servicing

The following article prepared by Mr. Joseph Kaufman, Director of Education, National Radio Institute, offers suggestions for getting a new Radio service business off to a successful start.

Introduction. Any service technician having an adequate technical training and possessing sufficient equipment may be able to get enough work to keep as busy as a bee—but unless he understands the business principles involved in his work, he will not find it profitable from a financial standpoint. On the other hand, that same trained man can spend most of his time in idleness if business doesn't come to him and he doesn't know how to go out after it.

As a general rule, the Radio service man is more of a technician than a business man. So greatly has he concentrated on acquiring the technical knowledge and mechanical ability required for his trade that he has underrated or entirely overlooked the all-important fact that *Radio servicing is a business*, a commercial enterprise. To be successful, then, a Radio-Trician must know how to sell his product at a profit, how to bring customers to his door, and how to keep them satisfied.

What a Service Man Has to Sell. At this time it might be well to list briefly the different services and products which the average service man has to offer to the public.

1. *The maintenance and repair of receivers.* This is obviously the most important of the Radio-Trician's wares, and is what makes Radio servicing a "personal service" business. This personal service is what you really are selling; the sale of merchandise in the form of new parts and new tubes is secondary.

2. *The installation of Radio receivers*, including erection of a suitable antenna and the placing of interference-eliminating filters on trouble-making electrical apparatus in the vicinity. The sale and installation of all-wave, noise-reducing and multiple antenna systems which replace unsatisfactory and obsolete systems also fall in this classification.

3. *The sale of Radio receivers*, either in the service man's place of business or in the customer's home.

4. *Over-the-counter sales of Radio accessories* such as tubes, replacement parts, extra loudspeakers, etc.

5. *Designing, building, selling, renting, operating and servicing of public address, home recording, inter-office communication, and electronic control systems.*

What the Customer Expects. The average person is completely uninformed of the intricacies of Radio, and must therefore rely upon the fairness of the man with whom he deals. Unscrupulous service men have taken advantage of this customer lack of understanding in some instances, with the result that some people are suspicious and wary of all members of the servicing field. Certain service men, in fact, have openly advertised free inspection or very low charges to secure a customer, then installed new power transformers, condenser banks, or other large parts to pad their bill, where a loose wire might have been the only trouble.

Some people hate to spend money for repairs on their Radio sets, especially if the set be one of the low-priced midgets. More important, once a customer has had his Radio repaired by a service man, he expects it to operate satisfactorily for at least six months. The service man may simply have changed a tube, replaced a resistor or soldered a voice coil lead, yet he may be expected to give a guarantee on every other part in the set—on parts which he did not even check and on which the original manufacturer's guarantee may have expired years ago.

(Page 24, please)

Business Problems in Radio Servicing (Continued from page 23)

The average customer, however, is by no means as "cantankerous" as those just described—all he asks is a satisfactory repair of his Radio receiver at a price which will commensurate with the value of the receiver and at the same time give a fair and reasonable profit to the service man. No sensible customer expects to get his Radio parts free, or have the service man donate his time—no customer will begrudge a profit on a transaction if he feels that the profit is fair.

There are hundreds of little ways of making the customer feel that he is getting honest value for his money—show and offer to return the part repaired if it happens to be the power transformer, filter pack, or some other unit which appears large enough to justify your charge; offer to return all defective tubes; test the Radio set in the presence of the customer before and after the repair, placing on the customer's receipt a written guarantee covering the actual work done; call the customer by telephone (or send a postcard) a few days after completing a job to inquire how the set is working, etc.

Getting Started in Business. In most instances, the man who has a steady job will do spare time Radio work in his home at the start, gradually building up his stock of parts and equipment and gradually gaining customers and experience until finally the volume of business and the profits warrant operation on a full time basis.

It is not at all difficult for a beginning service man to decide when to drop his regular job; when he is confident that his average income as a full time service man will equal what he is earning at his regular job, he can give up the job and concentrate his efforts on servicing.

By starting out gradually in this way, little or no capital is needed; if money is at hand to purchase the required instruments and parts and to finance operating costs, the day when the beginner opens up a shop of his own can be brought that much nearer.

Problems of the Independent Service Man. Fundamentally, there is no difference between the one-man Radio service shop and the large service organization; each has the same problems of advertising, bookkeeping and customer policies. A small shop has the advantage of lower overhead, lower initial investment, greater flexibility in business policies, and an opportunity to "personalize" to a greater extent the dealings with customers. Big business has greater volume and consequent greater profits, but the independent service man who succeeds in building up a reputation for "delivering the goods" and charging fair prices is decidedly not at a disadvantage.

Before an estimate of the price of a servicing job can be given, the service man must make tests to determine the nature of the trouble; whether or not to charge for this inspection is an important question and one which can be answered only by considering the policies of competing service men in the same territory. Many service men make a fixed charge for inspecting a Radio, including certain minor services such as cleaning the chassis, testing tubes and checking external connections: if the repair job is secured, the inspection charge is deducted from the repair bill. Time spent in calling upon a prospect and examining his Radio is just as valuable as time spent on actual repair work; the service man must either collect for this time or boost the charges on other jobs to make up for losses incurred through free inspection, if he is to operate at a profit.

To sell parts at list or to give discounts—which is best? The service man must here remember that he is a business man and is therefore entitled to a fair profit on everything he sells. There will be exceptions to any rule which is made; for instance, the list price of a replacement power transformer for a low-priced midget receiver may be pretty nearly equal to the initial cost of the entire receiver, and a reduction in price might be made here to retain customer good-will.

Should new Radio receivers, public address amplifiers, and Radio accessories be sold? What discounts should be granted, or should list prices be maintained? How about credit and trade-ins? The answers to these questions are of vital importance to the beginner in Radio, for considerable extra profit can be derived from the sale of merchandise of this nature: again the answers depend to a great extent upon the policies of competitors.

A service man is generally looked upon as an authority, and his recommendations for the purchase of a certain make and model of receiver gain more attention than would the words of a salesman in a hardware or furniture store.

A warning is in order though—get the most important part of your Radio servicing business firmly established before going into merchandising. The display space required, the capital needed for the purchase of demonstration receivers, the problems of installment sales and the possibility of overstocking with consequent losses may prove the downfall of the too-ambitious man.

(*To be continued in next issue.*)

The Service Forum

Conducted by

J. B. Straughn, N. R. I. Service Consultant

PHILCO INTERPHONE — BROADCAST INTERFERENCE

Cross modulation from local broadcast stations may be eliminated by by-passing the volume controls with small condensers whose best value lying between .0001 mfd. and .001 mfd. can be determined by trial.

—n r i—

COIL REPLACEMENTS — I.F. AND R.F. OSCILLATOR

The Carron Manufacturing Company, 415 South Aberdeen Street, Chicago, Illinois can duplicate any coil. The Radolek wholesale mail order house handles Carron products.

RUDOLPH MOE, Minnesota.

—n r i—

HALSON MODEL CW-11 — CRACKLING NOISE

Replace the electrolytic condenser connected from the cathode of the 25Z5 to the chassis.

H. HOEVELER, New York.

—n r i—

BOSCH MODELS 200 AND 201 — LOW VOLUME

Low volume accompanied by noise is usually due to a leaky electrolytic filter condenser in the power pack. This is a dual unit having a capacity of 4 and 8 microfarad. It is also wise to replace the .01 microfarad 600 volt line buffer condenser.

—n r i—

BOSCH MODEL 350 — INTERMITTENT AND HUM

Check the rivet fastening the soldering lug to the grounded side of the filament. Loose rivets will allow the circuit to open giving rise to the above mentioned complaint.

—n r i—

BOSCH MODEL 350 — IMAGE INTERFERENCE

To cure this difficulty move the aerial wire away from the first detector R.F. coil and shield the wire by placing a piece of metal braid over the cambric insulation. Ground this braid to the shielding. A plate of sheet metal placed over the end of the chassis will decrease pick-up by the coils and wiring.

GENERAL ELECTRIC MODEL J-80 — CRACKLING AND WEAK RECEPTION

This is generally due to a partial open or short in the first audio primary. A new duplicate transformer should be installed.

—n r i—

GENERAL ELECTRIC MODELS A-82, A-87 — FADING

When the sensitivity control is found inoperative in any position, it may be well to check the position of the 6A8 bias resistor within the "sentry box." Often the lead of the carbon resistor (soldered to a lug on the terminal strip) grounds to the case of the longwave band padding condenser.

—n r i—

GENERAL ELECTRIC MODELS A-82, A-87 — INOPERATIVE SENSITIVITY CONTROL

If the sensitivity control is found to be inoperative in all positions make certain that the bias resistor for the 6A8 inside the coil container has not shorted to the case of the long wave band padding condenser. This will of course short out the sensitivity control.

—n r i—

GENERAL ELECTRIC MODEL J-83 — INTERMITTENT

Replace the 50,000 ohm resistor under the R.F. coil unit with a new resistor and go over all of the connections in the oscillator circuit with a hot soldering iron.

—n r i—

GENERAL ELECTRIC MODELS A-82 AND A-87 — DEAD

If the receiver is only dead when the tone control is in the bass position the trouble is due to a shorted .08 microfarad tone control condenser. This should be replaced with another rated at 600 volts.

—n r i—

GENERAL ELECTRIC MODEL J-107 — MOTORBOATING

When this action occurs and the volume remains the same with the AVC tube pulled out, replace condensers C19, C21, C35, C36 and C38. These condensers have in the same order the follow-

(Page 27, please)

Chicago Chapter

By the time you read this the party of June 26th will be but a memory—and what a memory. It was the cabaret type with a floor show by professional entertainers. A lively dance orchestra kept things pepped up at all times. It was strictly a social party at which all business cares were completely forgotten.

Not all of the entertainment was professional. Some of the amateur talent was "plenty good." Refreshments were served—soft, hard and medium—a strictly non-profit affair. Valuable door prizes were offered. The party was a fitting climax to a busy season. These affairs for the benefit of wives and sweethearts are always extremely popular. With this party the boys of Chicago Chapter rang down the curtain until the first Friday night in September. Big things are in store for this fall. Keep your ear to the ground.

———*n r i*———

Baltimore Chapter

It is anticipated that an important announcement will soon be made by the Chairman of the Baltimore Chapter which will be of great interest to all members of this Chapter. A dance is being discussed, but no definite decision has been made up to this time. Those who attended previous dances sponsored by the Baltimore Chapter are hoping these plans may soon be formulated.

At a recent get-together meeting in Baltimore the attendance was below expectations owing to the extremely warm weather, but what the occasion lacked in numbers was more than compensated for in spirit. Several members of Headquarters attended and enjoyed themselves immensely.

Chairman Jensen plans an affair which will be open to every student and graduate of N. R. I. in the Baltimore area. A good program is being arranged and due notice will be given in plenty of time so that every N. R. I. man in Baltimore and vicinity may arrange to attend.

Keep your eyes on the Baltimore Chapter—it is a live organization.

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Detroit Chapter

In spite of season and warm weather the attendance of the Detroit Chapter has not fallen off greatly, because the fellows who are genuinely interested feel they cannot afford to miss a single round table discussion.

A most interesting discussion was one on auto Radio antenna, installation, comparison of results of various types and how best reception can be obtained.

Many important topics are on schedule for discussion in forthcoming meetings. Every member of the Detroit Chapter should make it a point of duty to attend all of these meetings. Meetings are held on the second and fourth Friday of each month at 11305 oWodward Ave. All N. R. I. men are cordially invited to attend.

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Directory of Chapters

Baltimore—I. A. Willett, Secretary, 2411 Arunah Ave., Baltimore, Md.

Philadelphia-Camden—Clarence Stokes, Treasurer, 3347 N. Front St., Philadelphia, Pa.

New York—L. J. Kunert, Secretary, 66-11 74th St., Middle Village, L. I., N. Y.

Buffalo—T. J. Telaak, Chairman, 657 Broadway, Buffalo, N. Y.

Toronto—Ed. Witherstone, Secretary, 363 Nairn Ave., Toronto, Ont., Canada.

Chicago—L. Lewandowski, Secretary, 3130 So. 55th Court, Cicero, Ill.

Pittsburgh—Albert Maas, Secretary, 9 S. Howard Ave., Bellevue, Pa.

Detroit—C. H. Mills, Secretary, 5458 15th St., Detroit, Mich.

Directory of Officers

(To Serve Until January, 1938)

President—P. J. Dunn, Baltimore, Md.

Vice-Presidents—Earl Bennett, Evanston, Ill.
R. H. Rood, Los Angeles, Calif.
F. E. Oliver, Detroit, Mich.
Clarence Stokes, Phila., Pa.

Secretary—Earl Merryman, Washington, D. C.

Executive Secretary — L. L. Menne, National Headquarters, Washington, D. C.

———*n r i*———

I think the Alumni Association is a great thing and I hope we can have a local chapter near here before long.

LEON D. MARKHAM,
420 Prospect Ave.,
St. Louis, Mich.

ing values. .1 microfarad 600 volts, .5 microfarad 600 volts, 10 microfarads 400 volts, 10 microfarads 400 volts and 10 microfarads 200 volts. The trouble has definitely been traced to leakage between the condenser section.

n r i

GENERAL ELECTRIC MODEL K80-X — INOPERATIVE

Failure to operate at the high-frequency end of bands D and C where complete failure on these bands is generally due to a defective 2A7 type mixer tube. Try several of these tubes in the oscillator socket. A microphonic howl on strong signals is due to feed-back to the grid lead of the second detector. Shielding the control grid of this tube (2B7) will eliminate the trouble.

n r i

GENERAL ELECTRIC MODEL K-80 — DEAD

If a circuit disturbance test shows the audio system to be all right check the voltages applied to the 2A7. Extremely high voltage on the control grid with low plate and screen voltages indicates a short between the detector coils. In some instances it is possible to repair the coil but usually a new one should be installed.

n r i

GENERAL ELECTRIC MODEL J-100 — OSCILLATION

This is generally due to an open in the 10 microfarad electrolytic condenser whose yellow lead goes to a lug on the volume control. A new condenser should be installed and it must be remembered that the positive lead of the condenser in this particular circuit goes to ground.

n r i

GENERAL ELECTRIC MODEL M-106 — WEAK ON SHORT WAVES

Check the continuity of the R. F. and detector condensers in the control grid return circuit. If any leakage is observed the condenser should be replaced. Dial slippage at fast speed may be eliminated by removing the chassis and bending down the three contact springs on the tuning knob shaft.

n r i

PHILCO MODEL 112 — SHIFTING TUNING CONDENSERS

If it is found necessary to retune the receiver after it has been set to a station the trouble is probably due to the tuning condenser slipping to another point. A stretched dial cord or a weak tension spring will allow this to occur. Philco spring part No. 77760 should be employed.

n r i

PHILCO MODEL 112-X — WHISTLE

Locate the plate leads of the pentode tubes. If they run around the inside edge of the chassis to the two lower terminals of the speaker socket run them diagonally across the chassis base to the plates of the tubes. It is necessary that their polarity remain the same.

n r i

PHILCO MODELS 116 AND 116X — HUM

If hum is heard with the gain turned on low place .1 microfarad 600 volt condensers from each side of the power transformer primary to the chassis.

n r i

PHILCO MODEL 118 — INTERMITTENT

Replace the .05 microfarad condenser connected to one lug of the volume control. The Philco replacement part number is 30-4020, although an ordinary tubular condenser can be used.

n r i

PHILCO MODEL 118 — LOW VOLUME

This is often caused by a high resistance short in the R.F. trimmer condenser. The installation of a new trimmer will clear up the trouble.

n r i

ATWATER KENT MODEL 489 — DISTORTION

This is often due to a defective volume control. It should be checked with an ohmmeter and if its value has increased above normal (500,000 ohms) a new control should be installed.

n r i

ATWATER KENT MODEL 510 — AUDIO HOWL

This is due to use of power tubes in the push-pull audio system which are not matched. The use of tubes which draw approximately the same plate currents will eliminate the trouble.

n r i

ATWATER KENT MODEL 510 — DEAD

If the receiver is dead and the shadowgraph indicator functions normally check the R.F. choke in the diode circuit as it may be open.

n r i

ATWATER KENT MODEL 510 — 80 TUBE OVERHEATS

This instead of being due to broken down filter condensers as is usually the case may be caused by a grounded filter choke. The coil winding becomes short-circuited to the iron core which is normally grounded. While temporary repairs can be made by insulating the choke assembly from the chassis thus ungrounding the core, it is best to install a new part.

n r i

ATWATER KENT MODEL 511W — GENERAL FAULTS

Automatic feature won't shut off, tuning condensers swing to 1,600 kc. O.K., but line is not cut. Look at nine point normal, off, and automatic switch at right on front panel. Switching blades are a little too wide and sometimes contact two points at once, preventing opening of

(Page 29, please)

New York Chapter

Allen Arndt, the energetic Chairman of the New York Chapter is planning big things for this fall and winter. Executive Secretary Menne is scheduled to confer with Chairman Arndt to lend aid from Headquarters to complete an extensive fall and winter program for this large and enthusiastic Chapter.

Headquarters has been pleased to receive a number of visitors from New York Chapter who have been in Washington. Summertime is vacationtime and all students and graduates and Alumni members who visit Washington are assured a cordial welcome at Headquarters.

Chairman Arndt's able talks in the solution of Radio problems have received many favorable comments. All members are urgently requested to attend every meeting to profit through these interesting talks and discussions.

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Philadelphia-Camden Chapter

Chairman Helmig repeats that all students and graduates in the Philadelphia-Camden area are cordially invited to attend meetings and a profitable evening is assured. Meetings are held at 3347 N. Front St., Philadelphia, on Wednesday of each week, starting promptly at 8:15 P. M.

The business meeting is held on the first Wednesday of the month. The second meeting is devoted to instructions and demonstrations in salesmanship, under the direction of Clarence Stokes. The third weekly meeting is given to practical demonstrations and discussion of Radio problems and the fourth and last meeting of the month is devoted to an open forum of advanced Radio subjects in which discussion all are invited to participate.

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P. R. Mallory & Co., Inc., Purchase Assets of Electrad, Inc.

P. R. Mallory & Co., Inc., Indianapolis, Ind., announce the purchase of the assets, good will, trade-marks, patents and patent rights of Electrad, Inc., New York City. L. A. de Rosa, Chief Engineer, and other key employees of Electrad, Inc., will join the Mallory organization. Plant and offices will be moved to Indianapolis.

General Electric Announces New Radio Outlet

A convenient and attractive outlet for noise-reducing or "doublet" antennas, which eliminates the usually unsightly wiring connections characteristic of most Radio receivers installed in the home, has been announced by G-E. The outlet affords a compact means of separable attachment for ground, antenna (two-wire), and power leads for a Radio set. Lead-in wires are thereby eliminated and replaced by neat, short lengths of cord.

The new outlet has three slots in the upper portion for ground and antenna connections, and the conventional two in the lower portion for the power plug. A metal divider is attached securely to the body of the outlet to separate the low and high tension circuits in the switch or outlet box.

A special cap is also available, with polarity prongs arranged so as to prevent antenna and ground circuit from connecting with the power side of the outlet. The circuit connections are clearly indicated on the face of the outlet.

The slots in the Radio side of the outlet for the ground and antenna circuit, and the prongs of the special cap are set at an angle not found in any other type of convenience outlet. The special cap cannot be used with any other outlet.

———n r i———

Arcturus Publishes Revised Tube Index

An up-to-date index of all broadcast receiving tubes has just been published by the Arcturus Radio Tube Company, Newark, N. J. The index serves as a quick reference source for ascertaining the purpose of any specific tube. Every tube is identified by filament voltage, filament current, whether filamentary or cathode type, description of its function and the number of useful elements.

Three hundred and thirty tubes are listed in this index which is a ten page letterhead size pamphlet. Space is provided in the directory so that any new tubes which may be placed on the market for years to come can be readily entered in proper numerical order.

These indexes are available through Arcturus distributors or direct from the factory at a cost of ten cents each which also entitles the subscriber to receive automatically periodic notices of changes and additions of new tubes.

———n r i———

The fellow who does not see things through—is through.

The Service Forum (Continued from page 27)

the circuit. File blades down a little or replace with later type switch available from factory. No reception. Look for leads soldered to tone control switch touching housing of volume control and grounding out. These two are mounted so close together on front panel that sometimes the rubber insulated pieces on the tone control leads slip off from vibration. Slide them back in place or bend the leads back. Hum not due to circuit faults may be due to reversal of antenna and ground. 5Z3 rectifier and 2A3 tubes also seem critical. Change them when looking for hum.

n r i

ATWATER KENT MODEL 555 — AUDIO HOWL

Audio howl in this set has been found to result from an open 4 microfarad plate filter condenser in the A.F. circuit. A misleading factor in diagnosing the trouble is that the open condenser does not cause any appreciable increase in hum. It is listed as C14 in the A.K. schematic.

n r i

ATWATER KENT MODEL 557 — DISTORTION

This distortion accompanied by a narrow shadow on the tuning indicator is usually due to grounding of the cathode terminal of the 55 type tube by one of the screws used to hold the bottom plate shielding to the chassis. This screw may be loosened, a shorter one installed or the cathode terminal of the socket may be bent to prevent this occurrence. Voltage checks indicate lack of cathode voltage on the 55 tube thus showing up the trouble. Also a cathode to chassis check with an ohmmeter will indicate the presence of the short. Naturally the difficulty will show up when the bottom plate of the chassis is removed.

n r i

ATWATER KENT MODEL 557 — OSCILLATOR DRIFT

This trouble when experienced on the short wave bands may be corrected by bonding (connecting) the frame of the wave band switch to the chassis by means of a flexible piece of wire. Also clean the contacts of the switch with carbon tetrachloride. Try not to disturb the position of the wires connected to the wave band switch as movement of these wires will necessitate realignment of the receiver.

n r i

ATWATER KENT MODEL 557 — INTERMITTENT

This difficulty has oftentimes been traced to poorly soldered connections. It is worth while to pull on the various leads and push on contacts with some insulated instrument such as an aligning tool. Poor connections can sometimes be shown up in this manner. A hot soldering iron applied to the various connections until solder flows freely will clear up rosin joints.

n r i

ATWATER KENT MODEL 637 — DEAD ON BROADCAST BANDS

Check the value of the 30,000 ohm gray resistor used to supply the plate of the 6A8 tube with voltage. If the resistor has increased in value it should be replaced with another rated at 1 watt.

n r i

CLARION MODEL 100 — INTERMITTENT AND NOISY

This is sometimes due to a partial open in the oscillator coil. To check momentarily short the plate end of the coil to the chassis and if it was defective the coil will completely open up. A new coil should be installed and the receiver realigned. This chassis is the same used in the Silvertone 1506.

HOWARD SPEIDEL, Iowa.

n r i

STEWART WARNER MODEL 127A — OSCILLATION

If this receiver howls and oscillates intermittently and everything seems to check O.K. pull all tubes and shields. Then using a punch and small anvil tighten rivets on all shield bases and sockets. Tighten all nuts on chassis and coil shield supports. When replacing tube shields bend them for a tight fit and the trouble will be remedied.

HOWARD SPEIDEL, Iowa.

n r i

CROSLEY MODEL 706 SHOWBOX — SERVICING

It has been found that considerable leakage usually exists in the metal clad by-pass condensers. Always check these individually and if necessary use a good grade of tubular condenser rated at 600 volts D.C. Such condensers as replacements have given me better results than the originals and are less expensive.

JOHN REPTIK, JR., Indiana.

n r i

BATTERY CORROSION — REMOVING

Dissolve a teaspoonful of baking soda in a glass of water. Immerse the battery clips in this solution which will remove the corrosion in about 15 or 20 minutes.

ARTHUR E. KROHN, Illinois.

n r i

NEUTRALIZING WITHOUT AN ADAPTER

When an adapter is not available or the socket prong holes are too tight to allow one to slip a soda water straw over the filament prong, wrap one filament prong with silk thread. This effectively opens the filament circuit and the stage may then be neutralized in the usual manner.

DAVE OWENS, Canada.

Here and There Among Alumni Members

Graduate Charles Sicuranza of Brooklyn has reached great heights as a technical writer for Radio Craft magazine. He is now preparing five articles describing a super-powerful 30 tube receiver.

—n r i—

One of our newest members is Clarence Sturmer of Meriden, Conn. He is already a 100% booster. His enthusiasm for the Alumni Association and what it stands for is genuinely inspiring.

—n r i—

Bowden, North Dakota, is a town of 303 people, yet it has its own telephone exchange and lighting system. Fellow member T. Tellinghuisen is the man who takes care of both and in addition he made $800 last year, in his spare time, doing Radio servicing.

—n r i—

Somebody sold C. Alexander, the genial accountant at headquarters, the idea that two can live as economically as one. And he being Scotch, too. Yes, sir, Alex took upon himself a bride. The boys gave him a swell party, steak dinner and all that sort of thing. Good luck, Alex! Now will some one please start working on Mr. Luber, the remaining eligible bachelor.

—n r i—

Greetings to all members come from Dr. Mohammed Fouad in Guiza, Egypt. Dr. Fouad is doing very nicely in Radio. He is a graduate of this year.

—n r i—

Here's a lesson in perserverance. Charles W. Sult of Wytheville, Virginia, operates the Community Radio Service in his city. In spite of a serious accident which happened shortly after he enrolled and confined him to bed for a year, ninety-six days in a plaster cast and three months in a hospital, he carried on and today has a prosperous business to reward him. There are eight good reasons why Sult must make money—a devoted wife and seven husky youngsters.

—n r i—

And here is a cheerio from Edwin Boehm, Glenwood, Iowa.

—n r i—

A. Singleton of Chicopee, Mass., gives us a bouquet on the job sheets which he says have "helped him plenty."

—n r i—

The expert piano tuner of Tucker, Georgia, is W. S. Holloway, who now is also an expert Radio man. Says he likes the News so well would like to receive it every month.

This column is conducted for you fellows. We need help. Let us have your comments, please.

—n r i—

Thos. Michenvitch of Hamilton, Ont., Canada, recently made a connection with Westinghouse of that place and found as his co-workers, two other N.R.I. men. Already they are fast friends.

—n r i—

L. H. Alberga of St. Andrews, Jamaica, B.W.I., one of our newer members is agent for Stromberg-Carlson in Jamaica and earns $25 to $30 weekly which, he says, is equivalent to $50 to $60 in the United States. You're telling us!

—n r i—

Sir Walter Scott said, "To the timid and hesitating everything is impossible because it seems so." Step out, fellows, have the courage to try and then hang on through thick and thin. This is indeed a day of opportunity but you must be aggressive. Nothing is impossible, at least nothing is until it has been proved otherwise.

—n r i—

O. A. England of Eugene, Oregon, is telephone and telegraph inspector for a railroad. Been with them fifteen years, but his spare time Radio business has grown so he now plans to open a Radio shop this fall. That's the spirit.

—n r i—

On the stationery of Canadian DX Relay comes a letter of greetings from J. Ls. Huard, amateur Radio VE21G, Drummondville, Que., Canada. Mr. Huard is glad to be a member of the N. R. I. Alumni, which he refers to as "that great fraternity of N. R. I. men."

—n r i—

Our sincere friend, fellow member F. R. Hills of Regina, Sask., Canada, sends us an announcement of the birth of a bouncing nine pound boy. He says "you will notice an N. R. I. graduate scores again." Mr. Hills has helped dozens of fellows over the rough spots. Young Robert dropped in at the right place. Congratulations!

—n r i—

Orville E. Hartford of Hyde Park, Mass., writes he is official field serviceman for Midwest Radio Corp., and that he has applications with Sears Roebuck, Chicago, Ill., Western Auto Supply Co., Kansas City, and Montgomery Ward, Albany, N. Y. He suggests that N. R. I. graduates might find it advantageous to apply for appointments for the territory in which they reside.

—n r i—

What's new? Help! Help!

Thinks Everyone Satisfied Now

A few words about the Service Forum. I think the nail was hit squarely on the head in the April-May issue. Having the service notes on one side of the page and non-technical material that is of no value after it is read on the other side, will enable one to remove the notes and paste them on 3 by 5 inch cards and file them according to set model and name.

I have all of mine on such cards and have them indexed. In this manner I can glance at the index and see if I have any material on any certain set that I may be working on or that is to be repaired. This saves a lot of time and enables one to do more efficient work. As I said before, the April-May issue was ideal and I know that everybody will be satisfied now.

John Reptik,
Indianapolis, Ind.

—n r i—

Additions to N. R. I. Ham List

The following call letters of amateur stations have been received since the last issue of the News:

James F. Gossage—W29N4—Long Beach, Calif.
Joseph P. Adrosko—W21CJ—Elizabeth, N. J.
Bruce A. Wood—W3FYO—Westchester, Pa.
Robert E. Hahn—W9RFL—Waverly, Iowa.
Harold A. Stevens—VE1LF—
New Glasgow, N. S., Canada.
Chester Osiechi—W1KNT—Ansonia, Conn.
J. H. Crowley, Jr.—W4DNS—Memphis, Tenn.
James Walmsley—VE4AEM—
Moose Jaw, Sask., Canada.
Joseph Tatkosky—W4ETR—Pensacola, Fla.

—n r i—

Wants Comments On New Cover

Doesn't *anybody* like the new cover on "our" News? Have seen only one comment so far. Well, I think it's swell, anyhow.

George Dunkirk,
Los Angeles, Calif.

More About The Service Forum

In former issues of the News there have appeared suggestions by Gus Sankey of New York City and H. Segell of Johannesburg, South Africa, concerning the publication of the Service Forum. Mr. Sankey suggests the Service Forum be printed opposite the Alumni News, as it now is, Mr. Segell wants it published in the same manner as the Service Sheets, so that the notes may be filed in our Radio Trician Service Manual.

Well, I will illustrate Mr. Segell's suggestion with the following example: After reading the News I extract the Service Forum Sheets, punch holes and file them in my Radio Trician Service Manual. In a few months I would have quite a few Service Forum Sheets on file. Suppose a customer brought me a receiver for repair, for instance a Stewart-Warner. I would have to look through all the Service Forum Sheets to find the correct hint to cover the particular trouble with this particular receiver.

Now let us consider Mr. Sankey's suggestion in the light of the following example: I extract the Service Forum Sheets, cut out each hint separately, and paste them on separate sheets of paper: all hints on Stewart-Warner models on a sheet entitled "Stewart-Warner"; all those on General Electric models on a sheet entitled "General Electric"; and so on. I then arrange these pages in my Service Manual in alphabetical order. To find a hint on a certain model I have only to refer to the sheet corresponding in name to the make of the receiver, and I have the Service Notes "in a jiffy."

With Mr. Segell's suggestion, I would have to look through all the Service Forum Sheets to find the correct hint. This would involve the loss of much precious time which the serviceman can't afford to waste, just in finding the correct service notes.

I personally favor Mr. Sankey's suggestion as nothing will be lost after the Service Forum Sheets have been extracted, whereas in Mr. Se-

(Page 32, please)

The Mailbag (Continued from page 31)

gell's suggestion only half of the hint would be available because the other half would be lost through that side of the sheet being pasted on another sheet for filing purposes. With my version of Mr. Sankey's suggestion, I make my Service Manual more attractive, time saving and easier to use.

PAUL MELNITSKY,
Erie, Pa.

———n r i———

Radio's Biggest Summer

Warm Weather Slump Disappearing

(Condensed from "Broadcasting & Broadcast Advertising")

The summer of 1937 will make Radio advertising history, and lots of it, for two reasons:

1. National Advertisers, finally convinced that people listen in the summer, are continuing their use of network and spot time right through the erstwhile "doldrum" season.

2. Spot placements are flaring upward so swiftly that time buyers are finding it difficult to get choice periods as dozens of new advertisers are joining the spot ranks.

Around network headquarters, the schedule makers have been waiting for agencies to barge in with the usual summer cancellations but only a few sponsors have tightened the purse strings for the season, and they are mostly seasonal distributors who practically shut-up shop when the blossoms appear.

Most striking of all current trends, however, is the unexpected mushrooming of spot placements all over the Radio map.

This roundup of the time-buying business is based on an agency-to-agency survey made by Broadcasting correspondents in a half-dozen cities where the bulk of Radio time is placed.

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New Ham Catalog

A catalog compiled exclusively for the Radio amateur and short-wave broadcast fan has just been released for free distribution by Wholesale Radio Service Company, Inc., of 100 Sixth Avenue, New York City.

It lists complete lines of short-wave receiving and transmitting accessories as well as factory-built receivers and transmitters. Every nationally-known manufacturer is represented. A post-card with your name and address on it or a phone call will bring you a free copy.

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Index