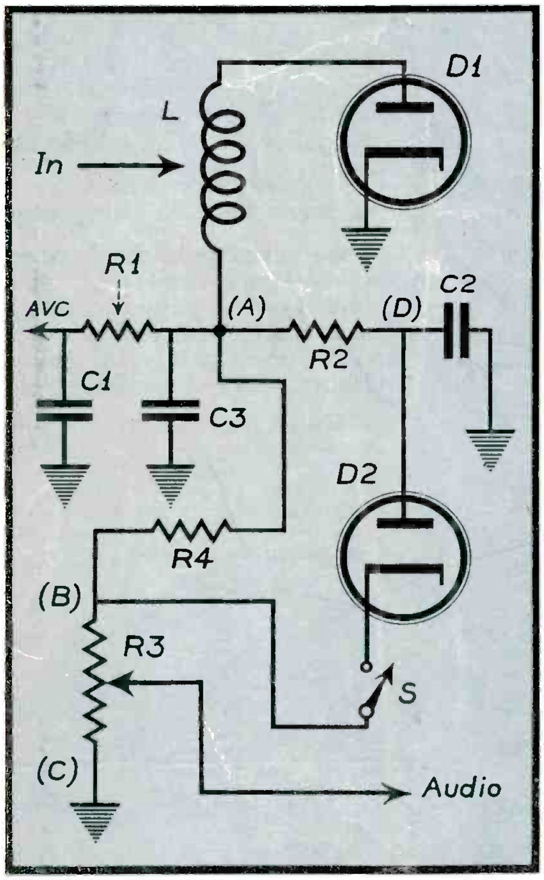
NATIONAL TRADE SHOW ISSUE

SERVICE

A Monthly Digest of **RADIO** and Allied Maintenance



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(*See page* 338)

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JUNE
1937

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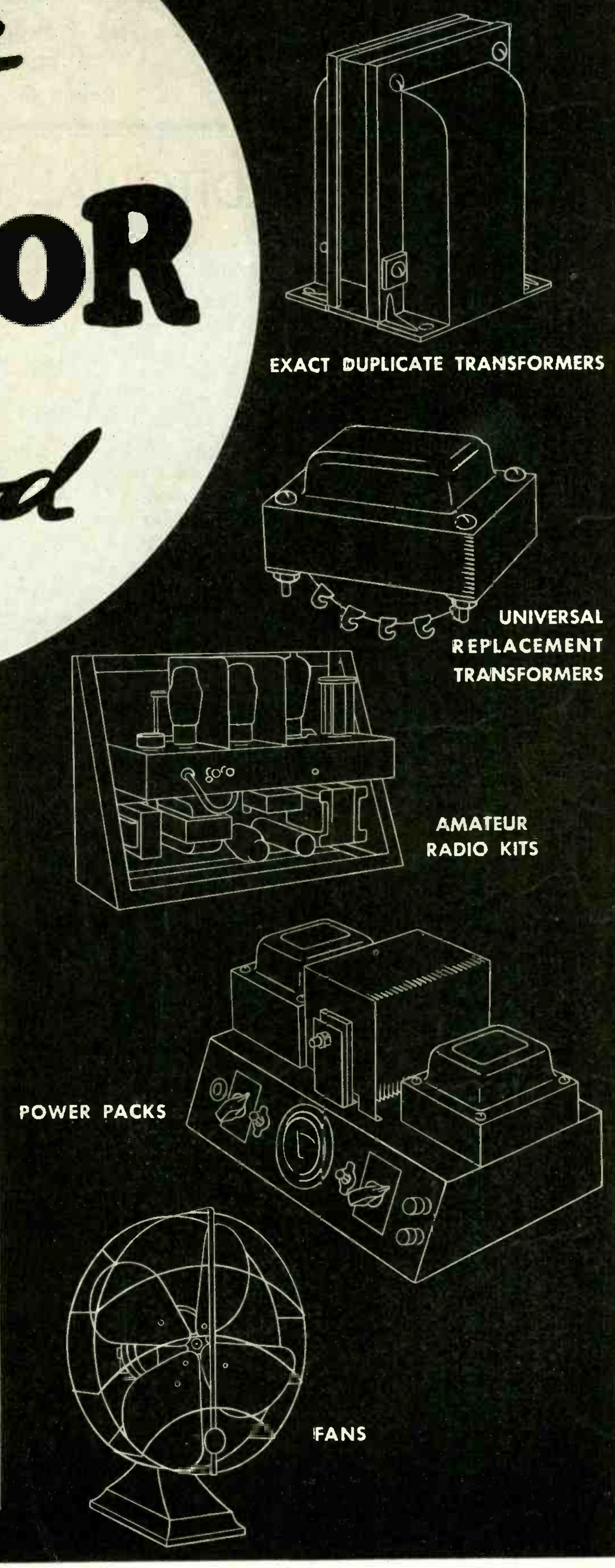

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office. Member, Audit Bureau of Circulations

EDITOR
Robert G. Herzog

JUNE, 1937 VOL. 6, NO. 6

EDITORIAL CONTENTS

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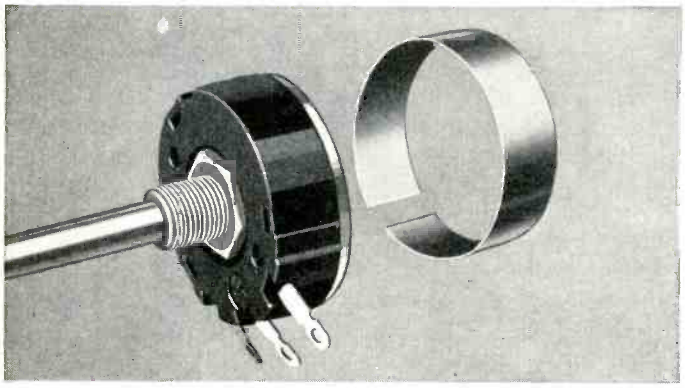
The LONGEST *path is the* SHORTEST



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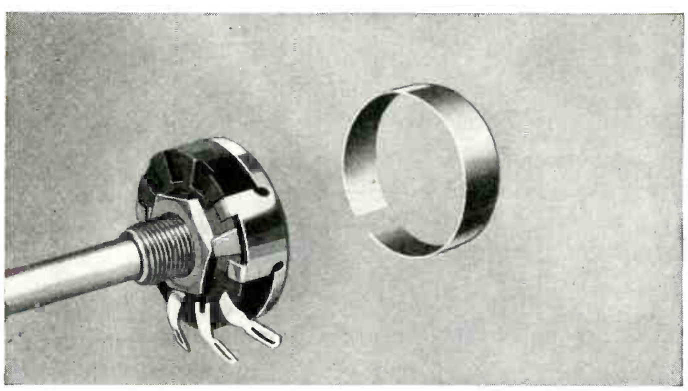

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THE ANTENNA . . .

NATIONAL PARTS SHOW

AS THIS ISSUE COMES OFF the press the National Parts Show opens at the Stevens Hotel in Chicago. The Show and attending conventions are scheduled for four days, June 10 to 13 inclusive. Sales managers, distributors and engineers representing every parts manufacturer will be there personally to meet the Service Man, discuss his many problems and make possible suggestions for better cooperation in the future.

These shows present quite a problem to those who stage them; the cost to the manufacturers is enormous . . . yet it is all for your benefit, to help you do a better job and make more money from it.

Your part in this affair is your attendance at the show and technical sessions . . . bring your ears and your problems . . . see what's new . . . much can be learned to help increase your profits.

• • •

HANDY-MEN AND TINKERERS

NO MATTER HOW REMOTE our connection with radio, we all continually find ourselves taunted with:

"My wife's cousin has a Blank radio, I think it has six tubes . . . well, it makes funny little noises. Do you think if I changed the power transformer . . ."
or maybe

"I've got a radio, it's eight years old and it plays swell, better than any of these new pieces of junk . . . but the other day . . ."

You should have a series of tactful answers, when these are directed at you, some humorous, or technical or serious as the case might warrant. In any event the reply should be such as to completely discourage the owner from tinkering with the receiver.

There isn't one of you who has not encountered receivers in which parts were interchanged or "mended" by owners without regard to circuit constants. Certainly you have all met with the chassis in which the trimmer condensers were "adjusted" until their screwheads were worn ragged.

This tinkering with expensive receivers when trouble develops may be partly a hangover from the earlier days in radio when many otherwise respectable citizens were radio bugs, built their own sets and discussed wave-lengths, vacuum tubes, regeneration, etc., with the same enthusiasm now reserved for the pitching abilities of Carl Hubbell or Dizzy Dean.

The reluctance of many people to call in their Service Man may also be partly a result of the "fix anything" handy-man type of owner whose ability to take anything apart, whether it be a dollar alarm clock, a hundred dollar radio or a thousand dollar automobile, is considered ample to cope with any receiver trouble without the need of such gadgets as tube testers, vacuum tube voltmeters or cathode-ray oscillographs.

In a good many cases, however, this reluctance is due to a sad lack of confidence in the local Service Man, or more correctly, in Service Men in general, and a fear that he will overcharge. . . . The practice of unscrupulous dabblers styling themselves "Service Men" has undoubtedly done much to strengthen this attitude.

But a new day is due! The competent and thoroughly conscientious honest service rendered by the vast majority of Service Men should be brought to the attention of the public. Many Service Men's associations are considering this as one of their prime functions. Advertisements in daily newspapers, phone books, shop windows, etc., are carrying the banners of a competent and honest service industry. The National Trade Show in Chicago and the attendant publicity should also go far toward convincing the public of the competence of the service industry.

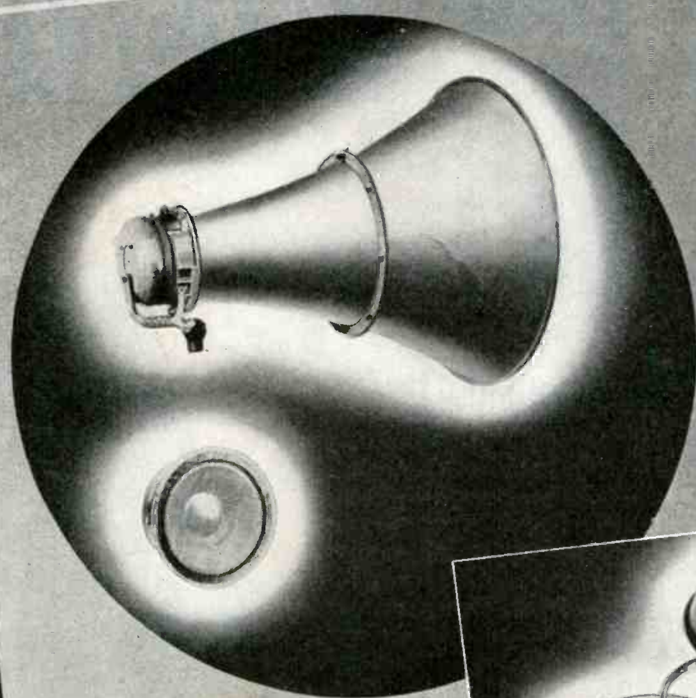
• • •

INTERCOMMUNICATING SYSTEMS

FOR SEVERAL MONTHS WE have been stressing the fact that the sale of intercommunicating systems is a natural for the Service Man. Reports from wide awake Service Men who have already taken our advice show ever increasing sales.

In every locality there are undoubtedly innumerable factories, offices and homes that can be sold some type of system. If making a living from the sale of radio devices and service is your job, you owe it to yourself to go out after this business. With a good line you will find, as others have, that the sale of these systems will make your business show *real* profits.

RECOGNITION—the REWARD FOR ACCOMPLISHMENT



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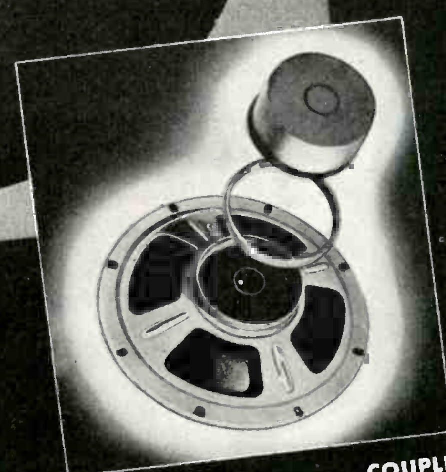

COUPLING RING UNIT ASSEMBLY Assures Permanent Voice Coil Alignment and Simplifies Cone Replacement.

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WINDOW DISPLAY, 11 x 17, and . . . .
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VELOCITY **AMPERITE** MICROPHONES

SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR JUNE, 1937

GRAPHS

By JOSEPH SCHOENBAUM

THE ARTICLE presented below is quite elementary and is written largely as an introduction to this subject for the Service Man who is wholly unfamiliar with graphs. It should, however, prove of interest to practically every Service Man.

Graphs are used profusely throughout all radio literature. If any iota of value can be gleaned from reading an article on this all-important subject, the time may be considered well spent.

GRAPHIC: Syn. vivid.—suggests telling, vivid, salient, forcible. (*Webster's Collegiate Dictionary.*)

GRAPHS are to numbers what the tabloids are to the everyday news of the world. They present in condensed comprehensive form complete pictures that in other modes of expression require thousands of words or complex formulae. One might spend fifteen minutes reading a report of the types of uniforms worn in a parade, while one graphic photo will show all at once, and in detail that a written report would not attempt to cover. Similarly a graph is a picture, not only of a mathematical equation or series of equations, but a picture of these equations in action.

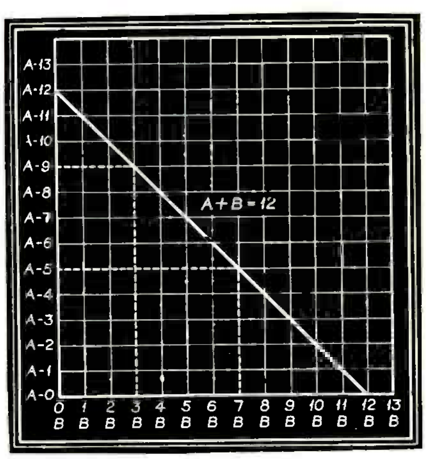


Fig. 1. Graph of the sum of any two numbers equal to 12.

In another sense a graph is like a map of a city. It might be quite difficult to explain to a stranger just how to get to a distant point, but give him a map and show him just where he stands on the map, and he will have little difficulty in finding his way. In like fashion, one can easily read a graph while the complex formulas which go to make up the graph are often beyond the abilities of even advanced students.

Graph Presents All Solutions

A graph is the only mathematical instrument that presents all the solutions to a problem at once, in addition to solving the problem. Graphs, too, can give the answers to several related problems all at the same time. They are actually a method of solving arithmetic and algebraic problems, and require only an understanding of their simple basic principles to accomplish mathematical wonders.

How to Read Them

The reading of a graph is one of the quickest solutions to any problem. If we did not know how to perform addition we could still get a correct answer to a problem if a graph of the problem were at hand. Let us suppose that we had a graph as shown in Fig. 1 with horizontal lines representing A from A = 0 and A = 1 to A = 12, and vertical lines representing B from B = 0 to B = 12. The slanted dark line represents the equation

$$A + B = 12$$

which means the sum of any two numbers that equals 12. We want to know what B equals when A is equal to 5. But we do not know how to add so we

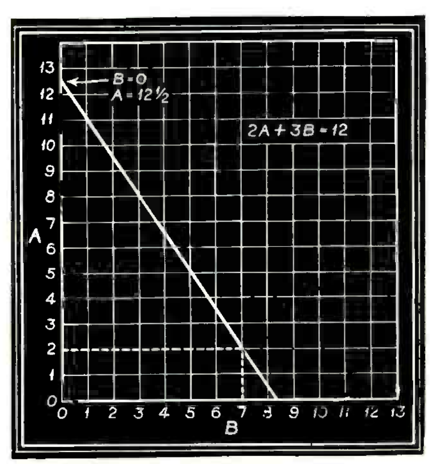


Fig. 2. The sum of two products.

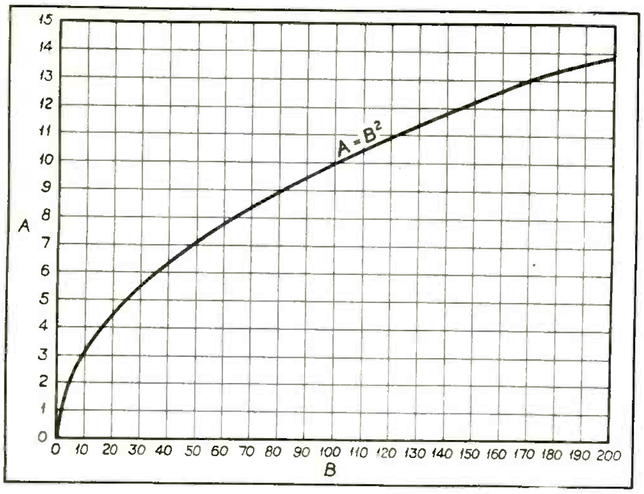


Fig. 3. Square and square-root graph.

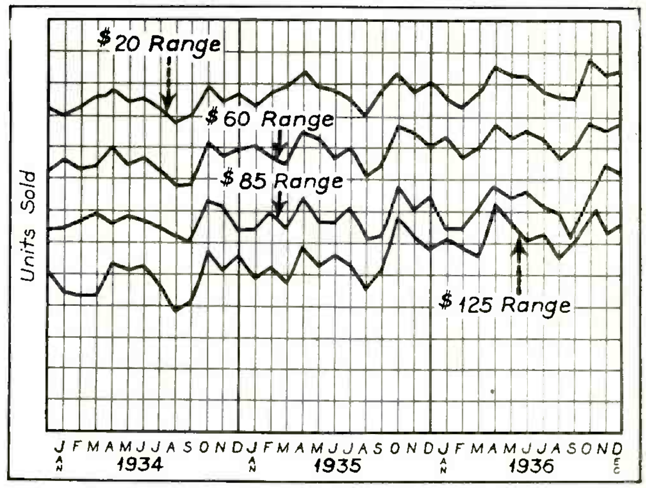


Fig. 4. Sales trend graph.

start at the point A = 5 and go to the right along the dotted line. When we reach the slant line we stop and change our direction downward. When we reach the end of this new line we find that we are on the line B-7, or B is equal to 7. Similarly if B is 3, to find A, we start at the line B-3, go up until stopped by the formula line, and find ourselves on the line A-9.

If we could add and subtract but had not yet learned to multiply, we would find ourselves stopped by the equation

$$2A + 3B = 25$$

Having at hand in Fig. 2 the graph for this equation we can find the value of B for any value of A or vice versa. The question is to find B when A is 2. Starting with 2 in the A group we go to the right until we reach the formula line, and then go down along the line at that point. Our answer, it is apparent, is that B is 7.

In the case where B is zero, we follow upward along the B-O line, which is the A axis, until we reach the formula line. Since we are already on the A line, and need not go to the left, our answer is right there, or A = 12½.

To illustrate a problem easily solved in a finished graph, but quite difficult without the graph, we see in Fig. 3 the solution of the equation $A = B^2$, which in graph form gives to a fraction the squares and square roots of numbers, limited only by the size and form of the sheet of graph paper. The square of 13, for instance, if we follow the horizontal line numbered 13 from the left to the equation line and then down, is 169. In reverse, the square root of 158, if we go vertically along the 158 line until we reach the equation curve and then go left, is 12.6.

Why They Are Used

Frequently in the everyday world it becomes necessary to compile long lists of statistical figures, as in the study of automobile accidents, stock market figures, birth rates, sales trends, etc. These figures by themselves give certain definite information which may have various uses. However, their value is quite limited unless they are

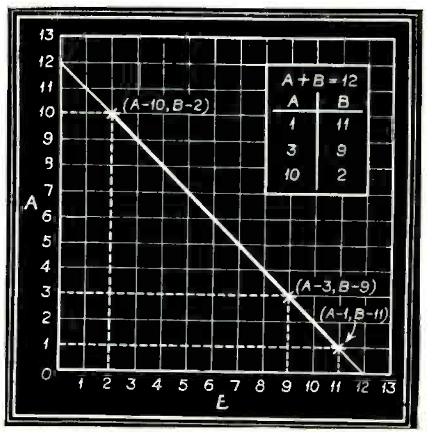


Fig. 5. Plotting the graph.

indicated graphically. The plain figures have no way of indicating change or rate of change, which are the most important factors in life. When pictured in the form of a graph these figures convey new meaning. They may be compared—the slopes of the graph indicate how rapidly and to what extent changes are occurring; they indicate any possible periodic variation and when new highs and lows may be expected in the future. Truly when once cold figures are assembled in graphic form, a complete picture unfolds. For instance, in Fig. 4 is a sales graph showing the result of a three-year survey of sales in four price ranges. At practically a single glance one can see a definite seasonal trend with its different variations for the different price groups, and just how the sales of the several models are related. Observation of such a graph which is produced by competent authorities will lead a manufacturer to balance his purchases, production and sales, and will show him where and in what manner he must put forth special effort to balance his annual schedule.

Almost any list of figures leads to a graph. If one were to try to examine the tabulations of one day's operations on the stock exchange, he would find it necessary to spend considerably more time making enough comparisons from which to draw conclusions of any value than results arrived at in such manner would be worth. A rapid transfer of these figures to a graph sheet would show a comprehensive picture of the day's operations as well as provide a quick means of comparison with previous days. Further, the trend of the market at every moment is indicated so that a relationship between cause—the economic occurrences of the time—and result—price fluctuations—may be observed for future use.

How to Make Them

There are several variations in the ruled forms used in making graphs, some more convenient than others depending upon the exact form of the graph desired. Some of these forms have widely spaced lines, ruled in squares, from four to eight to the inch. Frequently finer spacing is used, about ten lines to the inch both vertically and horizontally. This gives us 100 squares to the square inch. Usually in this ruling every fifth line is slightly heavier than the other lines, and every tenth line still darker, thus providing a more convenient form for the rapid construction and easy reading of the graph.

In Fig. 5 is shown a sheet of graph paper on which we are going to plot, as an illustration, the graph used earlier, of the formula

$$A + B = 12$$

Starting at a convenient point 0 near the lower left corner, we draw a vertical line which will represent values of A, and a horizontal line which will represent values of B. Then we mark off the squares starting with zero at the intersection and ending with 13 near the right and top of the two lines. In order to plot the line we first select several representative points; let us say, points at which A equals 1, 3 and 10 respectively. For these few values of A we note from the formula the respective values of B, 11, 9 and 2. These three sets of values are noted in the following manner:

1 (A = 1, B = 11)
2 (A = 3, B = 9)
3 (A = 10, B = 2)

We now proceed to the graph. Starting at 1 on the A or vertical line, we go horizontally to the right until the vertical line that passes through (B = 11) is reached, as shown by the dotted line. At the intersection of these two lines A(1), B(11) we mark a small cross. The same process is repeated for the other two points, so that finally there are three crosses marking three line intersections. After drawing a line connecting these three points we note that the line is straight, and to complete the graph we extend this line at both ends until it intersects A and B. We now have the complete graph of all the positive values of the equation A + B = 12 from which we can read to a fraction the value of B for any value whole or fractional of A and vice versa.

The graph just completed is that of a straight line; now we will proceed to construct the graph of a curve. Let us take the apparently simple formula AB = 12 and prepare the vertical and horizontal guide lines, or axis, as in the previous example. Now in order to facilitate the construction of a graph in which more than two or three points are desired, the points selected are generally first tabulated as follows:

A	B
1	12
2	6
3	4
4	3
6	2
12	1

Each line of the table represents the intersection of an A and a B line, and in Fig. 6 we mark crosses at these spots. When these points are finally plotted it is seen that no three are in a line that could be drawn by a ruler. Now, in order to obtain a representative curve it is desirable to draw not straight lines from point to point, but a rough freehand curve that goes from point to point. Another thing we note is that this curve shows no very great inclination to intersect either the horizontal or vertical lines representing A and B. As a matter of fact the curve never does reach either guide line, for no matter how large A or B may be, the other still has a positive value; for instance, if A is 24, B is ½ as shown in the figure. Similarly if A is 120, B still has a value of 1/10 which can be measured. It is only at infinity when either A or B becomes zero that the curve ends. The curve that we have just drawn is known as a hyperbola.

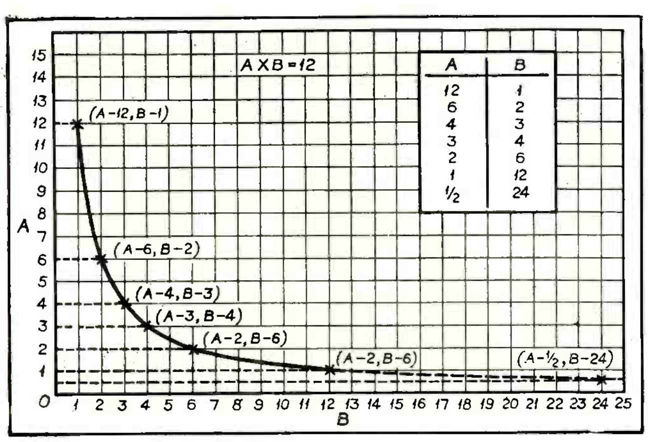
Solving a Problem By Graph

We have just purchased a new tube which the characteristics sheet shows as a Class B output tube. However, we want as few tube types as possible and would like to use one of these tubes as a Class A power driver. In order to do this properly we must know the correct bias. With the aid of a voltmeter, a milliammeter and a few batteries, we can determine exactly where to spot the bias by using the following procedure. In Fig. 7 is shown the fundamental circuit for plotting the grid-voltage plate-current curve of the tube. With the plate supply fixed at 250 volts, we vary the grid voltage by means of the potentiometer from plus 5 to minus 30 volts in steps of one volt. For each value of voltage impressed on the grid there is a corresponding value of plate current. After tabulating these values opposite each other we obtain a sheet of graph paper and proceed to plot these points as shown in Fig. 7. After these points are plotted with crosses a smooth curve is drawn through all of them as illustrated. The curve we now have is the characteristic curve of the tube with a plate voltage of 250, and is shaped somewhat like a drawn out letter S, bending from the straight portion at a and b. For best Class A operation the grid bias should be adjusted to a point about midway between the upper and lower bends. Selecting visually or with a ruler the point midway between a and b, we find that the grid bias should be —13 volts. We also learn that for maximum undistorted output an rms signal of 20 volts should be delivered to the grid. If more than twenty volts of signal is applied to the grid, or ten volts each side of the bias, distortion will appear since the tube begins operating past the ends of the straight portion of the curve.

Other Types

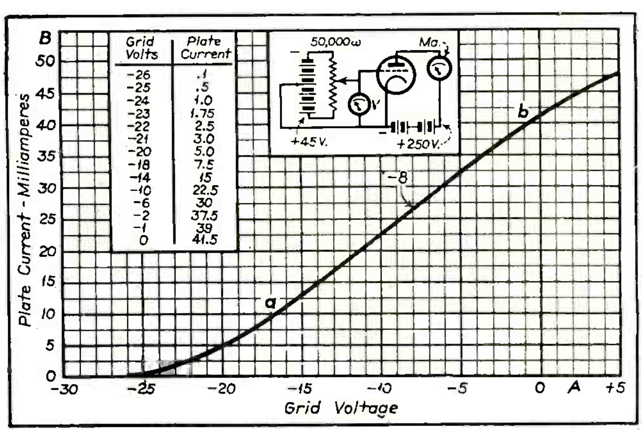
There are several different forms of graphs, notably the polar, or circular type, and the logarithmic. While these may sound complicated, they are different only in form, their construction and use is the same as the construction and use of the graphs described in the preceding paragraphs. Polar types are used frequently for repeating phenomena, and logarithmic for condensing curves that on straight graph paper would take up too much space.

Frequently we come across graphs that give us relations between capacity, inductance and frequency, between db and voltage, between turns, area and inductance, and so on. Indeed the graph since the beginning of radio has been one of the engineers' most useful and powerful instruments.



A	B
12	1
6	2
4	3
3	4
2	6
1	12
½	24

Fig. 6. The product of two numbers.



Grid Volts	Plate Current
-26	.1
-25	.5
-24	1.0
-23	1.75
-22	2.5
-21	3.0
-20	5.0
-18	7.5
-14	15
-10	22.5
-6	30
-2	37.5
-1	39
0	41.5

Fig. 7. Plotting the characteristic curve of a Class A tube.

Practical Notes on

MATCHING TRANSFORMERS

By EMIL BUCHWALD

MANY Service Men consider that a transformer's specifications adapt it only to a given type of service—that it is suitable for coupling a definite source to a fixed load. This, however, is not the case since, if the theoretical considerations governing the use of coupling transformers are known, wider application for each unit is readily apparent.

Theoretical Consideration

(1) The primary impedance of a transformer depends on the secondary load; (2) A transformer may be used for impedances other than those for which it is rated without appreciable loss provided the variation is not too far from the manufacturer's rating—the original impedance ratio will still apply; and (3) A transformer operating with a lower source impedance than normal will generally give a better frequence response[1] . . . these are the considerations which govern coupling transformer application.

The primary impedance, secondary impedance and the turn ratio of the transformer are factors which are related to each other. To determine any one of these three factors in terms of the other two the following formulas may be used.

$$T = \sqrt{\frac{R_p}{R_s}}$$

$$R_p = R_s \times T^2$$

$$R_s = \frac{R_p}{T^2}$$

where T is the turn ratio, R_p is the primary impedance and R_s is the secondary impedance.

Practical Examples

A few examples will be given to show how this information can be put to practical use.

A speaker having a voice coil of 15 ohms impedance is to be connected to a pair of 45 output tubes in push-pull, requiring a load resistance of 9,200 ohms. What ratio is necessary in the output transformer? The turn ratio of the transformer is the square root of the quotient of the primary impedance divided by the secondary impedance; hence,

Dividing

$$9{,}200 \div 15 = 613$$

Extracting the square root

$$\sqrt{613} = 24.8$$

The turn ratio necessary is 24.8; however, a ratio of 25 may be used.

Determining Turn Ratio

It is necessary to find the impedance of a burned-out voice coil in the speaker used on a battery operated job which uses a single 33 pentode as the output tube. For economical reasons the output transformer will be retained and to make a low cost repair only the speaker will be replaced. Since the impedance of the voice coil can no longer be measured it is necessary to seek another method of obtaining the same result.

The turn ratio of the output transformer can be determined by applying 2 or 3 volts. a-c across the secondary terminals. The voltage appearing across the primary can be read with a high resistance a-c voltmeter. This may be a vacuum-tube voltmeter or a copper-oxide rectifier type meter. Since the current in the transformer is low, the turn ratio is proportional to the voltages, viz:

$$T = \frac{E_p}{E_s}$$

where T is the turn ratio, E_s is the secondary voltage and E_p is the primary voltage. Suppose the secondary input voltage is 2 volts and the voltage across the primary measures 70 volts, it is found that the turn ratio is 35.

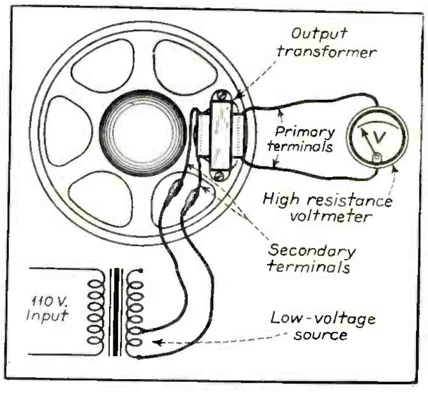


Fig. 1. Determining turns ratio of an output transformer.

The recommended load resistance of a 33 pentode is 6,000 ohms, according to the handbook on tubes. With these two figures the secondary load may now be determined. Since this is equal to the primary load divided by the square of the turn ratio it is found that; multiplying,

$$35 \times 35 = 1225$$

dividing,

$$6{,}000 \div 1225 = 4.9 \text{ ohms approximately.}$$

Hence the impedance of the voice coil may be 5 ohms which is close enough for this type of work.

Data pertaining to the output transformer on a particular make of speaker is often found only on the speaker carton. It may happen that cartons become mixed and the Service Man or dealer is not sure as to just which speaker belongs to which carton.

Practically all of the speaker manufacturers have standardized on the voice coils of their various types of speakers, that is, all the speakers of one type have the same voice-coil impedance. The value of this impedance may be found in the manufacturers' catalogs.

Consider the case of a speaker whose carton was misplaced. The manufacturer's catalog gives the voice-coil impedance, at the reference frequency, as 10 ohms. The voice coil is temporarily disconnected from the output transformer and its turn ratio determined as described above. It is found that the turn ratio of the particular speaker is 26.5.

The third step is the primary impedance and since this is equal to the secondary load times the square of the

[1]Matching Transformers to Special Purposes, by I. A. Mitchell, Service, May 1936, p. 222.

turn ratio, it is found that; multiplying

$$26.5 \times 26.5 = 702.25$$
$$10 \times 702.25 = 7022.5 \text{ ohms}$$

primary impedance. Hence this speaker and output transformer may be used with a 2A5, or a 47 or any tube having a recommended load impedance of 7,000 ohms.

Voltage Analogy

The fact that a matching transformer may be used for other impedances than those for which it is rated may be explained by an analogy. When the deviation is in the direction of a higher source impedance connected to a transformer with a lower impedance rating, losses occur. The extent of the losses is dependent upon the amount of deviation. If the transformer is considered in terms of voltage rather than impedances, the picture then becomes somewhat clearer and the reason for losses becomes apparent. Suppose the power transformer as used in the typical radio set is taken as the basis for an analogy. These transformers are usually rated at 110 volts, 60 cycles alternating current. So long as this transformer is connected to a 110-volt source, all is well, but if it is connected to a 220-volt source, disaster is inevitable and manifests itself immediately in the form of a burned-out primary and possibly a blown fuse in the lighting circuit. The reason is that the impedance of the primary is not high enough to limit the current to a safe operating value at the higher source of voltage. This is equivalent to a coupling transformer rated for a 500-ohm line and connected to a 600-ohm source, the only difference, however, is a loss of low frequencies rather than a burned-out transformer, since the audio powers involved are generally of a small magnitude.

The power transformer, however, may be used at 220 volts with some measure of success if the frequency is doubled, that is, 120 cycles instead of 60. In this case the inductive reactance of the primary is doubled but the impedance falls somewhat short of twice

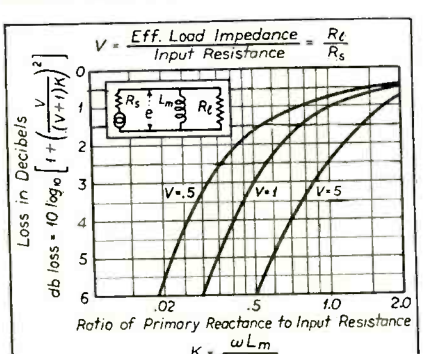


Fig. 2. Loss in low-frequency response caused by the primary inductance with the source and load impedances considered.

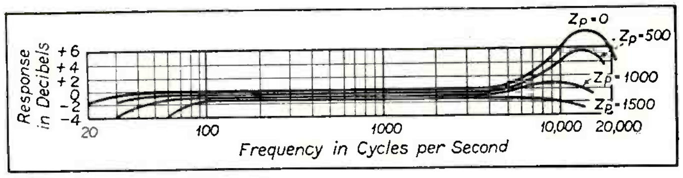


Fig. 4. Operation characteristics of a typical line-to-grid transformer with various source impedances.

the value at 60 cycles due to the copper and core losses. Some additional loss occurs then at 120 cycles and 220 volts, but for analogous reasons it may be assumed that the transformer operates as well, when both the frequency and voltage is doubled, as it does at the original ratings. If the voltage is held constant at 220 volts and the frequency is reduced from 120 cycles more and more power is used in heating the primary than is transmitted to the secondary. This is equivalent to a partial short circuit. For the same reason attenuation of low frequencies occurs when a coupling transformer is used in

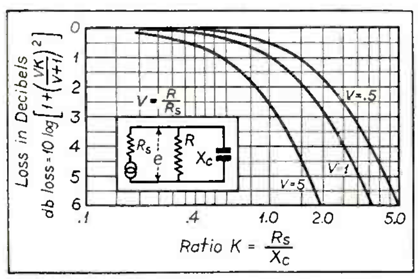


Fig. 3. Loss in low-frequency response caused by the distributed capacitance with the source and load impedances considered.

a circuit which has a higher source impedance than that for which it is rated.

Other Losses

In addition to the low frequency loss, losses also occur at the higher frequencies. These, however, are caused by different conditions. The capacity between adjacent turns of wire on both the primary and secondary account for the distributed capacity, which has the same loss effects as a condenser would have connected across the secondary.

Leakage inductance is also a factor and is caused by some of the magnetic flux traveling through the air instead of the core. This acts the same as if an inductance were connected in series with the load. At low frequencies, the impedance of the leakage inductance is low and the impedance of the distributed capacity is high, so the losses from these two causes are not appreciable. At high frequencies, the converse holds true and for a definite voltage and frequency a certain loss takes place; say 1 watt.

If the voltage is doubled, as in the case of the power transformer, it will be seen that the losses are augmented, so that a loss of 2 watts takes place at high frequencies. Figuratively, this explains to a certain extent the loss that occurs at high frequencies when the source impedance is higher than the rating of the transformer. In a transformer especially designed for a higher voltage, or impedance, these losses are taken into consideration during the design and compensations made accordingly.

In low-power audio-frequency work, deviation from the rating is possible, since no damage will result as far as the transformer is concerned. The amount of deviation from the transformer rating may be considered as dependent upon the ear, that is, as far as the quality of the signal is concerned. For instance; an output transformer labeled 10,000 ohms primary and 10 ohms secondary may be used in an output circuit of 12,000 ohms to a 12-ohm voice coil. This variation is within 20 per cent which is considered the maximum deviation consistent with fair quality.

Considering the power transformer again, it will be remembered that if the voltage source is increased beyond that of the transformer rating, a power loss takes place. On the other hand, if the applied voltage is reduced below the rating, little power loss takes place and the transformer works as well on, say 75 volts, as it does on 110 volts. Here the impedance of the primary is ample to take care of the lowered applied voltage and very little power is wasted in heating the primary. In fact, since the applied voltage has been reduced from that of the transformer rating, it is possible to work the transformer at a lower frequency, say 40 cycles, and still realize good efficiency.

For the same reasons it is possible to work the transformer at higher frequencies since the secondary voltage is proportionately less, the high frequency losses are proportionally less. From this it will be seen that the frequency range of the transformer may be increased both on the low end and the high end of the spectrum consistent with good results. A similar effect occurs when a coupling transformer of a definite rating is coupled to a lower source impedance, as for instance, a transformer labeled 500 ohms and connected to a 400-ohm source.

Lower Source Impedances

Coupling transformers may be used with lower source impedances as follows: a dynamic microphone of 250 ohms is to be connected to a transformer feeding

(Continued on page 340)

NOISE CONTROL†

(See Front Cover)

By J. E. DICKERT

THE defeat of noise, whether a natural physical phenomena or man-made, is the hidden bogey man constantly prodding the engineering brains to further accomplishments.

Discriminating Characteristic

Any attempt at noise reduction in radio reception must start necessarily with a search for some discriminating characteristic of noise not found in the signal. Diversity reception is as old as radio and as new as this year's automobile receiver. It depends for its efficacy on the assumption that radio signals are unlike noise or static in directional qualities. Generally two antenna systems are used, each picking up the same amount of noise but different amounts of signal. If the energy from one antenna is combined out of phase with the other with such accuracy that the noise is balanced out there still exists an unbalance in signal which passes on to the receiver by an amount which will depend upon the unbalance. Certain other advantages accrue to make this method advantageous for fixed-station use, and the variety of its applications is enormous.

Another method, and quite similar to the diversity system, assumed that noise picked up ten or twenty kilocycles from the received carrier could be combined with noise present with the carrier in such a way as to balance out. The fallacy was that noise is not identical at different frequencies, but strangely enough a slightly different application of the theory has been used successfully on the ultra-high frequencies quite recently.

Noiseless Antennas

While common static is still with us as much as ever, the effects of it in many cases are submerged by the barrage of high-powered transmitters. Coincident, however, with the general increase in power is an even greater increase in man-made noises caused by home and commercial electrical appliances. The answer to this from the commercial radio and communications angle is to locate the receiving system away from the noise area, but the answer from the man-on-the-street angle is to purchase "noiseless" antennas offered by many manufacturers. The latter depend upon the assumption that radio-frequency transmission lines can be so well balanced that when properly terminated they are immune to alternating fields or radiation and that they will conduct, without serious attenuation, radio-frequency energy from an antenna located far enough away from the noise source. This method is successful, particularly if the input to the receiver is properly balanced and shielded against capacity coupling.

Significantly, as reception means for ultra-high frequencies improves, interference energy picked up by the flat-top antenna increases. In the case of motor-car and airplane ignition system, radiation is destructive to fairly high signal intensities over comparatively great distances. In the vicinity of fifty to sixty megacycles ignition interference has been experienced from planes flying at distances up to five miles and from automobiles within a radius of more than a half-mile.

The distinguishing characteristic of this type of interference is the high ratio of peak to root-mean-square value, together with a comparatively long time interval between individual pulses. Because of this feature such noise is not psychologically objectionable until the peak voltage exceeds the received carrier level. Noise which is of greater value than the signal, then, possesses the discriminating characteristic used for suppression by the limiting method.

In the category of noise limiters comes first non-linear electro-acoustic transducers giving rise to a high degree of amplitude distortion, which definitely determines the maximum output of the device. The assumption is that auditory response for ordinary sounds is masked by extremely loud noise which, if suppressed in level, would render the underlying signal intelligible though distorted. Practical distortion means, such as, easily overloaded audio stages, saturable core reactors, gaseous discharge tubes, and in fact most all non-linear devices, constitute limiters of this type. The obvious disadvantage is severe distortion and more or less lack of control. Limiting is applied not only to noise but to the modulation component of the signal as well, without planned regard to the possible deleterious effect on the intelligibility and consequent fatigue to the listener.

In consideration of the needs of noise control and with a view toward simplicity and reliability, a method for such control is herein submitted.

Noise Limiter

Referring to the circuit on the front cover, L and D-1 represent a normal diode detector circuit where L is the inductance which may be the secondary of an intermediate-frequency transformer. Elements R-4 and R-3 constitute the resistive diode load. The constants of R-1 and C-1 may be any suitable value for normal automatic-volume-control voltage. C-3 is indicated as an intermediate-frequency filter and audio load capacity. Also R-2 and C-2 make up a separate automatic voltage reservoir determined by the rectified carrier voltage in the same manner as the regular automatic-volume-control circuit. However, both values are made rather large in order that the time constants of the combination will be somewhere between a tenth and one second. Element D-2 represents, what we shall term, the noise diode and may ordinarily be combined in the same envelope with D-1, such as, the type 6H6 tube.

The switch and the cathode lead of D-2 indicates the proper position for breaking the noise-silencer circuit. To obtain an idea as to the action of the circuit let us assume a signal of such magnitude that after rectification, a negative potential of 10 volts appears at point A in Fig. 1. Then at point B the potential would be a function of the ratio of R-3 and R-4, since point C is already at ground potential. If R-4 be made equal to R-3, it is obvious that point B would have an average poten-

†The material for this article was obtained from the April 1937 issue of COMMUNICATION AND BROADCAST ENGINEERING.

tial of minus 5 volts. Point D, which is the reservoir for noise diode bias voltage, also will be at a potential of minus 10 volts. This leaves the plate of D-2 five volts more negative than the cathode so that the diode is essentially non-conductive. If, however, a high instantaneous noise-voltage peak reaches a value of, let us say, minus 40 volts after rectification, the instantaneous value at point B will be half of that, or minus 20 volts, which at the same time is the instantaneous potential at the cathode of the noise diode. The plate of the noise diode, however, remains at the original value of minus 10 volts due to the delay occasioned by the ratio of R-2 and C-2. In other words, the plate of D-2 is instantaneously 10 volts more positive than the cathode, which allows a current to flow through the lowered impedance of the diode. What happens essentially is that the alternating-current impedance for point B through D-2 and C-2 to ground is instantaneously much lower than the impedance of R-3 which is normally the audio load circuit to ground. At the termination of the noise pulse, which may last for only a thousandth of a second or even less, the circuit returns to normal almost instantly. Condenser C-2 because of its high capacity contains a sufficient amount of energy so that its normal charge is not altered materially by noise voltages appearing via R-2.

Assuming our original 10-volt rectified carrier is one hundred percent modulated, the pulsating voltage appears at point A as varying at modulation frequencies between the values of minus 20 volts and zero. At point B these values are divided by two, making a total variation from minus 10 volts to zero, so that even during one hundred percent modulation peaks the cathode of D-2 never is more negative than the plate, but merely approaches that value. In other words, this system is capable of squelching noise peaks of higher than carrier value but still does not distort the demodulated signal.

Since the action is a function of signal strength, the threshold value of noise suppression changes with signal strength. Hence, if the received signal strength goes down, the potential at point D goes down with it, and the differential audio potential at point B maintains automatically its proper ratio. Carrying the illustration to the extreme, or to no-signal value, point D is essentially at zero potential, so that any instantaneous noise present between carriers will automatically take the path to ground through D-2. Thus the system operates as a practical squelch for inter-carrier noises.

In the preceding illustration we have made R-4 equal to R-3, the reason being that the noise circuit was not to distort a rectified signal. We can assume, however, in most cases that modulation on sustained tones will seldom exceed the fifty percent value. Therefore, R-4 can be only half the value of R-3, thus immediately improving the noise-silencing action to something below the one hundred percent modulation level. Heavy modulation peaks of instantaneous character will be by-passed through D-2 the same as noise. However, these peaks much like noise go quite unnoticed by their absence. This does not mean that one hundred percent modulation is not the ideal value for commercial and broadcast stations, but that in practice the full capabilities of modulation are seldom obtained.

For many types of communication work, where some audio distortion is acceptable, R-4 can be left out or maintained at a very low value, thus suppressing all noise down to the average unmodulated carrier level, with the positive modulation peaks as well. In practice—particularly on voice modulation—the deletion of the positive modulation peaks does not detract from the intelligibility of the rectified signal, nor is the resulting quality displeasing even after long periods of listening.

Fig. 2 shows a more desirable method of obtaining a high degree of noise suppression along with some audio distortion. Elements R-4 and R-3 can still be maintained at equal values, but R-4 is shunted by a small capacity C-4 which is of such a value as to equalize for the difference in modulation for the various voice frequencies. It has been shown that the percentage of modulation of an average voice varies with frequency to the extent that above 500 cycles the percentage curve drops very rapidly to a point in the neighborhood of a fraction of one percent at 5000 cycles. While this procedure in itself distorts the received frequency characteristic, it adds rather than detracts from the intelligibility since the higher modulation frequencies are given a rising characteristic, as far as the load circuit R-3 is concerned. It is significant that the noise-suppression ability is increased at the same time so that the effect is just the opposite from what might be expected by those accustomed to tone controls and drooping characteristics for practical noise suppression.

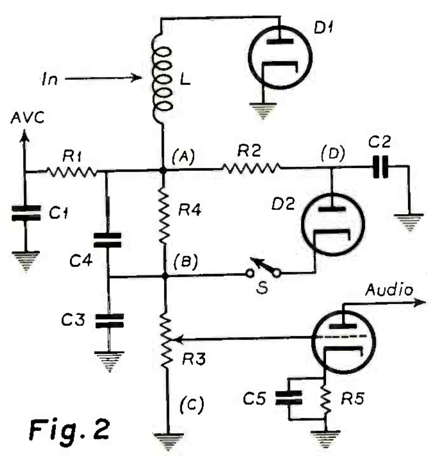


Fig. 2

A more desirable method of obtaining a high degree of noise suppression along with some audio distortion.

Since all peak-type noises are characterized by exceedingly steep wave fronts and high damping, a pulse is similar to a single lobe of a very high-frequency wave. The appearance of this noise, as regards point B, is the same as if R-4 were not present, since C-4 offers such low impedance. Thus in most cases the full noise voltage appears at B and the cathode of D-2, allowing more complete suppression. Condenser C-3 is the intermediate-frequency filter capacity in a new position. This change is necessary in order that C-4 may exhibit its full effect without shunting action through the filter capacity. Note that in Fig. 2 the type of audio coupling indicated is prescribed where the grid bias is obtained from the drop across R-3, and known generally as diode-biasing. Elements C-5 and R-5 merely determine the limiting bias for the audio tube. By the use of C-4 under certain conditions of instantaneous voltages, the potential at B can even go slightly positive—at which time the audio tube becomes non-linear due to a positive grid, and the resulting bucking bias obtained through R-5 from change in plate current.

Precautions

A few precautions in the installation and use of the circuit in either Fig. 1 or Fig. 2 may not be amiss. C-3 should be kept as small as possible. The reason for this is that in order to obtain good silencing action the original characteristics of the noise pulse must be retained. The discriminating characteristic used in this type of suppression is due to the fact that the noise pulses have a very high ratio of peak voltage to total power. The steepness of the wave front in making the pulse appear as a very high frequency means that any shunting capacity tending to attenuate high frequencies will distort the characteristic of the pulse and reduce the difference between it and the signal. This applies also to small inductances used in conjunction with capacities for intermediate-frequency filtering.

The aim should be to maintain high fidelity in the associated circuits of both signal and noise diodes whether or not such fidelity is warranted by intermediate-frequency sideband cutting and audio restrictions. To aid this condition the sum of R-3 and R-4 should be made fairly low in resistance—in the neighborhood of 100,000 to 150,000 ohms. While this necessitates a fairly high value of signal to be rectified with good fidelity, the attenuation of high frequencies is less pronounced due to stray capacity in the circuit. Leads to the resistors or noise diodes and to the audio amplifier should be kept short in order to eliminate the necessity for shielding.

In obtaining the proper time constant for the noise diode bias reservoir at D, R-2 should be a rather high value of resistance up to perhaps one megohm in order not to shunt the signal diode load. C-2 should also be a large value in order that the a-c impedance from the noise diode to ground be minimized. It is important that C-2 be non-inductive in order to be a low impedance also at very high frequencies, and good practice is to shunt this capacity with a mica condenser of smaller capacity. In any case, diode biasing of the first audio is recommended where at all possible, since coupling capacity and grid leaks complicate the detector load.

As applies to communications receivers the circuit of Fig. 2 allows practically quiet operation on all frequencies regardless of the signal strength received. Since the action is entirely automatic no controls are indicated with the exception of the switch S to cut the silencer in or out.

Noise of a sine wave character, as differentiated from the peak spark-discharge type, is suppressed to a lesser degree since the character constitutes what is more like a signal in its action on the second detector. In other words, the type of noise which changes the normal avc voltage of the receiver to any great degree is difficult to suppress by this method, but happily is the type noise not ordinarily picked up by an antenna in the clear, coupled to the receiver through an efficient transmission line.

Slight Loss

Obviously, when using the type of circuit herein described, a fraction of the audio voltage available at the plate of the signal diode is used for control bias on the noise diode so that a slight loss—never more than three decibels—is apparent in audio gain. Ordinarily such loss is negligible and can be made up easily if thought necessary. Standard practice indicates total receiver sensitivity to include audio gain, whereas radio-frequency and intermediate-frequency gain—admittedly most important—can be measured at the input to the second detector just as easily, and it may be a more accurate yardstick for receiver excellence.

Using this standard, inclusion of the suppressor circuit causes no loss whatever to sensitivity, and in fact may apparently increase it. High noise pulses at fast interruption rates, which ordinarily reduce sensitivity through avc action, due to the relatively fast time constant of the avc resistance-capacity network, are rendered ineffectual to this end by virtue of suppression. Also, because of the lack of noise, audio gain may be maintained at a higher level with more comfort.

None of the remaining high-frequency functions are disturbed. Selectivity is not changed by addition of shunt intermediate circuits, and the suppressor has no feature which conceivably can cause unstable operation in any part of the receiver.

Applications

Size and space are important considerations when installation is contemplated for portable and mobile use. A few ounces at most are added to the weight of airplane equipment and, if the noise diode is combined in the same envelope with the signal diode, the extra space necessary is only that used for a few resistors and capacities.

As regards aviation, it has been noted that when a suppressor-equipped receiver is left idling on one of the three or five megacycle channels, the stand-by between transmissions is remarkably free from normal inter-channel noise. Even key-clicks from adjacent or image channels are attenuated satisfactorily. No trouble was experienced with delay on quick break-ins on these channels, but since these transmissions are audio equalized for efficiency it may be advisable to decrease the time constant of R-2, C-2 by making C-2 a lower value.

While ultra-high-frequency installations in police cars can well use suppression of this type it is anticipated that some additional suppression will take care of the source of ignition interference. It is found that, while such exceedingly heavy noise is limited to the pre-determined value, the length of the silent period during pulses may become objectionable unless the ignition system is maintained at perfect adjustment. Happily, interference from passing cars is practically eliminated—which is not the case with the diversity method of noise control as installed in some mobile receivers.

It is suggested that all-wave and multi-band amateur-commercial receivers incorporate, as part of the band change switch, means for allowing suppression with high-fidelity response for the broadcast frequencies and varying degrees of suppression for the other bands. The automatic feature otherwise will take care of different signal levels encountered within certain bands including the rapid fading encountered above ten megacycles.

Complete Satisfaction Not Anticipated

It is believed that no single method for noise reduction can be expected to accomplish complete satisfaction. Because of the various types of interference encountered—each with a favored method for elimination—the ultimate must necessarily be a combination of tactics. Hundreds of thousands of dollars are spent annually in noise research by aviation, communications and television companies. New methods are known to be in the laboratories and it is hoped that, when television becomes a reality, extraneous noise must cease to exist.

•

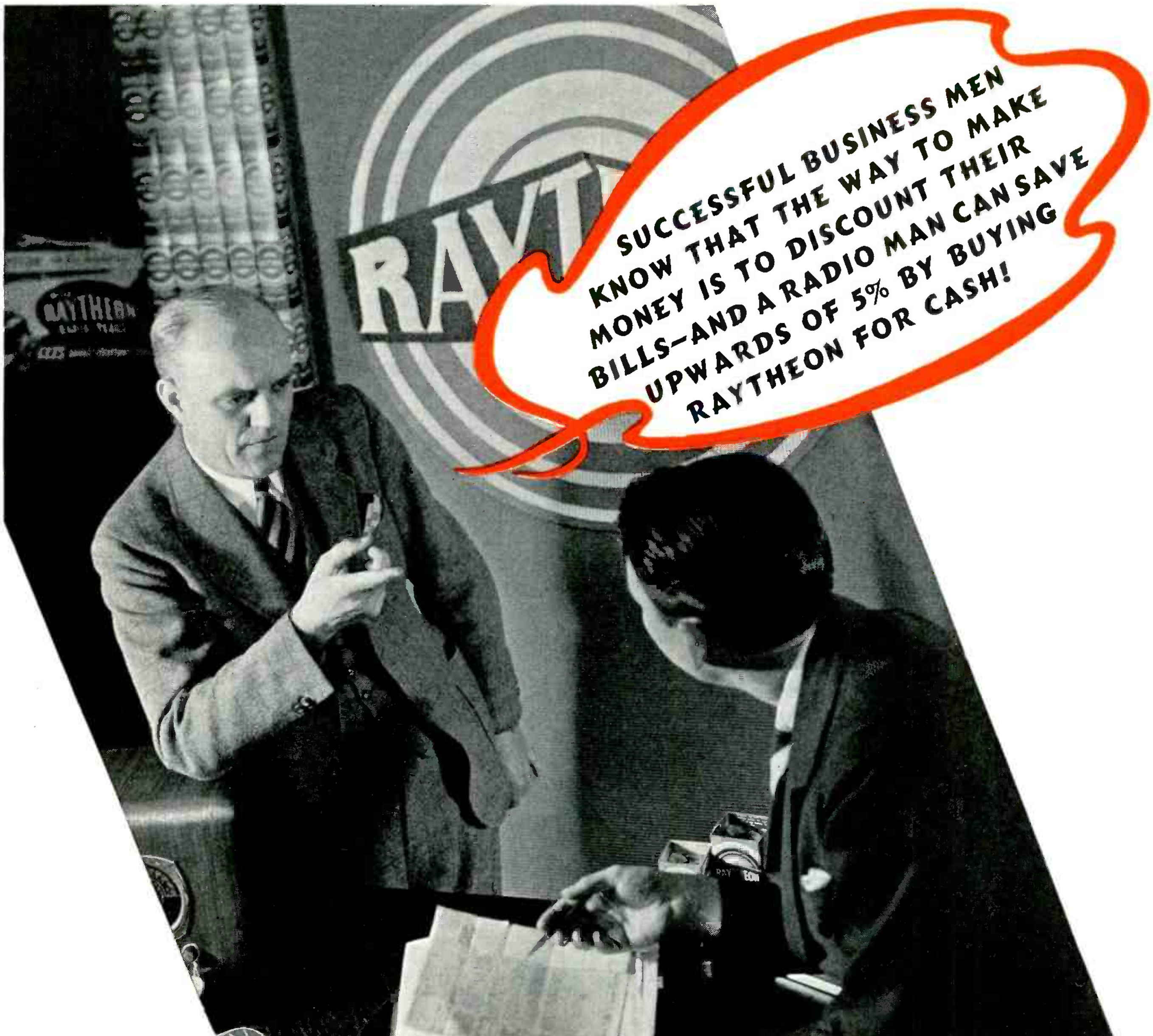
MATCHING TRANSFORMERS

(*Continued from page* 337)

into a grid. If a 250-ohm transformer is not on hand, one of the popular brands labeled: 125-500 ohms-to-grid, may be used. Since the difference between the 125- and 500-ohm taps is 375 ohms, the mike may be connected to these two taps. Here the source impedance is lower than the transformer rating and since this improves the frequency characteristic, good results may be expected. In the same way a low impedance pickup, say 20 ohms, may be connected to a transformer having a rating of 50 ohms to grid.

Similar arrangements may be made with output transformers, and speaking of output transformers, they may be used for other purposes than to couple a tube or tubes to a voice coil. Suppose it is desired to couple a low impedance pickup of 8 ohms to a grid. An output transformer having a high impedance ratio may be used as for instance, one to couple a pair of 2A5s to an 8-ohm voice coil. The transformer is used in the reverse way, that is, the voice coil side is used as the primary and the original primary is considered the secondary. The pickup is connected to the primary and the secondary is connected to the grid and ground, or cathode as the case may be. The center tap is disregarded. A 15,000-ohm volume control may be connected across the secondary for attenuation purposes. The voltage ratio is not as high as the conventional pickup-to-grid transformer, but it will serve with fair results.

The Best "BUYS" Are Made For Cash!



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General Data . . .

Belmont 878

The Belmont Model 878 is a 3-band, high-fidelity, a-c superheterodyne receiver using 7 metal tubes and a glass tuning indicator tube. A circuit diagram of the Series B receiver is shown in Fig. 1. The Series A is almost identical. In the oscillator padding circuit of the Series A receiver an additional 300-mmfd (working capacity) adjustable padder (C25) is connected across the fixed padder C23. The capacity of the latter is 0.0021 mfd, instead of 0.0034 mfd as indicated for the Series B receiver. Other changes are negligible.

Transformers are available and chassis are sometimes equipped with universal transformers for operation on 25, 40 and 60 cycles and with primary taps for 108, 127, 150, 225, and 260 volts and also sometimes equipped with 25 cycle transformers with 105-115 volt or 220 volt primaries, not universals.

Voltages taken from different points of circuit to chassis are measured with volume control full on, all tubes in their sockets and speaker connected, with a volt meter having a resistance of 1000-ohms-per-volt. These voltages are indicated on the circuit diagram.

In order to prevent the signal from acting upon the avc and affecting the accuracy of the voltage measurements the aerial and ground leads should be shorted together while making the measurements.

The voltages were measured with 119 volts on the primary of the power transformer. The d-c resistances of the various coils and transformer windings are also lettered on the circuit diagram of Fig. 1.

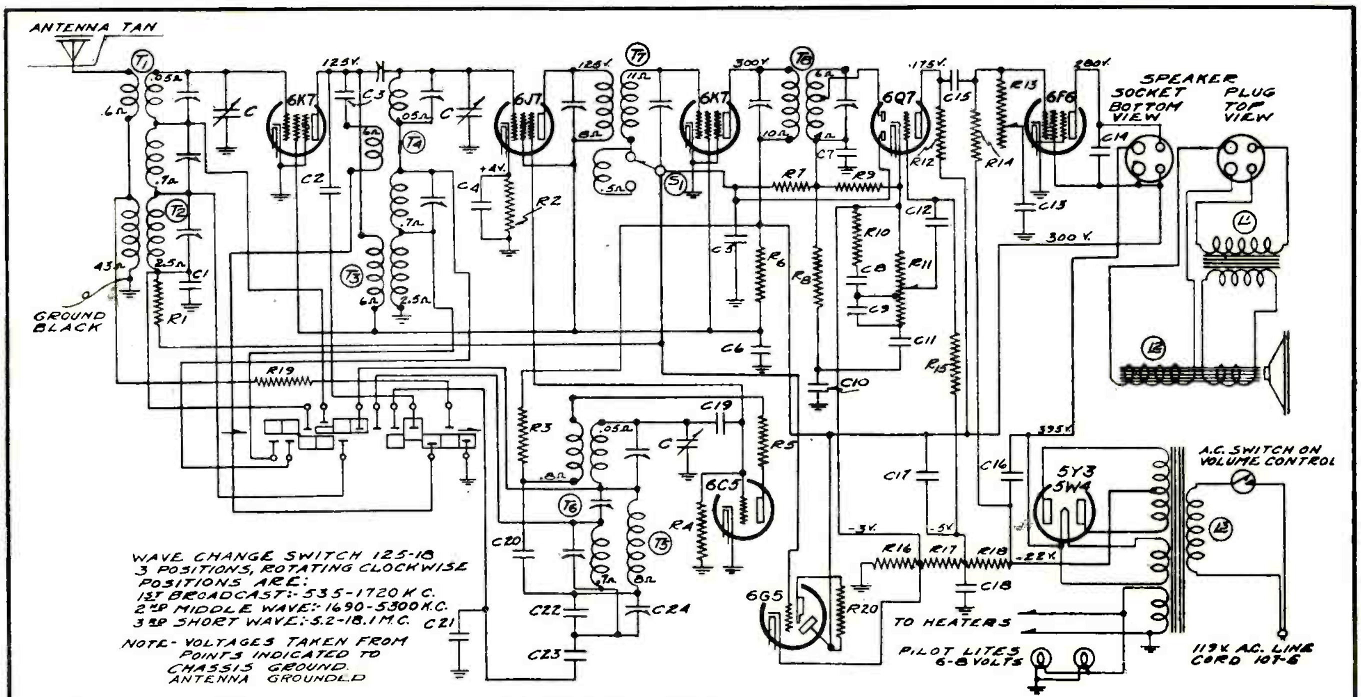
The frequency range is from 535 kc to 18.1 mc and is identical for both the Series A and B receivers. The i-f peak is 465 kc for both types.

Alignment Procedure

Dummy antennas: The following dummy antennas are used in aligning the Model 878 and are referred to in the aligning instructions as dummy 1, 2 and 3 respectively. Dummy 1, used in the i-f alignment, consists of a 0.1-mfd condenser connected in series with the external test oscillator. Dummy 2, used on the broadcast band, consists of a 200-mmfd condenser and a 20-ohm resistor connected in series with each other and the external test oscillator. Dummy 3, used on the shorter wavebands, consists of a 0.1-mfd condenser and a 400-ohm resistor connected in series with each other and the external test oscillator.

Resonance indicator: Use as a resonance indicator an output meter connected across the primary of the speaker input transformer or by means of an adapter between the plate and screen terminals of the type 6F6 output tube. Maximum deflection of the meter indicates resonance. Use only enough signal to get a readily readable output. A low range output meter or the low scale of a multi-range meter should be used.

Caution: No aligning adjustments should be attempted without first thoroughly checking over all other possible causes of trouble, such as poor installations, open or grounded antenna



No.	Part No.	Description
		RESISTORS
R1	130-20	100M Ohms—1/3 W.—20%—50 V.—Car.
R2	130-43	2500 Ohms—1/3 W.—20%—20 V.—Car.
R3	130-77	10M Ohms—1 W.—20%—100V.—Car.
R4	130-12	50M Ohms—1/3 W.—20%—20 V.—Car.
R5	130-60	100 Ohms—1/3 W.—20%—10 V.—Car.
R6	130-88	10M Ohms—2 W.—20%—Wire Wound
R7	130-38	2 meg Ohms—1/3 W.—20%—100 V.—Car.
R8	130-20	100M Ohms—1/3 W.—20%—50 V.—Car.
R9	130-11	250M Ohms—1/3 W.—20%—50 V.—Car.
R10	130-22	5000 Ohms—1/3 W.—20%—10 V.—Car.
R11	101-47	1 meg Ohm—Vol. Con. with AC Switch
R12	130-20	100M Ohms—1/3 W.—20%—50 V.—Car.
R13	101-38	100M Ohms—Tone Con with Fid. Switch.
R14	130-3	500M Ohms—1/3 W.—20%—100 V.—Car.
R15	130-38	2 meg Ohm—1/3W.—20%—100 V.—Car
R16	106-27	38 Ohms—10% Muter Resistor
R17	106-27	28 Ohms—10% Muter Resistor
R18	106-27	220 Ohms—10% Muter Resistor
R19	130-27	50 Ohms—1/3 Watt—20% Car.
		Note: R16, R17, R18 in one unit—part No. 106-27
R20	130-110	1 Megohm—1/10 W.—10%—100V.—Car.
		CONDENSERS
C	102-35	One sec. of 3 gang var. condenser
C1	100-9	.05—200 Volt—25%
C2	129-59	.0003 Mica—MT—0—5%
C3	129-39	.00005 Mica—MT—0—20%
C4	100-9	.05—200 Volt—25%
C5	100-9	.05—200 Volt—25%
C6	100-41	.25—400 Volt—20%
C7	129-5	.0001 Mica—MT—0—20%
C8	100-9	.05—200 Volt—25%
C9	129-2	.0005 Mica—MT—0—20%
C10	129-60	.00015 Mica—MT—0—20%
C11	100-22	.05—200 Volt—25%
C12	100-11	.01—400 Volt—25%
C13	100-26	.02—400 Volt—25%
C14	100-32	.0005—1000 Volt—20%
C15	100-11	.01—400 Volt—25%
C16	103-8	14 mfd.—400 Volt Electrolytic
C17	103-6	8 mfd.—350 Volt Electrolytic
C18	100-46	.25—200 Volt—20%
C19	129-31	.000025 Mica—MT—0—15%
C20	100-13	.05—400 Volt—25%
C21	129-69	.0023 Mica—MW—W—2½%
C22	129-57	.0005 Mica—MT—0—5%
C23	129-55	.0034 Mica—MW—W—2½%
C24	124-34	Padder, working capacity, 200 mmf.

Fig. 1. Belmont 878 circuit diagram.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systems, low line voltages, defective tubes, condensers and resistors. In order to properly align this chassis, an oscillator (generator) is absolutely necessary. No aligning adjustments should be attempted with the chassis in the cabinet. To remove the knobs, pull them off and to take the chassis out of the cabinet, remove the four bolts by which it is fastened.

I-F Alignment

The i-f transformers have two adjustments, both of which are accessible from the underside of the chassis (see bottom view, Fig. 2).

Allow both the receiver and test oscillator at least 15 minutes to warm up before attempting any adjustments.

With volume control full on (the extreme right of its rotation), the wave changing switch in the broadcast position (extreme left of its rotation), the tone control on "Hi" part of the sharp position (as much right rotation as possible without operating the high fidelity switch), and with the variable condenser set to approximately 1400 kilocycles, make the following connections and adjustments:

Connect the external test oscillator, set at 465 kc, in series with dummy antenna 1 to the control grid cap of the 6K7 tube located between the two i-f transformers, and adjust the output secondary and primary trimmers (in that order) for resonance.

With dummy antenna still connected in series with the test oscillator output move the connection to the grid of the 6J7 and adjust the input i-f secondary and primary trimmers (in that order) for resonance.

With the connections to the 6J7 tube in place repeat the i-f adjustments.

R-F Alignment

Broadcast band: With band changing switch in the broadcast position, extreme left of its rotation, and with external oscillator set at 600 kilocycles and connected in series with dummy 2 to the tan antenna and black ground lead, make the following adjustments:

(a) Adjust broadcast series pad (adjustment number 3) to resonance with oscillator. Keep set in tune with oscillator by slowly rocking to and fro the variable condenser until maximum output is obtained. Note: This adjustment is accessible from the top of the chassis and is located between the variable condenser and the output i-f transformer.

(b) Re-set external oscillator to 1400 kc, move dial pointer to 1400 kc and adjust oscillator (adjustment number 4), r-f (adjustment number 6) and antenna (adjustment number 7), to resonance. See bottom view for location of these adjustments, Fig. 2.

(c) Repeat adjustments "a" and "b" until sensitivity is at its maximum.

Note: It is extremely necessary in making these adjustments that the fundamental oscillator signal be tuned in and not the image frequency which will fall below the fundamental.

Short-wave band: With band changing switch in the short-wave position, extreme right of its rotation, and with external oscillator set at 17 megacycles and connected in series with dummy 3 to the tan antenna and black ground lead, make the following adjustments:

(a) Move dial pointer to 17 megacycles and adjust short-wave oscillator (adjustment number 1), short-wave r-f (adjustment number 8) and short-wave antenna (adjustment number 9) to resonance.

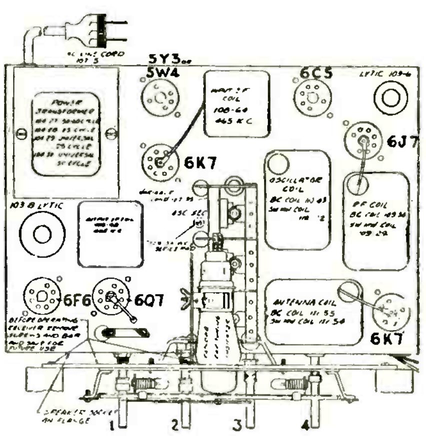

Fig. 3. Parts and tube layout.

(b) Re-set external oscillator to 6 megacycles and pick up signal by rotating variable condenser and check for sensitivity.

Middle-wave band: With band changing switch in the middle-wave position, center of its rotation, and with external oscillator set at 5 mc and connected in series with dummy 3 to the tan antenna and black ground lead, make the following adjustments:

(a) Rotate condenser, pick up signal and adjust middle-wave r-f (adjustment number 10), middle-wave antenna (adjustment number 5) and middle-wave oscillator (adjustment number 2) to resonance.

(b) Recheck broadcast alignment and if it is found necessary to re-adjust either r-f or antenna trimmers, repeat the 17 mc short-wave and 5 mc middle-wave adjustments.

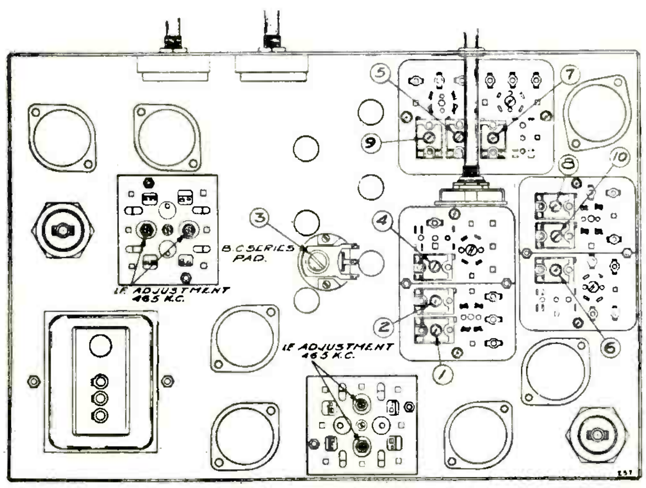

Fig. 2. Tube and trimmer locations.

Emerson G-127

The Emerson Model G-127 is a 5-tube combination phonograph and radio using glass tubes in a superheterodyne circuit. There are two tuning ranges which cover the frequencies from 540 to 1625 kc and from 5.6 to 18.0 mc. The receiver and phonograph motor are designed for operation from 105 to 125 volts either a-c or d-c. The current drain for the receiver is 0.42 amperes and 0.2 amperes for the motor.

The single bakelite knob on the motor board is the switch for changing from radio reception to phonograph. A switch is also provided on the motor board for adapting the motor to either a-c or d-c operation. After ascertaining the kind of power available, it is important that this switch be thrown to the position corresponding to that power supply. The third control on the motor

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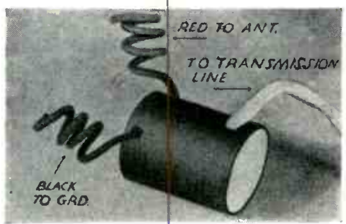

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board is the on-off switch for the phonograph motor.

A circuit diagram of the G-127 is shown in Fig. 1 with the tubes used and the various voltages encountered on the socket prongs lettered on the diagram. These voltage readings were taken with a 1000-ohm-per-volt voltmeter from the point indicated to the receiver chassis with the volume control on full. The antenna was shorted to the chassis while making the measurements. The line voltage was 117.5 volts.

On the circuit diagram (Fig. 1) the various resistors and condensers are numbered. These numbers correspond to values given in the accompanying parts list.

Several production changes have been incorporated in the model G-127 and are shown on the diagram. Early receivers differed from the schematic diagram as follows:

(a) A 50,000-ohm resistor, by-passed with a 0.1-mfd, 200-volt condenser was used in the plate circuit of the 75 tube as an R-C filter.

(b) The rotor of C28 was returned to ground instead of the coil, as shown on the schematic.

(c) R11 and R12 were 250,000-ohm carbon resistors.

(d) The 6A7 and 6D6 cathodes were connected together. R2 was a 150-ohm, ½-watt wire-wound resistor, and C7 was 0.15-mfd, 200-volt condenser. R9 and C26 were not in the circuit.

(e) C1 was an 0.01-mfd, 200-volt condenser.

Alignment Procedure

The set's oscillator is higher in frequency than the signal; images should be observed on the low frequency side of the signals.

Always choose the minimum capacity peak on oscillator trimmers and maximum capacity peaks on antenna trimmers. The last motion in adjusting trimmers should always be a tightening one, not a loosening one.

Always use as weak a test signal as possible during alignment.

Never leave a trimmer with the outside plate so loose that there is no tension on the screw. Either bend the plate up or remove the screw entirely.

An output meter should be used across the voice coil or the output for observing maximum response.

Trimmer Locations

The broadcast antenna coil, the short-wave antenna coil and the 456-kc wave trap are one assembly mounted underneath the chassis deck to the right of the variable condenser. The trimmers for these coils are accessible through three holes in the top of the chassis. The trimmer closest to the front of the chassis is for the short-wave antenna coil. The central trimmer is for the broadcast antenna coil and the trimmer farthest from the chassis front is for the 456-kc wave trap.

The broadcast oscillator and short-wave oscillator coils are wound on one tubing and mounted on the inside of the rear chassis wall. The trimmers for these coils are accessible through two holes in the rear chassis wall. The left-hand trimmer (looking at the rear wall)

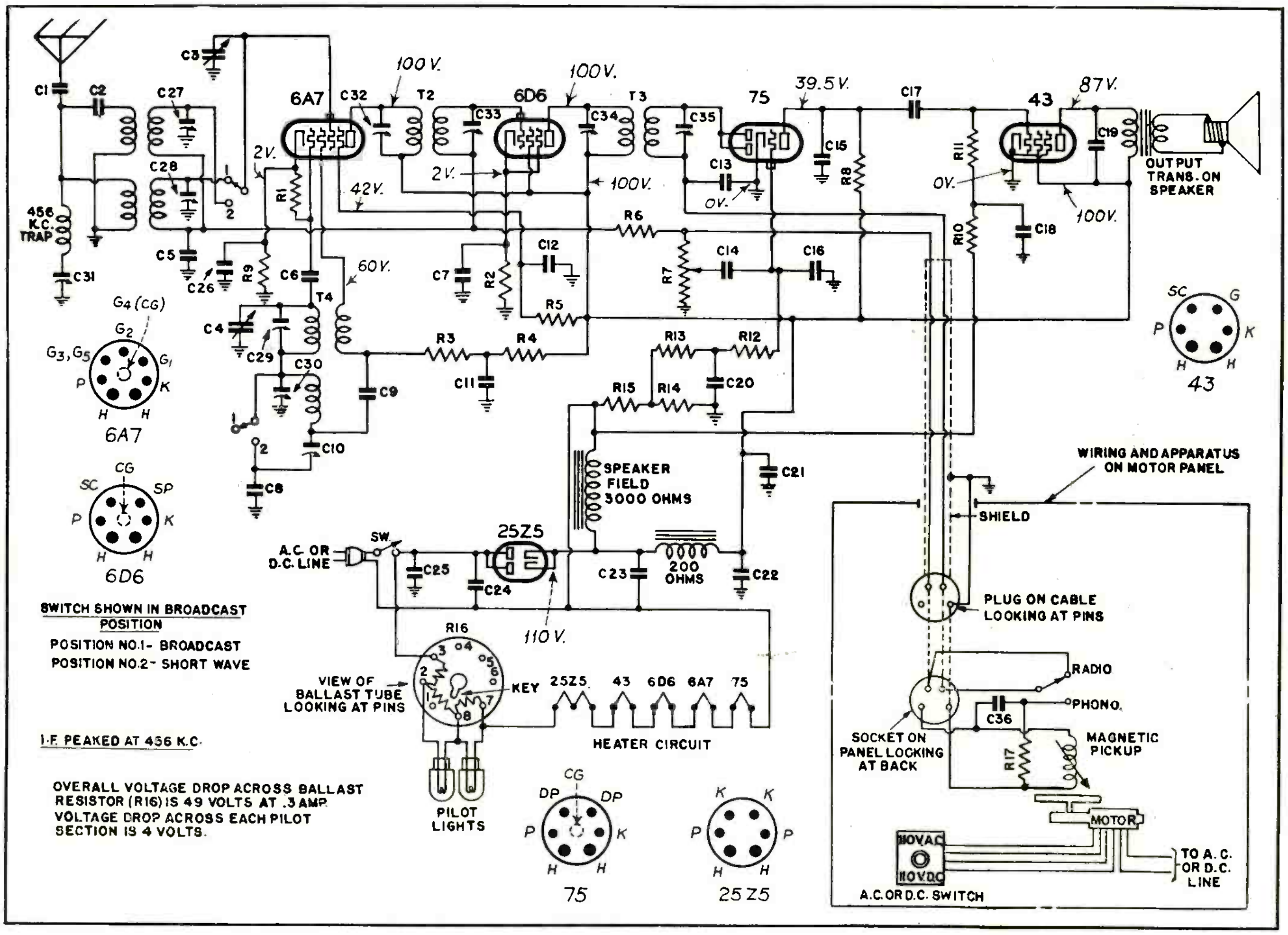
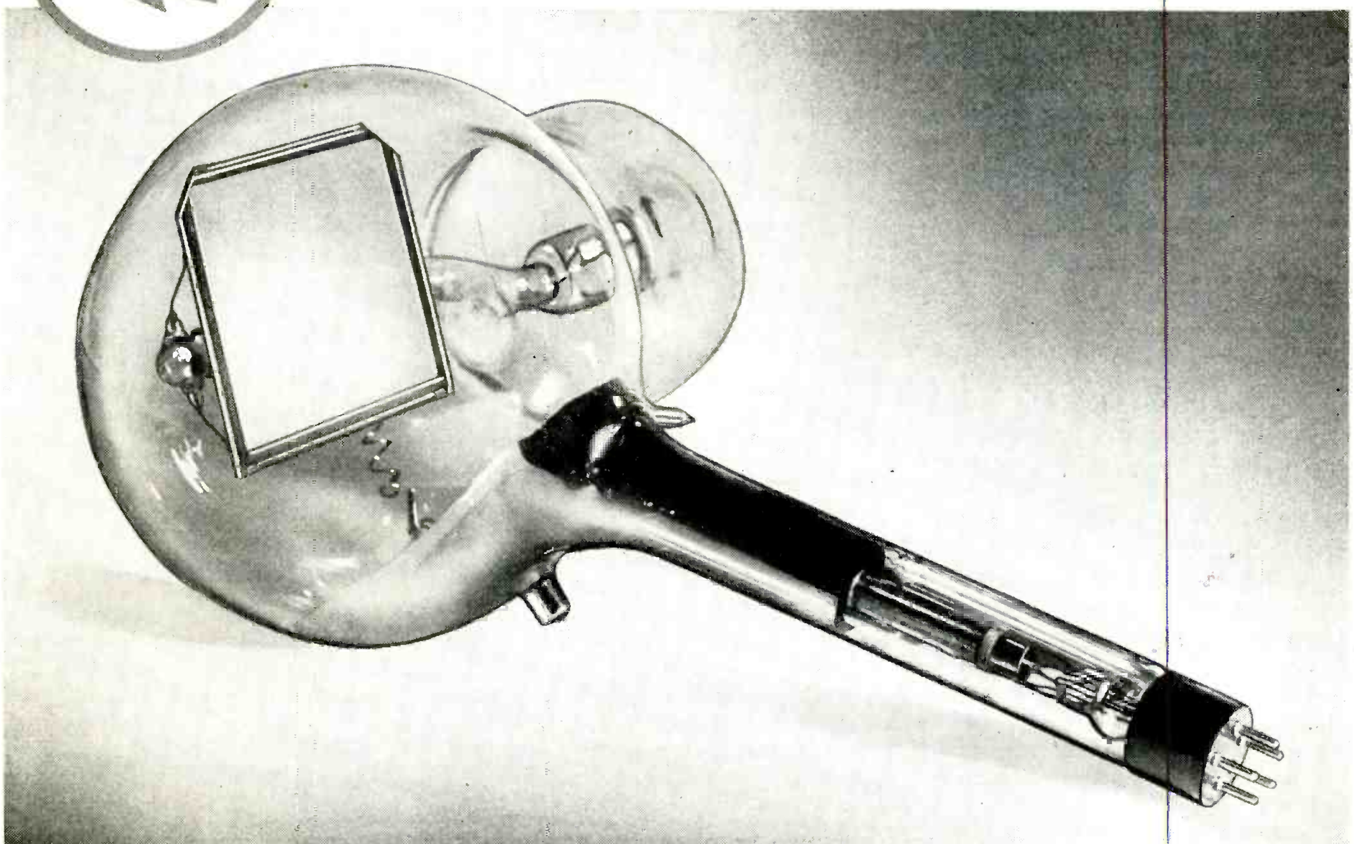


Fig. 1. Emerson G-127 circuit diagram.



is for the short-wave oscillator coil and the right-hand trimmer is for the broadcast oscillator coil.

The two i-f transformers are in oblong coil cans located on the top of the chassis. The first i-f transformer is the one behind the variable condenser. The trimmers for these transformers are accessible through holes in the tops of the cans.

The broadcast series padding condenser is located on the rear wall of the chassis below the 6A7 tube.

I-F Alignment

Turn the switch clockwise to the broadcast position and rotate the variable condenser to the minimum capacity position. Feed 456 kc to the grip cap of the 6A7 tube and adjust the four i-f trimmers for maximum response. Feed 456 kc to the antenna and adjust the wave-trap trimmer (rear screw beside variable condenser) for minimum response.

Short-Wave Alignment

Use a dummy antenna (400-ohm resistor) when aligning the short-wave coils.

Rotate the wave-band switch counterclockwise to the short-wave position and set the dial pointer to 15 megacycles. Feed 15 megacycles through the dummy antenna and adjust the short-wave oscillator trimmer (left-hand screw on rear chassis wall) for maximum response and then adjust the short-wave antenna trimmer (front screw beside variable condenser) for maximum response. The variable condenser should be rocked while adjusting the antenna trimmer. (Rotate variable condenser rotor shaft back and forth through a small arc).

EMERSON G-127 PARTS LIST

Item Resistor	*Item Condenser*
R1—50,000 ohms	C1—0.001 mfd
R2—300 ohms	C2—0.00005 mfd
R3—10,000 ohms	C5—0.05 mfd
R4—10,000 ohms	C6—0.00005 mfd
R5—30,000 ohms	C7—0.1 mfd
R6—1 megohm	C8—0.0042 mfd
R7—250,000 ohms	C9—0.01 mfd
R8—250,000 ohms	C11—4 mfd
R9—300 ohms	C12—0.1 mfd
R10—25,000 ohms	C13—0.00025 mfd
R11—500,000 ohms	C14—0.02 mfd
R12—500,000 ohms	C15—0.00025 mfd
R13—250,000 ohms	C17—0.02 mfd
R14—20 ohms	C18—0.1 mfd
R15—230 ohms	C19—0.01 mfd
R16—Ballast	C20—0.1 mfd
R17—100,000 ohms	C21—0.1 mfd
	C22—20 mfd
	C23—20 mfd
	C24—0.1 mfd
	C25—0.01 mfd
	C26—0.1 mfd

Broadcast Alignment

Rotate the wave-band switch to the broadcast position, clockwise, and set the dial pointer at 60. Feed 600 kc through a standard dummy antenna (a 0.0002-mfd condenser may be used as a substitute).

Adjust the broadcast series padding condenser (on rear chassis wall below 6A7 tube) for maximum response. Move pointer to 142.5, feed 1425 kc and adjust the broadcast oscillator trimmer (right-hand screw on rear chassis wall) for maximum response and then adjust the broadcast antenna trimmer (central screw beside variable condenser) for maximum response. Return pointer to 60, feed 600 kc and readjust the series padding condenser rocking the variable condenser for maximum response.

The alignment procedure should be repeated.

•

RCA 9T, 9K2, 9U, 9U2

These models are 9-tube "Magic Brain" receivers using 7 metal tubes, a glass rectifier and a glass tuning eye. The long-wave range from 150 to 410 kc is covered in Band X. Four additional bands cover the ranges from 530 kc to 60.0 mc. The radio receiver

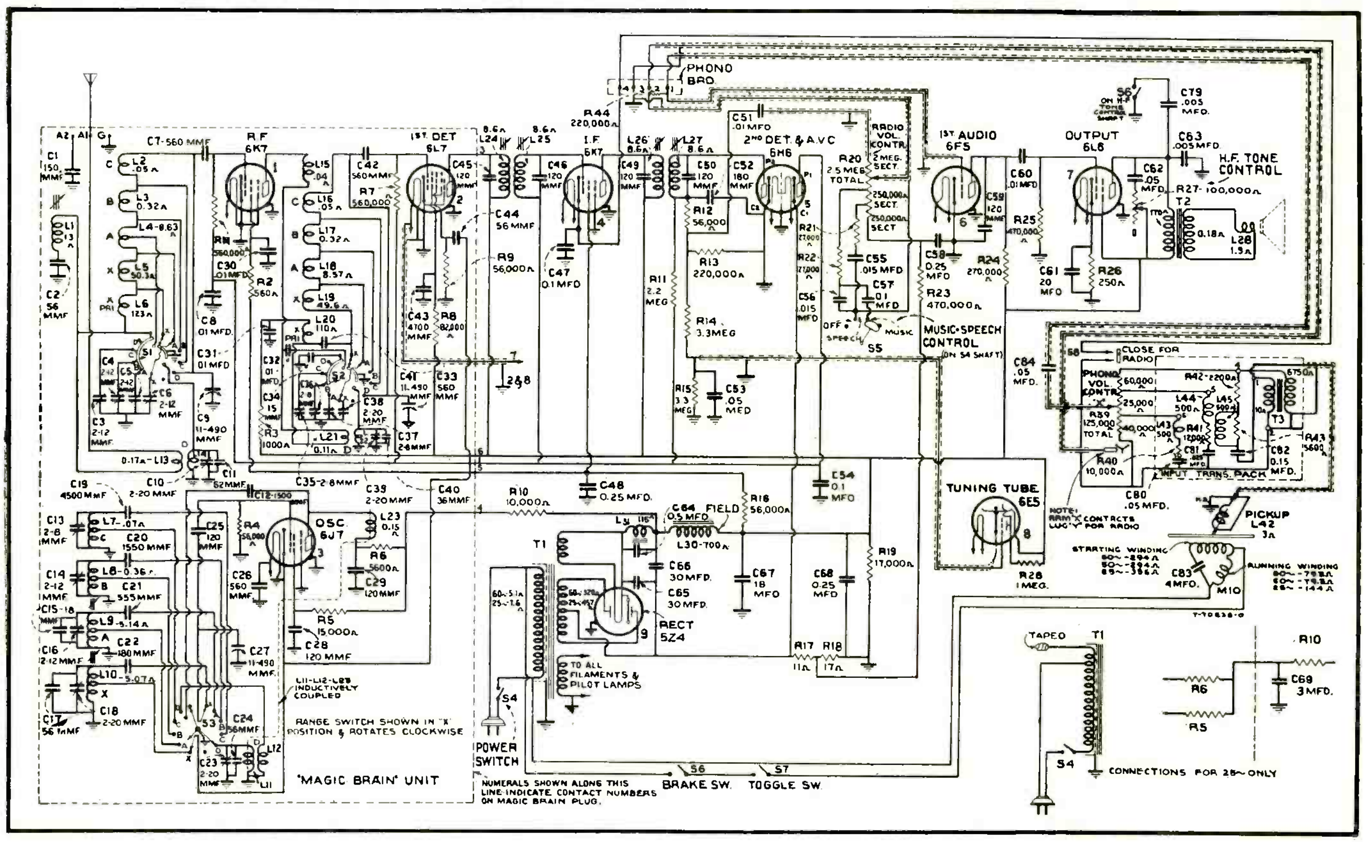


Fig. 1. RCA 9T, 9K2, 9U, 9U2 circuit diagram.

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and amplifier will draw 150 watts from the 60-cycle, 115-volt, a-c line. The phonograph motor will draw an additional 25 watts.

The Model 9T is a table type with an 8-in speaker. The Model 9K2 is of the console type with a 12-in speaker.

The Models 9U and 9U2 are combination receivers and automatically operated phonographs. These instruments are electrically identical but differ in mechanical construction and cabinet design. Model 9U has the radio chassis mounted directly below the phonograph motor board with its controls operated from the front of the cabinet. Model 9U2 has its radio chassis mounted vertically to the right of the phonograph motor board. The respective controls in the phonograph and the radio compartments are made accessible by means of separate hinged covers at the top of the cabinet. Both instruments employ 12-in speakers.

The Models 9K2, 9U and 9U2 incorporate the "Magic-Voice."

Five watts of undistorted output is available from all models with a maximum of 9 watts. Electrodynamic speakers are used with a voice-coil impedance of 2.2-ohms at 400 cycles.

Design features include a built-in doublet antenna coupler; "Magic Brain"; improved plunger-type air-dielectric adjustable trimming capacitors in the antenna, detector, and oscillator coil circuits; tuned r-f amplifier; high-efficiency first detector (converter) with separate oscillator; beam-type power amplifier; magnetite core adjusted i-f transformers, low-frequency oscillator tracking, and wave-trap; two-point aural compensated radio and phonograph volume controls; music-speech switch; automatic volume control; continuously-variable high-frequency tone control; improved selector dial; dust-proof electrodynamic loudspeaker; and an automatic record player employing a synchronous motor.

Service convenience has been a controlling factor in the layout of the chassis parts and wiring. The assembly of these various elements is such that the number of conductors is minimized, with all important connections being readily accessible.

R-F CIRCUIT

The conventional type of superheterodyne circuit is used. It consists of an r-f amplifier stage, first-detector (converter) stage, separate oscillator stage, an i-f amplifier stage, a diode-detector — automatic - volume - control stage, an audio voltage-amplifier stage, a beam-type power-amplifier stage, a tuning indicator "Magic Eye," and a full-wave rectifier.

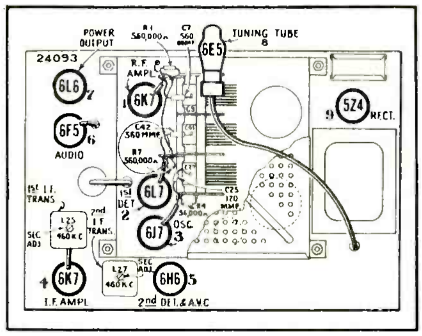

Fig. 2. Tube and i-f trimmer locations.

The "Magic Brain" is constructed as a separate, self-contained, completely shielded, five-band, oscillator-detector-antenna-tuning unit which plugs into the main chassis.

A single-wire antenna, or a doublet antenna, when connected to the proper input terminals of the receiver, is coupled to the control grid of the 6K7 r-f amplifier tube through the tuned r-f transformer consisting of L6, L5, L4, L3, and L2 (except when range selector is in ultra-short wave position). The primary coil L13 of the ultra-short wave (D) band tuned r-f transformer remains in the antenna circuit at all times. A unique method of switching is used. In the long-wave (X) band, L6 becomes the primary with L5, L4, L3, and L2 as secondary. In the standard-broadcast (A) band, L5 becomes the primary with L4, L3, and L2 as secondary (L6 shorted out). In the medium-wave (B) band, L4 becomes the primary with L3 and L2 as secondary (L6 and L5 shorted out). In the short-wave (C) band, L3 becomes the primary with L2 as secondary (L6, L5, L4, and tap on L4 shorted out). The tap on L4 is provided to prevent interaction with L3 and L2 when operating receiver in short-wave band. In the ultra-short-wave (D) band, L6, L5, L4, and L3 are shorted out and grounded, and secondary L14 is placed in shunt with L2. The latter connection prevents undesirable interaction of L2 with L14. This method of switching reduces the total number of coils and leads, and results in having a low-loss primary and secondary winding for each band with high efficiency of operation.

CATHODE CURRENT READINGS

Measured with Milliammeter Connected at Tube Socket Cathode Terminal under Conditions Similar to Those of Voltage Measurements

(1) 6K7—R-F	8.0 ma
(2) 6L7—First Det.	4.4 ma
(3) 6J7—Osc.	6.7 ma
(4) 6K7—I.F.	8.0 ma
(5) 6H6—Second Det.-A.V.C.	—
(6) 6F5—A.F.	0.3 ma
(7) 6L6—Power	63 ma
(8) 6E5—Eye	3.0 ma
(9) 5Z4—Rect.	110 ma *

(*Cannot be measured at socket)

The band switching of the detector circuits is similar to that of the antenna circuits. Coils L15, L21, and L20 are always connected in series with the plate circuit of the 6K7 r-f amplifier tube. In the long-wave (X) band, L19, L18, L17, and L16 are connected in series as the secondary circuit. The ground of the coil system is at the low end of L19. L20 acts as the primary which transfers energy to the secondary L19. Capacitor C33 resonates primary L20 at the proper frequency. In the standard-broadcast (A) band, L18, L17, and L16 are connected in series as the secondary circuit. The ground of the coil system is now between L18 and L19. L19 is used as the primary and is resonated at the proper frequency by capacitors C34 and C35 which are in shunt with this coil. Capacitor C33 is connected to transfer energy to the primary coil L19. In the medium-wave (B) band, L17 and L16 are connected in series as the secondary. The ground of the coil system is now between L17 and L18. L18 is used as the primary and is resonated at the proper frequency by capacitor C34 which is in shunt with this coil. L19 is shorted by the range selector. Capacitor C33 transfers the r-f energy from the plate circuit to the primary L18. In the short-wave (C) band, L16 is the secondary. The ground of the coil system is now between L16 and L17. L17 is used as the primary and is resonated to the proper frequency by capacitor C34. In addition, L15 acts as a high-frequency primary which resonates above 20 mc and improves the gain at the high-frequency end of the short-wave band. Coils L19 and L18 are shorted by the range selector. L21 is effectively r-f by-passed in this position by capacitor C32. In the ultra-short-wave (D) band, L22 is the secondary, or grid coil, and consists of approximately a single turn of silver plated strap around a ⅞-in coil form. The primary coils, L21 and L15 are in series on this band, with L21 acting as a low-frequency primary and L15 as a high-frequency primary. L16 is

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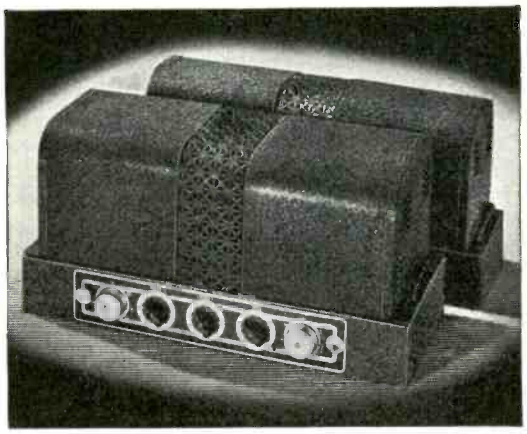

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PAK-2M

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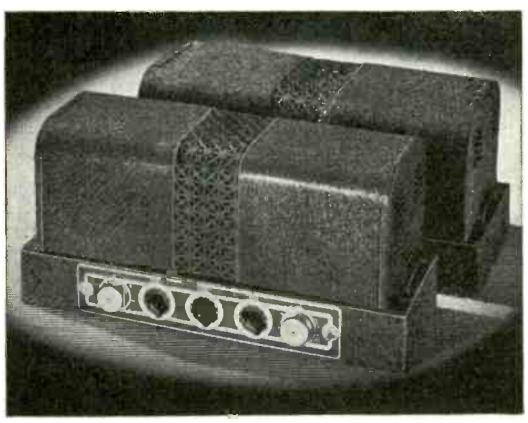
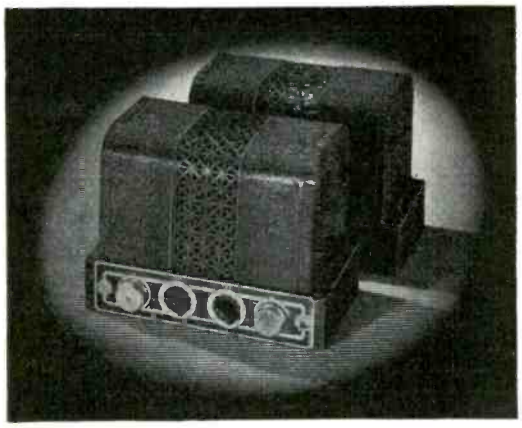
Tubes required for PAK-1M and PAK-2M kits are 1-6J7, 3-6C5's, 2-6L6's, 1-83.



PAK-3M

Uses 4-6L6's—70 watts self bias—110 watts fixed bias, total gain 110 DB. High impedance input. Separate chassis for power and audio for rack or cabinet mounting. Tubes are 1-6J5, 1-6C5, 2-6A5G's, 4-6L6's, 3-83's, 1-80. Output transformer impedances 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories such as resistors, condensers, sockets, calibration plates, etched mixer panel, controls and accessories for a dual gain, two position high impedance mixer, chassis, dust covers, handles, hardware—except tubes—all fully mounted. Net price **$78.00**



PAK-4M

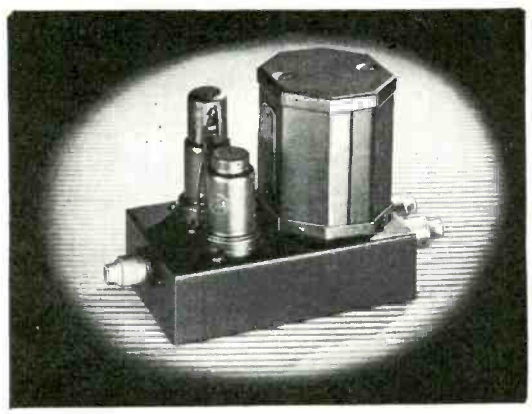
DC-AC amplifier. Four 25L6 Beam Power tubes are used to deliver 8 watts output on 115 volts. Tubes used are 1-6J7, 1-6C5, 4-25L6's, High impedance input—100 DB gain. The audio section is self contained (6 x 8 x 10½ inches) and can be operated directly on DC. For AC operation a separate power supply (6 x 8 x 10½) is used. Audio amplifier kit only, output impedance 500, 200, 15, 8, 5, 3, 1½ ohms, including all accessories, with dual gain, two position mixer and VARITONE equalizer control, less tubes, fully mounted. Net price **$21.00**

PAK-4P

AC power supply components and accessories for PAK-4M. Net price **$15.00**

PAK-5M

15 watt compact power amplifier. Uses two 6V6 Beam Power tubes. Power supply and audio amplifier on one chassis 6 x 9 x 17 inches. Tubes are 6J7, 6C5, 2-6V6's-120 DB gain. High impedance input. 500, 200, 15, 8, 5, 3, 1½ ohms output. Kit includes all accessories and pre-wired resistor—condenser strip, mixer panel, controls and accessories for a dual gain, two position mixer and VARITONE equalizer control, less tubes. Net price **$33.00**



PAK-7A

Pre-amplifier. High gain well filtered pre-amplifier designed to operate from power supply in main amplifier. High impedance input. 6F5 resistance coupled to 6C5—50, 200, 500 ohm output. Gain 60 DB. Amplifier kit only including all accessories, less tubes. Net price **$9.00**

PAK-7P

Power supply—components and accessories for 7A preamplifier. Net price **$9.00**

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EXPORT DIVISION: 100 VARICK STREET NEW YORK, N.Y. CABLES: "ARLAB" shunted by L22 instead of being shorted directly by the range selector. Any inductive effect of L16 is thus eliminated. L19, L18, and L17 are shorted directly by the range selector.

Separate windings, with the exception of L23, are employed in the oscillator stage for each position of the range selector. L23 (inductively coupled to L11 and L12) is placed in the oscillator plate circuit to provide additional feedback when operating receiver on the ultra-short-wave (D) band. This coil is effectively r-f by-passed by capacitor C12, when range selector is in the short-wave (C) position, to prevent undesirable reactions. Its effect on the remaining bands is negligible. The inherent stability of the oscillator circuit provides minimum frequency drift which is especially advantageous for high-frequency reception. The locally generated signal is capacitance coupled to grid No. 3 of the 6L7 first detector.

The output of the "Magic Brain" is fed to the i-f amplifier through a plug-in cable. This cable also supplies all power required to the "Magic Brain" unit.

The i-f amplifier consists of a 6K7 in a transformer-coupled circuit. The windings of these transformers are resonated with fixed capacitors, and are adjusted by molded magnetite cores (both primary and secondary) to tune to 460 kc.

The modulated signal as obtained from the output of the i-f stage is detected by a 6H6 twin-diode tube (No. 2 diode). The audio frequency secured by this process is transferred to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistors R12 and R13, is applied as automatic control-grid bias to the r-f, first-detector, and i-f tubes. The No. 1 diode of the 6H6 is used to supply residual bias to the controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current which flows through resistors R11, R12, and R13, thereby maintaining the desired operating bias on such tubes. On application of signal energy above a certain level, however, the No. 1 diode ceases to draw current and the avc diode takes over the biasing function.

A-F Circuit

The manual radio volume control consists of an acoustically tapered potentiometer in the audio circuit between the output of the detector-diode and the input grid of the 6F5 audio voltage-amplifier tube. This control has a two-point tone-compensating filter connected to it so that the correct aural balance will be obtained at different volume settings.

The output of the voltage amplifier is resistance-capacitance coupled to the control grid of the 6L6 power output tube. The output of this stage is transformer coupled to the voice coil of the speaker.

The music-speech control consists of a switch S5 which, in the speech position, places an additional capacitor C57 in shunt with the capacitor C56 in one of the tone-compensating filters. This reduces the low-frequency response of the amplifier and provides maximum intelligibility of the voice frequencies.

The high-frequency tone control consists essentially of the combinations of capacitor C62 and variable resistor R27, capacitor C79 and switch S6 shunting the plate circuit of the output tube. When the tone control is in its extreme counter-clockwise position the resistance of R27 is a minimum, making capacitor C62 most effective, and switch S6 remains closed, connecting capacitor

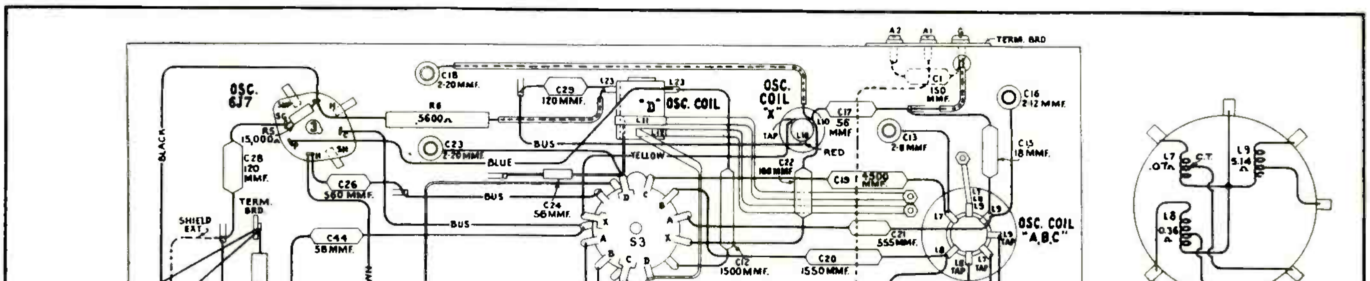


Fig. 3. "Magic Brain" wiring diagram.

C79 across the plate circuit, providing maximum attenuation of the higher audio frequencies. As the control is turned clockwise, placing more resistance in series with capacitor C62, this capacitor becomes less and less effective and the upper frequency range of the audio amplifier is extended. When the tone control nears its extreme clockwise position, resistor R27 and switch S6 open, removing capacitors C62 and C79 respectively from the audio circuit, thereby increasing the higher audio frequency range of the system.

Phonograph Circuit

The electrical impulses generated in the pickup coil L42 are boosted in the input transformer T3 before they are fed to the input grid of the 6F5 audio voltage-amplifier tube through the acoustically tapered phonograph volume control R39. The phonograph volume control also functions as a radio-phono transfer switch (see schematic diagram, Fig. 1). In the extreme counter-clockwise (radio) position, switch S8 is closed, completing the cathode circuit of the 6K7 i-f amplifier tube, and the movable arm "X" (which is connected to the input grid of the 6F5 through coupling capacitor C84) contacts lug "Y" (which is connected to the movable arm of the radio volume control R20), permitting normal radio reception. As the phonograph control is rotated clockwise, switch S8 is immediately opened (opening the i-f cathode circuit and making the i-f amplifier inoperative), and the movable arm "X" slides over the tapped resistance strip, thereby functioning as a phonograph volume control. A compensation filter is placed in shunt with the output of transformer T3 to correct the frequency response of the reproducing system so as to compensate for the recording characteristic.

Automatic Record Changer

An improved automatic mechanism, employing a synchronous motor, is used in these models. It is of the record ejector type, having a record capacity of seven for the 10-in type, and a capacity of six for the 12-in type. The turntable speed is fixed at 78 rpm by the design of the drive motor and the intermediate gear mechanism. This speed does not vary as long as the supply line frequency remains constant. The instrument may be purchased with any one of several ratings. It is very important that a machine of any particular rating be operated only at the voltage and frequency for which it is designed and rated. Attempts to operate on other voltages or frequencies will result in improper reproduction from the phonograph system and possible damage to the equipment. The ejecting mechanism is arranged so that it will trip on various types of records. This is obtained by having a trip mechanism which is actuated by the rate of needle acceleration toward the center of the record.

"Magic Eye"

A 6E5 cathode-ray tuning tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube consists of an amplifier section and a cathode-ray section built in the same glass envelope. A portion of the signal voltage developed across resistor R13 is used to actuate the grid of the amplifier section. Maximum voltage is applied to this grid when the receiver is tuned to resonance with an incoming carrier. This condition is evidenced by the minimum width of the dark sector on the fluorescent screen.

"Magic Voice"

These instruments are designed with cabinets incorporating the "Magic Voice." This is accomplished by having the rear of the speaker compartment completely enclosed by a tight-fitting back.

Five metal open-end pipes of equal diameter but of three different lengths are inserted in holes in the cabinet base and extend upward in the speaker compartment. The effect is to cause the lower-frequency waves, reaching the front of the cabinet through the pipes, to arrive approximately in-phase with the sound waves emitted from the front of the speaker, giving extended low-frequency response without boominess, or cabinet resonance.

Alignment Procedure

The various diagrams contain such information as will be needed to locate causes for defective operation if such develops. The values of the various resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagram. Identification titles, such as C1, L2, R1, etc., are provided for reference between the illustrations. The coils, reactors, and transformer windings are rated in terms of their d-c resistance only. Resistance values of less than one ohm are generally omitted.

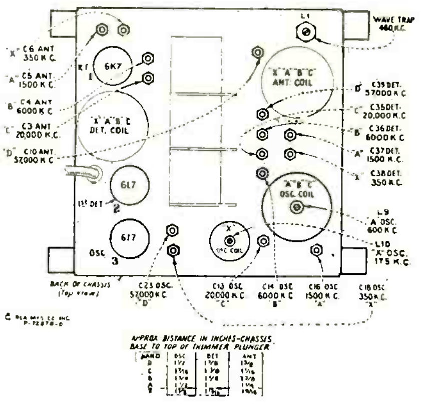


Fig. 4. "Magic Brain" trimmer locations.

There are seventeen adjustments required for the alignment of the oscillator, first-detector, and antenna-tuned circuits; one adjustment for the wave-trap; and four adjustments for the i-f system. Fifteen of these adjustments are made with plunger-type air trimming capacitors and require the use of an (RCA stock No. 12636) adjusting tool. Each of these capacitors has a lock nut for securing the plunger in place after adjustment. The remaining seven adjustments are made by means of screws attached to molded magnetite cores. These cores change the inductance of the particular coils in which they are inserted to provide exact alignment. Loss of sensitivity, improper tone quality, and poor selectivity are the usual indications of improper alignment. Such conditions will usually exist simultaneously.

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied in the sequence given, normal performance of the instrument will be obtained.

The plunger-type air trimming capacitors have their approximate plunger settings tabulated on Fig. 4. If the plungers have been disturbed from their original adjustments, they may be roughly set to the specified dimensions prior to alignment.

In performing services on the "Magic Brain," the leads should be restored to their original positions, since the lead-dress is important for proper operation and dial calibration.

Precautionary Dressing of Leads for "Magic Brain" Alignment

Band X:

(1) Keep blue lead A of S1 to antenna coil L4-5 dressed away from chassis, and from yellow lead X of S1 to antenna coil L5-6.

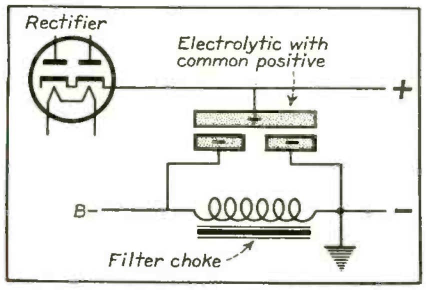
(2) Bus lead from C10 to S1 should be as short as possible.

(3) Keep blue lead A of S2 to detector coil L18-19 clear of chassis, coil shield, coil, and other leads.

ON THE JOB

Excessive Hum

In many receivers the filter choke or speaker field, as the case may be, is connected in the negative return of the high-voltage supply. In such circuits leakage between the two plates of the electrolytic condenser may occur where the filters are in a common container with a common positive lead as shown in the accompanying illustration. The possibility of this leakage increases directly with the magnitude of the voltage drop across the choke and, of course, depends upon the insulation



used between the two sections. Because of this latter reason small a-c, d-c sets are usually the worst offenders. In these because of attempts to save space and costs the insulation is cut to a minimum.

The condition will be eliminated if two individual condensers are substituted for the dual unit. Where price is a consideration, a single unit may be used for the second condenser and the two negative connections on the original filter connected together for use as the first condenser (across the rectifier).

Harold C. Dow

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Auto-Antenna Capacities

Many of the 1937 auto-radio receivers have provision for adjusting the antenna input circuit for proper matching with most of the numerous types of antennas available. For this reason it is desirable for the Service Man to know the approximate capacities of the various antennas.

The metal insert roof antenna used in the 1936 Chrysler, Dodge and DeSoto cars has an approximate capacity of 1,500 mmfd. The capacity of a typical running board antenna is about 200 mmfd. Wire-mesh roof antennas (In cars having a non-metallic top) vary in capacity from about 175 to 225 mmfd. Fishpole antennas have an approximate capacity of 70 mmfd and over the roof types average about 90 mmfd.

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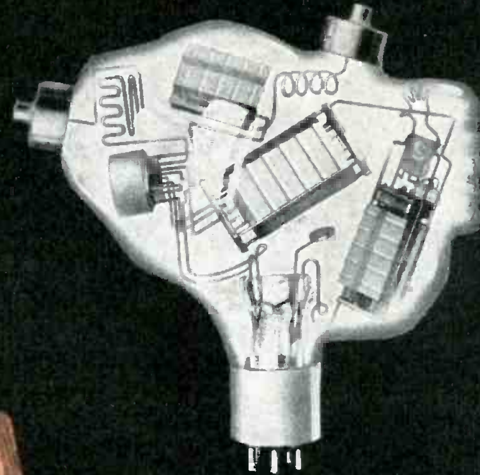

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16. Only six sockets test all tubes. No question as to which is the proper socket to use.
17. Panel only 13½ inches by 9 inches of Beautiful Antique Bronze.
18. Golden Oak Carrying Case.
19. Low ohms 0/200 ohm range has center scale reading of only 3.5 ohms! Just the unit to accurately measure voice coil and R. F. coil resistances, first division on this range is 0.1 ohms!

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GREENWOOD MISSISSIPPI

(4) Keep spaghetti lead C6 to X of S1 apart from spaghetti lead C5 to A of S1, and from chassis.

Band A:

(1) Keep green lead terminal S1 to antenna coil tap L4 away from chassis, coil shield, and coil.

(2) Keep spaghetti lead C5 to A of S1 apart from spaghetti lead C6 to X of S1 and from chassis.

Band C:

Lead from C19 to oscillator coil L7 should be maintained as short and straight as possible.

If the test-oscillator signal cannot be heard as the receiver (heterodyne) oscillator air-trimmer plunger is changed from its minimum-capacity to maximum-capacity position (receiver dial and test oscillator set to the specified frequencies, and the correct oscillator air-trimmer used) it may be an indication that the test-oscillator frequency is outside the range covered by the air-trimmer. Under such conditions, when a more accurate setting of the test oscillator cannot be determined, set the oscillator air-trimmer-plungers to the approximate settings given on Fig. 4. Tune the test oscillator until the signal is heard in the speaker. Each of two test-oscillator settings (the fundamentals or the harmonics of which are 920 kc apart) produce a signal. The lower-frequency test-oscillator setting should be used as this places the test-oscillator (signal) frequency 460 kc below the frequency of the receiver heterodyne oscillator.

Holes are provided in the top of the r-f and antenna coil cans on some models to enable a tuning check with the tuning wand. The hole in the top of the detector coil can has a cinch button which must be removed before insertion of the tuning wand. When the brass end of the wand is inserted in the coil, the inductance of the coil is decreased. If this results in an increase of output, the respective air-trimmer capacitance should be decreased (plunger pulled out). If inserting the iron end of the tuning wand causes an increase in output, resulting from an increase of inductance of the coil, the respective air-trimmer capacitance should be increased (plunger pushed in). If the range of the air trimmer is not sufficient to give the desired results, the lead-dress may be changed in the particular circuit being aligned, so as to cause the circuit to resonate within the range of the trimmer. An increase in the capacity-to-ground of the circuit will be required if the iron end of the tuning wand causes an increase of signal output when the air-trimmer plunger is full-in, while a decrease in the capacity-to-ground will be required if the brass end of the tuning wand causes an increase in signal output when the air-trimmer plunger is full-out.

Two methods of alignment are applicable—one requires use of the cathode-ray oscillograph, and the other requires an output meter. The cathode-ray alignment method is advantageous in that the indication provided is in the form of a wave-image which represents the resonance characteristics of the circuit being tuned. This method is preferred because of the i-f characteristics of these receivers. If oscillograph equipment is not available, an approximate alignment may be performed by the output-indicator method. Alignment by this method is similar to the cathode-ray method outlined below except that the receiver volume control should be at maximum, the trimmers adjusted to peak response and the test-oscillator sweeping operations omitted. Either of these methods require the use of a reliable test oscillator.

Cathode-Ray Alignment

Make alignment apparatus connections as indicated in the instructions for the particular make of oscillograph and frequency modulator used for making the adjustments. Connect the receiver chassis to a good external ground. The oscillograph "high" connection should be made to terminal No. 1 on the phonograph board. The "low" post of the oscillograph should be connected to the receiver chassis.

Set the oscillograph power switch on and adjust the intensity and focus controls to give a clearly defined spot or line on the cathode-ray screen. Set the vertical and horizontal amplifiers on and turn the vertical gain control to the full-clockwise position. Set the timing selector to the position for internal sweep. The synchronizing, frequency and horizontal gain controls should be set to about their mid-positions. For each of the following adjustments, the test-oscillator output must be regulated so that the image obtained on the oscillograph screen will be of the minimum size for accurate observation. The receiver volume-control setting is optional.

I-F Adjustments

(a) Set "Fidelity" control to counter-clockwise position, "Radio - Phono" switch to "Radio," and "Range Selector" to standard-broadcast band. Connect the "Ant." output of the test oscillator to the grid cap of 6K7 second i-f tube (with grid lead in place) through a 0.001-mfd capacitor, with "Gnd." to receiver chassis. Tune the test oscillator to 460 kc and place its modulation switch to "On" and its output switch to "Hi."

(b) Turn on the receiver and test oscillator. Increase the output of the test oscillator until a deflection is noticeable on the oscillograph screen. The figures obtained represent several waves of the detected signal, the amplitude of which may be observed as an indication of output. Cause the wave-image formed (400-cycle waves) to be spread completely across the screen by adjusting the horizontal gain control. The image should be synchronized and made to remain motionless by adjusting the "Sync." and "Freq." controls.

(c) Adjust the two magnetite core screws L27 and L26 (see Figs. 4 and 6) of the second i-f transformer (one on top and one on bottom) to produce maximum vertical deflection of the oscillographic image. This adjustment places the transformer in exact resonance with the 460-kc signal.

(d) The sweeping operation should

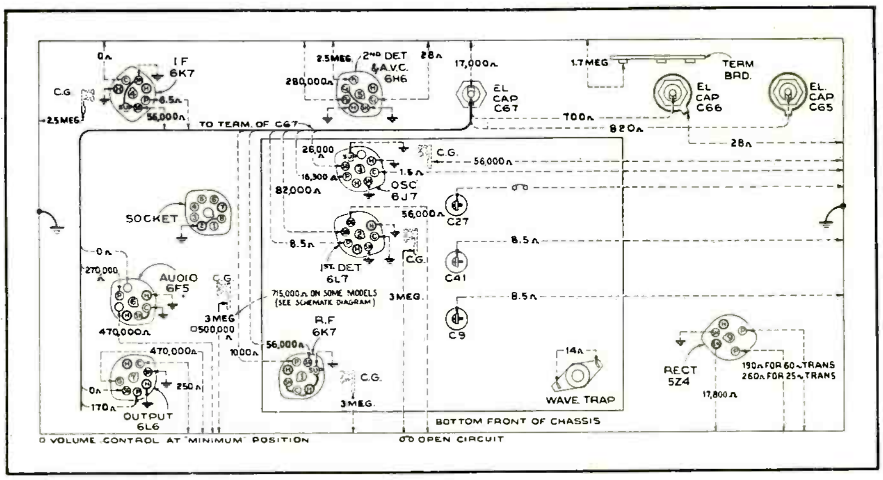


Fig. 5. Underchassis view with resistance measurements for various terminals indicated.

follow using the frequency modulator. Shift the oscillograph "Timing" switch to "Ext." Insert plug of frequency-modulator cable in test-oscillator jack. Turn the test-oscillator modulation switch to "Off." Turn on the frequency modulator and place its sweep-range switch to "Hi."

(e) Increase the frequency of the test oscillator by slowly turning its tuning control until two separate, distinct, and similar waves appear on the screen. If only one wave appears, increase the "Freq." control on the oscillograph to obtain two waves. These waves will be identical in shape, totally disconnected, and appear in reversed positions. They will have a common base line, which is discontinuous. Adjust the "Freq." and "Sync." controls of the oscillograph to make them remain motionless on the screen. Continue increasing the test-oscillator frequency until these forward and reverse curves move together and overlap, with their highest points exactly coincident.

(f) With the images established as in (e), re-adjust the two magnetite core screws L27 and L26 on the second i-f transformer so that they cause the curves on the oscillograph screen to become exactly coincident throughout their lengths and have maximum amplitude.

(g) Without altering the adjustments of the apparatus, shift the "Ant." output of the test oscillator to the input of the i-f system, i.e., to the 6L7 first-detector grid cap, through a 0.001-mfd capacitor (with grid lead in place). Regulate the test-oscillator output so that the amplitude of the oscillographic image is approximately the same as used for adjustment (f) above.

(h) The two first i-f transformer magnetite core screws L25 and L24 (one on top and one on bottom) should then be adjusted so that they cause the forward and reverse curves to become coincident throughout their lengths and have maximum amplitude. The composite wave obtained in this manner represents the resonance characteristic of the total i-f system. Lack of symmetry or irregularity of the resultant image will indicate the presence of a defect in the i-f system.

R-F Adjustments

Alignment must be made in sequence of wave-trap, ultra-short-wave band, short-wave band, medium-wave band, standard-broadcast band, and long-wave band.

Wave-Trap Adjustment:

(a) Connect output of test oscillator to antenna terminal "A1" through a 200-mmfd (important) capacitor. Remove the plug of the frequency-modulator cable from the test-oscillator jack. Turn test-oscillator modulation switch to "On." Shift the oscillograph "Timing" switch to "Int." Place receiver range selector in standard-broadcast position. Set the receiver dial to a position of no extraneous signals near 600 kc. Tune the test oscillator to 460 kc. Adjust the wave-trap magnetite core screw to the point which causes minimum amplitude of output (maximum suppression of signal) as shown by the waves on the oscillograph. An increase of the test-oscillator output may be necessary before this point of minimum amplitude, obtained by correct adjustment of wave-trap screw, becomes apparent on oscillograph screen.

Ultra-Short-Wave Band:

(b) Connect "Ant." output of test oscillator to antenna terminal "A1" of the receiver through a 300-ohm resistor. Set the receiver range selector to its ultra-short-wave position and its dial pointer to 57,000 kc. Adjust the test oscillator to 19,000 kc. The 3d harmonic of 19,000 kc is used for this adjustment. If the indication on the oscillograph screen is not sufficient for the following adjustments at 57,000 kc, the vertical-input terminals of the cathode-ray oscillograph may be connected thus: "Hi" to the plate contact of the 6L6 power-output tube socket with the "0" terminal to chassis-ground. The receiver should be turned off while making this connection since the plate potential is impressed across the oscillograph input and a severe shock will result if contact is made between these two points. If this connection is made, advance the receiver volume control to its maximum position. Adjust oscillator air-trimmer C23 for maximum (peak) output. Two positions, each producing maximum output, may be found. The position of minimum capacitance (plunger near out) should be used. This places the receiver heterodyne oscillator 460 kc higher in frequency than the incoming signal. Tighten lock nut. Adjust the detector air-trimmer C39, while slightly rocking the gang tuning condenser back and forth through the signal, for maximum (peak) output. Two peaks may be found on this trimmer. The peak of maximum capacitance (plunger near in) should be used. Tighten lock nut. Adjust the antenna air-trimmer C10 for maximum (peak) output while slightly rocking the gang tuning condenser back and forth through the signal. Two peaks may be found on this trimmer which produce maximum output. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Check the image frequency by changing the receiver dial setting to 56,080 kc. If the image signal is received at this position, the adjustment of the oscillator air-trimmer C23 has been correctly made. No adjustments should be made while checking for the image signal.

(c) Retune receiver for maximum response to 57,000 kc (not image response) without disturbing test oscillator adjustments. Change test oscillator to 6,800-14,000 kc range. Tune test oscillator until signal is heard in speaker. Two test-oscillator settings (230 kc apart) will produce a signal at this point. The lower frequency test-oscillator setting should be used, as this places the test oscillator harmonic 460 kc below the frequency of the receiver heterodyne oscillator.

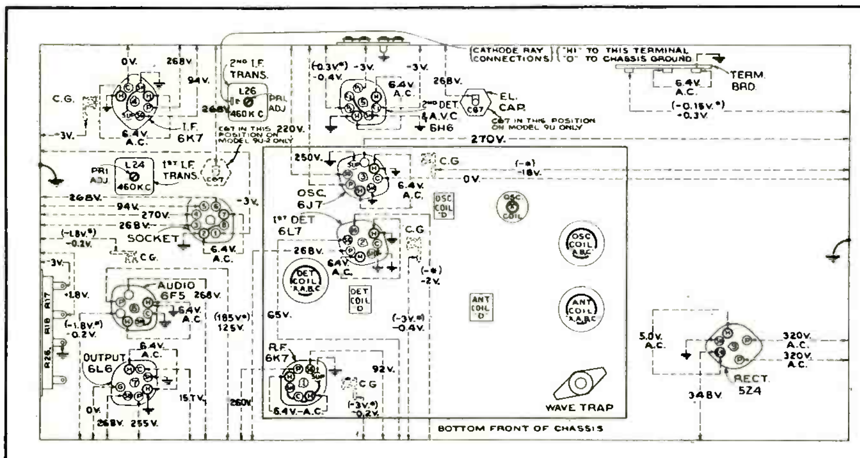


Fig. 6. Underchassis view with voltage measurements for various terminals indicated.

Tune receiver for maximum response at a dial setting of approximately 28,500 kc (image should tune in at a dial setting approximately 27,580 kc) without altering test-oscillator adjustment. Test-oscillator second harmonic of 14,250 kc is used for the following check. Check calibration of receiver dial. A receiver-dial reading of less than 28,500 kc indicates that the inductance of the oscillator secondary coil L11 is too low and should be increased. If the receiver dial reading is greater than 28,500 kc, the inductance of L11 is too high and should be decreased. If it is necessary to change the inductance of L11, first remove bottom cover of "Magic Brain" and then set receiver dial pointer to 28,500 kc. To decrease inductance, move the grounded ends (straps) of L11 and L12 (see Fig. 3) nearer chassis. Do not allow straps to touch chassis except where connected. To increase inductance, move the straps farther away from chassis. Adjust position of straps until maximum (peak) output results. The alignment of the detector tuned circuit should next be checked at 28,500 kc without changing either the receiver or test-oscillator adjustments. An increase of output when the brass end of a tuning wand is brought near L22 indicates that L22 is too high in inductance, while an increase when the iron end is brought near the coil indicates that the inductance is too low. The inductance of L22 may be varied by changing the spacing between the grounded end (strap) of L22 and the strap connected from C41 to contact on S2 (Fig. 3). Adjust the spacing until maximum (peak) output results. Replace "Magic Brain" bottom cover and repeat adjustments in (b) prior to those of short-wave band.

Short-Wave Band:

(d) Set the receiver range selector to its short-wave position and its dial pointer to 20,000 kc. Adjust the test oscillator to 20,000 kc. Adjust oscillator air trimmer C13 until maximum (peak) output is reached. Two peaks may be found with this circuit. The peak with minimum capacitance (plunger near out) should be used. Tighten lock nut. Adjust detector air-trimmer C35 until maximum (peak) output is reached, while slightly rocking the gang tuning condensers back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Adjust antenna air-trimmer C3 until maximum (peak) output is reached while slightly rocking the gang tuning condenser back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Check the image frequency by changing the receiver dial setting to 19,080 kc. The image signal should be received at this position indicating that the adjustment of C13 has been correctly made. No adjustments should be made while checking for the image signal.

Medium-Wave Band:

(e) Place receiver range selector to its medium-wave position with its dial pointer set to 6,000 kc. Tune the test oscillator to 6,000 kc. Adjust oscillator air-trimmer C14 to produce maximum (peak) output as shown by the waves on the oscillograph. Two peaks may be found with this circuit. The peak with minimum capacitance (plunger near out) should be used. Tighten lock nut. Adjust the detector air-trimmer C36 for maximum (peak) output while slightly rocking the gang tuning condenser back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Adjust antenna air-trimmer C4 to produce maximum (peak) output. Tighten lock nut.

Standard-Broadcast Band:

(f) Remove the 300-ohm resistor from between the test-oscillator "Ant." post and receiver antenna terminal "A1" and insert a 200-mmfd capacitor in its place. Place receiver range selector to standard-broadcast position with receiver dial pointer set to 600 kc. Tune the test oscillator to 600 kc. Adjust oscillator magnetite core screw L9 (top of large oscillator coil can) for maximum (peak) output as shown by the waves on the oscillograph screen.

(g) Set receiver dial pointer to 1,500 kc. Tune test oscillator to 1,500 kc (1,500-3,100-kc range) and increase its output to produce a registration on the oscillograph screen. Carefully adjust the oscillator, detector, and antenna air-trimmers C16, C37 and C5, respectively, to produce maximum (peak) output as shown by the waves on the oscillograph screen. Shift the oscillograph "Timing" switch to "Ext." Place the frequency modulator sweep-range switch to its "Lo" position and insert plug of the frequency-modulator cable in test-oscillator jack. Turn test-oscillator modulation switch to "Off." Retune the test oscillator (increase frequency) until the forward and reverse waves show on the oscillograph screen and become coincident at their highest points. This will occur at a test-oscillator setting of approximately 1,680 kc. Adjust trimmers C16, C37, and C5 again, setting each to the point which produces the best coincidence and maximum amplitude of the images.

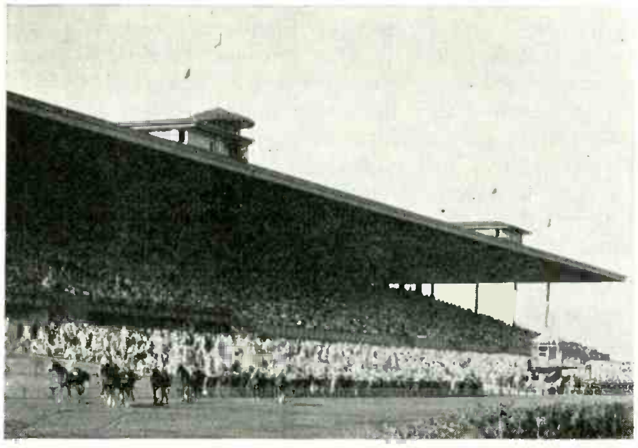
(h) Remove the plug of the frequency-modulator cable from the test-oscillator jack. Turn test-oscillator modulation switch to "On." Set oscillograph "Timing" switch to "Int." Tune test oscillator to 200 kc (200-400 kc range). Tune receiver for maximum response to this signal at a dial reading of approximately 600 kc. The third harmonic of the 200-kc signal is used for this adjustment. Shift oscillograph "Timing" switch to "Ext." Insert the plug of the frequency modulator cable in test-oscillator jack. Turn test-oscillator modulation switch to "Off." Retune the test oscillator (increase frequency) until the forward and reverse waves show on the oscillograph screen. This will occur at a test-oscillator setting of approximately 230 kc. Disregarding the fact that the two traces may or may not come together, adjust the oscillator magnetite-core screw L9 (top of large oscillator coil can) to produce maximum (peak) amplitude of the traces. Shift the oscillograph "Timing" switch to "Int." Remove the plug of the frequency-modulator cable from the test-oscillator jack. Turn the test-oscillator modulation switch to "On." Repeat adjustments in (g) above to compensate for any changes caused by the adjustment of L9 core, tightening lock nuts on C16, C37, and C5, respectively, after each is adjusted.

Long-Wave Band:

(i) Shift the oscillograph "Timing" switch to "Int." Remove the plug of the frequency-modulator cable from the test-oscillator jack. Turn the test-oscillator modulation switch to "on." Place receiver range selector to its long-wave position. Set the receiver dial pointer to 175 kc. Tune the test oscillator to 175 kc and increase its output until a deflection is noticeable on the oscillograph screen. Adjust oscillator magnetite-core screw L10 (located on top of small oscillator coil can) so that maximum (peak) amplitude of output is shown on the oscillograph screen.

(j) Set receiver dial pointer to 350 kc. Tune test oscillator to 350 kc. Adjust the oscillator, detector, and antenna air-trimmers C18, C38, and C6 to pro-

Wherever You Go..



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duce maximum (peak) output as shown by the waves on the oscillograph screen. Without disturbing the connections, shift the oscillograph "Timing" switch to "Ext." Place the frequency-modulator sweep-range switch to its "Hi" position and insert plug of frequency-modulator cable in test-oscillator jack. Turn test-oscillator modulation switch to "Off." Retune the test oscillator (decrease frequency) until the forward and reverse waves show on the oscillograph screen and become coincident at their highest points. This setting places the test-oscillator frequency to 175 kc. The second harmonic is now used for the 350 kc adjustment. Adjust air-trimmers C18, C38, and C6, again, to produce maximum amplitude of the images and best coincidence throughout their lengths.

(k) Retune the receiver to approximately 175 kc so that the forward and reverse waves appear on the oscillograph screen. Adjust the oscillator magnetite core screw L10 to produce maximum (peak) amplitude of the waves, disregarding the fact that the two traces may or may not come together.

(l) Shift the receiver dial setting to 350 kc without altering any other adjustments (frequency modulator still in operation). Adjust air-trimmers C18, C38, and C6, respectively, to produce maximum amplitude and best coincidence of the waves. These adjustments compensate for any changes caused by the adjustment of the magnetite core screw L10. Tighten lock nuts on C18, C38, and C6, respectively, after each is adjusted.

Output Indicator Alignment

Attach the output indicator across the loudspeaker voice-coil circuit. Advance the receiver volume control to its maximum position, letting it remain in such position for all adjustments. For each adjusting operation, regulate the test-oscillator output so that the signal level is as low as possible and still be observable at the receiver output. Use of such small signal will obviate broadness of tuning which would otherwise result from avc action on a stronger one.

I-F Adjustments

(a) Connect the "Ant." output of the test oscillator to the grid cap of the 6L7 first detector tube (with grid lead in place) through a 0.001-mfd capacitor, with "Gnd." to receiver chassis. Tune the test oscillator to 460 kc. Place its mdulation switch to "On" and its output switch to "Hi."

(b) Adjust the two magnetite core screws of the second i-f transformer (one on top and one on bottom) to produce maximum (peak) output.

(c) The two first i-f transformer magnetite core screws (one on top and one on bottom) should be adjusted to produce maximum (peak) output. It is advisable to repeat the adjustment of all i-f magnetite core screws to assure that the interaction between them has not disturbed the original adjustments.

R-F Adjustments

Alignment must be made in sequence of wave-trap, ultra-short wave band, short-wave band, medium-wave band, standard-broadcast band, and long-wave band.

Wave-Trap Adjustment:

(a) Connect the "Ant." output of the test oscillator to the antenna terminal "A1" on the receiver through a 200-

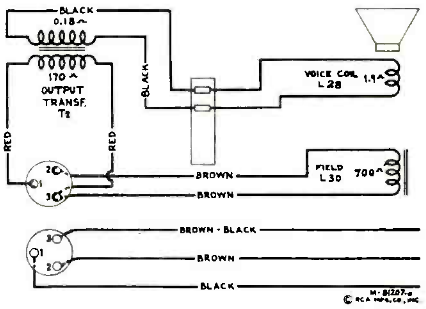

Fig. 7. RCA 9T, 9K2, 9U, 9U2 loudspeaker wiring.

mmfd (important) capacitor. Place the range selector to its standard-broadcast position and set the receiver dial pointer to a position of no extraneous signals near 600 kc. Tune the test oscillator to 460 kc. Adjust the wave-trap magnetite core screw to the point which causes minimum output (maximum suppression of signal). An increase of the test-oscillator output may be necessary before the point of minimum output, obtained by adjustment of wave-trap screw, becomes apparent on the output indicator.

Ultra-Short-Wave Band:

(b) Connect the "Ant." output of the test oscillator to the antenna terminal "A1" through a 300-ohm resistor. Set receiver range selector to its ultra-short-wave position and its dial pointer to 57,000 kc. Adjust the test oscillator to 19,000 kc. The third harmonic of 19,-000 kc is used for this adjustment. Adjust the oscillator air-trimmer C23 for maximum (peak) output. Two positions for maximum output may be found. The position of minimum capacitance (plunger near out) should be used. This places the receiver heterodyne oscillator 460 kc higher in frequency than the incoming signal. Tighten lock nut. Adjust the detector air-trimmer C39 while slightly rocking the gang tuning condenser back and forth through the signal for maximum (peak) output. Two peaks may be found on this trimmer. The peak of maximum capacitance (plunger near in) should be used. Tighten lock nut. Adjust the antenna air-trimmer C10 for maximum (peak) output while slightly rocking the gang tuning condenser back and forth through the signal. Two peaks may be found on this trimmer which produce maximum output. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Check the image frequency by changing the receiver dial setting to 56,080 kc. If the image signal is received at this position, the adjustment of the oscillator air-trimmer C23 has been correctly made. No adjustments should be made while checking for the image signal.

(c) Retune receiver for maximum response to 57,000 kc (not image response) without disturbing test-oscillator adjustments. Change test oscillator to 6,800-14,000-kc range. Tune test oscillator until signal is heard in speaker. Two test-oscillator settings (230 kc apart) will produce a signal at this point. The lower frequency test-oscillator setting should be used, as this places the test oscillator harmonic 460 kc below the frequency of the receiver heterodyne oscillator. Tune receiver for maximum response at a dial setting of approximately 28,500 kc (image should tune in at a dial setting of approximately 27,580 kc) without altering test-oscillator adjustment. Test-oscillator second harmonic of 14,250 kc is used for the following check. Check calibration of receiver dial. A receiver-dial reading of less than 28,500 kc indicates that the inductance of the oscillator secondary coil L11 is too low and should be increased. If the receiver-dial reading is greater than 28,500 kc, the inductance of L11 is too high and should be decreased. If it is necessary to change the inductance of L11, first remove bottom cover of "Magic Brain" and then set receiver dial pointer to 28,500 kc. To decrease inductance, move the grounded ends (straps) of L11 and L12 (see Fig. 3) nearer chassis. Do not allow straps to touch chassis except where connected. To increase inductance move the straps farther away from chassis. Adjust position of straps till maximum (peak) output results.

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P. A. EQUIPMENT AND SPEAKER HEADQUARTERS FOR THE NATION

The alignment of the detector-tuned circuit should next be checked at 28,500 kc without changing either the receiver or test oscillator adjustments. An increase of output when the brass end of a tuning wand is brought near L22 indicates that L22 is too high in inductance, while an increase when the iron end is brought near the coil indicates that the inductance is too low. The inductance of L22 may be varied by changing the spacing between the grounded end strap of L22 and the strap connected from C41 to the contact on S2. An increase of spacing will increase the inductance, while a decrease of spacing will decrease the inductance. Adjust the spacing until maximum (peak) output results. Replace "Magic Brain" bottom cover and repeat adjustments in (b) prior to those of short-wave band.

Short-Wave Band:

(d) Set the receiver range selector to its short-wave position and its dial pointer to 20,000 kc. Adjust the test oscillator to 20,000 kc. Adjust oscillator air-trimmer C13 until maximum (peak) output is reached. Two peaks may be found for this circuit. The peak with minimum capacity (plunger near out) should be used. Tighten lock nut. Adjust detector air-trimmer C35 until maximum (peak) output is reached, while rocking the gang tuning condenser back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Adjust antenna air-trimmer C3 until maximum output is reached, while slightly rocking the tuning condenser back and forth through the signal. Two peaks may be found for this circuit. The peak with maximum capacity (plunger near in) should be used. Tighten lock nut. Check the image frequency by changing the receiver dial setting to 19,080 kc. The signal should be received at this position indicating that the adjustment of C13 has been correctly made. No adjustments should be made while checking for the image signal.

Medium-Wave Band:

(e) Place the receiver range selector to its medium-wave position with the receiver dial pointer set to 6000 kc. Tune the test oscillator to 6000 kc. Adjust the oscillator air-trimmer C14 to produce maximum output. Two peaks may be found with this circuit. The peak with minimum capacitance (plunger near out) should be used. Tighten lock nut. Adjust the detector air-trimmer C36 for maximum (peak) output while slightly rocking the receiver gang tuning condenser back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacitance (plunger near in) should be used. Tighten lock nut. Adjust antenna air-trimmer C4 to produce maximum (peak) output. Tighten lock nut.

Standard Broadcast Band:

(f) Remove the 300-ohm resistor from between the test-oscillator "Ant" post and receiver antenna terminal "A1" and insert a 200-mmfd capacitor in its place. Place receiver range selector to its standard-broadcast position with the receiver dial pointer set to 600 kc. Tune the test oscillator to 600 kc. Adjust the oscillator magnetite-core screw L9 (top of large oscillator coil can) for maximum (peak) output.

(g) Set receiver dial pointer to 1,500 kc. Tune test oscillator to 1,500 kc and regulate its output until a slight indication of output is visible. Carefully adjust the oscillator, detector, and antenna air-trimmers C16, C37, and C5, respectively, to produce maximum (peak) output.

(h) Tune test oscillator to 600 kc. Tune the receiver to pick up this signal near 600 kc, disregarding the dial reading at which it is best received. Adjust oscillator magnetite core screw L9 (top of large oscillator coil can) for maximum (peak) output while slightly rocking the gang tuning condenser back and forth through the signal. Repeat adjustments in (g) above to compensate for any change caused by adjustment of L9 magnetite core screw, tightening lock nuts on C16, C37, and C5, respectively, after each is adjusted.

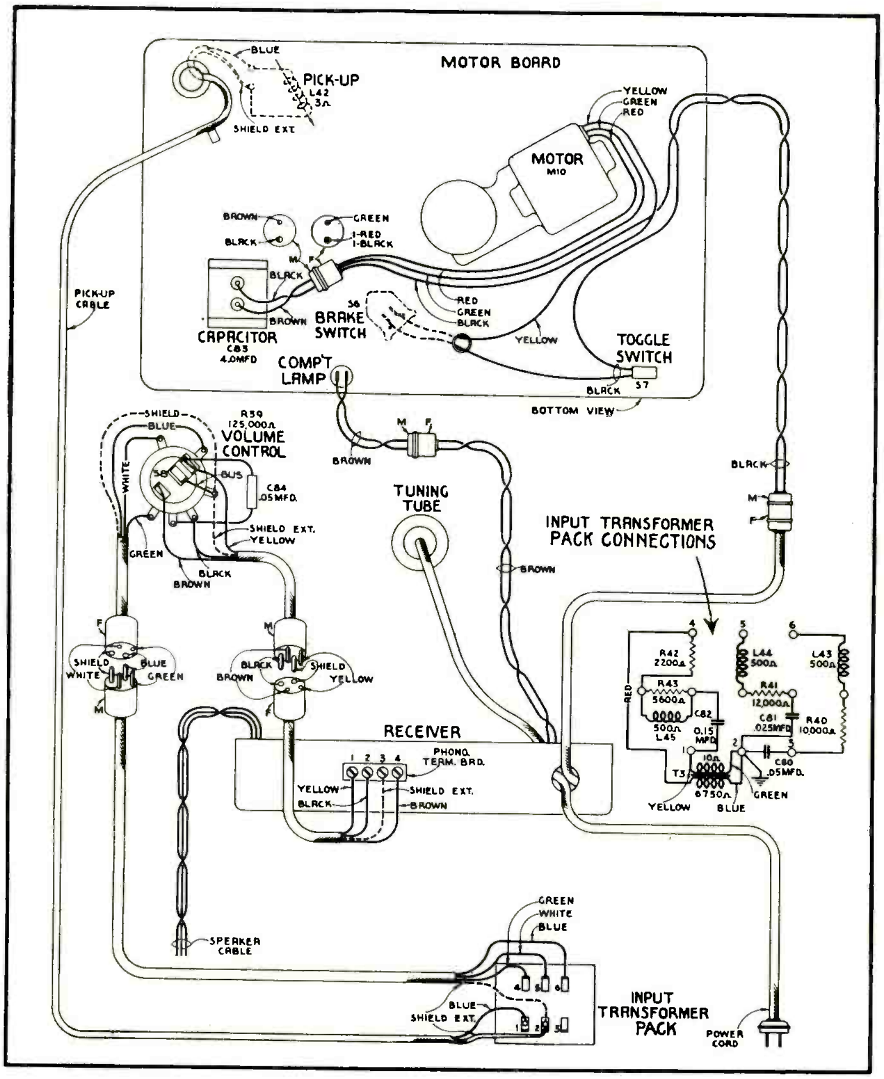

Fig. 8. Assembly wiring.

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Long-Wave Band:

(i) Place receiver range selector to its long-wave position, with dial pointer set to 175 kc. Tune the test oscillator to 175 kc and increase its output until a slight indication of output is visible. Adjust oscillator magnetite core screw L10 (top of small oscillator coil can) for maximum (peak) output.

(j) Set receiver dial position to 350 kc. Tune test oscillator to 350 kc. Adjust the oscillator, detector, and antenna air-trimmers C18, C38, and C6, respectively, to produce maximum (peak) output.

(k) Tune test oscillator to 175 kc. Tune receiver to pick up this signal near 175 kc, disregarding the dial reading at which it is best received. Adjust oscillator magnetite core screw L10 (top of small oscillator coil can) for maximum (peak) output while slightly rocking the gang tuning condenser back and forth through the signal. Repeat adjustments in (j) above to compensate for any changes caused by the adjustment of the magnetite core screw L10. Tighten lock nuts on C18, C38, and C6 respectively, after each is adjusted.

Loudspeaker

Centering of the loudspeaker voice coil is made in the usual manner with three narrow paper feelers after first removing the front paper dust cover. This may be removed by softening its cement with a very light application of acetone using care not to allow the acetone to flow down into the air gap. The dust cover may be cemented back in place with ambroid upon completion of adjustment.

Antenna and Ground Terminals

These receivers are equipped with an antenna-ground terminal board having three terminals. These terminals are marked "A2," "A1" and "G," the latter being the ground terminal and should always be connected to a good external ground. The transmission-line leads of an RCA RK-40A antenna system should be connected to terminals "A2" and "A1." The receiver coupling units of the RK-40 and the Spider-Webb antenna systems should be connected to terminals "A1" and "G." Connect a single-wire antenna to terminal "A1."

Resistance Values

The resistance values shown between socket contacts, grid caps, resistors and terminals to receiver chassis or to other pertinent point on Fig. 5, were taken with the a-c supply disconnected, tubes in their respective sockets, the tuning condenser in full-mesh, range selector in the standard-broadcast position and the volume control at maximum. The use of this diagram in conjunction with the circuit diagram, Fig. 1, and wiring diagram, Fig. 3, will permit the location of certain troubles which might otherwise be difficult to ascertain. Each value as specified should hold within ± 20%. Variations in excess of this limit will usually be indicative of trouble in circuit under test.

Socket Voltages

Note: Two voltage values are shown for some readings. The values shown in parenthesis with asterisk (*) indicates

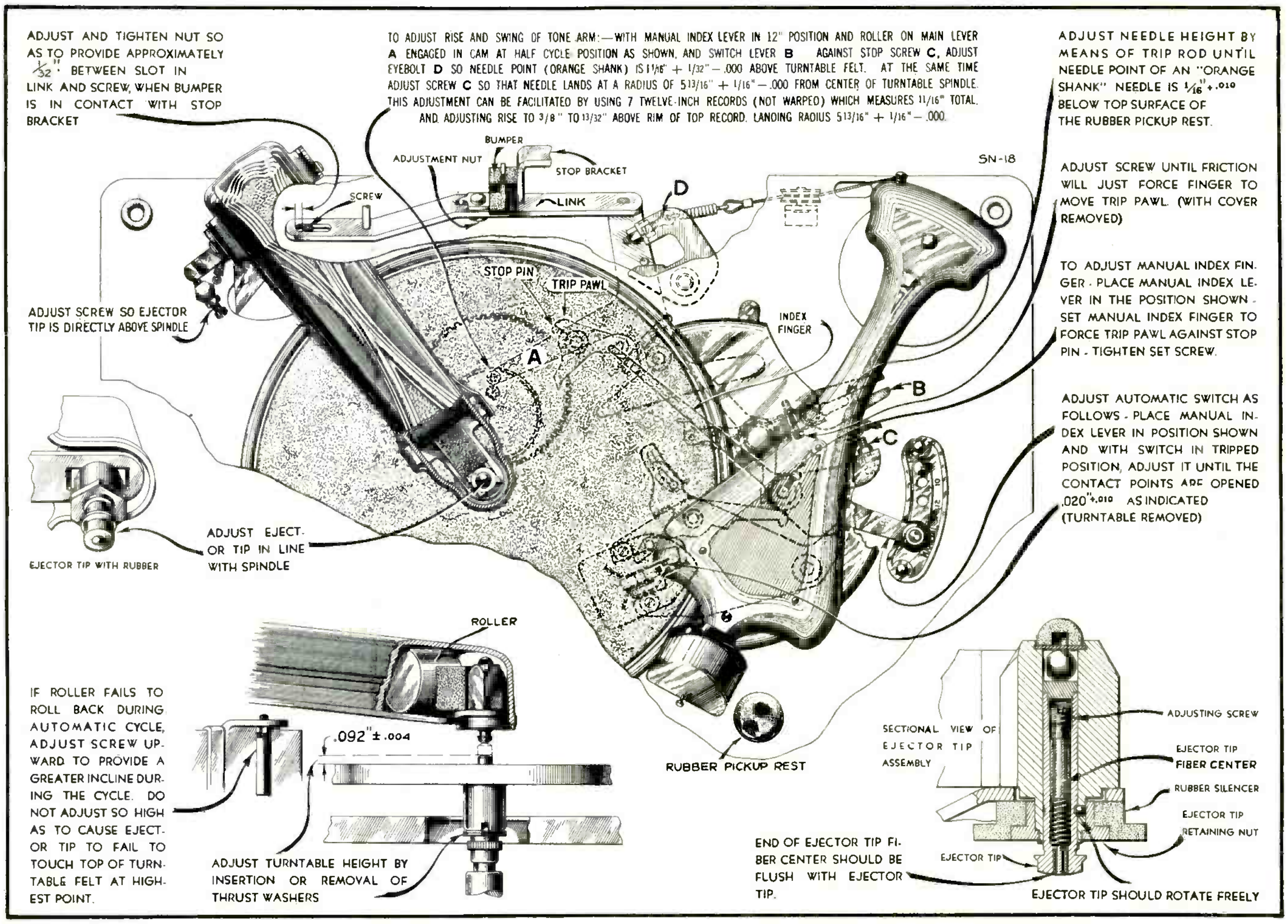

Fig. 9.—Automatic record changer adjustments.

operating conditions without voltmeter loading. The other value (generally lower) is the actual measured voltage and differs from the value shown in parenthesis because of the additional loading of the voltmeter through the high series circuit resistance.

The voltage values indicated from the socket contacts, grid caps, resistors, and terminals to receiver chassis on Fig. 6 were taken with a 115-volt line supply and the receiver tuned to approximately 1,000 kc. The antenna was shorted to the chassis and the radio volume control turned off. The phonograph volume control was also turned off during the measurements.

Each value as specified should hold within ± 20% when the receiver is normally operative at its rated line voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. To duplicate the conditions under which the voltages were measured requires a 1,000-ohm-per-volt d-c meter, having ranges of 10, 50, 250, 500, and 1,000 volts. Use the nearest range above the specified measured voltage. A-c voltages were measured with a corresponding a-c meter.

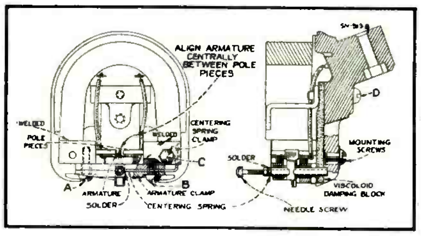

Fig. 10. Phonograph pickup details.

Magnetic Pickup

The pickup used in the phonograph unit employs a horseshoe magnet which is rigidly welded to the pole pieces and cannot be taken apart. There is a centering spring attached to the armature to maintain proper adjustment and to provide a limiting effect on the movement of the armature. The frequency response is substantially uniform over a wide range. Service operations which may be necessary on the pickup are as follows:

Centering Armature

Refer to Fig. 10 showing the pickup inner structure. The armature is shown in its proper relation to the magnet pole pieces, i.e., exactly centered. Whenever this centering adjustment has been disturbed, the screws A, B, and C should be loosened and the armature clamp adjusted to the point where the vertical axis of the armature is at right angles to the horizontal axis of the pole pieces, and centered between them. This centering operation may be facilitated by inserting a small rod or nail into the armature needle hole, using it as a lever to test the angular movement of the armature. The limitations of the movement in each direction will be caused by the armature striking the pole pieces. The proper adjustment is obtained when there is equal angular displacement of the armature and adjustment rod or nail to each side of the vertical axis of the magnet and coil assembly. The screws A and B should then be secured, observing care not to disturb the adjustment of the armature clamp. Then place the pickup in a vise and secure the centering spring-clamp by means of the screw C, allowing the centering spring to remain in the position at which the armature is exactly centered between the pole pieces. With a little practice, the correct adjustment of the armature may be readily obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other such foreign materials which would obstruct the movement of the pickup armature.

Damping Block

The viscoloid block which is attached to the back end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform. Should it be necessary to replace this damping block, it may be done by removing screw D and the cover support bracket from the mechanism and taking off the old viscoloid block. The surface of the armature which is in contact with the viscoloid should be thoroughly cleaned with fine emery cloth. Then insert the new block so that it occupies the same position as it did originally. Make certain that the block is in correct vertical alignment with the armature. The hole in the new viscoloid block is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the viscoloid aligned on the armature, screw D and the cover support bracket should then be replaced. Heat should be applied to the armature (viscoloid side) so that the viscoloid block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron constructed as shown in Fig. 11 will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block and cause a small bulge on both sides.

Replacing Coil

Whenever there is defective operation due to an open or shorted pickup coil, this coil should be replaced. The method of replacement will be obvious upon inspection of the pickup assembly and by study of the cut-a-way illustrations. Make sure that the new coil is properly centered with the hole in the support strip and glued securely in that position. It is important to readjust the armature as previously explained after reassembly of the mechanism. Only rosin core solder should be used for soldering the coil leads in the pickup. This same type of solder should be used when necessary for soldering the centering spring to the armature.

Magnetizing

Loss of magnetization will not usually occur when the pickup has received normal care because the magnet and pole pieces are one unit and the magnetic circuit remains practically closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to remagnetize the entire structure. To do this, it will be necessary to first remove the pickup mechanism from the tone arm, and then remove the magnet assembly. Place the magnet assembly on the poles of a standard pickup magnetizer such as the (RCA stock No. 9549) pickup magnetizer and charge the magnet.

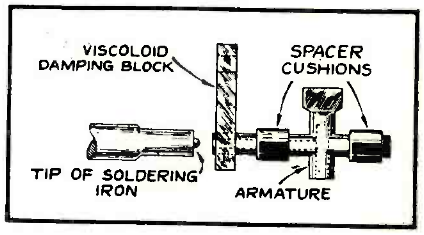

Fig. 11. Special soldering iron tip.

Automatic Record Ejector

The record changing mechanism is designed to be simple and fool-proof. Occasionally, however, certain adjustments may be required. These adjustments are illustrated and explained in Fig. 9.

It is important when servicing the automatic mechanism, to have it placed on a level support. It is also important to refrain from forcing the mechanism if there is a tendency to bind or jam, since bent levers and possibly broken parts may result.

TEST EQUIPMENT...

ZERO-CURRENT VOLTMETER

By BRADLEY THOMPSON*

THE advent of automatic volume control and automatic tuning in modern receivers has presented a special requirement in test equipment. The Service Man must have instruments capable of measuring voltages accurately in high resistance networks in these circuits without disturbing the operation of the receiver.

AVC CIRCUITS

Fig. 1 shows a typical avc circuit with a 6H6 as the rectifier. In operation when no signal is applied to the plates of the 6H6 no plate current flows in the tube and there is no voltage across the resistor R1 and the grids of the r-f and i-f tubes are at ground potential. Minimum bias for these tubes is maintained by the cathode bias resistor R2. When a signal is applied to the plates of the 6H6 it acts as a rectifier in exactly the same way as the familiar full-wave rectifier in a receiver power supply. Current flows between the plates and cathode and through the resistor R1 causing a voltage drop in R1 which makes point X negative with respect to ground. Since the amount of current flowing in the circuit is very small it is necessary that R1 be high. From 100,000 ohms to 2 megohms are used depending on the number and type of tubes used in the r-f and i-f amplifiers. Since no current can flow from point X through the grids of the r-f and i-f tubes these grids assume a negative potential or bias equal to the voltage drop across R1. When the signal to the 6H6 is increased more current flows through the tube and a higher voltage is developed across R1 increasing the bias on the grids and lowering the volume of the set. When the signal to the 6H6 is decreased less current flows through R1 and a lower voltage is developed across it lowering the bias on the grids and raising the volume of the set. The resistors R3, R4, R5 and R6 are decoupling or isolating resistors which prevent the signal getting into the automatic volume control line. The size of these resistors and the capacity of condenser C1 determine the time constant or lag of the circuit. It is necessary to have a slight delay in the avc action to prevent static chopping up the signal. This lag may be increased by increasing resistors, R3, R4, R5 and R6 or by raising the capacity of C1.

*Hickok Electrical Instrument Co.

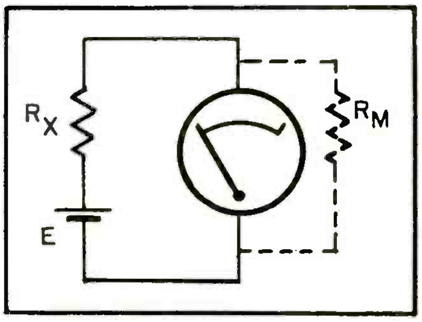

Fig. 2. Equivalent circuit which will result if a d-c voltmeter is connected from grid to ground of one of the tubes of Fig. 1.

ATTEMPTING MEASUREMENTS

If an attempt is made to measure the bias voltage on the grid of one of these tubes with an ordinary d-c voltmeter practically no indication will be obtained because the meter will draw enough current through the resistors in the avc line to drop the bias to a very low value. This may be seen by referring to Fig. 2 which shows the equivalent circuit which will result if a d-c voltmeter is connected from grid to ground or cathode of one of the tubes in Fig. 1. The bias voltage developed by the avc tube is represented by the battery E. The total series resistance in the avc line is Rx. Rm, shown in dotted lines, is the resistance of the voltmeter. From this circuit it can be seen that the voltage of E will be divided between Rx and Rm in direct proportion to the ratio of their resistance. If the 10-volt range of a standard 1000-oms-per-volt meter is used Rm will be 10,000 ohms. Then if E is 6 volts and Rx is 500,000 ohms the actual voltage which the meter will indicate can be determined by the formula:

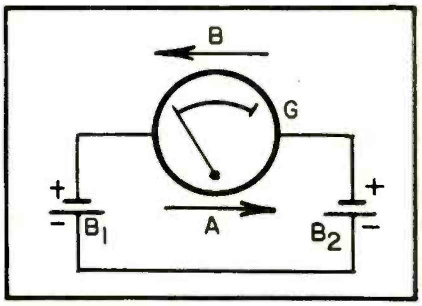

Fig. 3. Fundamental circuit of the zero-current voltmeter.

$$Em = \frac{6}{Rx + Rm} \times Rm$$

$$= \frac{6}{500{,}000 + 10{,}000} \times 10{,}000$$

$$= 0.11 \text{ volts}$$

If the sensitivity of the voltmeter is in-

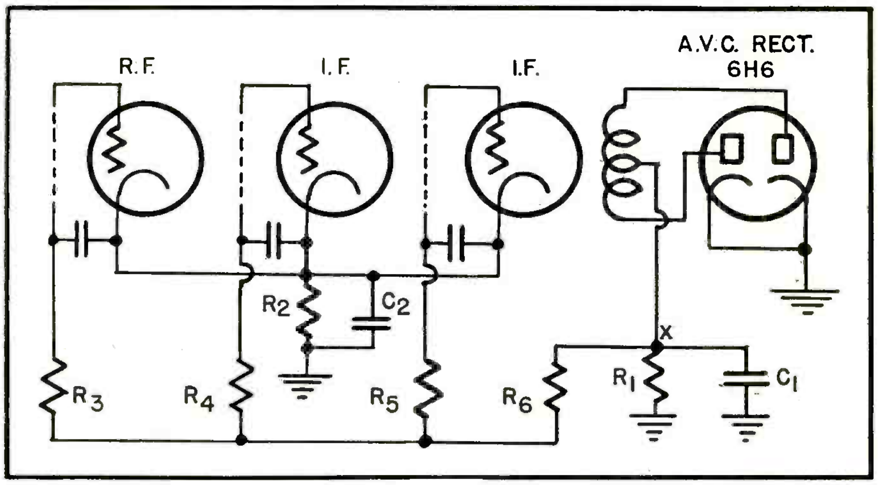

Fig. 1. Typical avc circuit with 6H6 rectifier.

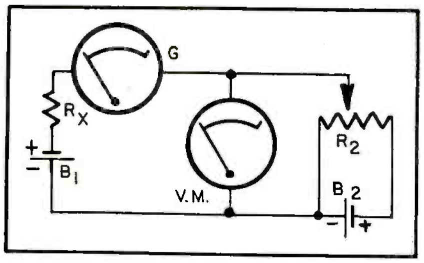

Fig. 4. Reading the voltage taken from the potentiometer with a d-c voltmeter.

creased to 20,000-ohms-per-volt the voltage indicated would be

$$Em = \frac{6}{500{,}000 + 200{,}000} \times 200{,}000$$
$$= 1.7 \text{ volts}$$

The results obtained in these two examples indicate that if a very sensitive meter of several megohms per volt were used the indicated voltage would be very nearly the same as the voltage being measured.

A well-constructed vacuum-tube voltmeter will give slightly better results, but it is subject to some error since it is very difficult to obtain stable operation of a vacuum tube with more than two or three megohms in the grid circuit. This grid circuit resistance will draw current from the voltage being measured and cause a corresponding drop in voltage.

Zero-Current Voltmeter

It may be seen from these examples that in order to accurately measure voltage in a high resistance network such as the automatic volume control circuit in Fig. 1 it is necessary to use an instrument that will draw no current from the circuit and may be connected to the grid of the tube without disturbing the voltage to be measured.

The zero current voltmeter to be described is just what its name implies. A null reading d-c voltmeter which presents an infinite resistance to the unknown voltage to be measured. The fundamental circuit is shown in Fig. 3. Two batteries B1 and B2 are connected in series with a galvanometer G. The polarity of the batteries is such that the negative terminals of both are connected together and the positive of B1 connects to one side of the galvanometer while the positive of B2 connects to the other side of the galvanometer. Now if the voltage of B2 is greater than B1 current will flow in

Hickok 4900 set tester, illustrated above, uses the zero-current voltmeter.

the circuit in the direction shown by arrow B causing an indication in the galvanometer. However, if the voltage of B2 is less than B1 current will flow in the direction of arrow A and cause an indication in the galvanometer, but in the opposite direction. If the voltages of B1 and B2 are exactly equal no current will flow in the circuit and there will be no indication in the galvanometer. If a potentiometer is connected across B2 so that the voltage taken from it can be varied it will be possible to balance the galvanometer

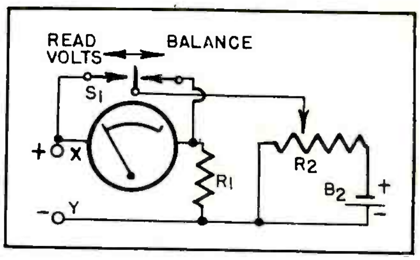

Fig. 5. Switching arrangement permitting the use of one meter as both galvanometer and voltmeter.

against any voltage of B1 which is less than B2. Then if a d-c voltmeter of suitable range is connected as shown in Fig. 4 to read the voltage taken from the potentiometer it will indicate a voltage equal to B1 when the galvanometer is balanced.

Since the voltmeter is read when the galvanometer indicates that there is no current flowing through B1 any resistance that might be in series with it would not change the readings. However, as the resistance in series with B1 is increased it becomes more difficult to balance the galvanometer due to the current limiting effect on the off balance indications of the galvanometer. The accuracy depends on the sensitivity of the galvanometer. If a d-c milliammeter of the type commonly used in radio set testers having a full-scale sensitivity of 1/4 milliampere or better is used the battery of 6 volts in series with 500,000 ohms shown in Fig. 2 may be measured with an accuracy of about 5 percent.

Single Meter Used

One meter may be used as both the galvanometer and the voltmeter by means of a suitable switching arrangement as shown in the circuit of Fig. 5. A single-pole double-throw switch is used to connect the slider of R2 to one side of the meter movement to indicate balance or to the other side to indicate voltage. R1 is the voltmeter series resistance. The meter must have low internal resistance. Otherwise there will be a voltage change when the potentiometer slider is switched from one side to the other. If the meter resistance is less than one percent of R1 it will be satisfactory. When the arm of switch S1 is thrown to the right the meter acts as a galvanometer and may be balanced for zero indication by adjusting the slider of potentiometer R2. After the meter is balanced switch S1 is thrown to the left and the voltage read on the voltmeter scale. If the two terminals X and Y are connected to the

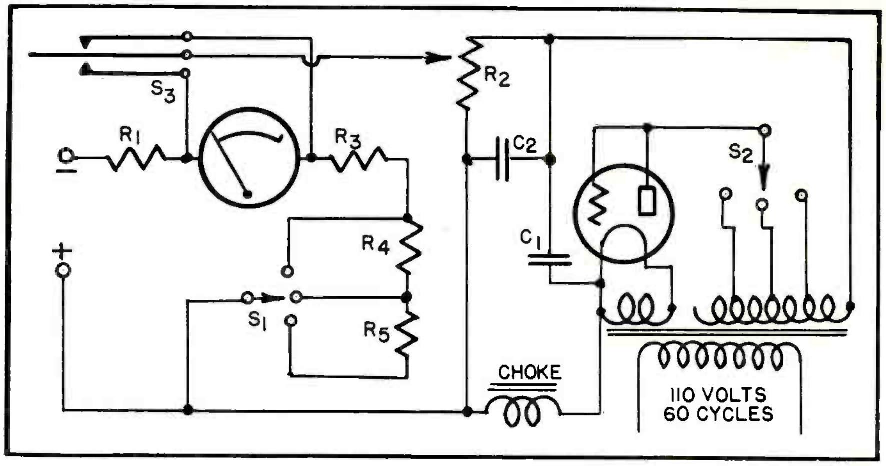

Fig. 6. The zero-current voltmeter circuit as adapted for the Hickok 4900 set tester.

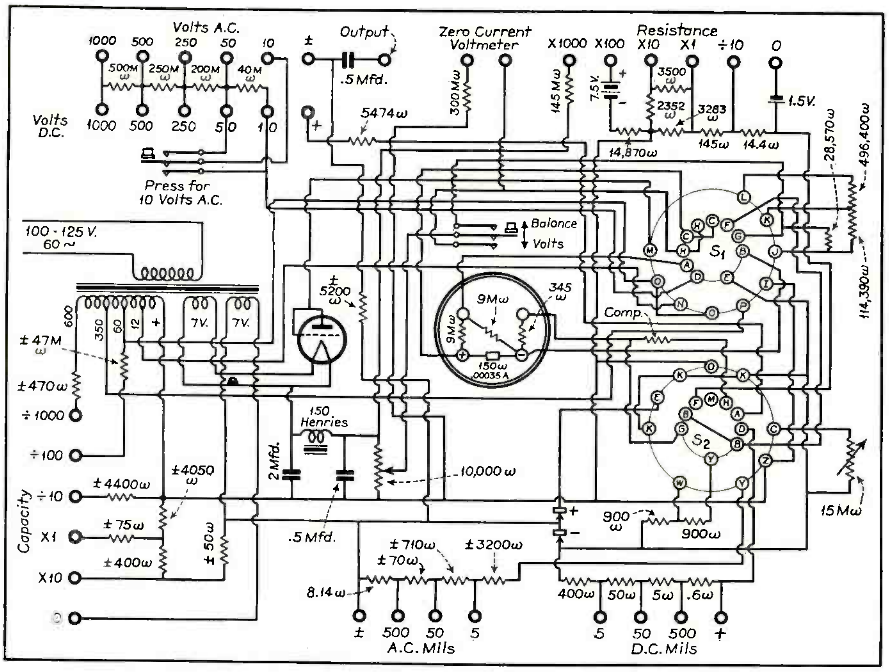

Fig. 7. Hickok 4900 set tester. The complete circuit of the instrument is given which includes the 3-range zero-current voltmeter.

grid and cathode of a tube instead of the battery and the galvanometer is balanced as before the voltmeter will indicate the bias on the grid. Since the meter will indicate only d-c the readings will not be upset by any signal voltage which may be present.

Fig. 6 shows the circuit as it has been adapted for use in a commercial instrument which has been recently announced. The battery for supplying balancing voltage has been replaced by a power supply consisting of a transformer, a half-wave rectifier and a suitable filter network. The switches S1 and S2 are operated simultaneously from the same shaft and change the voltage of the power supply and the range of the voltmeter. The ranges available are: 0-10, 0-50 and 0-250 volts. The power supply must have a well-designed filter network to prevent any a-c ripple voltage being applied to the grids in the receiver. The presence of any ripple voltage here would tend to operate the automatic volume control and change the bias. In the filter shown C1 is 2 mfd, C2 is 0.5 mfd and the choke is 150 henrys. The switch S3 is a three leaf push-button type which connects the meter as a galvanometer to indicate balance in the normal position.

Operation

The operation is very simple. The terminals of the instrument are connected to grid and cathode of the tube on which it is desired to measure the bias. The negative terminal connects to grid and the positive terminal to cathode. Switch S1 is set on the 0-10 volt range and the slider of potentiometer R2 is adjusted until the meter is balanced or shows no indication. The meter must be balanced very carefully for accurate results. Then the push-button S3 is pressed and the voltage read on the 0-10 volt scale of the voltmeter. If it is impossible to balance the meter change to the 0-50 range and try again. If it is still impossible to obtain balance change to the 0-250 range. When using the 0-50 or 0-250 ranges the voltage is read on the corresponding scale of the voltmeter. If the meter indicates off scale backwards and cannot be balanced the polarity of the voltage being measured is wrong and the leads should be reversed. When making adjustments in a circuit to cause a zero indication on a meter it is convenient to have some means by which any current flowing in the circuit may be switched into or out of the meter causing it to assume actual zero indication when the current is switched out. This is accomplished by adjusting the springs of S3 so that they short the meter when the push-button is partly depressed. When adjusting R2 for balance the push-button is pressed half way down then released. This is repeated while adjusting R2 until no indication is observed. Very slight deflections of the needle may be observed in this way. When measuring voltages which give only a small indication the exact zero may be determined by adjusting R2 until the smallest noticeable deflection is observed in the meter then turn R2 until an equal deflection is observed in the opposite direction. The exact zero will be half way between these two settings of R2.

The complete circuit of the tester which includes the 3-range zero-current voltmeter and the usual ranges of a-c and d-c volts at the 1000 ohms-per-volt, a-c and d-c milliamperes, resistance, capacity and output measurements is shown in Fig. 7. The ohmmeter is a combination battery and a-c operated type using two small batteries for the 4 ranges covering from 0.05 ohms to 1 megohm and rectified a-c for the high range; 0-10 megohms.

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DuMont 164 Service Oscillograph

The DuMont Model 164 service oscillograph is designed to meet the requirements of the Service Man. The type 34-XH 3-inch cathode-ray tube is supplied with the unit. This tube is of the high vacuum type with four electrostatic deflection plates mounted in a glass envelope having a full 3-inch screen. The sensitivity of the type 34-XH is 0.38 millimeter per volt. It is interchangeable with the type 906.

The Circuit

The amplified sweep circuit, contained in the unit, consists of an 885 gaseous discharge tube used as a sawtooth wave generator so biased that it uses only the linear portion of the condenser charging curve. The small signal thus obtained is amplified to a usable amplitude by means of the 6C6 horizontal amplifier. The frequency range of the sweep circuit is from 15 to 30,000 cycles. Both fine and coarse control of the sweep frequency is provided.

The instrument contains separately controlled horizontal and vertical amplifiers. These amplifiers have a linear range between 30 and 30,000 cycles. The horizontal amplifier has a gain of 40 and an input resistance of 800,000 ohms. The vertical amplifier has a gain of 70 and an input resistance of 1 megohm. The maximum allowable rms a-c input to either amplifier is 300 volts.

In order to prevent interaction of the controls and to produce a brilliant trace two power supply circuits are used. These supplies deliver 1,125 and 415 volts d-c, respectively. The unit is completely a-c operated from the 60-cycle,

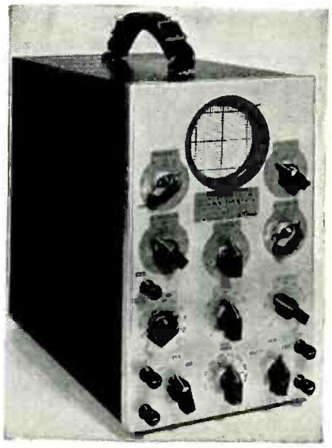
110-120 volt lines. The total power consumption is 50 watts.

The vertical input is to the binding posts on the left side of the panel, the lower post of the pair being the ground. The horizontal input is on the right side and as in the previous pair the bottom post is the ground.

On the back of the machine is a plate with five screw type binding posts. These permit the disconnecting of either or both circuits allowing direct connection to the deflection plates. This feature will be found a convenience to amateurs or others working with d-c or high frequency applications.

The Controls

All controls of the type 164 oscillograph are on the front panel and are plainly marked. Because all the controls are on the front panel it was deemed advisable to distinguish in some manner, the controls frequently adjusted from those more permanently set. Hence the synchronizing, rough and fine frequency and the horizontal and vertical amplifier controls have red bar knobs. In the upper left corner is the intensity control, it controls the intensity of the trace and also carries with it the off and on power switch. At the upper right is the focus control. Just below the intensity control is the vertical positioning knob which controls the up and down movement of the spot or



DuMont 164 service oscillograph.

trace while directly below the focus control is the horizontal positioning which controls the left to right movement of the pattern. The synchronizing control is in the center of the panel just below the cathode-ray tube. Directly below the position controls are the amplifier gain controls; the vertical on the left, and the horizontal on the right. In the center of the panel under synchronizing is the vernier or fine frequency control of the linear sweep while directly below it is the rotary switch which controls the frequency in rough steps. The approximate range of these steps are as follows: (1) off; (2) 15 to 60 cycles; (3) 60 to 220 cycles; (4) 220 to 900; (5) 900 to 3,000; (6) 3,000 to 10,000; and (7) 10,000 to 30,000 cycles.

At the bottom of the panel on the left side is the switch which permits either internal or external synchronization while on the right, a switch places the horizontal amplifier in operation with the sweep or connects it to the post for external use.

The controls are arranged so that the minimum setting is obtained when the knobs are turned counter-clockwise and maximum when turned clockwise.

A removable calibrated scale is supplied with the unit so that quantitative measurements may be made.

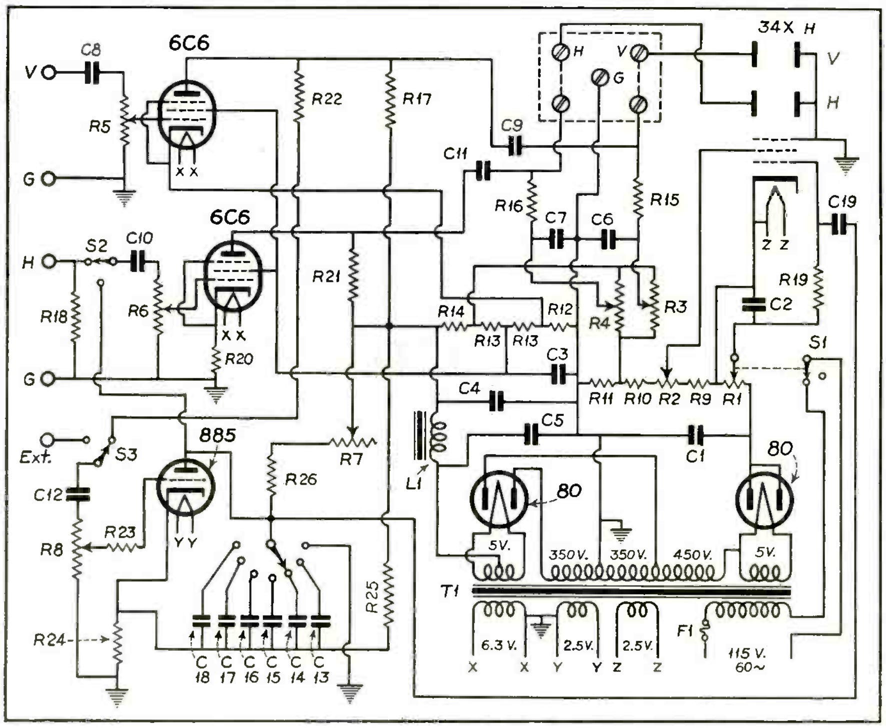


Fig. 1. DuMont 164 service oscillograph circuit.

Motorola Auto Radios

Chassis pickup: Because the field strength of ignition interference is high in the 1937 model Chrysler cars and 1937 Ford cars, some cases of chassis pickup may be encountered.

In most cases this can be overcome by removing the front cover from the set and cleaning the surfaces of the joints with fine sandpaper to provide greater area of metallic contact between the set cover and the set housing.

Also check the Acoustinator plug carefully to see that it is securing a good ground to its grounding contacts.

Dress the A lead directly away from the set. Do not allow it to run too close and parallel to the right side of the receiver.

In all Chrysler cars the field intensity can be materially reduced by grounding the "over drive" cable, gasoline gauge, tube, etc., at the point where they pass through the bulkhead of the car.

In the most severe cases it may be necessary to remove the chassis from the set housing and clean all the joints where the chassis intersects its housing. This cleaning should be done with fine sandpaper as in the case of cleaning the cover joint.

In those localities along the sea coast where salt air causes excessive corrosion of metal, be careful when cleaning the various joints that the plating is not removed from the steel, otherwise rust will occur at the points where the sand paper has cut through the plating.

When checking for chassis pickup in the Model 65 make sure that the right-hand breather screen secures a good ground to the set housing. Spotting it with solder to the housing at several places is sufficient to prevent interference from feeding in at this point.

Auto-Radio . . .

Ford-Philco F-1440

The Ford-Philco auto-radio receiver is a 6-tube, superheterodyne using glass tubes. The frequency range is from 540 to 1550 kc. A complete circuit diagram is given in Fig. 1.

The model is designed for use with the Ford rotary "reserve power" roof aerial and a concealed header bar speaker. A special antenna transformer is supplied as standard equipment which matches the receiver input to the unique antenna.

Alignment Procedure

The i-f transformers are assembled complete with padding condensers. Both the primary and secondary padders are placed side by side in the top of the transformer shield. The adjusting screws are accessible through the holes in the top of the shield. (See Fig. 2.)

An output meter should be connected to the plate of the type 41 output tube through an 0.25 mfd condenser and to the receiver chassis, or across the speaker voice coil.

With the receiver and signal generator set for operation at the prescribed frequency, turn the receiver volume control on full and set the signal generator attenuator so that a half scale reading is obtained on the output meter. The signal in the speaker should be audible but not loud. The shielding on the signal generator output lead should be connected to the receiver chassis.

Allow both the receiver and signal generator about 15 minutes to warm up before attempting adjustment.

I-F Alignment

Set the signal generator at exactly 260 kc. Connect the generator output lead to the grid cap of the 78 i-f tube in series with a 0.1 mfd condenser (without removing the grid cap connection).

Adjust the secondary screw padder No. 28 on the second i-f transformer for maximum reading on the output meter. Then adjust the primary screw padder No. 26 for maximum reading, keeping the reading near the middle of the output meter scale by means of the attenuator on the signal generator. See Fig. 2 for the location of the padders.

Remove the generator lead from the grid cap of the 78 i-f tube and connect it to the grid cap of the type 6A7 tube in series with the 0.1-mfd condenser (without removing the grid cap). Adjust the secondary (No. 24) and primary (No. 22) screw padders in that order for maximum output meter reading. Then readjust padders Nos. 28 and 26 with the generator lead still connected to the 6A7 tube's grid. See Fig. 2 for the location of padder condensers.

R-F Alignment

After padding the first i-f stage remove the generator lead from the 6A7 tube. Set the signal generator at 1550 kc and then connect the generator lead to the grid cap of the 78 r-f tube in series with a 0.1-mfd condenser (without removing the grid cap).

Using a piece of paper approximately 0.006-in. thick as a gauge between the heel of the rotor plates and the stator plates, turn the rotor plates in mesh until they strike against the paper.

With the tuning condenser in this position adjust the high-frequency padder 16 and the r-f padder 12 until the maximum reading is obtained on the output meter. This is the true setting for 1550 kc, 155 on the dial scale.

Turn the tuning condenser plates in mesh to approximately 600 kc, 60 on the dial scale and set the signal generator at 600 kc. Roll the tuning condenser and adjust the low frequency

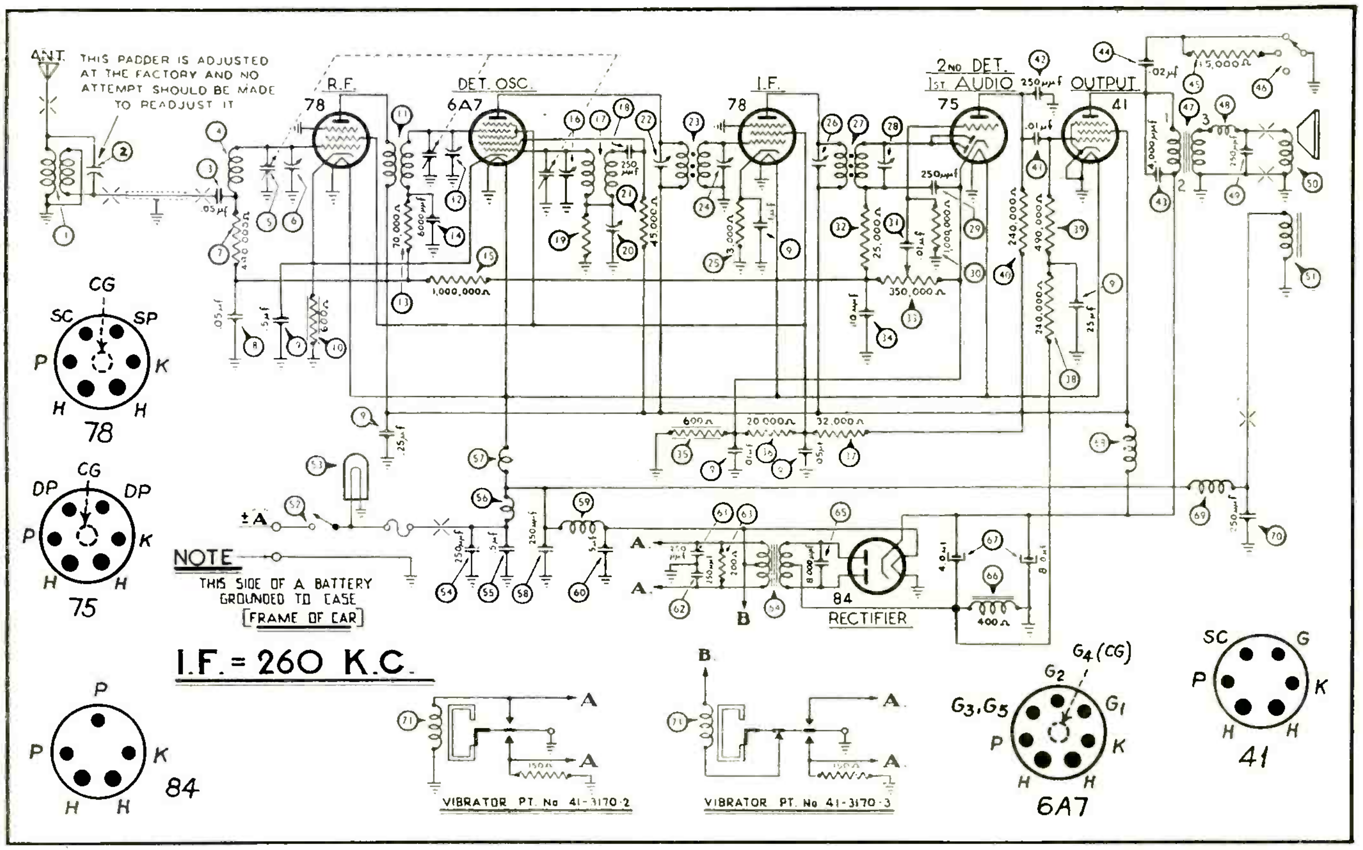


Fig. 1. Ford-Philco F-1440 circuit diagram.

Technical Features of 1937 Auto-Radio Receivers

	ADMIRAL				AMERICAN-BOSCH							ARVIN		
Model No.	66 and 660	77 and 770	78 and 780	88 and 880	536B	636	637	736	737	738	838	19	29	39
Range (Kc.)	550 to 1500				540 to 1500							540 to 1575		
Output Watts	3	4	4	6	3	3		3			5.5	3.5	4.5	7.5
Dynamic Sp'k'r	6"	6½"	8"	8"	6"	6"	5"	6"	5"	8"	10"	6"	6"	8"
I.F. Peak (Kc.)	175				456	175						170		
Current Drain	7	8	7	9	6.5	6.5		6.5			7.5	6.1	6.7	7.2
Control Drive Ratio	16 to 1				16 to 1							–	–	–
Tone Control	250M ω					1 Meg		250M ω			100M ω	–	100M ω	100M ω
Volume Control	500M ω S			1 Meg.	500 M ω			250 M ω				–	500M ω	500M ω
Sensitivity at 1 Watt Output	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sensitivity Control		Taps		Taps								–	3000 ω	3000 ω
R.F.	6D6	6D6	6D6	6D6		77		6K7			6K7	78	6K7G	6K7G
1st. Det. / Oscillator	6A7	6A7	6A7	6A7	6A7	77		6A8			6A8	6A7	6A8G	6A8G
Intermediate Frequency	6D6	6K7	6K7	6K7	78	78		6K7			6K7	78	6K7G	6K7G
2nd. Det. / AVC	75	6H6	6H6	6R7	75	75		6H6			6H6	75	6Q7G	6Q7G
1st. Audio		6C5	6C5					6F5			6F5			
2nd. Audio				6C5										6C5G
Output	41	6V6G	6V6G	(2) 6V6G	42	42		6F6			(2) 6F6	41	6V6G	6N7G
Rectifier	84	84	84	0Z4	84	84		0Z4			0Z4	84	6X5G	0Z4
Pilot Light No.	#51	#51	#51	#51	–	–	–	–	–	–	–	–	–	–

	AUTOMATIC				BELMONT		CADILLAC LaSALLE		CHAMPION	CHEVROLET DELCO	CHRYSLER PHILCO		CROSLEY		DETROLA
Model No.	M10	M20	M60	M80	661	667	5X	6KB	50VD	601814	C-1450	C-1452	A-266	A-366	111
Range (Kc.)	–				530 to 1500		528 to 1581		–	530 to 1610	550 to 1550		–	–	540 to 1570
Output Watts	2		3	7	2.5	4	2.4	5.5	–	–	2.5	2.5	–	–	–
Dynamic Sp'k'r	5"		5"	6½"	5"	6"	6"	8"	–	–	–	–	–	–	–
I.F. Peak (Kc.)	456				262.5		175		175	262	260		262		262
Current Drain	4.6		5	6	6.5	6.5	6.3	8.1	–	–	–	–	–	–	–
Control Drive Ratio	–	–	–	–	–	–	–	–	–	–	16 to 1		–	–	–
Tone Control		500M ω		50M ω			1 Meg.	1 Meg.		100M ω	Taps			50M ω	75M ω
Volume Control	500M ω		500M ω	500M ω	500M ω S	250M ω S	200M ω T	200M ω T	500M ω S	1 Meg. T	350M ω T	350M ω T	300M ω	1 Meg. T	500M ω
Sensitivity at 1 Watt Output	–	–	–	–	–	–	2.0 MV.	2.0 MV.	–	–	–	–	–	–	–
Sensitivity Control			3M ω	115 ω		Taps	Taps	Taps							1M ω
R.F.			6D6	6D6	6K7	6K7	6K7	6K7	6D6	6D6	78	78	6D6	6D6	78
1st. Det. / Oscillator	6A7		6A7	6A7	6A8	6A8	6J7	6J7	6A7	6A7	6A7	6A7	6A7	6A7	6A7
Intermediate Frequency	6D6		6D6	6D6	6K7	6K7	6K7	6K7	6D6	6F7 Pent.	78	78			78
2nd. Det. / AVC	75		6Q7G	6Q7G	6Q7	6Q7	6B7	6B7	75	85	75	75	6B7	6B7	75
1st. Audio													6D6	76	
2nd. Audio				76				41		6F7 Triode					
Output	41		41	(2) 6B5	41	6F6	6B5	6A6	41	(2) 41	41	41	42	(2) 41	6B5
Rectifier	84	6X5	84	0Z4	6X5	6X5	Sync. Vib.		84	Sync. Vib.	84	84	84	Sync. Vib.	0Z4
Pilot Light No.	(2) #51		(2) #51	(2) #51	T-50	T-50	–	–	–	–	–	–	–	–	–

S after Tone or Volume control means with switch attached ; **T** = Tapped

(Continued on Next Page)

padder screw 20 for maximum reading on the output meter.

Turn the tuning condenser plates out of mesh to 1550 kc and set the signal generator at 1550 kc. Then adjust the high-frequency padder 16 again, for maximum reading on the output meter. Remove the generator lead from the 78 r-f tube.

Antenna Adjustments

When padding the antenna stage, it is extremely important that the proper dummy antenna be constructed and used and that the antenna transformer assembly and lead be connected to the receiver.

Connect a 15-mmfd condenser in series between the signal generator and the socket on the antenna transformer assembly. Then connect the transformer lead to the antenna connector on the receiver housing.

Turn the tuning condenser to 1400 kc and set the generator at 1400 kc. Adjust the padders 12 and 6 for the maximum reading on the output meter.

When the antenna stage adjustment is made with the receiver installed in the car, the receiver antenna lead must be connected to the car antenna in the usual manner. The signal generator output lead should be connected to a wire placed near, but not connected to the car antenna.

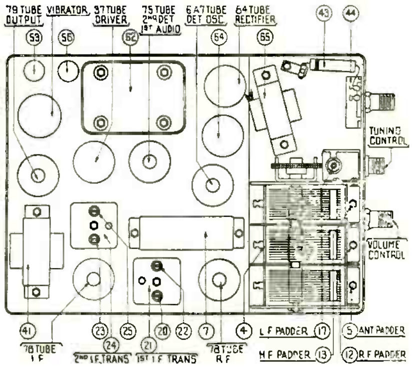


Fig. 2.—Ford-Philco F-1440 tube and trimmer locations.

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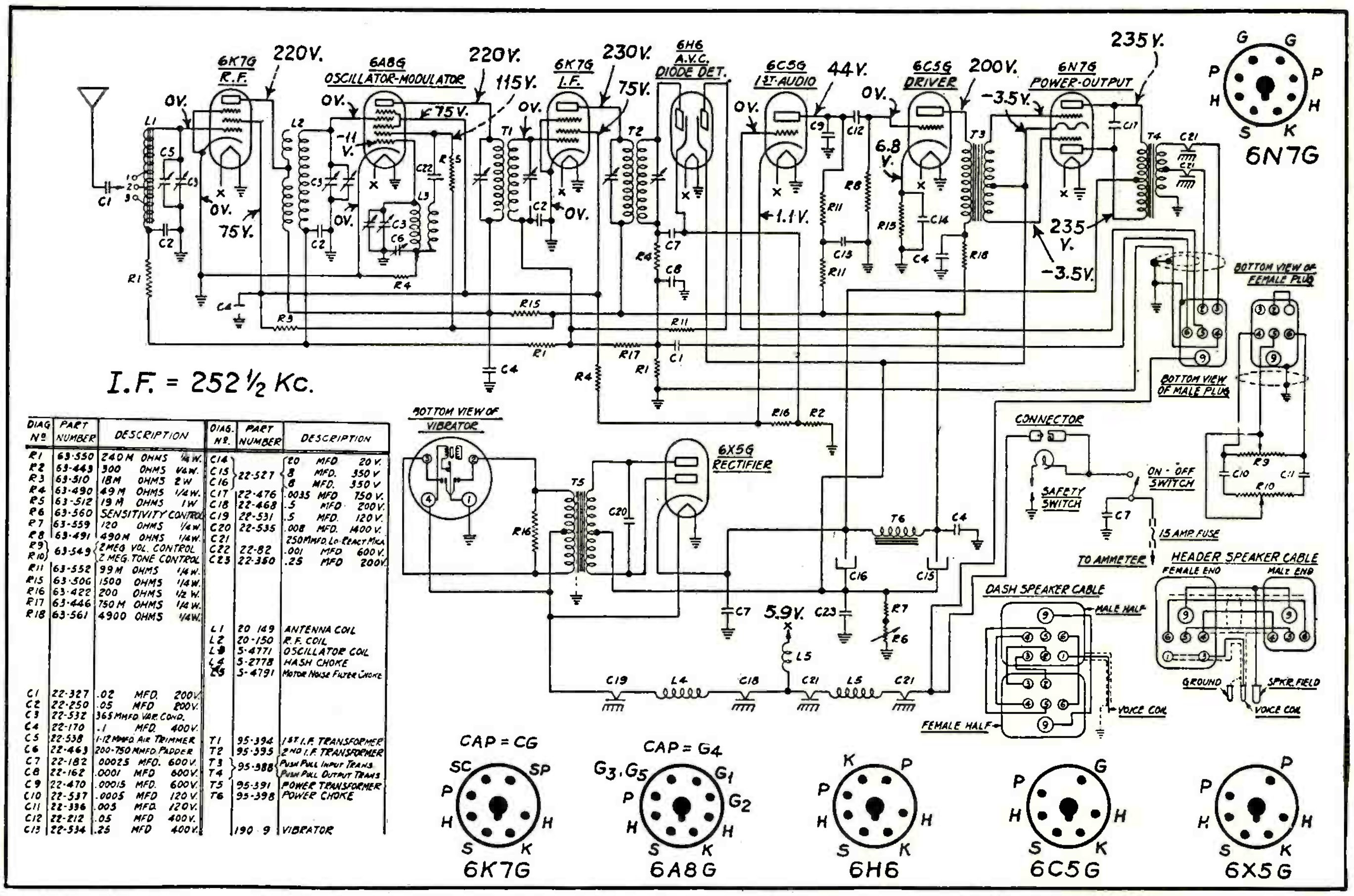
Zenith 5803 (8-M-195)

The Zenith chassis 5803 is an 8-tube auto radio using either metal or G type tubes (glass tubes with octal bases) in a conventional superheterodyne circuit. It has a frequency range from 540 to 1600 kc and an undistorted power output of 6 watts. The total current drain with a battery voltage of 6, is 9.2 amperes. The sensitivity at 1 watt output is 1 microvolt.

The Circuit

A complete circuit diagram of the 5803 is given in Fig. 1 with the tubes used, their functions and the various voltages encountered on the socket prongs lettered on the diagram. The voltages were measured with a battery input voltage (at the battery) of 6 volts. A 1000-ohm-per-volt voltmeter was used for the measurements. The volume control was turned on full and the antenna was disconnected during the measurements.

A tapped iron-core antenna coil (L1) of the auto-transformer type is used to feed the signal to the control grid of the 6K7G r-f stage. An even gain, air-core r-f coil (L2) is used between stages. A 6A8G tube is used as an oscillator-modulator stage. The oscillator portion of this tube together with the rear section of the 3-gang tuning condenser (C3), its associated trimmer and padder (C6) and the inductance L3 maintain the 252½-kc frequency difference between the oscillator signal and the station carrier. The padder (C6) is also used as the grid con-



DIAG Nº	PART NUMBER	DESCRIPTION	DIAG. Nº.	PART NUMBER	DESCRIPTION
R1	63-550	240 M OHMS ¼ W.	C14	22-527	20 MFD 20 V.
R2	63-443	300 OHMS ¼ W.	C15		8 MFD. 350 V
R3	63-510	18 M OHMS 2 W	C16		8 MFD. 350 V
R4	63-490	49 M OHMS ¼ W.	C17	22-476	.0035 MFD 750 V.
R5	63-512	19 M OHMS 1 W	C18	22-468	.5 MFD 200 V.
R6	63-560	SENSITIVITY CONTROL	C19	22-531	.5 MFD. 120 V.
R7	63-559	120 OHMS ¼ W.	C20	22-535	.008 MFD. 1400 V.
R8	63-491	490 M OHMS ¼ W.	C21		250 MMFD. Lo-React Mica
R9	63-549	2 MEG VOL. CONTROL	C22	22-82	.001 MFD 600 V.
R10		2 MEG. TONE CONTROL	C23	22-350	.25 MFD 200 V.
R11	63-552	99 M OHMS ¼ W.			
R15	63-506	1500 OHMS ¼ W.			
R16	63-422	200 OHMS ½ W.			
R17	63-446	750 M OHMS ¼ W.			
R18	63-561	4900 OHMS ¼ W.			
			L1	20 149	ANTENNA COIL
			L2	20-150	R.F. COIL
			L3	5-4771	OSCILLATOR COIL
			L4	5-2778	HASH CHOKE
			L5	5-4791	Motor Noise Filter Choke
C1	22-327	.02 MFD. 200 V.			
C2	22-250	.05 MFD 200 V.			
C3	22-532	365 MMFD VAR. COND.			
C4	22-170	.1 MFD. 400 V.			
C5	22-538	1-12 MMFD AIR TRIMMER	T1	95-394	1ST I.F. TRANSFORMER
C6	22-463	200-750 MMFD PADDER	T2	95-395	2ND I.F. TRANSFORMER
C7	22-182	.00025 MFD. 600 V.	T3	95-388	Push Pull Input Trans
C8	22-162	.0001 MFD 600 V.	T4		Push Pull Output Trans
C9	22-470	.00015 MFD. 600 V.	T5	95-391	POWER TRANSFORMER
C10	22-537	.0005 MFD 120 V.	T6	95-398	POWER CHOKE
C11	22-336	.005 MFD. 120 V.			
C12	22-212	.05 MFD 400 V.			
C13	22-534	.25 MFD 400 V.		190 9	VIBRATOR

Fig. 1. Zenith 5803 (8-M-195) circuit diagram.

Technical Features of 1937 Auto-Radio Receivers

	DETROLA	DE WALD			EMERSON		FADA	FORD PHILCO		GENERAL ELECTRIC			GOODYEAR WINGS	
Model No.	166	527	617	702*	U-154	V-155	267 267SD 267SF 267SG	F-1440	F-1442	‡FA-60	‡FA-61	‡FA-80⊙	661	667
Range (Kc.)	540 to 1570	550 to 1500			540 to 1530		535 to 1620	550 to 1550		540 to 1600			530 to 1550	
Output Watts	–	3	3	3	3	5	3	2.5	2.5	6		6	2.5	4
Dynamic Sp'k'r	–	5"	6"	6"	5"	8"	6½"‡	–	–	6½"		6½"	5"	6"
I.F. Peak (Kc.)	456	456	175		262.5		175	260		175			262.5	
Current Drain	–	6.25	6.5	6.5	6.1	7.2	5.8	–	–	7.0		8.5	6.5	6.5
Control Drive Ratio	–	8 to 1			16 to 1		–	16 to 1		12 to 1			–	–
Tone Control		75 Mω			Taps	50 Mω	100 Mω	Taps	Taps		Taps			
Volume Control	500 Mω	500 Mω			1 Meg.	1 Meg.	1 Meg.	350 Mω	350 Mω	1 Meg.		1 Meg	500 Mω S	250 Mω S
Sensitivity at 1 Watt Output	–	3.5 MV.	2.5 MV.	1.5 MV.	–	–	–	–	–	–	–	–	–	–
Sensitivity Control														Taps
R.F.			6D6	6D6		6D6	78	78	78	6K7		6K7	6K7	6K7
1st. Det.	6D6	6A7	6A7	6A7	6A7	6A7	6A7	6A7	6A7	6A8		6A8	6A8	6A8
Oscillator	76													
Intermediate Frequency	78	6D6	6D6	6D6	6D6		78	78	78	6K7		6K7	6K7	6K7
2nd. Det.	75	75	75	75 Diode	76	6B7	75	75	75	6H6		6H6	6Q7	6Q7
AVC				6H6								6R7 Diode Sect.		
1st. Audio				75 Triode	6D6	76				6F5		6C5		
2nd. Audio						76						6R7 Triode Sect.		
Output	42	41	41	41	41	(2) 41	41	41	41	6F6		6N7	41	6F6
Rectifier	84	84	84	84	84	84	84	84	84	Sync. Vib			6X5	6X5
Pilot Light No.	–	#44	#44	#51	–	–	–	–	–	#44		#44	T-50	T-50

	GRUNOW			MONTGOMERY WARD	MOTOROLA					PACIFIC			
Model No.	†614	†618	†625	62-130	35	45	65	70	GOLDEN VOICE	101	101C	102	102B
Range (Kc.)	530 to 1560			–	535 to 1600								
Output Watts	4.5		9	–	3	4	5	6	13	–	–	–	–
Dynamic Sp'k'r	6½"	8"	8"	–	5"	6"	8"	8"	8" & 10"	–	–	–	–
I.F. Peak (Kc.)	262			175	262					456	456	175	262.5
Current Drain	5.8		6.4	–	5.75	6.0	6.4	5.5	7.0	–	–	–	–
Control Drive Ratio	–		–	–	–	–	–	–	–	–	–	–	–
Tone Control	Taps		250 Mω	–		Taps	Taps	Taps					50 Mω
Volume Control	1 Meg. T		1 Meg. T	500 Mω S	500 Mω	250 Mω	500 Mω	500 Mω	500 Mω T	500 Mω			
Sensitivity at 1 Watt Output	–		–	–	3.5 MV.	1.5 MV.	1.5 MV.	1.5 MV.	1.5 MV.	–	–	–	–
Sensitivity Control							Taps	Taps	Taps				Taps
R.F.	6K7G		6K7G	6D6	78	78	78	78	6K7G			6D6	6K7
1st. Det.	6A8G		6A8G	6A7	6A7	6A7	6A7	6A7	6A8G	6A7	6A7	6A7	6A8
Oscillator													
Intermediate Frequency	6K7G		6K7G	6D6	78	78	78	78	6K7G	6D6	6D6	6D6	6K7
2nd. Det.	6Q7G		6R7G	75	75	75	75	75	6H6G	6B7	75	75	6Q7
AVC													
1st. Audio									6C5G				
2nd. Audio			6C5G						6J5G				
Output	6F6G		6A6	89	41	41	6A6G	42	6N7G	41	41	41	6F6
Rectifier	6X5G		Sync Vib.	6Z4	6Z4 or 84	6Z4 or 84	0Z4 or 6X5G	0Z4 or 6X5G	0Z4 or 6X5G	84	0Z4	84	0Z4
Pilot Light No.	–	–	–	–	#51	#51	(1)#50 (1)#51	(1)#50 (1)#51	(1)#50 (2)#51	–	–	–	–

* Employs Gas Limiter † High-Fidelity Models ‡ Employs Degeneration ⊙ Employs AFC ‡ Model 267SD, 8" Sp'kr. (Continued on Next Page)

denser for the oscillator section of the tube.

A 6K7G tube is used with two double-tuned i-f transformers in an i-f stage. One diode of the 6H6 tube is used as the second detector and the other diode is used as an avc rectifier. The cathodes of the controlled tubes are returned directly to the chassis. Minimum bias is obtained by connecting the avc return to a suitable tap in the negative leg of the voltage divider circuit.

A 6C5G is used as an audio amplifier, the desired amount of signal is fed to the control grid from the volume control (R9) located in the tuning head. Another 6C5G is used to drive the 6N7G power output stage. A tone control is also located in the control head.

A vibrator and step-up transformer are used to obtain the high voltage necessary for the power supply circuits. A 6X5G rectifier and a suitable filter network are used to convert the high voltage a-c thus obtained to smooth d-c used in the plate, screen and grid circuits.

Alignment Procedure

Connect the service oscillator output leads to the control grid of the 6A8G oscillator-modulator tube and to the receiver chassis. Connect an output meter across the primary of the speaker transformer or across the voice coil.

Turn on the service oscillator and the receiver and allow both at least 15 minutes to warm up before attempting adjustments.

The sensitivity control should be in the extreme clockwise position when making adjustments.

Because of the high gain of the i-f transformers used in this model it is essential that a non-metallic screwdriver be used in making the adjustments.

I-F Alignments

Set the service oscillator to 262½ kc and adjust the i-f trimmers to the point giving the greatest output reading on the output meter, starting with the secondary trimmer on the second i-f transformer and working toward the primary trimmer on the first i-f transformer. These as well as the following adjustments should be made using as small an output from the service oscillator that will give a readable indication on the output meter so that the avc action will be least effective.

Repeat the i-f adjustments to assure greater accuracy.

R-F Alignment

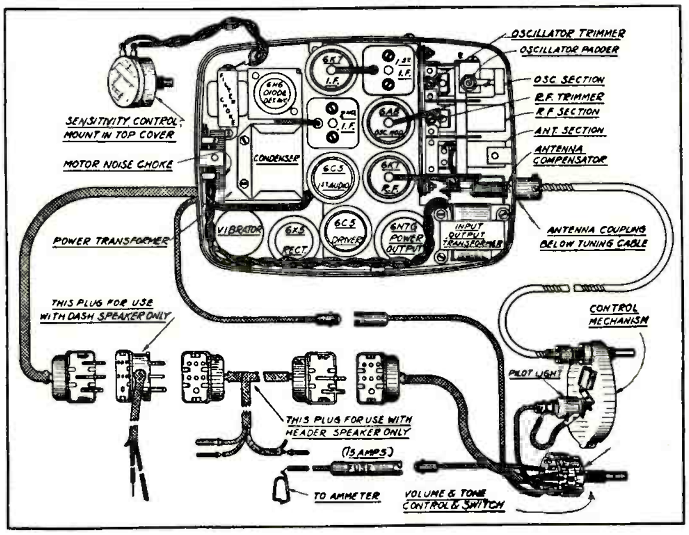
Change the service oscillator lead from the grid of the 6A8G to the antenna connection. A male Delco-Remy connector may be used in making the connection to the antenna lead.

Set the service oscillator to 1600 kc and rotate the gang condenser until the plates are entirely out of mesh. Adjust the oscillator section trimmer until the 1600-kc signal is tuned to maximum.

Change the service oscillator setting to 1400 kc. Rotate the gang condenser until this signal is tuned to a maximum and adjust the r-f trimmer on the gang condenser to the point giving the greatest output reading.

Set the service oscillator at 600 kc and rock the gang condenser slowly to and fro through the point where this signal is received, meanwhile adjusting the padder condenser for a setting which gives the greatest output reading.

Repeat the 1600 and 1800 kc adjustments.



Zenith 5803 (8-M-195) tube and trimmer locations.

Antenna Stage Alignment

There is such an extremely wide variation in antenna capacities that it is difficult to match the set to the antenna without some means of variable antenna alignment. To accomplish this, an antenna compensating adjustment is provided through the small hole directly above the antenna cable connector on the receiver case. In addition to this, a tapped antenna transformer is also incorporated. The proper method of alignment is as follows: After completely connecting receiver, tune in a signal between 1400 and 1450 kc and adjust the antenna compensator shown in Fig. 2, for either the roof antenna, or single or double under-car antenna. The receiver is shipped from the factory with the antenna tap set to the No. 2 position, and, therefore, need not be changed for either of the two types of antennas mentioned.

For Zenith "Fleet Wing," and "Over the Top Antennas," unsolder the antenna lead from the No. 2 lug, and resolder it to the No. 3 lug. After this is done, tune in a station between 1450 and 1400 kc and adjust the antenna compensator shown in Fig. 2 to resonance.

For high-capacity antennas such as the 1936 Dodge solid steel roof, or the Lincoln Zephyr luggage compartment, drawer antenna, etc., remove the antenna lead from the No. 2 lug, as it comes from the factory, and resolder it to the No. 1 connector. After this is done, the same procedure of tuning in a signal from 1450 to 1400 kc and balancing to resonance with the antenna compensator, as described above, should be followed.

This system of tapped transformer, and variable compensating adjustment gives a flexible means of resonating the receiver to any type of antenna, and it should be noted that the tap need only be changed in two cases.

•

Belmont 420, 430

Won't tune down to 1712 *kc*: If trouble is experienced in making the receiver tune down to 1712 kc, during alignment, inspect the green grid and black ground wires connected to the antenna coil. These should be well separated from each other. Both the green leads to the grid cap and the antenna should be clear of the tube shield. This reduces to a minimum the external capacity of the antenna coil circuit and will help in making the receiver tune to the higher frequency.

Technical Features of 1937 Auto-Radio Receivers

	PACKARD PHILCO		PHILCO						RCA				SILVERTONE	
Model No.	P-1417	P-1430	826	827	827K	828	828K	829	67M	67M1	67M2	67M3	†4600	†4601
Range (Kc.)	550 to 1550		580 to 1550						540 to 1600				540 to 1540	
Output Watts	2.5	2.5	2.5	2.5		4	6	–	3.5	9			–	–
Dynamic Sp'k'r	–	–	5"	6¼"	7½"	6¼"	7½"	–	5½"	6½"	8"	8" & 5"	8"	8"
I.F. Peak (Kc.)	260		260						260				262	
Current Drain	–	–	–	–	–	–	–	–	7.3	7.5	7.5	9	7.6	8.25
Control Drive Ratio	16 to 1		16 to 1						16 to 1				16 to 1	
Tone Control	Taps			Taps		Taps		Taps		100 Mω			500M ω	500M ω
Volume Control	350M ω	350M ω T	350M ω	350 Mω		350M ω	350 Mω		250M ω	1 Meg. T			500M ω S	500M ω TS
Sensitivity at 1 Watt Output	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sensitivity Control		1000 ω									–	–		
R.F.	78	78	78	78	78	78	78		6D6	6D6			6U7G	6U7G
1st. Det. / Oscillator	6A7	6A7	6A7	6A7		6A7	6A7		6A8	6A8			6A8G	6A8G
Intermediate Frequency	78	78	78	78		78	78		6K7	6K7			6U7G	6U7G
2nd. Det. / AVC / 1st. Audio	75	75	75	75		75	85		6B7	85			6Q7G	6V7G
2nd. Audio										6C5				6J7G
Output	41	41	41	41		(2) 41	(2) 41		42	6A6			6N6G	6N7G
Rectifier	84	84	84	84		84	84		84	Sync. Vib.			6X5G	6X5G
Pilot Light No.	–	–	–	–	–	–	–	–	#44	#44			–	–

	SPARTON		STEWART WARNER	TRUETONE			WELLS-GARDNER		WESTING-HOUSE		ZENITH				
Model No.	676	686	R-160	D-734	D-743	D-744	6K	6L	WR-502	WR-503	5M-191	6M-192	6M-193	6M-194	8M-195
Range (Kc.)	–		–	530 to 1550			530 to 1575		540 to 1600		540 to 1600				
Output Watts	–	–	3	3	2.5	4	6	3	3	3	3.2	4.5	4.5		9
Dynamic Sp'k'r	–	–		–	5"	6"	6"	5¼"	6"	–	5¼"	5¼"	6"	6" & 8"	8"
I.F. Peak (Kc.)	172.5		177.5	465	262.5		175		175	175	456	252.5			
Current Drain	–	–	–	–	–	–	7.8	7.0	6.5	6.5	5.5	7.5	6.0	6.0	9.2
Control Drive Ratio	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tone Control	1 Meg.	1 Meg.	Taps		500M ω S	250M ω S	1 Meg.	150M ω	1 Meg.	250M ω			2 Meg.		2 Meg.
Volume Control	250M ω	250M ω	500M ω S	500M ω S	–	–	500M ω T	500M ω	500M ω	250M ω	1 Meg.	1 Meg.	2 Meg.		2 Meg.
Sensitivity at 1 Watt Output	–	–	–	–		Taps	1.0 MV.	1.0 MV.	–	–	5 MV.	0.9 MV.	0.9 MV.		0.9 MV.
Sensitivity Control	–	–	–		–	–	Taps		–	–					Var.
R.F.	6K7	6K7	6D6		6K7	6K7	6K7	6D6	77	6K7		6K7G	6K7G		6K7G
1st. Det. / Oscillator	6A8	6A8	77	6A8	6A8	6A8	6J7	6C6	77	6A8	6A8G	6A8G	6A8G		6A8G
Intermediate Frequency	6K7	6K7	6D6	6K7	6K7	6K7	6K7	6D6	78	6K7	6K7G	6K7G	6K7G		6K7G
2nd. Det. / AVC	6Q7	6Q7	75	6Q7	6Q7	6Q7	6B7	75	75	6H6	6Q7G	6Q7G	6Q7G		6H6
1st. Audio										6F5					6C5G
2nd. Audio							41								6C5G
Output	6F6	6F6	41	6F6	41	6F6	6A6	41	42	6F6	6F6G	6F6G	6F6G		6N7G
Rectifier	84	84	84	6X5	6X5	6X5	Sync. Vib.	84	84	0Z4	6X5 or 0Z4	6X5 or 0Z4	6X5 or 0Z4		6X5G
Pilot Light No.	–	–	–	–	T-50	T-50	–	–	–	–	–	–	–	–	–

† High-Fidelity Models

Public Address . . .

P-A SERVICE PROBLEMS

By AARON NADELL

WHILE servicing public address equipment is and can always be made more profitable than receiver service work it is more intricate and extensive in nature and in fact rests upon somewhat different requirements. The two appear similar only at first glance. It is, of course, true that standard radio methods, both technical and commercial, have their own proper place in p-a service work, but seldom as more than one part of an inherently larger procedure.

The basic differences between these two kinds of servicing are responsible not only for the fact that p-a work, job for job, is much better paid, but also for further opportunities it offers of a kind that are not found in radio work at all.

In general, there are four essential distinctions—two technical and two commercial.

The set owner is less exacting; he can afford to tolerate some minor trouble, such as a hum or a small degree of distortion, much longer than the p-a user can. The latter will call on the Service Man far more readily—and wants correspondingly perfect results.

Promptness Required

Therefore, one of the two commercial differences between radio and p-a servicing may be summarized as an imperative demand for quick and perfect results in time of trouble.

A second difference arises out of this one, namely, that p-a offers opportunities for maintenance work to an extent unknown to the radio field.

Economically speaking, p-a requires promptness of repair to a degree that is practiced very little in radio servicing. There is seldom any such thing as taking a p-a system back to the shop and keeping it there a week to find out what's wrong with it. P-a equipment is not used in the home, but in business, and the dance hall, sound truck or other business enterprise using it may be exposed to serious losses if repairs are not made promptly. Consider, for example, the case of a cabaret owner whose system breaks down at the beginning of a holiday or even a Saturday evening. The equipment may be only a matter of entertainment to those who listen to it, but it means dollars and cents to the man who owns it. He will be willing to pay a reasonable repair charge without waiting to shop around. But he will not welcome delay.

Such delay as, for instance, wiring to a supply source for a new transformer will be as intolerable as any other, and here lies still another opportunity for the Service Man.

In some cases, it is to the owner's best interest to install an emergency channel for instant protection in case of failure of the equipment; in nearly all cases he should stock spare parts—not only spare tubes but any uncommon part, such as a power transformer or disc rectifier, that may delay repairs materially if it should go bad.

The danger of a breakdown on a busy day is so serious to many (though, of course, not to all) p-a owners that it is distinctly to their advantage to pay a reasonable weekly or monthly sum for regular inspection of their equipment. Such inspection is designed to keep the apparatus in condition to deliver the best possible results at all times, and also to catch and cure such troubles as overheating, leaky condensers, bad tubes and others that may lead to breakdown if left unchecked.

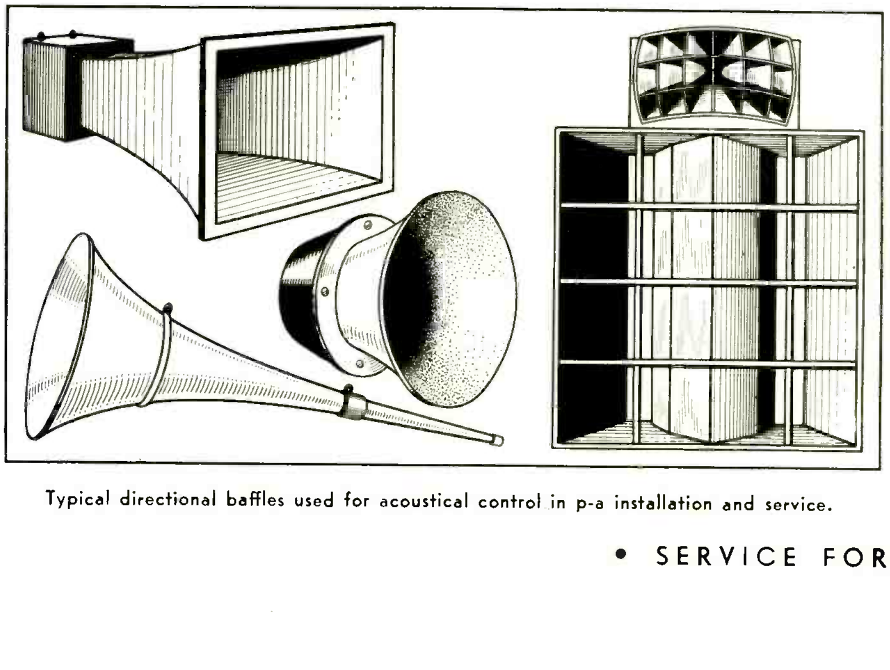
Another striking difference between p-a and receiver servicing often makes the former easier. Unlike the receiver, the larger p-a system is composed of more than one unit. Trouble is often easily isolated by testing along the connecting lines and at the connection terminals. Finding the exact nature of the difficulty is greatly simplified in consequence. Very frequently the need for haste stops the trouble-shooting as soon as the defective unit has been located; instead of proceeding to repair that unit the Service Man simply replaces it on a temporary basis. Further and complete repairs can then be carried out at his leisure. Thus in one sense it *is* possible to take a p-a system back to the shop for deferred attention—a single part of the system can be treated that way, provided a satisfactory substitute is available.

Where a regular inspection contract has been arranged with the user, it is naturally the business of the Service Man to know the exact specifications for any component that may ever have to be replaced and where it can be obtained quickly if the owner does not stock a duplicate. Also to know in advance how connections can be modified to dispense with some unit temporarily—one speaker for example—still maintaining satisfactory impedance match and other qualifications for reasonable emergency performance.

Acoustic Problems

The difference between the commercial requirements here outlined and those encountered in receiver servicing is sufficiently obvious; the divergence in technical requirements is in some ways equally striking.

One point of prime importance is that p-a work involves acoustic troubles and acoustic servicing, where radio work, of course, does not. Every Service Man knows that the tone of radio reproduction can be modified by placing the receiver in different parts of the same room but the differences so obtained are not very great and considerations of domestic convenience and appearance outweigh them. When sound at the loudspeaker is satisfactory as to quality and volume no more is asked. The



Typical directional baffles used for acoustical control in p-a installation and service.

rooms of any normal home are comparatively small and well filled with furniture.

Places of public assembly present a different picture. Since sound moves slowly (about 1,000 feet per second) there is an appreciable lapse of time between reflections of sound waves from opposing walls. There are large blank surfaces that will reflect waves of even the lowest frequency without breaking them up. These factors permit and encourage various types of acoustic distortion. The quality of sound at the loudspeaker may be no criterion at all of the quality heard by the audience.

Acoustic problems include the acoustic distortion of quality and acoustic feedback that all Service Men know is likely to accompany use of a microphone.

Acoustic problems also include the question of volume distribution, seeing to it that sound is loud enough in the furthest seats without being too loud in the nearest seats, and overcoming dead spots and loud spots which may appear almost anywhere by virtue of acoustic conditions.

Volume Distribution

Taking the last point first, bad distribution can be caused by using the wrong speakers for the job, by improper placement or pointing of the speakers and by acoustic reflections that emphasize sound at some points and destroy it at others.

Volume distribution is selective with reference to sound frequency. The ideal distribution presents an equal volume of every frequency to the ear of every listener. The ideal is never reached in actual practice, but it can be very closely approached.

However, even moderately satisfactory distribution is difficult or impossible to obtain unless a sufficient number of speakers equipped with the necessary type of baffle are used. Where sound is to be distributed over reasonably large distances, indoors or outdoors, the trumpet-type of baffle is usually most effective. Unless sound can be projected there is little chance of getting enough volume far back without blasting the ears of the nearest listeners. With trumpets, however, the main beam is sent out over their heads; they get the spillage, and if the trumpet is pointed with sufficient care the spillage in front will substantially equal the beam volume at the rear. Where the positioning is done properly the middle seats, at which the spillage begins to fall off, are those in which the beam just begins to cut in.

Where sound is to be spread over a wide lateral range, a sufficient number of trumpets should be used.

Since 3 db represents that difference in loudspeaker volume which the ear is capable of detecting, the volume control may be calibrated in 3 db points. A frequency test record may be played, and the volume control turned down until sound is lost. The control is then raised 3 db, and sound is heard. In any portion of the area to be supplied, sound should still be heard, and, in any portion of that area sound should be so low that turning the volume control down 3 db will cause it to be lost. If this can be done at some central frequency, such as 1,000 cycles, and if playing a standard phono record of music recorded at fairly even level shows no glaring discrepancy in the overall volume at all frequencies, distribution may be considered commercially satisfactory in the present stage of the art. The musical record must follow the single-frequency test, for sound at one frequency is deceptive by reason of the possibility of standing waves. These are repeated reflections of sound between two opposing surfaces, in which the reflections happen to be so phased that the sound is strongly reenforced. Of course, at other frequencies (except harmonics) the phase relations will not be the same, and the same reenforcement will not take place. A standing wave may, with the single-frequency test just described, show excellent results in a spot that really is dead to overall sound.

In indoor work sound reflection may seriously interfere with the desired distribution. Very often the best pointing for the speakers is not all that which the eye would guess it to be and can be obtained only after prolonged and repeated tests and adjustments checked by ear.

Reverberation

Reflection is also responsible for many forms of acoustic distortion of quality.

Of these, the commonest is too much reverberation—that is, excessive reflections repeated from wall to wall and prolonging the sound after it should normally die away. This condition not only makes for an unnatural quality, but also causes sound to overlap with the result that the audience has difficulty in hearing and understanding it. Reverberation is essentially an indoor trouble. Acoustic treatment for it involves the introduction of extensive areas of sound absorbing material, which is a costly process. In the absence of such treatment the best remedy is to keep the volume just as low as is

PUBLIC ADDRESS—continued

consistent with good hearing. Another remedy is to point the sound directly at the audience. Human beings and their clothing have very high absorption factors. An average individual will absorb as much sound as would be lost through a window opening of four and a half square feet.

Concentrated reverberation is echo; the remedy lies in finding the reflecting surface and pointing sound away from it. If this cannot be done the surface in question must be covered with absorbing material.

Insufficient reverberation destroys the illusion of natural sound—takes out the sparkle and life. "Dead" rooms are encountered occasionally, and are somewhat common where sound treatment to reduce reverberation has been overdone. Primarily, however, insufficient reverberation is an outdoor trouble, and is the reason why outdoor band stands and the like are built with concrete sound reflectors.

Reflection of sound is never the same at all frequencies; neither is the efficiency of sound-absorbing materials. Frequency discrimination in the reflection of sound proves troublesome occasionally, but becomes particularly serious when standing waves are created since these cause an intense reinforcement of some frequencies in some areas. Repointing the speakers (being careful to maintain sufficiently satisfactory distribution in the process) usually helps eliminate the more drastic manifestations of this trouble. Stubborn cases may require extensive treatment with acoustic materials.

Acoustic Feedback

Acoustic feedback between loudspeakers and microphone is familiar to everyone who has done p-a work. There are a number of remedies which may be used alone or in combination: (1) directional baffles to point sound away from the microphone or from surfaces that may reflect it to the microphone; (2) directional microphone to limit the angle of response, and (3) microphone, amplifier and speakers—speakers especially—of flat characteristic which will avoid feedback caused by peaks at some one frequency while the overall volume still remains low, using the mike close-up (which requires one that doesn't sound boomy when so used) to limit the sensitivity of the system. A precaution that scarcely deserves the name of remedy, but still is sometimes overlooked, is, of course, the obvious one of placing microphones and loudspeakers in such relative locations that the former will receive a minimum of the sound emitted by the latter.

ASSOCIATION NEWS . . .

IRSM REPORTS

Convention and Trade Show

The convention committee reports a complete program for the fifth annual convention of the Institute of Radio Service Men, to be held at the Stevens Hotel, Chicago, June 10 to 13. A lecture hall in which the technical sessions are to be conducted is located in one corner of the exhibition hall where the trade show will progress. During the duration of the show the following program will be presented:

Thursday, June 10

2:00 P.M.-7:30 P.M.

Registration and viewing of exhibits.

7:30 P.M.

"Radio Tomorrow," by O. H. Caldwell, *Radio Today*, New York City.

8:00 P.M.

"Proven Merchandising Ideas That Will Boost Profits," by Sandy Cowan, SERVICE Magazine, New York City.

8:30 P.M.

"Universal Coils," by Charles S. Linell, Carron Manufacturing Co.

9:00 P.M.

"Psychology of Selling Service," by J. P. Kennedy, Triumph Manufacturing Co., Chicago.

Friday, June 11

2:00 P.M.

"Crystal Devices in the Service Field," by J. A. Altmeyer, Brush Development Co., Cleveland, Ohio.

2:30 P.M.

"Recent Developments in Crystal Microphones and Phonograph Pickups," by Ralph P. Glover, Shure Brothers, Chicago.

3:00 P.M.

"New Developments in Crystal Microphone Cable," by N. Hogenbirk, Belden Manufacturing Co., Chicago.

3:30 P.M.

"The Development of Heavy Duty Vibrators and Converters," by W. W. Garstang, Electronic Laboratories, Inc., Indianapolis, Ind.

4:00 P.M.

"Mutual Conductance Tube Testers," by J. R. Barnhard, Hickok Electrical Instrument Co., Cleveland, Ohio.

The evening program will be under the auspices of the IRE.

6:00 P.M.

Institute of Radio Engineers' Banquet.

"Tubes," by Roger Wise, Chief Engineer, Hygrade-Sylvania Corp., Emporium, Pa.

"Instruments," by Kendall Clough, Clough-Brengle Co., Chicago.

"Receivers," speaker to be announced.

The Saturday afternoon program will be under the auspices of the ARRL.

2:00 P.M.

"Amateur Transmitting Tubes," by A. Anderson, Taylor Tube Co., Chicago.

2:30 P.M.

"Antennas and Antenna Systems," by Robert Wood, Galvin Manufacturing Corp., Chicago.

3:00 P.M.

"Recent Research Developments on Ultra-High-Frequency Problems," by Dave Elam, Montgomery Ward & Co., Chicago.

3:30 P.M.

"Modern Transmitter Design," by Henry Argento, Raytheon Production Corp., Waltham, Mass.

4:00 P.M.

"Amateur Receiver Design," by K. W. Miles, The Hallicrafters, Inc., Chicago.

4:30 P.M.

"Oscillographic Measurements on Amateur Transmitter and Receiver Equipment," by Floyd Faucett, Supreme Instrument Corp., Greenwood, Miss.

5:00 P.M.

"Scientific Method of Improving Code Speed," by T. R. McElroy, National Code Champ.

8:00 P.M.

Installation of IRSM Officers; John T. Rose, presiding.

8:30 P.M.

"How to Choose Test Instruments," by John S. Meck, Electronic Design Corp., Chicago.

9:00 P.M.

"A Technical Discussion of Inter-Office Communication Systems," by Robert G. Herzog, Editor, SERVICE Magazine, New York City.

9:30 P.M.

"Oscillographic Demonstration of New Developments in Receiver Circuits," by Charles Herbst, RCA Manufacturing Co., Inc., Camden, N. J.

Sunday, June 13

1:30 P.M.

"A-C, D-C Ballast Tube Resistors," by Edward Trefz, Clarostat Manufacturing Co., Inc., Brooklyn, New York.

2:00 P.M.

"Twenty-Thousand-Ohms-per-Volt Radio Testing Instruments," by O. J. Morelock, Weston Electrical Instrument Corp., Newark, N. J.

2:30 P.M.

"Auto Antennas," by Neal Bear, Ward Products Corp., Cleveland, Ohio.

3:00 P.M.

"New Tube Developments," by Walter Jones, Hygrade-Sylvania Corp., Emporium, Pa.

4:00 P.M.

"Practical Testing of Vibrators," by I. M. Slater, P. R. Mallory & Co., Inc., Indianapolis, Ind.

4:30 P.M.

"Hum and Distortion Problems in P-A Work," by J. H. Kleker, Thordarson Electric Manufacturing Co., Chicago.

7:30 P.M.

"Noise in Volume Control Circuits," by W. H. Fritz, Centralab, Milwaukee, Wis.

8:00 P.M.

"Speakers and Speaker Systems; Their Proper Selection and Application," by Austin Ellmore, Utah Radio Products Co., Chicago.

8:30 P.M.

"Vacuum Tube Voltmeters and Their Applications to receiver Test Problems," by R. L. Barr, Clough-Brengle Co., Chicago.

9:00 P.M.

"Identification of Interference Sources, Including a Demonstration of Their Sound and Wave Form," by C. W. Metcalf, Tobe Deutschman Corp., Canton, Mass.

11:00 P.M.

Exhibits close.

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Newark Chapter

The Newark Chapter of the Institute of Radio Service Men held a regular meeting May 27, 1937, at the Hotel Douglas, Newark, New Jersey.

The guest speaker was Bruce Burlingame, well known as an authority on test equipment. The subject of the talk was "Application of Test Equipment to Various Stages of Receiver."

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RADIO SERVICE ASSN. OF CALIFORNIA

At the May 17 meeting, held at 921 Harrison Street, Oakland, Cal., B. C. Bridges of the Alameda Police Dept., spoke on "Fingerprinting and Criminal Investigation." This was a welcome and interesting diversion from the usual radio technicalities.

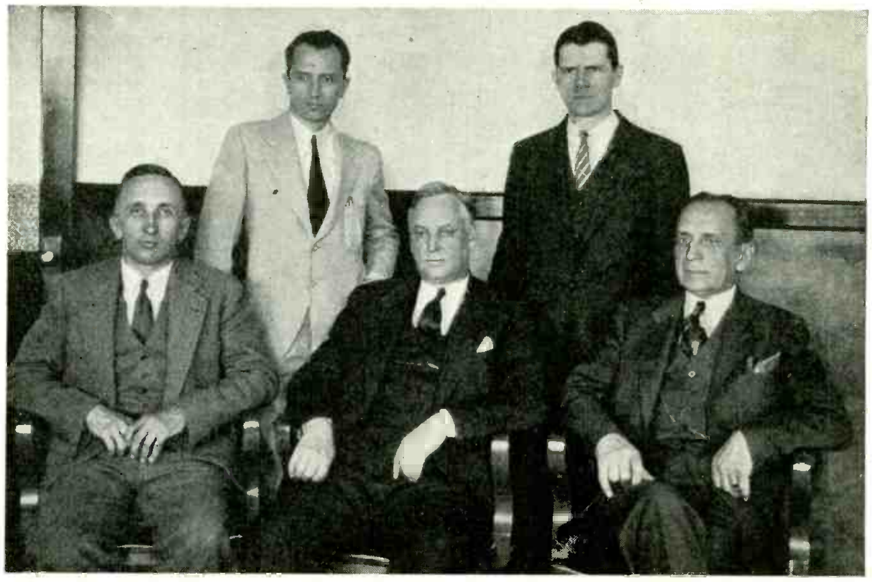
"Ocktail" Al Grabau has a couple of newly painted, higher priced tubes for our consideration. And we still have some more election to get off our chests. We plumb overlooked the fact that Wil Styles and Wally Wahlgren have been serving on the Board on borrowed time. So two new members must be elected at the next meeting. . . . Frank Jallu, Carl Penther, Claire Lanam, and Al Schoss have been nominated, so take your pick and come and vote for two.

At last meeting the nominating committee reported that of our members, the one most suitable, and who was able and willing to take the job of Treasurer, was Don Caples. This choice seemed to be mutually satisfactory and a white ballot was cast. Take a bow, Treasurer Caples! (Looks to us like he might be full of Wim and Winegar and it might be a good idea to bring along some Dough for Dues.) Carl Penther reviewed an RCA article on External Cross-Modulation which answered a lot of puzzling questions. . . . Al Grabau gave the dope on the 5T4. . . . Our speaker, Jules Cohn of the Jensen Company gave a fine talk and an eye-opening demonstration with a gadget known as a "Bass-Reflex" baffle. . . . Of which more anon.

Members and their families and friends have been invited to hear Prof. Lester E. Reukema give a talk on Earthquakes. This was scheduled for Monday, May 24, at 8:00 P. M., in Room 2503 of the Life-Science building, on the Berkeley Campus. Those of us who have heard Prof. Reukama when he gets turned loose on an engrossing subject such as this needed no further invitation.

We have an interesting talk scheduled for our meeting of June 7. Robert S. Prussia, Lighting Engineer, will speak on Light and Lighting Effects and demonstrate various phenomena with his equipment.

HIGHLIGHTS . . .



Executives of the Cinaudagraph Corp., Stamford, Conn. Sitting: S. R. Hoyt; H. W. Harwell and H. C. Seaman. Standing: L. B. Cornwell and H. H. Friend.

INTERFERENCE ELIMINATION LESSON

Recognizing a steadily growing importance of interference elimination as a profit-builder for Service Men, the Sprague Products Co., North Adams, Mass., makers of Sprague Condensers, have made arrangements with the National Radio Institute of Washington, D. C., to distribute a number of free copies of the N. R. I. Lesson, "How to Eliminate Man-Made Interference." Requests for the lesson booklet should be made directly to the Sprague Products Co.

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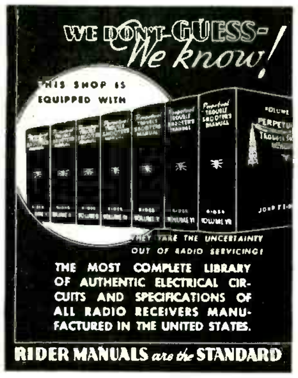
RIDER DISPLAYS

Service Men who own the complete set of 7 Rider Manuals can obtain two certificates, one for framing and the other for the bill folder, as well as the display illustrated. These devices are intended as a means whereby the Service Man can assure his customers that he has all the information needed to repair any receiver.



The certificates and display may be obtained by sending the title pages from the seven Rider Manuals together with a return address to John F. Rider, Publisher, 1440 Broadway, New York City.

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STEWART DISPLAY

The F. W. Stewart Mfg. Corp., 340 W. Huron St., Chicago, have added an all-metal display to their line. The 23- by 50-in. stand is designed for displaying the Stewart custom built radio panel plates as they would appear on the car instrument panel.

The display board consists of 29, 1937 panel kits, 1 tuning unit, 1 volume control (with on-off switch), 1 pair of flexible control shafts, necessary wiring with fuse and the display board with the panels mounted.

An illustrated folder explaining the features of the display may be obtained from the manufacturer.

George and Victor Mucher looking over a resistance brain child. George heads the engineering activities for Clarostat Mfg. Co., Inc., Brooklyn, N. Y., while Vic is in charge of sales.

SOLAR CATALOG

Listing their line of dry electrolytic, wet electrolytic and paper exact replacement condensers, the Solar 1-R catalog also carries a-c motor starting replacements.

This catalog is companion to and supplements Solar catalog 8-S, general condenser catalog recently announced; both are available on request from the Solar Manufacturing Corp., 599 Broadway, New York City.

•

AMPERITE CONTEST FORM

The Amperite Company, 561 Broadway, New York City, has prepared a special form stipulating the details of their recently announced contest. A microphone and stand is offered as first prize in the contest in an effort to find the best name for the stand. Duplicate prizes will be awarded in case of ties. The ten next best names will receive a stand free. The contest closes July 1. The stand is illustrated and described on the form.

Copies of this form may be obtained by requesting Bulletin NSH directly from Amperite.

This contest will be one of the features of the Amperite display—booth 36—at the Chicago Trade Show.

Sam Ruttenberg, of Amperite, New York City, inspecting a RBHn microphone retrieved from the Portsmouth, Ohio, flood. The microphone still worked after having been under water for 10 days.

•

OPEN HOUSE AT QUAM-NICHOLS

The Quam-Nichols Co., manufacturers of radio speakers and equipment, is holding open house at their factory during the Convention and Show in Chicago. All manufacturers, jobbers, dealers and Service Men are cordially invited to visit this plant. Here is an opportunity to see a speaker factory in action. Capacity is 10,000 speakers per day. Interesting innovations in manufacturing procedure and equipment, as well as useful speaker information make this trip worth while. The factory is located at 33 Place and Cottage Grove Ave.

•

AEROVOX CATALOG

Aerovox Corp., 70 Washington St., Brooklyn, N. Y., is issuing its largest catalog in years—twice the number of pages of recent editions.

Copies of the catalog may be obtained directly from Aerovox.

Aerovox will display their complete line at the National Trade Show, booth 62.

Tore Lundahl, sales manager of Technical Appliance Corp., New York City, at his desk working on correspondence.

HIGHLIGHTS—continued

NATIONAL UNION CLOCKS

National Union Corp., 570 Lexington Ave., New York City, have released to the service trade a specially designed electric clock. The face glass size is 16 by 24 in. with a 1-in. two-tone black and silver frame. The face design is in five colors with a silver mirror.

The copy has been developed by a pat-

ented process to produce a neon effect when illuminated. The clock is equipped with a switch for light control so that the lights can be extinguished without affecting the operation of the clock movement. The movement is driven by a Hammond motor.

National Union is giving this clock to Service Men throughout the country with the purchase of National Union tubes.

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BOOK REVIEW

ALTERNATING CURRENTS IN RADIO RECEIVERS, written and published by John F. Rider, 1440 Broadway, New York. 96 pages, hard covers, price 60 cents.

In this latest volume in the Hour a Day with Rider series, John F. Rider covers the subject of alternating currents in a manner which should appeal to the Service Man. In the opening sections of the book, the Service Man is introduced to the fundamental ideas associated with alternating currents, such as the physical concept of an alternating current, clear explanations of the meaning of cycle, frequency, amplitude, sine wave, and average, peak and effective values of alternating currents.

The explanations of phase are of special interest in view of the widespread use of phase inversion, push-pull, a. f. c., and other circuits which depend for their action upon the presence of certain phase relations. From the standpoint of the service field the author's treatment of the subject of sine waves and complex waves is to be recommended. In this connection, the origin of harmonic frequencies and their effect upon the waveform of alternating currents and voltages is well illustrated with numerous drawings and actual unretouched oscillograms made in the author's laboratory. Service Men will find much of value in this practical, well illustrated volume.

THE MANUFACTURERS . . .

ARVIN AUTO RADIO

The makers of Arvin auto radios, Noblitt-Sparks Industries, Inc., Columbus, Ind., have announced a low-priced 6-tube tailor-fit auto radio complete with in-the-set speaker and any one of the 47 Arvin matching panel or universal controls.

The new Arvin radio is known as the Model 9A. The chassis and speaker are packed as one unit. All Arvin controls—matching panel and universal types—are packed individually. Dealers may order any one of the 47 Arvin types for installation with the 9A.

This receiver has a 3-gang condenser and a 5-in dynamic speaker. Many of the improvements of the higher priced Arvins are built into the model. The metal case is finished in taupe morocco.

•

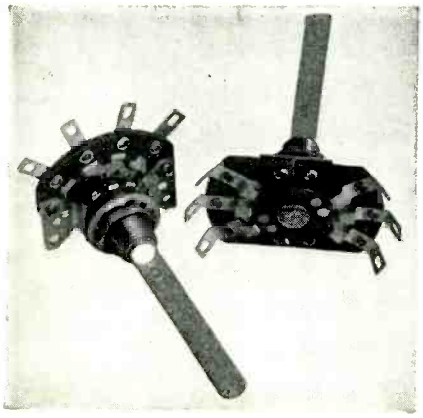
PANEL INSTRUMENTS

A line of low-priced panel instruments with bridge type construction and soft iron pole-pieces has been announced by the Simpson Electric Company, 5216 Kinsie Street, Chicago. This type of construction, states the Simpson organization, has only been available in instruments selling at considerably higher prices. Increased initial accuracy and lasting accuracy over a period of years are the advantages claimed for this construction.

•

CENTRALAB TONE SWITCHES

Centralab, 900 E. Keefe Ave., Milwaukee, Wis., have announced a tone switch. The switch is available in 3 types: 1 pole, 2 positions; 1 pole, 3 positions and 2 pole, 2 positions. The common terminal is insulated from the shaft and bushing in all types. The controls are designed chiefly for use as step-type tone controls in midget receivers. The switch may be adapted to other uses, however.

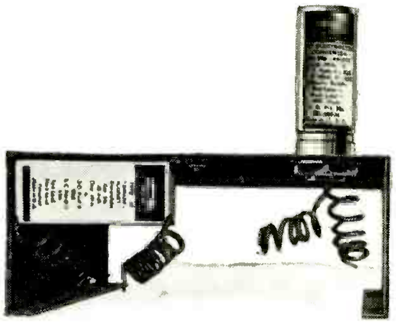


Additional information may be obtained from the manufacturer.

•

CORNELL-DUBILIER CAPACITORS

Flexibility in mounting and compactness in design makes the Cornell-Dubilier JR and KR series of etched foil dry electrolytic capacitors valuable to the Service Man, it is said. The type JR is enclosed in a square silver container. The type KR, shown mounted on top of the chassis, is less than one-half the size of a similar



can-type electrolytic.

Additional information may be obtained from the Cornell-Dubilier Corp., South Plainfield, N. J.

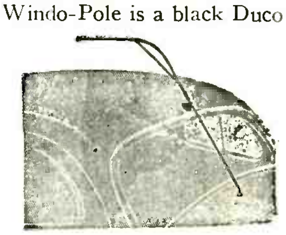
•

ICA AUTO ANTENNAS

The Insuline Corporation of America, 25 Park Place, New York City, are marketing a series of 6 streamlined auto antennas. Five are finished in chromium. The top of the car need not be drilled to install any of the models.

The Moto-Whip, a streamlined antenna, can be adjusted for city and country driving. The Hinge Whip is a telescopic antenna attached to the hinge pin of any car while the Auto-Whip is similar to the Hinge Whip except that it is a solid one-piece flexible rod.

The Windo-Pole is a black Duco parker-



ized finish antenna for home use. It is a telescopic antenna, extends to a height of 8 feet and may be attached to any window sill.

Additional information may be obtained directly from ICA.

•

CROSLEY AUTO RADIO

Crosley Radio Corp., Cincinnati, Ohio, have announced a new low priced auto-radio receiver.

The set is complete in itself, uses five tubes and is mounted in one piece under the instrument panel of any make car. One bolt mounts the receiver to the dash and two fasten it to the instrument panel. No remote control cables are used.

ELECTRO-ACOUSTIC AMPLIFIER

A Class A heavy-duty booster power amplifier, designed for general p-a applications requiring more than 30 watts of power, has been announced by Electro-Acoustic Products Co., Fort Wayne, Ind. The new amplifier, Model A-3041, may be used and added to the base Electro-Acoustic Model A-1831, 15-watt amplifier or the Model A-3023, 30-watt amplifier, either of which will supply sufficient input voltage for operation of any number of A-3041 amplifiers.

The combination is recommended for race courses, convention halls, cemeteries, organ and chime tower installations, large rentals, fair grounds, industrial call systems and other applications having high power output requirements.

The Model A-3041 incorporates beam power output tubes and is built with all parts enclosed. Connections between the base system and the A-3041 power stages are made through flexible cables and plugs.

Additional information may be obtained from the manufacturer.

•

RCA RECORD PLAYERS

As a successor to the R-93 model RCA Victor introduces the record-player model 93-A. In appearance the new instrument resembles a chest or a cigar humidor.

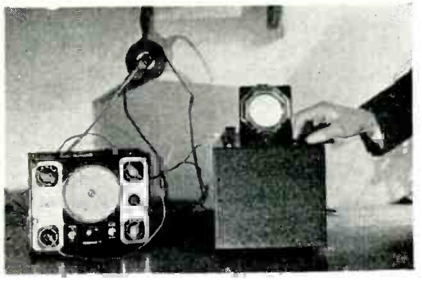
To replace the model R-93-2, the model R-94 has been announced. This instrument is housed in a hinged cabinet of walnut veneers. Both 10- and 12-inch records can be played on the R-94 with the lid closed. Automatic starting of the turntable and bass compensation are two of its features.

The new instruments are of the type which reproduces phonograph records when connected to electrically operated receivers.

MANUFACTURERS—continued

SINE-WAVE GENERATOR

The new Triumph Model 120A signal generator delivers both r-f and a-f or r-f modulated with the a-f in a sine-wave pattern. The generator covers a frequency band of 100 kc to 75 mc and the audio



modulation is a tone of 380 cycles.

A calibrated attenuator on the signal generator provides for accurate attenuation of the r-f output from 0 to 50,000 microvolts. The oscillograph in the illustration is a standard Triumph Model 800 3-inch combination oscillograph and linear sweep.

Further information may be obtained from the Triumph Manufacturing Co., 4017-19 West Lake St., Chicago.

•

ERIE INSULATED RESISTORS

The Erie Resistor Corp., Erie, Pa., announces a line of insulated resistors in ¼ and ½ watt sizes.

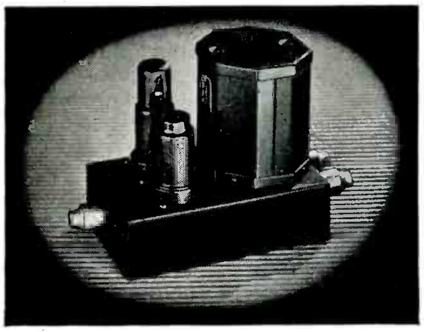
The units are called "ceramic-sealed" insulated resistors and are completely covered with a preformed ceramic case and sealed at the ends with a high-dielectric ceramic cement which bonds itself to the insulating case, the tinned-copper terminal wires and to the brass cap covering the end of the solid molded carbon resistance pin.

Both the ¼ and ½ watt insulated "ceramic-sealed" resistors are obtainable in all resistance values from a few ohms to several megohms. ¼ watt unit measures approximately ¼ by ½ in. The ½ watt size measures ¼ by ¾ in. Both sizes have 2-in. tinned-copper terminal wires.

•

UTC PREAMPLIFIER

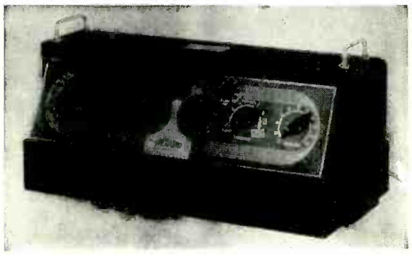
The United Transformer Corp., 72 Spring St., New York, N. Y., have just brought out a preamplifier which obtains its power supply directly from the main amplifier. It incorporates a 6F5 resistance coupled to a 6C5 providing 60 db of gain.



The input is high impedance and the output provides universal line impedance. Filtering is provided in the preamplifier to assure low hum level. If desired, a separate power supply can also be obtained for this unit.

OPERADIO 55-80 WATT AMPLIFIER

The Operadio Model 855 incorporates four channel input, volume expansion, volume compression, visual overload indicator and visual output indicator. An



equalizer is also used for tone balancing.
Twelve tubes are used in the six stage high-gain unit.
Specifications and other details may be obtained directly from Operadio Manufacturing Co., St. Charles, Ill. Write for catalog S-12.

•

WESTON "MATCHED TWIN"

A servicing set, comprising both the Weston 20,000-ohm-per-volt analyzer and its "matched twin" tube tester in a single portable case, is now available to Service Men. Though the two instruments are electrically independent, it is said, that they form a balanced operating unit in function and design.
The flexibility of this dual-unit arrangement makes it possible for those who already own the supersensitive analyzer to utilize it as part of the new combination instrument by transferring it from its present case.
The "matched twin" servicing instruments may also be used conveniently for workshop panel mounting. This permits a symmetrical arrangement for built-in shop equipment.
Additional information and prices may be obtained from the Weston Electrical Instrument Corp., Newark, N. J.

•

WEBSTER INCREASES INTERCOMMUNICATING LINE

Webster-Chicago has added two systems and have revised and improved their two previous systems, for interoffice communication. All systems are now contained in plastic cases and can be secured in various color combinations.
Webster-Chicago has planned a complete display of their intercommunicating system line at the National Trade Show.
Additional information can be obtained directly from Webster Co., 5622 Bloomingdale Ave., Chicago.

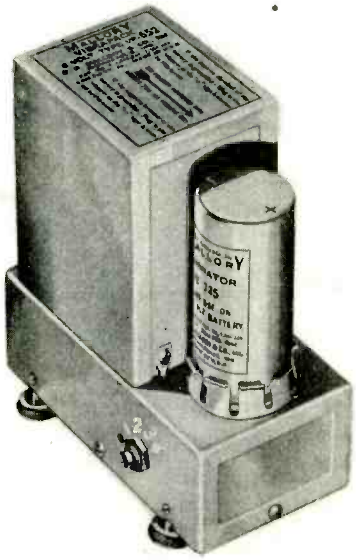
•

FOX SPEAKER UNIT

The Fox Sound Equipment Corp., Toledo, Ohio, announces a 10-watt Alnico permanent magnet type dynamic unit. The unit contains the regular Fox type diaphragm, is enclosed in a water-tight aluminum case and is equipped with a standard connecting flange.
A one-piece metal diaphragm, electric dynamic units, aluminum trumpet horns, the B-5 Universal baffle type horn, and low level speaker, are among the items manufactured by the Fox Sound Equipment Corp.

MALLORY VIBRAPACKS

To provide portable power for radio transmitters, p-a equipment and similar apparatus, P. R. Mallory & Co., Inc., Indianapolis, Ind., have introduced a line of six-volt power supplies, called Vibrapacks.
The two high voltage models of Vibrapacks have a maximum rated output of 300 volts, 100 ma of rectified d-c with three lower voltages of 275, 250 and 225



volts available at the turn of a tap switch.
The lower voltage models of the Vibrapacks deliver 200-, 175-, 150- and 125-volts output and may be used for converting 110-volt a-c receivers for 6-volt battery operation.
Mallory Vibrapacks are manufactured in both synchronous or self-rectifying types, and in interrupter or tube rectifying types, the latter are required only when B— can not be at ground potential.
Additional information may be obtained directly from P. R. Mallory & Co., Inc.

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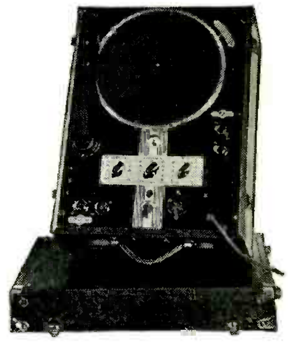
UNITED SOUND AMPLIFIER

The United Sound Engineering Com-



pany's amplifier Model 20-E, shown in the accompanying illustration, is an example of recent design in 6-volt d-c, 110-volt a-c amplifiers and includes the electric eye monitor. Complete details of the 20-E are given in catalog 107S which may be obtained directly from the United Sound Engineering Company, St. Paul, Minn.

DEPENDABLE TEST INSTRUMENTS

The Radio City Products Co., New York City, announce their Dependable Models 306 tube tester and 701 signal generator.
The tube tester is designed with a view toward future advances in tube types, it is said.
The signal generator features attenuation from 1 microvolt to ½ volt through a constant impedance ladder network of 5 steps. The frequency range from 125 kc to 60 mc is covered.
Radio City Products Co. will display their products at booth 67 at the National Trade Show.
Additional information on Radio City Products may be obtained directly from the manufacturer.

•

UTAH P.M. SPEAKERS

Utah Radio Products Co. have expanded their line of permanent magnet dynamic speakers. Thirty-four models are available, with cone diameters ranging from five inches to fourteen inches, employing magnets weighing from five to forty-six ounces and with output capacities as high as thirty watts.
Inquiries on specifications and prices are invited. Visit booths 69 and 70 at the National Radio Parts Trade Show, or write Utah Radio Products Co., Orleans St., Chicago.

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PRECISION MULTIMETER

Precision Apparatus Corp., Brooklyn, N. Y., announce their Model 840 Multimeter with five a-c voltage ranges; five d-c voltage ranges; four d-c ranges; three resistance ranges and five db ranges. The instrument uses a square type meter (approx. 4-in.) and has an accuracy of 2 percent.
Additional information can be obtained from the manufacturer.

•

VOCAGRAPH AMPLIFIERS

Vocagraph amplifiers and portable sound systems, announced by the Electronic Design Corp., 164 N. May St., Chicago, feature a reproducing principle termed "Hushed-Power." It is claimed that this development makes possible an amplifier with greater usable power output than can be achieved through former designs.
These amplifiers are offered in output ratings of twenty, forty and sixty watts. All have streamlined cases with built-in monitor speaker and indirect lighting of

the entire control panel.
An engineering bulletin, entitled "None Have Dared," may be secured without cost directly from the manufacturer.

SYLVANIA TYPE 6T5

Hygrade-Sylvania Corporation, Emporium, Pa., have announced the type 6T5 tuning indicator tube. The 6T5 is designed for operation on 6.3 volts at 0.3 amperes.

Sylvania type 6T5 is a new tuning indicator tube which has operating conditions similar to those for the 250 volt rating of type 6G5. It differs from the 6G5 in that the visible indication is annular in shape. The lighted portion covers only a very narrow region at the periphery of the target when no voltage is applied to the control grid of the tube. When negative voltage is applied to the control grid the width of the fluorescent ring increases until it covers practically all of the target. Changes in annular width, or diameter of the shaded section, are more readily detected than are changes in the shaded angular sector when type 6G5 is employed.

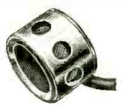
Technical data and characteristics can be obtained directly from Hygrade-Sylvania.

•

SHURE STETHOPHONE

A new improved non-acoustic piezoelectric stethophone, Model 66A, is announced by Shure Brothers, 225 W. Huron St., Chicago. The new device is designed for pickup of heartbeats and chest sounds for reproduction and recording.

Extremely faint noises can be heard clearly and fully with the stethophone which would be difficult or impossible to



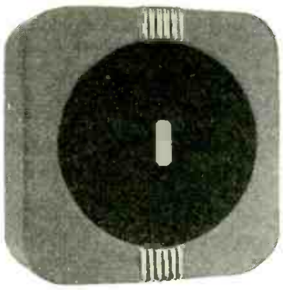
detect with the ordinary stethoscope. The stethophone is specially designed for high sensitivity to vibrations produced by the body and insensitive to "air-borne" or acoustic sounds. An outstanding feature of this new model is the anti-feedback design which permits the stethophone to be used near loudspeakers without acoustic feedback.

•

WRIGHT DECOSTER CABINET

Wright DeCoster, Inc., St. Paul, Minn., have announced a suede vehicle cabinet of modernistic design. A black grille is used which contrasts with the taupe cabinet. Chrome plated metal ornaments are at the top and bottom.

Across the back of the cabinet is a 4-



inch metal strip with a single stud for mounting. This arrangement makes the cabinet carry the weight of the speaker. The cabinet also has holes on the bottom for base mounting. The cabinet is square with rounded corners. Sizes are available for both 8- and 10-inch speakers.

An illustrative and descriptive sheet may be obtained directly from the manufacturer.

INDEX TO ADVERTISERS

ELECTRO-VOICE

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An efficient all-feature velocity microphone, preferred by broadcast, sound and public address engineers throughout the world. Three models —$35.00 to $75.00, list

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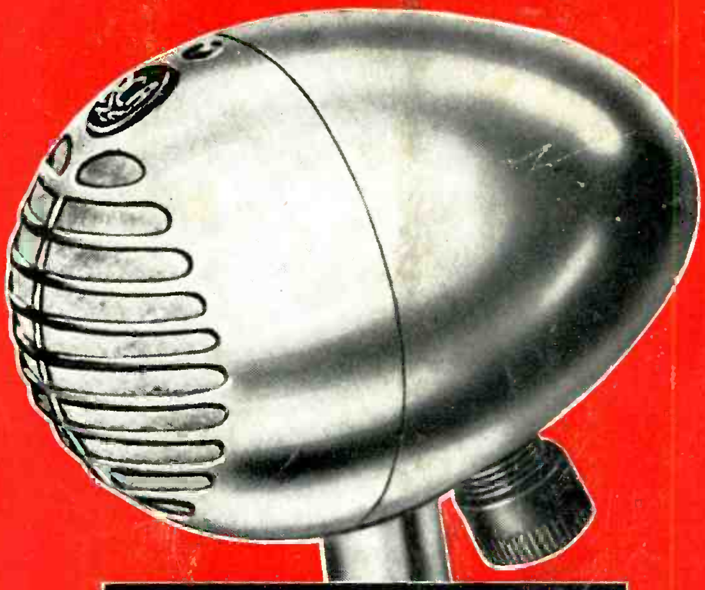

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May be located from one to over 1,000 feet distant from amplifier
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30 feet of shielded cable

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Type: Pressure operated
Impedance: 40,000 ohms
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Frequency range: 100 to 6,000 cycles
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