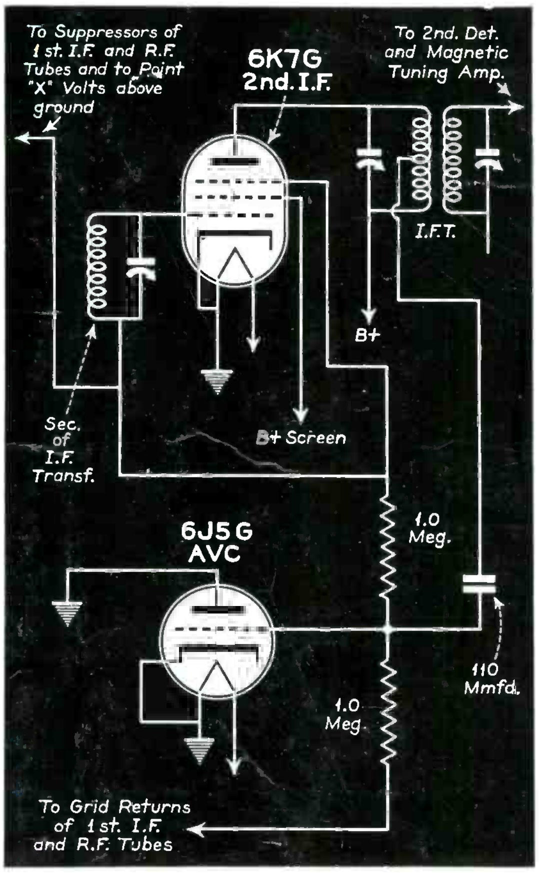
SERVICE

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



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A Monthly Digest of Radio and Allied Maintenance

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EDITORS

OCTOBER, 1937 — Ray D. Rettenmeyer — W. W. Waltz — VOL. 6, NO. 10

EDITORIAL CONTENTS

* Indicates that a circuit accompanies the text.

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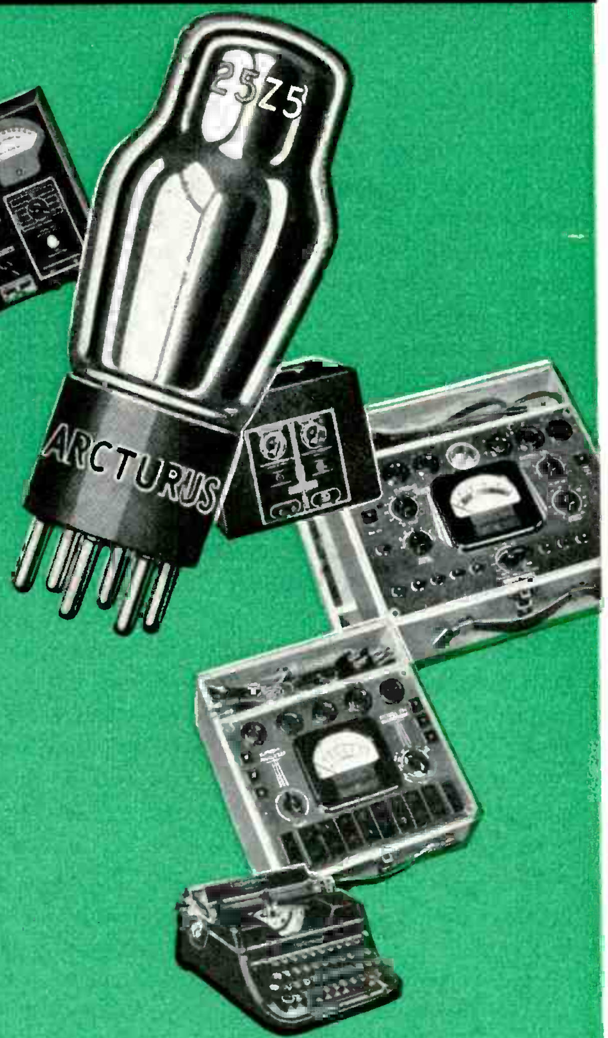

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THE ANTENNA . . .

TRAINING

THOSE OF US who were privileged to hear John Rider's talk at the recent New York show were impressed by his assertion that Service Men not only want, but need material which tells the "why" as well as the "how" of circuits. Evidently, the idea has been to assume that the men in the field didn't give a damn about why a circuit functioned as it did as long as they (Service Men) could make the proper replacements or changes to restore the circuit's original operation.

We like the idea of using material that is somewhat more technical than has been the custom. For one thing, it makes for a more interesting magazine all around—much more so from the standpoint of editing, and, we hope, more so to our readers. After all, it's a swell idea to know that connecting "a" to "b" will cause something to happen, but it's a hell of a lot more fun to know why that something does happen. We can all agree that despite the fact troubles for any circuit can be fairly well predicted and cataloged, every now and then something "not according to Hoyle" may turn up. It isn't necessary to be an Edison or a Marconi to find the answer if the basic reasons for each type of circuit are known.

It is with these thoughts in mind that we are reproducing, further on, the first of RCA's service lectures. Perhaps we had better say right now that we are reproducing as much as possible of this lecture. Obviously, we can't show what, by this time, many Service Men have both seen and heard; the demonstration which accompanies the lecture is all-important and it can only be regretted that it is impossible to convey, on paper, more than a hint of what the demonstration so clearly brings out. Likewise, space limitations caused us to make cuts here and there in the material.

This idea of "servicing by ear" is one to which little attention has been paid. Still, it is just like an auto mechanic taking a car out for a trial run during the course of which he listens to the motor, spring squeaks, brake-rod chatter, and perhaps others. It doesn't follow that that's all he does, but as a preliminary or a starting point it's an excellent idea. We sometimes wonder if it wouldn't be better if, instead of taking the customer's diagnosis at face value, the Service Man would make a "trial run" and thus get a complete picture of what the set is or is not doing. This may be standard practice with a lot of men—but try it the next time with some of the thoughts of the RCA lecture in mind.

• • •

SOUND SERVICE

THE SECTION on Public Address dies a more or less natural death with this issue. It is our belief that the time has passed when a Service Man, who is actually selling p-a, or inter-communicating systems, or anything else connected with sound reproduction and reinforcement, needs to be told where or to whom to sell it. The big part of the job is to keep an installation sold and the user happy.

For this reason, among others, we branch out with a section headed Sound Service. In it will be found the material which you generally found in the old Public Address section, but with this difference: In the future we are going to give you material of the kind that isn't usually the subject of articles or books. Just exactly what this will be will, of course, have to remain for the future to disclose. But, rest assured that the Sound Service section is "going places."

To start with, we are giving you an article on the industrial uses of public-address equipment. We don't guarantee that it doesn't mention prospects, etc., but we can say that you won't be exhausted by several pages of "John Jones runs a skating rink—therefore, John Jones is a good prospect for p-a." You fellows know all that tripe—it's been fed to you by the ton.

• • •

FORUM

QUITE A WHILE ago, we had a section entitled, Forum. In this, you, the readers, had your say; and, as we recall, it was good fun and often productive of ideas.

On going through some files, we have found quite a number of letters which would have been run in that section had it continued. Next month—unless something happens to interfere—we're going to start the Forum again. This is an open invitation to all of you to join in the fun; we'll print anything within reason (subject to the well-known laws about traveling salesmen stories!) so get busy and let's have your pet peeves, experiences, etc.

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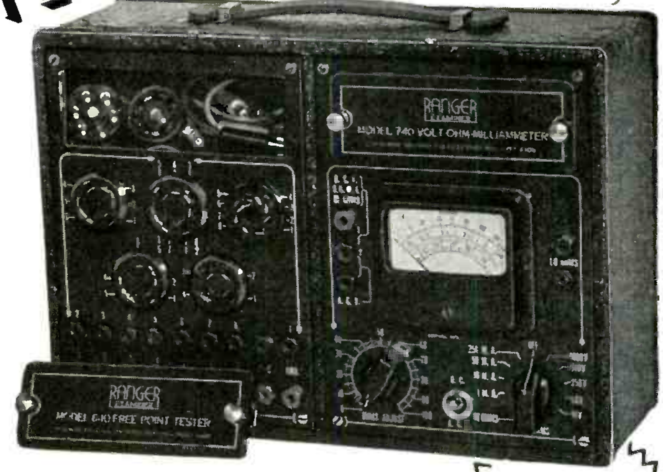

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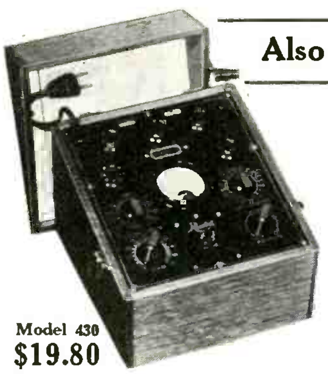

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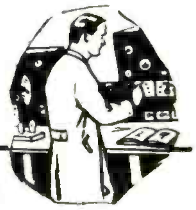

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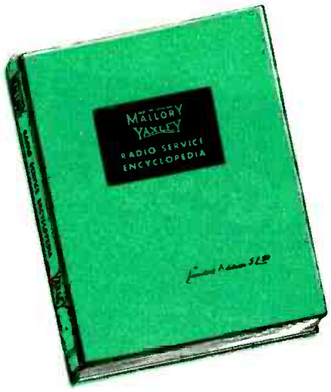

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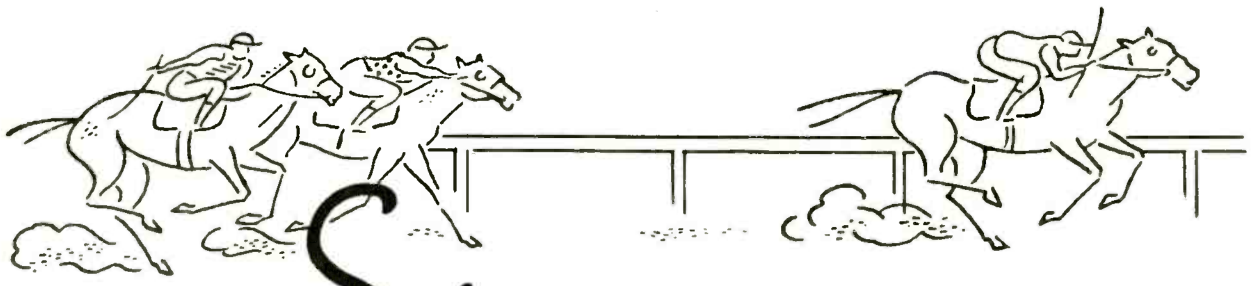

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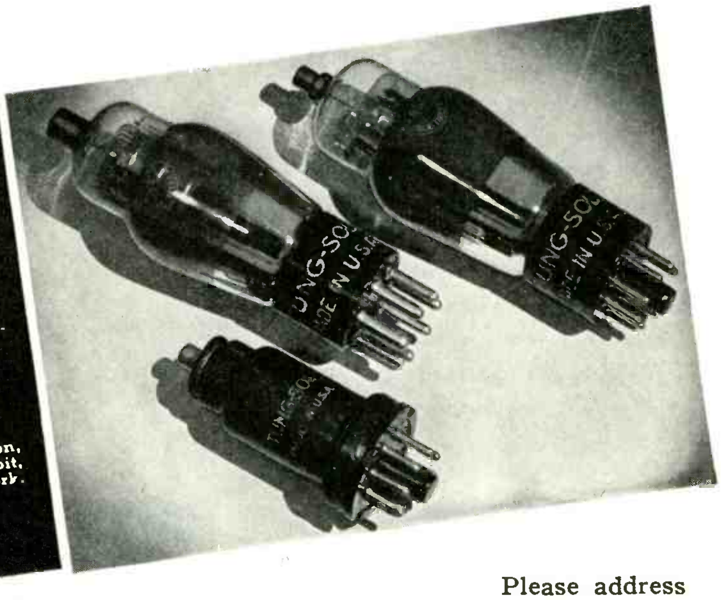

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR OCTOBER, 1937

VISUAL ALIGNMENT

By JACK AVINS

Service Men who have experienced difficulty in getting the most out of their visual alignment equipment, as well as those interested in learning more about the equipment available for visual ailgnment, will find much valuable information in this article. The author has a wide experience with the servicing aspects of visual alignment and discusses a number of the important phases which have received too little attention in service literature.

LONG BEFORE the advent of visual alignment, one of the principal tests in the measurement of receiver performance was the determination of receiver selectivity. This was generally carried out, as Fig. 1 shows, by feeding a signal of constant strength to the receiver under test, and noting the response for each of a number of different frequencies spaced more or less uniformly about the resonant frequency. Since this involved a considerable number of measurements, elaborate systems for recording selectivity curves and presenting them visually were in use long before the present cathode-ray methods. All of these systems involved some means for continuously sweeping or varying the input frequency a number of kilocycles about the resonant frequency and continuously recording the response of the set to the frequencies in the band.

With the development and perfection of the cathode-ray oscillograph, it has become a relatively simple matter to use the beam of electrons provided by the cathode-ray tube to trace out the selectivity curve of receivers. The basic method behind this application is to apply to the horizontal plates of the oscillograph a voltage which sweeps the beam uniformly across the screen, and to vary the frequency of the signal generator connected to the receiver in synchronism with the horizontal spot movement. If, at the same time, the rectified output of the receiver corresponding to this signal of varying frequency is applied to the vertical plates of the oscillograph, a trace of the receiver response appears on the screen of the cathode-ray tube; this curve is similar to that shown in Fig. 1, the only difference being that the curve is produced visually rather than manually.

There are many different methods for putting this system into practice, and a number of these will be considered later; for the present it should be emphasized that all systems of visual alignment, whether electromechanical or purely electronic, without exception function according to the basic method of operation illustrated in Fig. 2.

Why Visual Alignment?

That the servicing of a receiver should involve the measurement of its response to more than just a single frequency is natural when we take into account that a receiver functions to amplify a *band* of frequencies, and not just a *single* frequency. When a receiver is tuned to an 800-kc signal, for example, it must amplify not only the 800-kc carrier, but it must also amplify the band of frequencies extending from five to ten kc on either side of 800 kc. From a performance standpoint, then, the Service Man must necessarily know how the receiver which he is servicing behaves over this band of frequencies, in order to secure the best possible receiver adjustment.

Within the past few years two conditions have arisen which have made it necessary for the Service Man to investigate the response of a receiver to the band of frequencies about the exact frequency to which it is tuned; before this time it was quite sufficient to align a receiver for maximum output at the dial frequency, and to conclude that the receiver adjustment to the sideband frequencies was satisfactory. One of the reasons why this procedure is no longer satisfactory is that many present-day transmitters broadcast programs of the high-fidelity type, which carry broader sidebands extending further from the carrier, and that present-day receivers are designed so that they are capable of receiving these programs and of translating the outer sidebands into the higher audio frequencies. As a result the sideband response occupies a position of increased importance in determining the performance of receivers.

The second reason why it is necessary to know something more about the response of receivers to the sideband frequencies is that it is no longer sufficient, in the case of many receivers, to peak the i-f amplifier at a single frequency and to conclude therefrom that the sideband response is satisfactory. Fundamentally, this latter condition is due to the fact that in aligning overcoupled transformers, there is a multiplicity of adjustments which will yield an apparent maximum output when the conventional output-meter method of alignment is used. As far as the effect on the operation of a receiver which has been misaligned in this manner is concerned, it would make itself evident by an unequal amplification of the various sideband frequencies, and therefore of the audio frequencies which these sideband frequencies represent.

We do not wish to imply here that satisfactory alignment is impossible with the conventional audio-modulated signal generator, but rather that a special

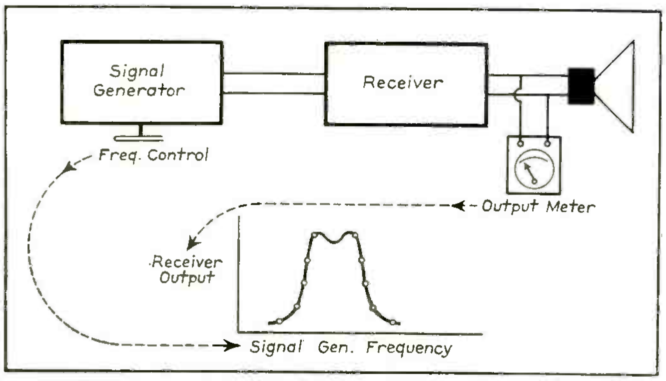


Fig. 1. The response of a receiver can be measured by noting the receiver output for a signal of variable frequency and constant amplitude. The circles on the selectivity curve denote the points at which measurments were taken.

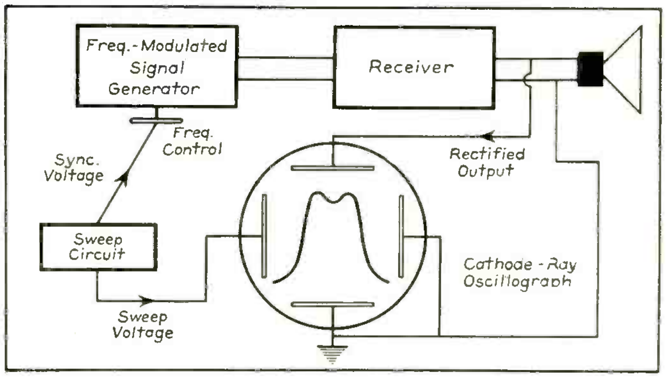


Fig. 2. The response of a receiver can be observed visually by connecting a frequency-modulated signal generator, applying the rectified receiver output to the vertical plates of an oscillograph, and sweeping the beam horizontally across the screen in synchronism with the frequency variation. Compare with Fig. 1.

method must be used to obtain correct alignment. In general this involves a procedure which is often more time consuming than the visual methods discussed in this article.

Basic Equipment

We have seen that the visual alignment of a receiver requires the use of a frequency-modulated signal generator—one in which the frequency can be periodically varied over a range of frequencies about the indicated output frequency. Some of the early types of signal generators used a motor-driven condenser across the tuned circuit of the oscillator to accomplish frequency modulation, but for reasons which were discussed in a previous article by this author (see SERVICE, August, 1937), this method is no longer in use to any extent. A survey of the current frequency-modulated signal generators shows that an electronic method of frequency modulation is almost universally used.

For reasons which are discussed in very great detail in the aforementioned article, all of these signal generators are of the beat-frequency type, in which the fixed-frequency oscillator receives the frequency modulation. As the basic arrangement in Fig. 3 shows, the output of this oscillator is mixed with the output of a variable-frequency oscillator, as a result of which the sum and difference of these frequencies are produced. Since both the sum and difference frequencies carry the frequency modulation, it follows that either can be used for visual alignment work.

In the typical case shown in Fig. 3, the frequency of the fixed-frequency oscillator is 1000 kc, and the variable frequency oscillator is set at 1470 kc. As a result of the rectification in the

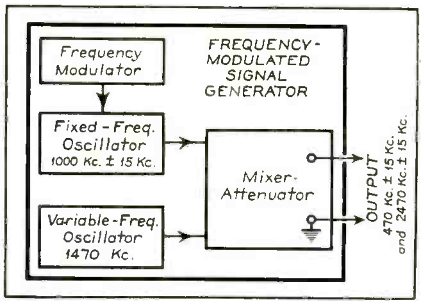


Fig. 3. Modern frequency-modulated signal generators use the beat principle.

mixer stage of the generator, the sum frequency 2470 kc and the difference frequency 470 kc are present in the output of the signal generator. If, as is the case in practice, provision is made for varying the frequency of the fixed-frequency oscillator over a 15 kc range on either side of 1000 kc, then the output frequencies will also be varied over this same range. In other words, the 470-kc signal will be swept from 455 kc to 485 kc, and the 2470-kc signal will be swept from 2455 kc to 2485 kc. It may be noted that the 1000-kc signal which is also present in the output will be unmodulated.

Many Types of Traces

To the Service Man who examines for the first time the numerous different types of traces which are produced by commercial frequency-modulated signal generators, the situation is somewhat confusing. He is confronted with single traces, folded traces, double-image traces, signal-beacon markers, linear sweeps, pyramid sweeps, 60-cycle sweeps, and various other combinations. Let it be said at the outset that fundamentally there is no great difference between all these types of traces, that basically they all function to produce a selectivity curve.

Perhaps the simplest type of trace to understand is that wherein a linear sweep voltage is used on the horizontal plates, and the frequency variation also follows a linear variation in synchronism with the spot movement across the screen. This condition is illustrated in Fig. 4. At the instant when the spot is at the extreme left of the screen, the frequency generated is 580 kc and the rectified output is practically zero. As

Fig. 4. Linear frequency variation and linear sweep voltage.

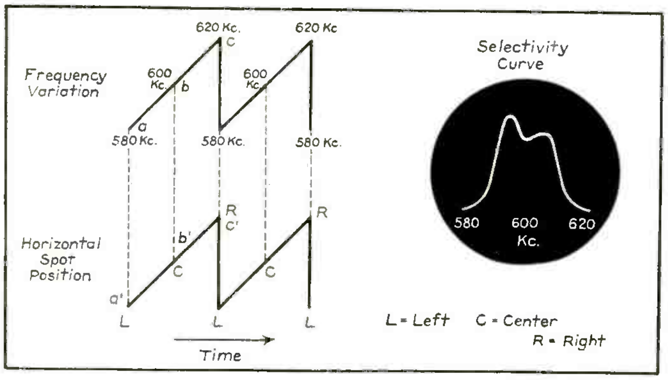
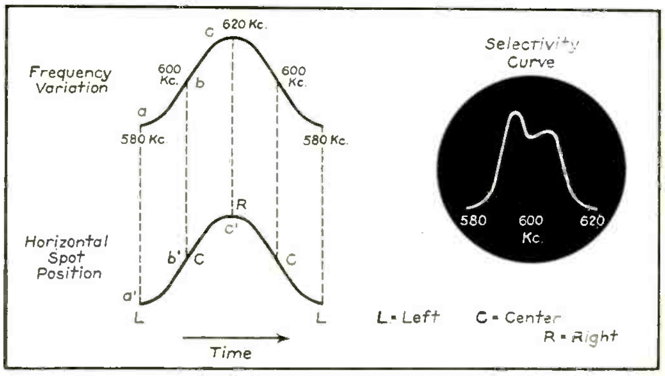


Fig. 5. 60-cycle frequency variation and 60-cycle sweep voltage.



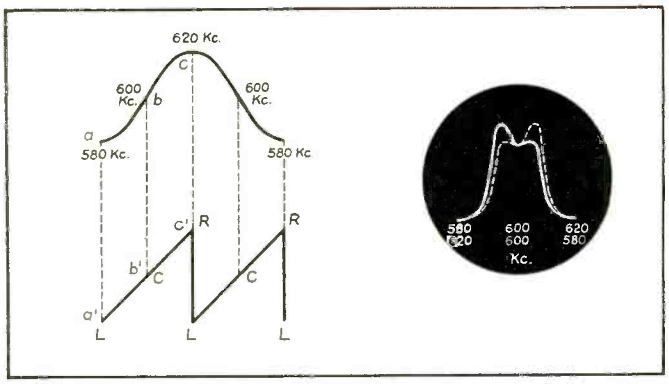


Fig. 6. 60-cycle frequency variation and linear sweep voltage.

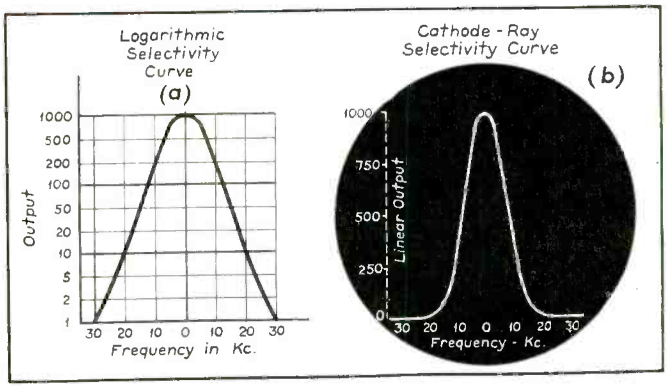


Fig. 7. The same receiver response plotted on a logaritmic scale and when it appears on the linear axis of an oscillograph.

the spot moves toward the center of the screen, the frequency increases uniformly, and, because the resonant frequency of the receiver is being approached, the output (vertical deflection of the spot) increases. The frequency of the input signal continues to increase as the spot moves past the center of the screen, and the output again falls off as the signal frequency differs more and more from the frequency to which the receiver is tuned. At the extreme right of the screen, the spot is returned very rapidly to the left side of the screen and the frequency is also changed very rapidly from 620 kc back to 580 kc; the whole cycle is then repeated over and over again some 30-120 times per second so that a stationary trace of the receiver selectivity appears on the screen.

In this, as in all other types of visual alignment patterns, the proper frequency and phase relation between the sweep voltage and the frequency variation of the signal generator is of great importance. In practice the maintenance of this phase relation is called *synchronization* of the horizontal sweep, and a means for making this adjustment—where it is not automatically performed—is provided in all commercial equipment.

Folded Traces

It is also possible to have a system employing a sine-wave frequency variation, and a sine-wave sweep on the horizontal plates. This condition is illustrated in Fig. 5. Here again a single image is produced, but the image is folded back on itself. Moreover, the two traces invariably coincide, regardless of the lack of symmetry in the selectivity curve, since each point on the screen along the horizontal axis corresponds to but a single frequency. It is worth noting that the screen calibration for this system is also linear; this linearity obtains because the spot movement is proportional to the frequency variation, although they both follow a sine-wave variation. Thus at the instant when the spot movement is rapid, the frequency variation is also correspondingly rapid; and when the spot movement is relatively slow, the frequency variation is likewise slow. In this way a linear relationship is maintained between the frequency variation and the horizontal spot movement.

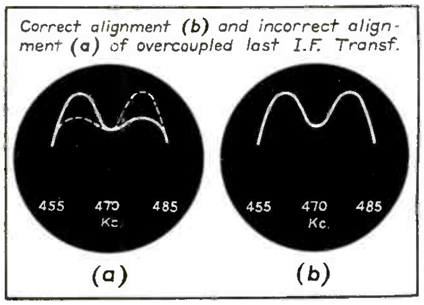


Fig. 9. The reverse trace is shown dotted in the oscillograms above.

Synchronization with this system is accomplished by using the same (60-cycle) power source to supply both the sweep voltage and the frequency modulation.

Double-Image Traces

Both the previous systems which we described are characterized by the fact that a single image is produced regardless of the type of selectivity curve which is being viewed. In the so-called double-image system, however, two distinct traces are swept out on the screen, and in the case of an asymmetrical curve, a double image appears on the screen.

In one form of double-image system, shown in Fig. 6, the signal is frequency modulated at a 60-cycle rate, while a linear sweep voltage is applied to the horizontal plates of the oscillograph. Starting with the spot at the extreme left of the screen, the frequency increases from 580 kc; when the spot has reached

Fig. 8. Methods of coupling the vertical plate of the oscillograph to the output of the second detector.

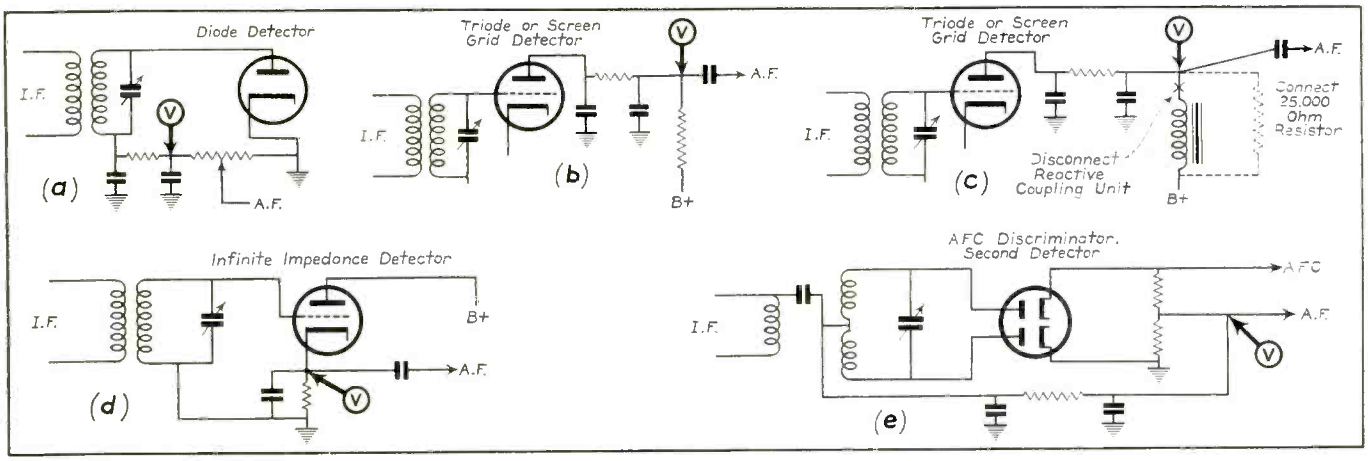


Fig. 10. Clough-Brengle 111 frequency modulator.

the extreme right of the screen the frequency has reached 620 kc. At this instant the sweep returns the spot very rapidly to the left side of the screen; as the spot again moves across the screen from left to right, the frequency generated *decreases* from 620 kc to 580 kc. This process is repeated periodically and on consecutive sweeps the selectivity curve is traced for increasing and decreasing values of frequency. Each point on the screen thus corresponds to two frequencies and, as the figure shows, an asymmetrical curve gives rise to a double trace—one produced on the sweep corresponding to increasing values of frequency, and the other produced on the sweep corresponding to decreasing values of frequency. It is only in the case where the selectivity curve is symmetrical that these two traces superimpose to form a single image.

There are many other combinations and variations used which we do not have the space to discuss. However, in alignment work with all these systems, regardless of the type of trace which is produced, the ultimate object is to so make the various receiver adjustments that a symmetrical trace is obtained. In the case of the single-image trace, this means that the adjustments will be made so that the curve is symmetrical and at the same time has the greatest amplitude. In the case of the double-image trace, proper alignment is indicated when the two traces coincide. More important than the type of trace which is used, is that the proper procedure be followed in the making of the several adjustments required during the alignment procedure.

Visual Trace Qualitative

In this connection, it should be understood that the curves provided by visual alignment equipment are essentially qualitative rather than quantitative. The quantitative measurement of selectivity requires that output (or signal input) measurements be made over at least a 1000 to 1 range, as illustrated in Fig. 7(a). This curve shows the variation in the output of a receiver as the frequency is varied over a range extending 15 kc on either side of the frequency to which the receiver is tuned. It is especially to be noted that the logarithmic output scale makes it possible to examine the response of the receiver over the entire 30-kc frequency band.

The selectivity trace of this same receiver as it would appear on the screen of the cathode-ray tube, using ordinary visual alignment equipment, is shown in Fig. 7(b). The marked difference in the shape of the two traces arises primarily because of the use of a logarithmic output scale on the plotted curve, whereas the cathode-ray trace employs a linear output scale. As a result, the cathode-ray trace in Fig. 7(b) tends to flatten out much more rapidly than the plotted trace in Fig. 7(a), so that it is not possible to examine the selectivity characteristic over the outer portions of the frequency sweep.

The comparison of the two traces, one of which is essentially an engineering curve dealing with the design of the receiver, and the other a rapid visual check of the receiver response, is made here to emphasize that the relative shape of the selectivity curve—as determined by the waveform of the sweep used and the rate of frequency variation of the frequency-modulated signal generator—is of secondary importance. From an alignment viewpoint the trace shown in Fig. 7(b) is quite as satisfactory as the curve shown in Fig. 7(a), since the former makes possible fully as accurate an adjustment of the receiver as the latter. Under all ordinary conditions, when the receiver is adjusted so that the curve obtained on the oscillograph is symmetrical, then it follows that the outer part of the selectivity curve, which is not visible in the cathode-ray trace, will show the proper variation.

Fig. 13. RCA 150 frequency-modulated signal generator.

Connecting the Units

The exact connections for visual alignment work vary for the different types of equipment in use for this purpose. As far as the connections between the frequency modulator (if a separate unit is used), the signal generator, and the oscillograph, are concerned, there is no problem—this subject is adequately covered in the manufacturer's instruction bulletin accompanying the instrument. Regardless of the type of equipment used, however, the connection between the vertical plate of the oscillograph and the second detector will invariably be the same.

In general, the purpose of the connection to the second-detector load is to feed the rectified output of the receiver to the vertical plate of the oscillograph, without introducing any phase shift which would seriously distort the trace, and hence introduce an error into the alignment adjustments. In the case of a diode second detector, which is by far the most common in the receivers on which visual alignment can be most advantageously used, the connections should be made to the high side of the second detector load. As Fig. 8(a) shows, the connection should not include the filter resistor or i-f choke, if one is used, since an unstable condition may be created by the considerable amount of i-f voltage generally present at this point. Although many receivers employ a complicated tone-compensating network in the second-detector load circuit, it will generally be an easy matter to connect the output to the high side of the resistor which carries the rectified diode current. In this way the phase shift, which otherwise would be introduced by the coupling and compensating condensers in the audio circuit, is avoided.

In the case of a triode or screen-grid second detector, Fig. 8(b), the vertical plate of the oscillograph should be connected directly to the high side of the plate load. Here again the connection should not include the i-f filter resistor or choke which may be connected between this point and the plate of the detector tube.

Where a reactive load—either a transformer or choke—is used to couple the second detector to the first a-f stage, a resistive load must be substituted for the reactive load in order to avoid a phase shift. As Fig. 8(c) shows, this

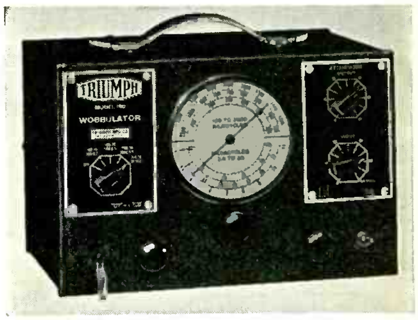


Fig. 15. Triumph 180 frequency-modulated signal generator.

is conveniently done by disconnecting the high side of the reactive coupling unit, and temporarily using a 25,000-ohm resistor for the plate load.

Where an infinite-impedance detector is used, Fig. 8(d), the vertical plate is connected across the resistive load which is located in the cathode circuit of the detector tube. No further changes are necessary for coupling to this new detector circuit which may find wider application in next year's receivers.

In those afc-equipped receivers where the discriminator functions to provide the audio voltage, the connection of the vertical plate should be made to the junction of the two discriminator-load resistors. Since, as Fig. 8(e) shows, this point is generally at ground i-f potential, no difficulty as a result of feedback will be encountered in making this connection. Where a separate second detector is used, the oscillograph is of course connected in the conventional manner to the diode load, as explained above.

Visual Alignment of I-F Amplifiers

By far the most important application of the visual method is in the proper alignment of high-fidelity band-pass i-f amplifiers. Assuming that the visual alignment equipment has been set up in accordance with the manufacturer's instruction bulletin, the frequency-modulated signal should be applied to the grid of the last i-f stage, and the signal generator connected across the second detector load.

It is worthwhile pausing for a moment to emphasize the importance of connecting the signal generator to the grid of the last i-f stage, rather than to the grid of the preceding stage or to the grid of the first detector. This is a point which has not been stressed in the service literature, and for reasons which will be explained below, failure to observe this procedure will result in improper alignment as well as a great deal of wasted effort.

If the signal generator is connected to the grid of the first detector, there will in general be at least four, and sometimes as many as six or eight, i-f trimmers which require adjustment. The accurate adjustment of these trimmers becomes impossible where overcoupled circuits are involved, because an initial error in the adjustment of one or more trimmers can apparently be compensated for—as far as the shape of the curve on the screen is concerned—by the improper adjustment of one or more of the other trimmers. This situation leads to a great deal of confusion, and the final adjustment of the i-f amplifier is liable to be far removed from the proper adjustment. The fact that the final alignment using the above procedure yields a symmetrical resonance curve is no assurance whatsoever that it is the best adjustment, and in the great majority of cases—unless the amplifier is initially in good alignment—the final adjustment arrived at will be unsatisfactory. Not only is the above procedure poor from the viewpoint of the results obtained, but, as many who have used this method will vouch for, an inordinate amount of time is consumed in attempting to obtain a final symmetrical curve—which, even after it is obtained, is not necessarily indicative of proper alignment.

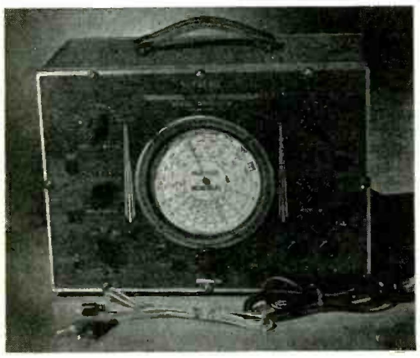


Fig. 14. Supreme 580 frequency-modulated signal generator.

Fig. 12. Jackson 420 frequency-modulated signal generator.

There are perhaps three reasons why this incorrect procedure of initially coupling to the first detector grid has been widely used. One of the reasons is that in conventional alignment procedure it is often permissible to feed the signal into the first detector and to align the i-f trimmers in any order. Another reason is that this subject has not been given sufficient emphasis in service literature. The third and most important contributing factor is that the Service Man, in attempting to feed the signal into the grid of the last i-f stage, has often encountered obstacles which have discouraged him from feeding the signal to this point. It is this latter condition with which we are now concerned.

The last i-f stage in high fidelity receivers, where this problem is of importance, is generally overcoupled. As a result, it often happens that the band width of the frequency modulation employed is not large enough to clearly delineate the resonance curve of this stage. In such cases, the type of curve appearing on the screen will be similar to the curve shown in Fig. 9(a); only the upper part of the resonance curve is recognizable because the output is still sufficiently great at the two extremities of the sweep so that the familiar sides of the selectivity curve are absent. Although this curve is unconventional in appearance, it is still possible to secure correct alignment by adjusting the two trimmers in the last i-f transformer for a symmetrical response, as shown in Fig. 9(b).

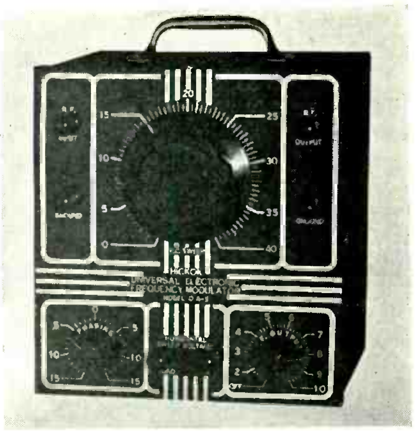


Fig. 11. Hickok OA-5 frequency modulator.

This procedure removes the difficulty which appears when the alignment of the entire i-f amplifier is attempted by feeding the signal to the first detector. Where the signal is fed to the grid of the last i-f stage, there are only two trimmers to be adjusted, and it invariably happens that there is only one combination of these trimmers—the correct one—which will produce a symmetrical resonance curve.

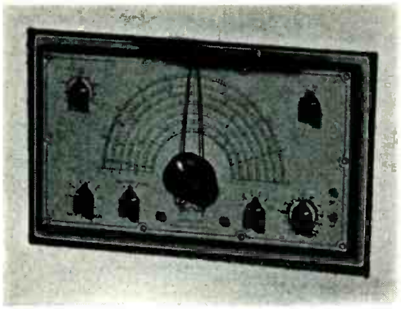
In some cases it will happen that insufficient output is available from the signal generator to produce a recognizable selectivity curve. In cases of this sort it is preferable to switch off the frequency modulation, switch on the audio modulation, connect the oscillograph across the plate of the output tube (i. e., use the oscillograph as a straight output meter, with a linear sweep), and to adjust the trimmers so that two peaks of equal height are obtained as the signal-generator frequency is varied manually about the intermediate frequency. If only one peak is obtained, then the adjustment of the trimmers should be made for maximum output; the presence of only a single peak merely indicates that the coupling in the last i-f stage is below the critical value. The advantage of using this method, when the output of the signal generator is not sufficiently great, is that the gain of the receiver audio amplifier makes possible sufficient additional amplification to provide a readable deflection on the oscillograph.

When the alignment of the last i-f transformer is completed, the output of the *frequency-modulated* signal generator will be large enough to permit the use of the more rapid visual method to effect the alignment of the preceding i-f transformers. The procedure here is to connect the signal generator to the grid of the preceding i-f stage and to align the i-f transformer in the plate circuit of this stage so as to produce a symmetrical trace on the screen of the oscillograph. When this is completed, the signal generator should be connected to the grid of the preceding stage, until finally a symmetrical overall curve is obtained with the signal generator connected to the grid of the first detector tube. Since each transformer individually produces a symmetrical response, there is no doubt as to the correctness of the overall alignment when this method is used.

Frequency Stability

There are a number of conditions which make it necessary to frequently check the calibration of frequency-modulated signal generators when they are used to align i-f amplifiers. Perhaps the most important factor is that all current frequency-modulated signal generators employ the beat principle; with this system, the comparatively low frequency used for visual alignment of the i-f amplifier is obtained by beating two oscillators, the frequencies of one or both of which are generally considerably higher than the intermediate frequency. Thus, in a typical signal generator, a 175-kc i-f signal may be produced as the result of beating 1400 kc (the fixed-oscillator frequency) against 1225 kc (the variable-oscillator frequency); both of these frequencies are high in comparison with the difference frequency used to carry out the alignment of the i-f amplifier.

Now, suppose that one of these oscillators is in error by 1%, an error which is not at all uncommon in practice. This will cause the beat frequency to be off by approximately 8%, and expressed in kilocycles will produce a beat frequency of 186 kc (or 164 kc) instead of the indicated value of 175 kc. The problem is further complicated because the presence of the oscillator control circuit (which effects the frequency modulation) tends to introduce frequency variations over a period of time which are of appreciable magnitude. While the manufacturers of visual alignment equipment have endeavored to keep these changes in calibration to a minimum, the Service Man must realize that there are practical limitations on the frequency stability of service frequency-modulated signal generators. In this



Triplett 1631 frequency-modulated signal generator.

connection it may be pointed out that the frequency calibration of precision laboratory signal generators selling above $400 is guaranteed by the manufacturer to have an accuracy of only ½%. The sole purpose of this discussion of calibration accuracy is merely to show the need for a more frequent check on the dial calibration when beat-type signal generators are used for alignment in the intermediate-frequency range.

The procedure to be followed in checking the calibration depends upon the type of signal generator being used. If a separate frequency-modulator unit is used, then the frequency modulator should be disconnected temporarily, and the i-f amplifier temporarily adjusted for a single peak in the conventional manner, using audio modulation and an output meter; the selectivity switch, if the receiver has one, should be in the sharp position and the oscillograph can be used as an output meter for this adjustment. The frequency modulator should then be reconnected, and the dial adjusted so that it indicates approximately the correct i-f peak; when the frequency control is adjusted so that the resonance curve of the i-f stage lies in the center of the screen, or, for the double-image system so that the two traces coincide, then the signal generator is set for the correct i-f peak. This will be true even though the reading of the signal generator may be off by as much as 10 kc, or possibly more. Having insured that the signal generator is producing the proper frequency, it is possible to go ahead and align the remaining circuits in the i-f amplifier.

It may be noted that where the i-f peak happens to be exactly or closely a submultiple of some broadcast station frequency, a quick and accurate check on the output frequency can be made by feeding the output into the antenna and beating it against the station signal. If a bandwidth adjustment is provided on the frequency modulator, it should preferably be in the zero position while this procedure is carried out.

Where the equipment is contained in one unit and does not employ an external frequency modulator, it is recommended that the frequency modulation switch be turned off (or the frequency sweep set in the zero sweep position) and that the signal generator calibration be checked in any one of the conventional ways.

Broadcast Band Alignment

Where the Service Man wishes to do so, the frequency-modulated setup can be used for the alignment of the broadcast band. The procedure here is to connect the signal generator to the antenna post and to adjust the several trimmers so as to obtain a symmetrical curve which has its peak amplitude at the frequency to which the receiver is tuned.

At the low-frequency end of the band, the use of a frequency-modulated signal removes the necessity for the "rocking" procedure which is ordinarily required to produce the best possible tracking between the radio-frequency and oscillator (receiver) circuits. Where the visual method is used, however, the procedure is simply to adjust the oscillator trimmer so that the selectivity curve has the greatest peak value, *regardless of whether or not this peak value occurs exactly in the center of the trace.* The extent to which it departs from the center of the trace is a measure of how far off the dial calibration is, assuming that the signal generator calibration has been checked and is known to be correct. Rocking is unnecessary where this method is used since the sweeping of the frequency through the 600-kc point replaces the customary rotation of the condenser gang; in this way, the simple adjustment of the oscillator padding condenser (or movement of the iron core of the oscillator coil) is sufficient to enable the selection of that setting, which, at some frequency near 600 kc, permits the greatest amplification in the r-f and detector circuits, and at the same time produces very nearly the correct intermediate frequency.

High Frequency Alignment

There are a number of different and compelling reasons why visual alignment should not be used by Service Men to carry out the alignment adjustments which are required on the short-wave ranges of multi-band receivers. Perhaps the most valid reason is that the visual method does not simplify the alignment procedure, but rather tends to make it more complicated, and to introduce room for errors in adjustment.

In the case of i-f amplifier alignment, it was demonstrated that the visual method is desirable because it makes possible the adjustment of the various i-f trimmers so as to produce an overall symmetrical i-f response; in this way the various sideband frequencies in the

(*Continued on page 646*)

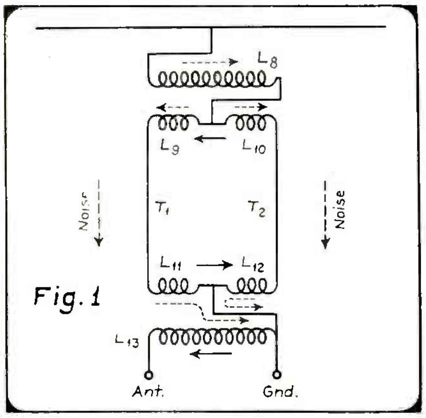
NOISE-REDUCING ANTENNAS

CARL F. GOUDY*

IN LOCATIONS where electrical disturbances are interfering with good radio reception, the ordinary straight wire antenna rarely gives satisfactory reception. To overcome this, engineers have developed and perfected noise-reducing antennas where the signals are collected by an aerial of the di-pole type, brought down by a transmission line immune from pickup of stray electrical disturbances and delivered to the set clear and undistorted.

By the proper design of the circuits and by careful manufacturing, the results obtained with this system show the advantages of a high "signal-to-noise" ratio for satisfactory all-wave reception. By the use of a low-impedance transmission line, the aerial proper can be located several hundred feet away from the set without impairing the results in the least.

For ease in explaining the functioning of the system, Fig. 1 shows the standard broadcast circuit. Fig. 2 shows the short-wave circuit and Fig. 3 shows the schematic wiring diagram of the complete system obtained through the combination of Fig. 1 and Fig. 2.



The broadcast band antenna.

STANDARD BROADCAST BAND

The voltage picked up by the antenna proper passes through the high inductances primary L8 into the center-tap between L9 and L10, through the transmission line and through the center tap between L11-L12 to ground. These primary voltages (indicated by dotted arrows) will not generate any voltage in L13 by virtue of the fact they enter L11 and L12 from opposing ends and leave by the center-tap. However, when the primary voltage passes through L8, secondary voltages are generated in L9 and L10 (as indicated by solid arrows). These currents, unlike the primary circuits, will circulate through the antenna and set transformers (L9-L10; L11-L12) interconnected by the transmission line. As this current enters the primary of the set transformer (L11-L12) from one end and leaves from the other, a voltage will appear across the secondary L13, which voltage is the desired radio signal for the receiver.

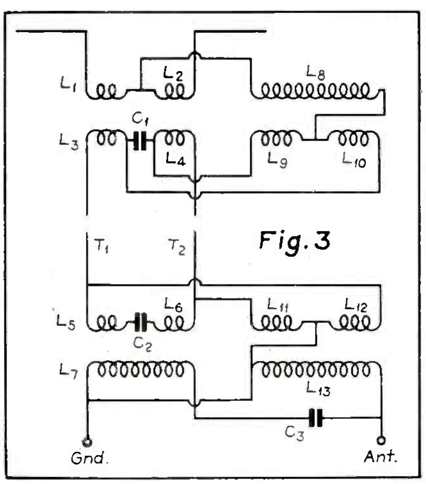
It is obvious that with a transmission line having its two conductors closely spaced, a noise source will strike both conductors with the same polarity, therefore, the noise will react in the circuit the same as the primary currents previously described, thus passing through the primary (L11-L12) to ground without inducing any voltage in the secondary **L13.**

As the voltage between antenna and ground terminals of L13 is the driving force for the set, it is obvious the noises are effectively separated and eliminated from the desired signals.

SHORT-WAVE SYSTEM

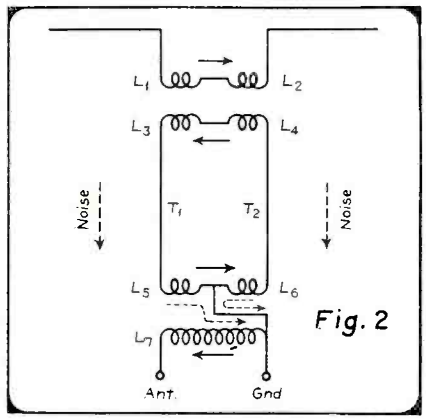
Fig. 2 shows the di-pole antenna which will induce currents traveling in opposite directions in the transmission line by virtue of difference in phase of wave front at the ends of the doublet. If transformers of suitable construction and ratio are introduced in both ends of the transmission line, the signal transfer will be improved through proper matching of the component parts. Where useful signal currents (indicated by solid arrows) and noise impulses (indicated by dotted arrows) are mixed in the transmission line, they will be separated as described, before the noise signals leave through the center tap between L5-L6 without affecting the performance of the radio set as they never enter the secondary L7, which feeds noise-free signals to the radio set.

The antenna for all-wave reception.



ALL-WAVE SYSTEM

The two sections of the antenna system as described above will operate efficiently in their particular bands. They may be readily interconnected by a suitable switching arrangement, but from a practical standpoint it is necessary to have such switching fully automatic as it is impractical to perform any manual switching in the aerial. The combination circuit as shown in Fig. 3, is based on the fact that the impedance of an inductance increases with increasing frequency, whereas the impedance of a capacity decreases with the frequency. Consequently a small inductance will effectively block a high-frequency signal, whereas a small capacity will prevent a standard broadcast signal from



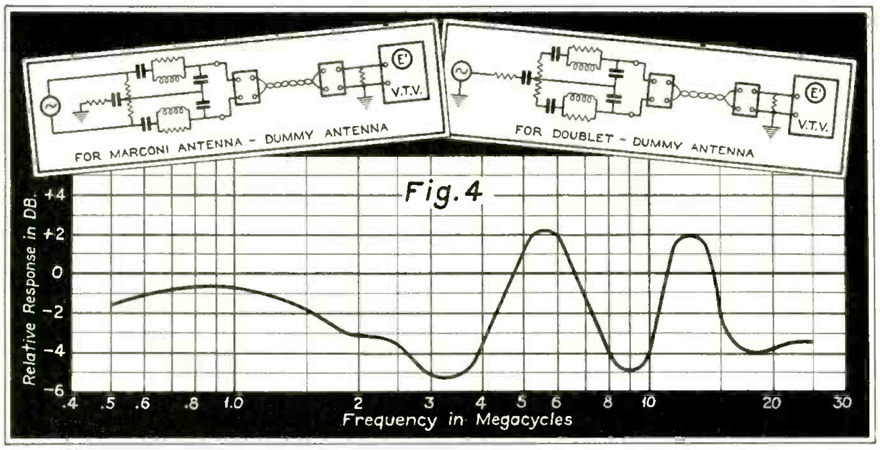
The short-wave antenna.

passing. By suitable design of the transformers, the performance of the two bands will not interfere with each other or with the overall performance.

Short-wave signals are transferred from L1-L2 into L3 and L4. The inductance of L8 prevents the high-frequency signals from going into the broadcast transformer. Condenser C1 completes the circuit L3-L4. Signals now pass through one conductor of the transmission line and primary windings L5-L6 and condenser C2 of the set coupler and back through the transmission line to complete the circuit. From the above it follows that the driving emf for the radio set will be across L7 between antenna and ground terminals.

The standard broadcast signals enter

*Chief Engineer, Technical Appliance Corp.



Relative antenna gain.

the broadcast primary L8 through L1 and L2, generating primary and secondary voltages as described previously. The condensers C1 and C2 have a small enough capacity to prevent L3-L4 and L5-L6 from short circuiting the broadcast primaries; therefore the circuit will be completed through the transmission line and L11 and L12 inducing the desired signals in L13. As the impedance of L7 is small, a capacity C3 is inserted in series with it to prevent L7 from short circuiting antenna and ground terminals for standard broadcast signals.

For maximum signal transfer, it is necessary that the antenna transformers insure a proper match between the aerial and transmission line and that the set coupler matches the transmission line and the input circuit of the radio set.

From the description of the system given above, it is readily understood that the ground lead must be as short as possible as otherwise the resistance in this lead will cause a drop of potential due to both signal and interference currents produced across it and it will be added in series to the secondary voltages, thereby re-introducing the noise voltage into the set. Connection of the ground lead to a ground may help the noise-suppression in some installations, the result depending on how "live" the available ground is with electrical currents. The only way to determine this is by trial. It is permissible to change the length of the transmission line without changing the characteristics of the system. This is very important as it permits the erection of the aerial proper hundreds of feet away from the set to a location where the noise level is low compared to what may be obtained in the vicinity of the set.

Response Tests

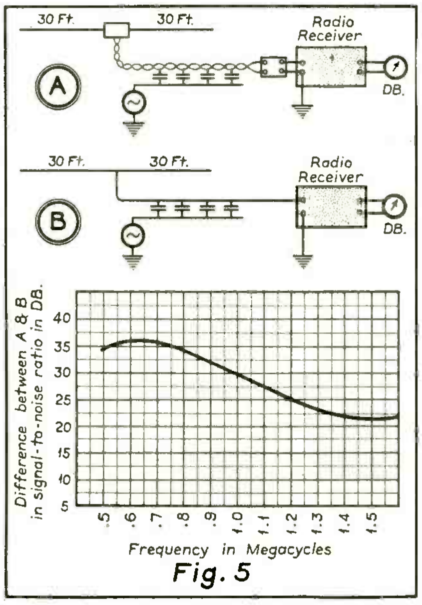
To test the response of an antenna system as described, actual operating conditions were duplicated by the use of dummy loads representing a doublet antenna. These tests, although not actually under operating conditions, have the advantage that they can be duplicated at any time and true comparative checks can be obtained with a very small percentage of error. Field tests with actual signals confirm the results given in Fig. 4.

Noise Tests

To check the noise reduction compared with a straight-wire aerial with a single lead in, a set up was made as shown in Fig. 5. Both downleads were exposed to a noise source, under exactly the same conditions. The curve clearly shows near immunity to pickup of noises which under actual home conditions would ruin the reception when an ordinary straight-wire antenna was used.

Transmission Line

For efficient transfer of the signals picked up by the aerial, it is necessary to have high-grade insulation for low losses and long life. Weather-proofed braid protects the rubber from the exposure to the sun and it adds materially to the mechanical strength of the transmission line.



Difference in noise level.

The surge impedance of the transmission line is approximately 100 ohms and the transformers used in the system are designed to match this line. If it is necessary to extend the length of the transmission line, use the same type wire; several hundred feet may be added without changing the characteristics of the system or materially lowering the signal strength. Never use picure wire or lamp cord as the dielectric losses in such wire are too high for high-frequency transmission. If the transmission line is too long, it can be cut off to the desired length or the excess wire may be rolled up in a coil of not less than 1½ ft diameter.

Installation Precautions

There are a few main points to bear in mind when planning any antenna installation and, if followed, they usually insure good results:

1. Erect the aerial proper as high as possible, away from noise sources.
2. Erect the aerial proper clear of shielding buildings.
3. Make sure transmission line is securely anchored to prevent short circuit or opens.
4. Mount the set coupler as close to the antenna and ground binding posts of the radio set as possible and do not lengthen the leads furnished with the set coupler.

Where signals have to travel great distances fading may be noticeable in spite of the avc in the receiver, but this is due to conditions beyond the antenna engineers' conrol and no antenna system can overcome this condition. Changing atmospheric conditions between the transmitting station and the receiving antenna often causes the so-called "skip-distance" to seriously affect the reception of short-wave signals. These conditions are unpredictable and may put you in a deadspot relative to certain stations. Skip-distances change from day to day and from hour to hour. As they are not due to faulty antennae or receivers, they make patience a necessary virtue for the short-wave listener.

Other Sources of Interference

In many localities, especially in d-c districts, disturbances frequently enter the set through the power line feeding the set. A good filter of the r-f choke type take usually cures this trouble.

If doctors' X-ray or ultra-violet-ray machines are the noise generators, it is usually necessary to eliminate the radiation of noise at the machine. Special screen rooms and filters may be necessary and the manufacturer of the machine in question usually can supply the necessary filters.

TRANSFORMER RATIOS

By EMIL BUCHWALD

A FEW MEASUREMENTS and a little calculation is all that is necessary to determine enough data to reclaim transformers that have been lying idle about the shop. A method is described where ratios of transformers may be ascertained. A vacuum-tube voltmeter is necessary, or a copper-oxide high-resistance voltmeter may be employed. A source of alternating current is also necessary; this may be obtained by connecting a potentiometer of 1,000 ohms or so across the house lighting circuit

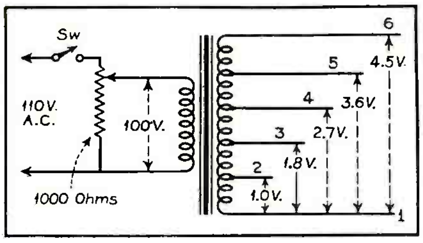


Fig. 1. Setup for output transformers.

as indicated in the illustration. This will give an alternating-current voltage from 0 to 110 volts which is ample for the work to be described. A fuse should be incorporated for safety, or a 100-watt lamp may be connected in series with one wire from the line.

The voltages given in these examples will not be the same for every transformer, since the turn ratios vary with different transformers. The figures given are shown to illustrate the voltage relationship between the various taps. The coils in audio transformers and impedances may have a relatively high direct-current resistance, hence if a voltmeter is used that draws considerable current, a voltage drop will take place causing the readings to be out of proportion to the actual voltage relationship between the windings. Magnetic leakage also causes inaccurate readings if the meter draws too much power. For these reasons it is advisable to use the highest resistance voltmeter obtainable.

Consider an output transformer designed for various tube and speaker combinations; these usually have a number of taps on the secondary and two or three on the primary. Assuming there are no markings on the transformer, we may proceed by locating and

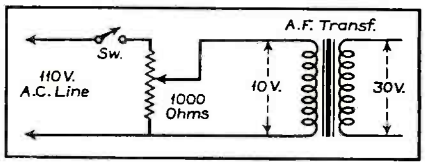


Fig. 2. Straight interstage transformer.

segregating the primary and secondary wires. The secondary will usually have several wires, perhaps six or more, and the primary has two or three. Fig. 1 shows 100 volts impressed on the two outside terminals of the primary. To find the terminals of the primary, the resistance between the leads may be measured with an ohmmeter. The pair of leads indicating the highest resistance is the complete primary. Assuming that the secondary has six taps, the voltage across combinations of two wires are measured until a pair is found that gives a maximum voltage reading. For instance, one pair of wires may indicate 3 volts, another pair may indicate 2 volts, etc. When all the two-wire combinations have been exhausted, the combination giving the highest voltage is labeled 1 and 6 as in Fig. 1. Assuming the highest voltage is 4.5, the sketch is then marked accordingly. Since this voltage is the highest obtainable, it follows that these two taps incorporate the whole secondary and the other taps are fractions of the secondary. With this thought in mind, we may proceed with the next step, this being the location of the next highest voltage. Tap No. 6 is disregarded and Tap No. 1 is connected to the voltmeter. Each one of the remaining taps is then checked for the highest voltage, and assuming this to be 3.6 volts, the wire is labeled No. 5 and also marked on the sketch. Tap No. 5 is then disconnected and with one leg of the voltmeter connected to No. 1 the other three taps are tested for the highest voltage. The procedure is continued

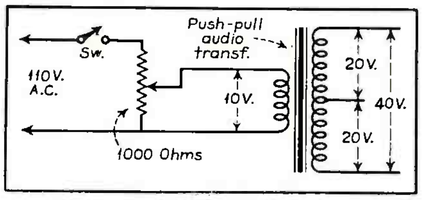


Fig. 3. Push-pull input transformers.

until the completed sketch looks like Fig. 1. Now we have a complete set of voltage ratios as follows:

10:4.5
100:3.6
100:2.7
100:1.8
100:1.0

As the load on the transformer was small during the tests, we may consider the voltage ratios equal to the turn ratios. Dividing each ratio by the secondary voltage we have,

22.2:1
27.8:1
37.1:1
55.5:1
100.0:1

Other combinations are possible; for instance, the voltage between taps 1 and 2 is .8 volt. The voltage ratio is 100.8 and dividing through by .8 we have a ratio of 126:1.

These ratios hold true for tubes in push-pull; for single tubes the center tap plus one outside wire is used. The ratio is then halved, that is, instead of

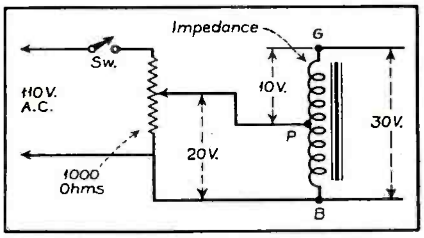


Fig. 4. Plate chokes.

100:1 for tubes in push-pull we have a ratio of 50:1 for a single tube. Of course the two outside wires may also be used for a single tube provided the ratio is correct for a good impedance match. The same general procedure may be used for any transformer.

Fig. 2 shows the connections for determining the ratio of an ordinary transformer, which may be an interstage audio unit. The voltage ratio is 10:30, and dividing by 10, the turn ratio equals 1:3.

Fig. 3 is the circuit for a push-pull transformer. Dividing the various voltages by the primary voltage, which in this case is 10, will give the turn ratios.

To check a tapped impedance, the

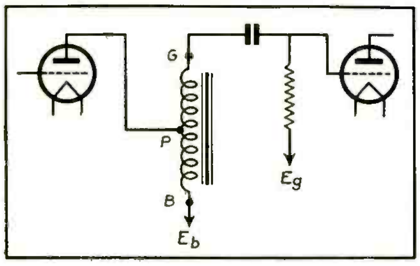


Fig. 5. Connections for the plate choke.

scheme in Fig. 4 may be followed. The highest voltage is developed across the total winding which is B and G. The voltage ratio is the voltage between P and B and the total voltage developed. This is 20:30, and dividing by 20 the turn ratio is seen to be 1:1.5. To take advantage of this step-up feature in actual use, the impedance is connected as in Fig. 5.

The power transformer used in the radio set can be checked by a similar method. A little experimenting plus the resulting deductions is essential for the first step. Suppose the transformer has a tangle of eleven wires originating from within the mass of shellac, varnish and insulating tape, or perhaps they may be lugs, or taps. It looks somewhat hopeless at first, but taking one step at a time, the transformer can be mastered and its secrets exposed. Upon close examination of the lead wires it is found that some of the wires are heavier than others. If the transformer has lugs instead of leads, the wires soldered on the lugs may be noted as to size.

There are several facts to work on, and one is that the transformer has a low-voltage winding for the heaters of the tubes and this may be 2.5 volts, or it may be 6.3 volts. Another is that the heaters of the various tubes draw a relatively high current, hence the wire supplying the heaters must be proportionately heavy to supply the demand. It follows, then, that the heaviest leads on the transformer are the low-voltage heater wires. Here is a definite point to start on, and accordingly, a low voltage is impressed across the two wires as in Fig. 6. The magnitude of this voltage is not particularly important so long as it is low, say, 0.5 volt.

The voltmeter is now connected to different two-wire combinations as in the previous examples and a sketch drawn as in Fig. 6. When all the two-wire combinations have been tested and there is an extra wire left over which apparently serves no purpose, it may be assumed that this wire is connected to the static shield which is placed between the primary and the secondaries. This is the wire marked S on the figure, and it is connected to ground in practice. Not every transformer has a static shield, neither is the wire always brought out if the transformer has a shield; hence if there is no wire left over it may be assumed that the shield is connected internally, or the device has no shield.

In this test, the voltage ratios are of no importance; the interesting facts are the relative voltages between the secondaries. In a transformer of this type, two extremes of voltages and currents are available for radio use. These are filament or heater windings which deliver a low voltage at a high current, and the plate supply which delivers a high voltage at low current. Obviously at some voltage between these two must be the primary, i. e., the 110-volt winding. This is the winding marked 22 on Fig. 6. In case the transformer has a 220-volt primary, then the intermediate voltage will be doubled, 44 instead of 22. This winding may be connected to the 110-volt lines, or 220-volt lines as the case may be, and the voltages across the various secondaries measured with a voltmeter. It might be a good idea to connect a 100-watt lamp in series with the primary and the line before the connection is completed. This will prevent damage to the transformer in case of error.

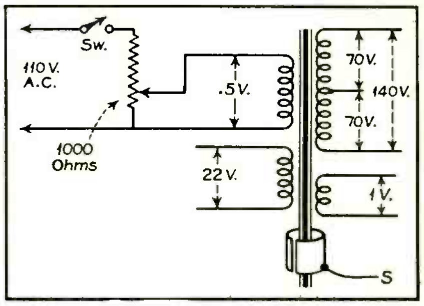


Fig. 6. Power transformers.

A-V-C ON SUPPRESSOR GRIDS

(See front cover)

IN GENERAL the published characteristic curves, for the types of tubes to which this method of gain control is adapted, do not show the effect of varying the suppressor-grid voltage on the transconductance of the tube. However, Fig. 1 shows this characteristic for the 6K7G type of tube. This curve was plotted with grid No. 1 at its nominally-rated voltage, —3; plate and screen voltages were 250 and 100, respectively. It is interesting to note—although not shown in the illustration—that the change in G_m, over the range from 0 to —47 volts on the suppressor, is greater than the change in G_m caused by the same voltage change (i.e., 0-47 volts) on the control grid. From this it may be assumed that, theoretically at least, varying the suppressor voltage will give even better control of volume than will the more conventional scheme of applying the control voltage to the signal grid.

So far as we know, one of the first receivers to make use of this method of automatic volume control is the Philco 38-116. The a-v-c circuit of this receiver is reproduced on our front cover.

It will be seen that the voltage for the a-v-c tube is taken from a center tap on the primary of the i-f transformer which couples the second i-f tube to the second detector. This voltage is applied, through a 110-mmfd condenser, to the grid of the 6J5G a-v-c tube the plate of which is at ground potential. From the grid of the 6J5G there are two resistors, 1 megohm each, across which the a-v-c voltage is developed in the usual manner.

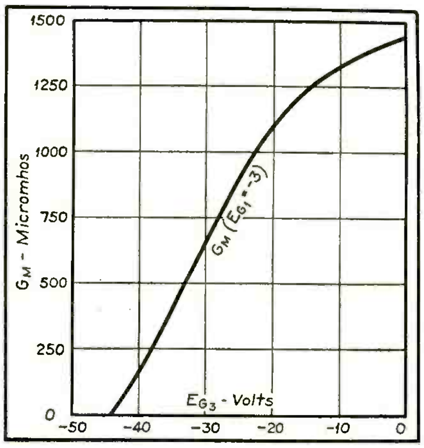


Fig. 1. Change in transconductance with suppressor-grid voltage (Type 6K7G).

One of these resistors connects to the grid returns of the first i-f amplifier and the r-f amplifier. The other connects to the suppressor grids of the second i-f, first i-f, and r-f amplifier tubes; it also connects to the grid return of the second i-f tube which, in turn, connects to a point on the power-supply voltage divider which is negative by an amount sufficient to insure nominal bias on these tubes in the absence of any a-v-c voltage; the steady bias for the first i-f and the r-f tubes is also supplied by means of this connection since these grid returns, obviously, are at the same potential as the other parts of this circuit.

It is evident that the gain control in this case is obtained by the variation of both the signal-grid and the suppressor bias.

TRAINING THE EAR FOR RADIO SERVICE†

TRAINING THE EAR for radio servicing may seem like a far-fetched subject, but considering that a radio receiver is designed to reproduce sounds, we realize it is on the basis of what is heard that the owner of a receiver voices his approval or disapproval of the instrument. A man may sit before his radio for an entire evening; if anything is wrong with the receiver, it is because of the disagreeable tones he hears, or the pleasant tones he does not hear that he asks us, as Service Men, to repair the receiver. This being the case, it is necessary to have our ears trained so we can not only hear the same things the customer hears, but be able to interpret what is heard in terms of circuit defects. Circuit defects may result in a lack of high-frequency response, a lack of low-frequency response or both. Again the receiver may have high-frequency response and low-frequency response, but no middle range. Of course, there are other defects which do not require ear training, as when the customer hears nothing or perhaps smells smoke. It is, however, desired to confine our discussion to those defects which can be detected by listening. During the course of this discussion there will be pointed out some of the things you should listen for while diagnosing radio receiver trouble.

* * *

Effect of Circuit Components

Assume there is a circuit similar to the one shown in Fig. 1; we will have various circuit components in series or in parallel with the circuit. The circuit component marked "X" can in either case be an inductance, a capacity or a combination of both. In the chart below the circuit are the patterns that we would get on the oscillograph screen with various connections of these circuit components. The left column shows the effect of parallel connections. The top picture in the left column shows the effect of a condenser placed across the circuit. Of course, this assumes a poor voltage regulation of the sweep oscillator so that the voltage drops off rapidly with load. The condenser across the circuit, as would be the case here, would offer very little load to low frequency. As the frequency was increased the load would increase, and consequently the voltage would decrease, giving us the decreasing voltage pattern shown for this connection.

The effect of an inductor placed in parallel is shown below the capacitor. An inductor offers practically no load at high frequencies but does offer a considerable load at low frequencies. Consequently, going from a low frequency

EFFECT OF CIRCUIT COMPONENTS

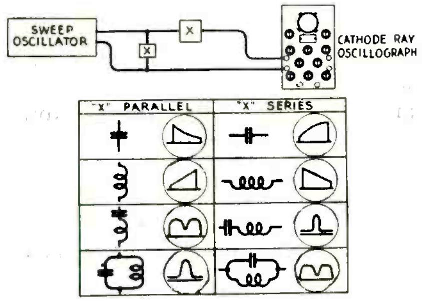


Fig. 1.

to a high frequency, the loading at the low-frequency end will give a low voltage output and as the frequency increases the loading will decrease and consequently we will get a higher voltage at the high frequencies.

Next is shown a series-resonant circuit placed across the line. If this series-resonant circuit is tuned to the middle of the frequency range, it will offer practically no loading at the low-frequency end of the band, due to the capacity and will offer practically no loading at the high end of the band due to the inductance. However, somewhere between these two points the combination will become resonant and cause considerable loading of the circuit, reducing the voltage at that point. The pattern shown for this circuit indicates a decrease in voltage at this particular frequency.

Next and directly below is shown the effect of a parallel-resonant circuit across the line. Here the circuit loads the oscillator at all frequencies except the one to which it is tuned. At low frequencies the inductor loads the circuit and at high frequencies the capacitor loads the circuit. However, at the resonant frequency there is no loading, and consequently at this frequency a high voltage is applied as is shown by the pattern for this circuit.

In the right column is shown the effect of these circuit components when placed in series with the circuit. At the top of the column is shown the effect of a condenser in the series position. A condenser in series with the circuit offers a high impedance to the low frequency and a much lesser impedance at the high frequency. Consequently, the voltage will be low for the low frequencies and high for the high frequencies, just opposite to the picture for the condenser in the parallel position.

Next and below this is the pattern for an inductor when placed in series with the circuit. An inductor will pass low frequencies much more readily than it will high frequencies. Consequently, we have a high voltage at low frequencies and the low voltage at high frequencies. This also is opposite to the picture we obtained for the inductor when in parallel.

Again is shown the effect of a series-resonant circuit in series with the line. This series-resonant circuit offers a high impedance to all frequencies except the one to which it is tuned. The pattern shows the high voltage at the frequency to which the circuit is tuned.

The last graph shows the parallel-resonant circuit and its effect when placed in series with the circuit. Here the inductor will pass low frequencies and the condenser will pass high frequencies, which means that it will pass all frequencies except that to which the combination is tuned.

There may be several interesting facts to point out in connection with this chart: 1. First we see that a parallel-resonant circuit in series with the circuit gives practically the same effect as a series-resonant circuit in parallel with the circuit. 2. A parallel-resonant circuit in parallel with the signal circuit gives the same effect as the series-

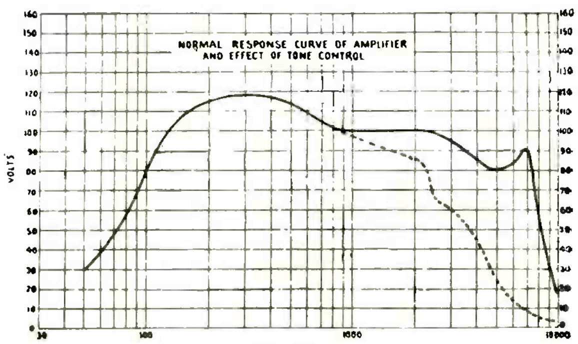


Fig. 2.

† Abstract of RCA Service Lecture. Copyright 1937 RCA Mfg. Co., Inc.

EFFECT OF CATHODE RESISTOR BY-PASS CONDENSER

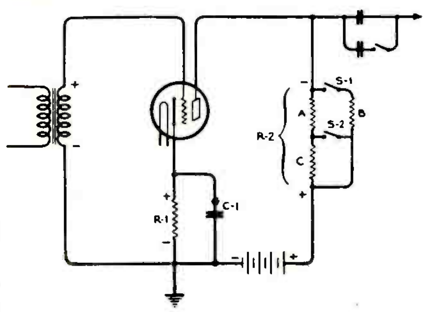


Fig. 3.

resonant circuit in series with the signal circuit. 3. An inductor in parallel with the circuit has practically the same effect as a condenser in series with the circuit. 4. An inductor in series with the circuit has practically the same effect as a condenser in parallel with the circuit.

From this it can be seen that loss of high frequencies or loss of low frequencies, can be brought about by a change in condenser values and can be restored by arranging the values of the circuit components to those used originally.

* * *

Normal Curve With Tone Control

In Fig. 2 is shown a normal response curve with and without the effect of the tone-control condenser. With the tone-control condenser connected across the circuit, the response curve is shown by the dotted line. The low-frequency end of the curve is not affected by this tone control. You will note that attenuation by the tone control begins approximately at 1,000 cycles. You will notice that as the tone control is manipulated the upper end of the curve varies considerably. With the maximum reduction of the high frequency response, very little reproduction is obtained above 5,000 cycles.

* * *

Effect of Cathode Resistor By-Pass Condenser

In Fig. 3 is shown a typical stage of an audio amplifier, and consists of an input transformer feeding the grid of a triode. The plate circuit is resistance-capacity coupled to the following stage; that is, the variations of plate current resulting from a change of grid voltage produces a variable voltage across the plate resistor, R-2, and these variations are coupled through a condenser to the grid of the following stage. To simplify the illustration we have shown a battery supplying the plate voltage. When the grid is most positive there is a maximum flow of plate current, and when it is most negative there is a minimum flow of plate current. Now in order that the tubes may operate properly, a certain amount of constant voltage must exist between the cathode and the grid. This constant voltage is called grid bias and maintains the grid at a negative potential with respect to the cathode. The usual method for producing this voltage is to operate the grid at ground potential, and the cathode at a positive voltage with respect to ground. To produce this positive voltage a resistor is inserted between the cathode and ground through which the plate current must pass, and the value of this resistor is such that the voltage developed across it by the plate current be sufficient to provide the proper bias voltage. Notice that the secondary of the input transformer is connected between grid and ground, placing the bias resistor, R-1, in series with the signal voltage, which exists between cathode and grid. As the plate loading resistor, R-2, develops a signal voltage across it which actuates the grid of the following stage, likewise the bias resistor, R-1, being in the same circuit, develops a signal voltage which is applied to the grid circuit of this first stage.

Now consider a certain portion of the cycle when the top of the input transformer secondary is positive and the lower end negative. This will make the grid more positive and cause an increase in flow of plate current. With the increase in plate current, the upper

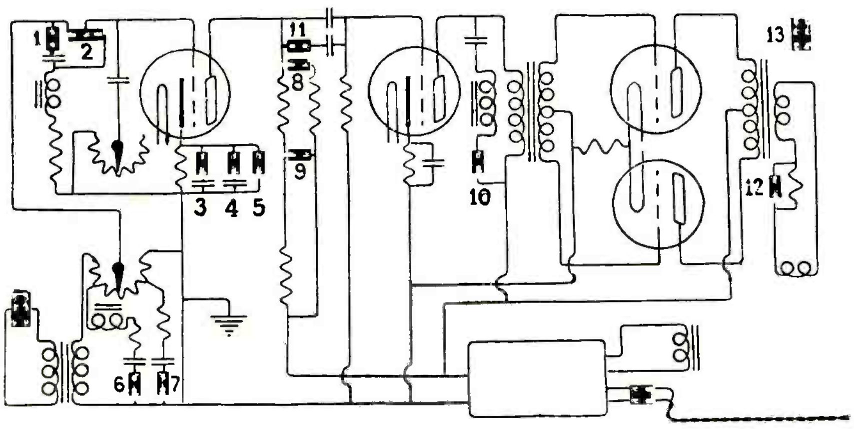


Fig. 4. The demonstration amplifier.

BIAS RESISTOR IN PUSH-PULL CIRCUIT

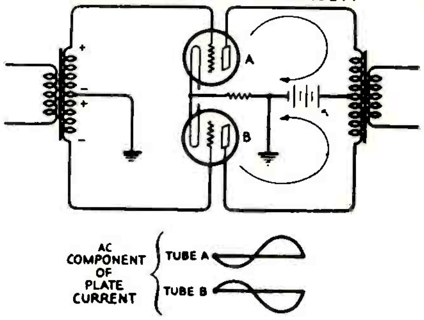


Fig. 5.

end of R-2 will become more negative and the lower end more positive, but at resistor R-1, the upper end will become more positive and the lower more negative. From observation it will be seen that the signal voltage built up across resistor R-1 is out of phase with the signal applied to the grid from the secondary of the input transformer. Consequently, this will oppose the voltage applied to the grid and reduce the gain of the stage considerably. In order to overcome this condition it is necessary to connect a by-pass condenser across resistor R-1, and by so doing condenser C-1 will assume a charge as well as by-pass the a-c component of the plate current. If condenser C-1 is small, it will provide an easy path for the higher frequencies and increase the gain of the stage at the high frequencies only. In order that there will be no frequency discrimination from this source, it is necessary that C-1 be sufficiently large so its impedance to all frequencies desired is low in comparison to the resistance of R-1. This point may be demonstrated more clearly on the large circuit drawing (Fig. 4). Observe that the bias resistor for the first stage in this amplifier has two by-pass condensers, with switches, so that either one or both can be disconnected. The condenser nearest the cathode is of very small value and the condenser next to it has a large value. Observe that when both condensers are disconnected the amplitude of the entire curve will drop to a very low value indicating an enormous loss of sensitivity. If the low value condenser is connected the sensitivity is restored to the high frequency end of the curve. If a phonograph record is played reproduction sounds very thin and has high-frequency response only.

Very often one finds this kind of trouble in a radio receiver if the by-pass condensers have become open. When a condenser opens there is usually still remaining a very slight amount of capacity due to the wiring of the amplifier and perhaps a small amount of effective capacity remaining in the condenser. Such a condition results in high-frequency response and when a trouble of this kind is encountered it is usually well to look for an open by-pass condenser. Of course, there are other things which produce this same effect such as an open signal circuit, at some other point, which will pass only the high frequencies through the small amount of capacity that is remaining. Of course, aside from becoming open circuited, these condensers may also become short circuited, and when this happens the bias voltage for the tube is short circuited and distortion results.

Bias Resistor in Push-Pull Circuit

In a push-pull amplifier stage it is not necessary to by-pass the cathode resistor (Fig. 5). This results from the fact that the a-c components of the plate current are out of phase across the bias resistor and therefore cancel. The d-c component across the bias resistor is constant, unless the amplifier is overloaded or the tubes mis-matched to such an extent that their plate currents are far from equal.

As an example we might state that both tubes normally draw 50 milliamperes so the total plate current thru the bias resistor will be 100 milliamperes. Upon exciting the grids with an alternating current, theoretically the plate of one tube should increase to 100 mils while the plate of the opposite tube decreases to zero plate current. Thus, the plate current changes through the primary of the output transformer but remains constant from the power supply source. Inasmuch as the effect of the by-pass condenser is to equalize the voltage across the cathode resistor, it is therefore unnecessary if the voltage across this resistor remains constant.

Your attention is called to the sine waves, so-called, shown on this illustration, and even if they were sine waves the effect of cancellation would be the same.

Effect of 1,000 Cycle Series Resonant Circuit

In Fig. 4, operation of switch No. 1 cuts in a resonant circuit tuned to 1,000 cycles, which results in the elimination of 1,000 cycle response and a high degree of attenuation of frequencies between 500 and 3,000 cycles. This high degree of attenuation shown in Fig. 6, results from the fact that the resonant circuit has an extremely low impedance at resonance, making it highly effective due to being connected across a reasonably high impedance source.

Resonant circuits used as audio filters may be tuned quite sharply or quite broadly, depending upon the degree of resistance incorporated, as well as upon the number of sections of filter used. The dotted line on this curve shows the effect of the tone control. The operation of the tone control will reduce frequencies above 1,000 cycles with the exception of a slight amount of energy between 2,000 and 5,000 cycles, and reproduction will now resemble a bass drum solo.

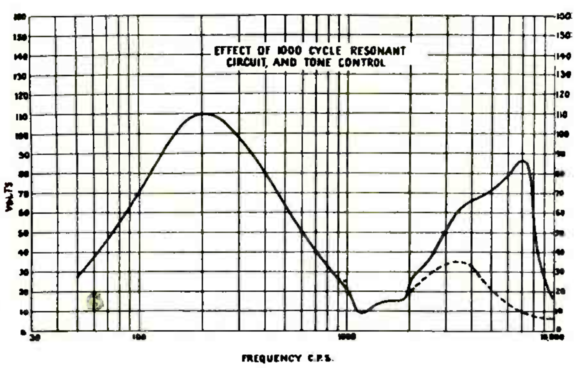
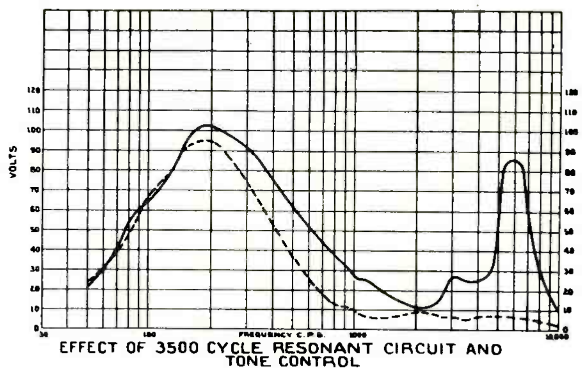


Fig. 6.

Effect of 3,500 Cycle Resonant Circuit

Operation of switch No. 10 cuts in a series-resonant circuit tuned to 3,500 cycles and connected from plate to ground of the second voltage amplifier. The curve of Fig. 7, shows a marked reduction of 3,500 cycle response and a high degree of attenuation from 1,000 to 5,000 cycles. The dotted curve shows the effect of the tone control with the amplifier set up in this manner. Closing switch No. 10 results in frequencies lying between 1,000 and 5,000 cycles being virtually eliminated; the music will have a characteristic sharpness due to the peaking of the amplifier from 5,000 to 7,000 cycles, with some low response from 30 to 500 cycles; reproduction will sound most unnatural.

Fig. 7.


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Effect of Coupling Capacitor

Assume that Fig. 4 is set up for normal response of the amplifier's characteristic curve; opening switch No. 11, leaves but a small value of coupling capacitance between the plate and grid of the first and second stage. The result is the curve shown in Fig. 8. This shows that the coupling capacitor, if too small, will have a high value of reactance at low frequencies and will reduce the low frequency response of the amplifier. The gain of a voltage amplifier is not a function of the coupling capacitance of a resistance coupled stage, but low frequency response will be reduced if the reactance of the capacitor is too high at low frequencies.

The above effect may be obtained by operation of switch No. 4, which removes 20 mfd cathode by-pass condenser and leaves connected a .5 mfd condenser, and the result is of course a reduction in low-frequency response in much the same manner as too small a coupling capacitor.

Effect of Varying Plate Load Resistance

With switch No. 8 open and switch No. 9 closed, the proper plate load resistor for maximum gain is placed in the circuit. Close switch No. 8, and there is placed in parallel with the plate load resistor a resistance of lesser value. This insufficient plate load resistance reduces the gain of the amplifier greatly. (See Fig. 9).

If switches Nos. 8 and 9, are opened a resistor of rather large value is connected in series with the normal plate load resistor. This plate resistance is too great and results in the overall gain of the amplifier being reduced.

* * *

There are essentially two types of audio frequency amplifiers, the voltage amplifier and the power amplifier.

Voltage Amplifiers

The voltage amplifier precedes the power amplifier, and is necessary in order to raise the low voltage output

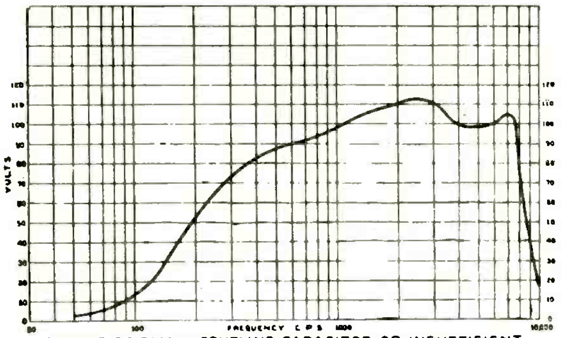

Fig. 8.

EFFECT OF SMALL COUPLING CAPACITOR OR INSUFFICIENT CATHODE BY-PASS

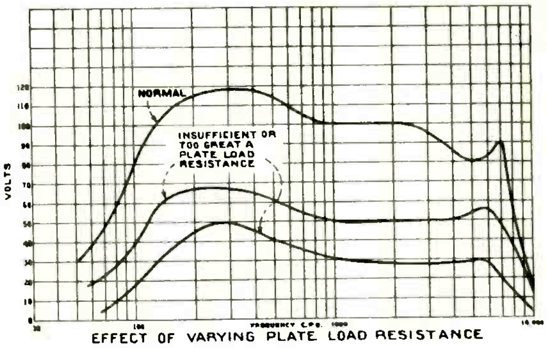

Fig. 9.

EFFECT OF VARYING PLATE LOAD RESISTANCE

of microphones, electric pick-ups, and transmission lines, sufficiently high to actuate the grids of power amplifier tubes.

The efficiency of voltage amplifiers, of course, depends upon the type of coupling and plate load used between successive stages. Voltage amplifiers in general are rather efficient due to the fact that the grid of the voltage amplifier tube, properly operated, draws no current and therefore consumes no power. A voltage gain per amplifier stage results from the fact that a small voltage applied to the grid of the tube controls a larger amount of power in the plate circuit. One cannot say that a tube amplifies, but rather that the smaller energy applied to the grid controls a larger amount of power in the plate circuit of the amplifier tube, the power being supplied by the power rectifier or batteries.

While the electron tube does not amplify, various tubes have what we call greater gain than others, expressed in terms of amplification factors. The amplification factor of a tube is determined by its geometric configuration, briefly the distances between the grid and cathode, and the plate and cathode, as well as the size of the grid mesh and the associated electrostatic shields within the tube.

Power Amplifiers

When the output voltage of the microphone, electric pick-up or transmission line has been raised to a level sufficiently high to meet certain requirements, it is applied to the grid or grids of the final stage, or power amplifier. The power amplifier tube or tubes, must develop across their output circuit, sufficient energy to do a certain amount of work. This work may be in the form of generating sound waves as in the case of the loudspeakers, actuating a cutter as in the case of recording or the operation of various commercial devices requiring power and not electrostatic forces for operation. The voltage gain of power amplifiers is seldom great enough to consider in calculations, due to low amplification factor and grid losses, and the efficiency of power amplifiers of course depends upon the method of operation, namely, Class "A," Class "B," or Class "AB" more commonly called Class "A"-prime.

There are essentially four types of coupling devices used in audio frequency amplifiers. These types of couplings are namely: direct coupling, resistance-capacity coupling, impedance-capacity coupling, and transformer coupling.

Direct Coupling

The direct coupled amplifier, Fig. 10, is probably the most efficient, due to its lack of coupling reactance, as well as parallel branch circuits, and the fact that it varies the bias of the succeeding stage as a direct function of a variation in plate current. The gain of two stages may easily exceed the product of the amplification factors of the two tubes used, due to the foregoing fact and lack of parallel branches and coupling devices, as well as the fact that regeneration between stages occurs. It is essentially a d-c amplifier but in this case the low-frequency response is determined by the transformers shown in the circuit outlined.

Resistance Coupling

Resistance coupled amplifiers, Fig. 11, may be constructed quite simply, and have a reasonably flat overall response curve. The attenuation at low frequencies is due to the high reactance of the coupling capacitor at this point. The attenuation at the high-frequency end of the response curve of resistance coupled amplifiers is due to inter-element capacitance, plate to cathode, which provides a low reactance path for high frequency energy. The gain of resistance coupled amplifiers is restricted to a value somewhat less than the amplification factor of the tube. However, under certain operating conditions and correct calculation of circuit constants, it is possible to obtain approximately 85 percent of the tube amplification factor per stage.

Impedance Coupling

Impedance-capacity, Fig. 12, coupled amplifiers have a slightly higher gain than resistance-capacity coupled amplifiers. The low-frequency response in the impedance-capacity coupled amplifier is attenuated both by the high reactance of the coupling capacitor and the low reactance of the plate choke coil in the neighborhood of 100 cycles and below. The high-frequency response of the impedance-capacity coupled amplifier is attenuated both by the inter-element capacitance of the tube and the distributed capacitance of the coupling choke. Under ideal operating conditions and correct design of circuit constants a gain equivalent to the amplification factor of the tube can be realized.

Transformer Coupling

Transformer-coupled amplifiers, Fig.

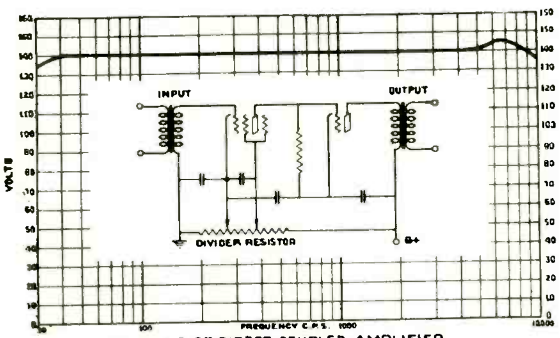

Fig. 10.

RESPONSE OF DIRECT COUPLED AMPLIFIER

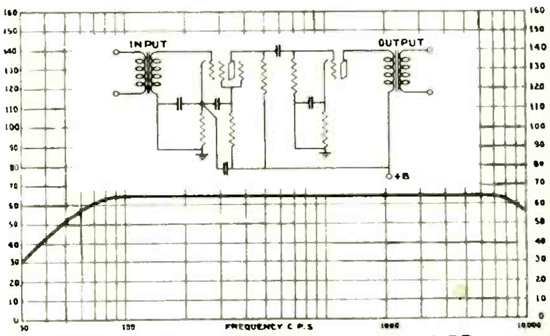

Fig. 11.

RESPONSE OF RESISTANCE COUPLED AMPLIFIER

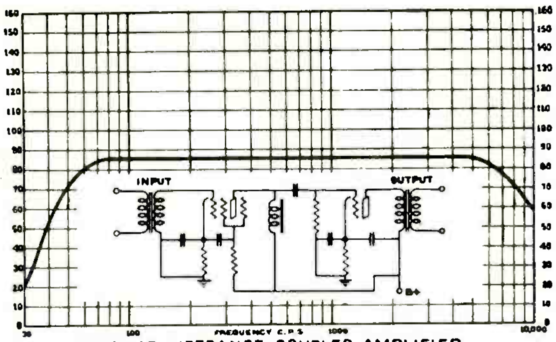

Fig. 12.

RESPONSE OF IMPEDANCE COUPLED AMPLIFIER

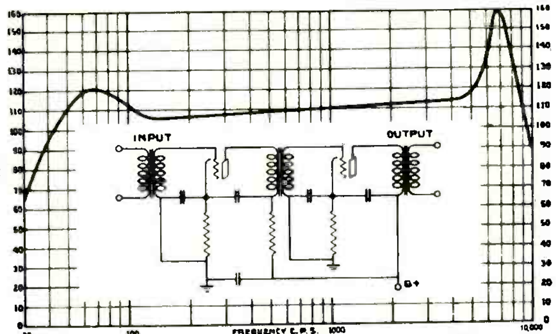

Fig. 13.

RESPONSE OF TRANSFORMER COUPLED AMPLIFIER

13, have the advantage of bringing about a voltage gain equal to the amplification factor of the tube, times the step-up ratio of the transformer. The response curve of a transformer coupled stage or stages may not be reasonably flat unless precautions are taken, for the low reactance of the transformer primary at low frequencies, and the fact that the transformer has two points of resonance, result in perhaps a lesser gain at the low frequency end and a greater gain at the high frequency end. This is brought about due to the following facts:

1. In order to obtain a step-up ratio of say 3 to 1 and at the same time keep the number of turns of the secondary as few as possible, to reduce the distributed secondary capacitance, the primary of the average transformer may not have a very high reactance, generally from 10 to 30 henries. This low reactance of the primary results in lessened amplification of low frequencies, beginning at a point where the reactance of the primary equals twice the plate impedance of the tube.

2. There are generally two points of resonance brought about by the fact that the distributed capacitance of the secondary winding tunes the primary to resonance at some frequency on the low end of the scale between 60 and 200 cycles. Resonance will result in a rise in voltage across the secondary at frequencies above and below resonance and especially, of course, at resonance. The second resonant point occurs from the fact that the leakage inductance, primary to secondary, is tuned to resonance by the distributed capacitance of the secondary at some higher frequency. This frequency of resonance may occur anywhere between 3,000 and 10,000 cycles or beyond depending upon the construction and quality of the transformer. This second point of resonance results in a considerable rise of voltage in the secondary due to the fact that the grid connection is taken across one branch of a series resonant circuit.

In certain types of transformers electrostatic shields between the primary and secondary, as well as the type of secondary windings, greatly reduce the effect of the high frequency resonant point. Generally, however, it has become common engineering practice to load the secondary with resistors of a value between 20,000 and 500,000 ohms, depending upon the particular case in question, to equalize the voltage across the secondary.

Operation of Audio-Frequency Amplifiers

In connection with the types of audio-frequency amplifiers, there are different methods of operation, namely, Class "A," Class "B" and Class "AB," or commonly called Class "A" prime. In order to clearly and accurately define these various types of operation, the term "angle of plate current," should be used. By angle of plate current is meant the duration of plate current flow with respect to one cycle of alternating-current grid excitation. Thus, if the plate current flows for the entire duration of one cycle of grid excitation, it can be stated that the angle of plate current is 360 degrees. If, on the other hand, the tube is biased to cut off and the plate current flows only during the positive half cycle of grid excitation, we will state that the plate current has an angle of 180 degrees or one-half cycle.

Class "A"

Class "A" audio-frequency amplifiers, Fig. 14, may then be defined as an amplifier in which the plate current flows for 360 degrees of grid excitation. Class "A" amplifiers are generally known as low efficiency amplifiers. This results from the fact that the plate current is generally flowing at a normal steady value and rises and falls and returns to normal during one cycle of grid excitation. On the other hand Class "A" amplifiers are generally termed "distortionless amplifiers" or amplifiers having a minimum of distortion.

Class "B"

Class "B" audio-amplifiers, Fig. 15, can be defined as amplifiers in which the plate current flows for approximately 180 to 190 degrees of grid excitation. Due to the fact that Class "B" amplifier tubes are generally biased to approximately cut off, or are so constructed that the plate current is very, very small without grid excitation, these amplifiers are known as high efficiency amplifiers. The higher degree of efficiency of a Class "B" amplifier results from the fact that the plate current is normally approximately zero. During excitation the plate current rises from zero to maximum and maximum to zero with the result that the rate of change of plate current is much greater than in the Class "A" audio amplifier using tubes of equal continuous current rat-

(*Continued on page* 650)

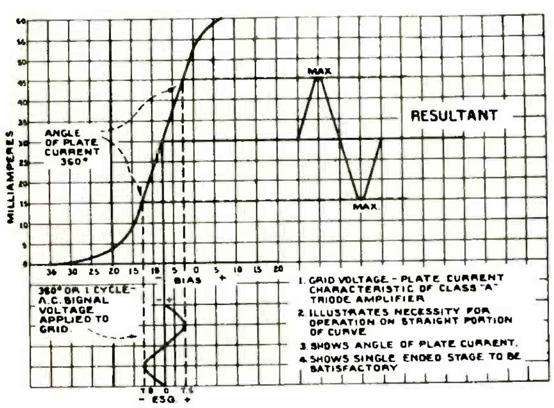

Fig. 14.

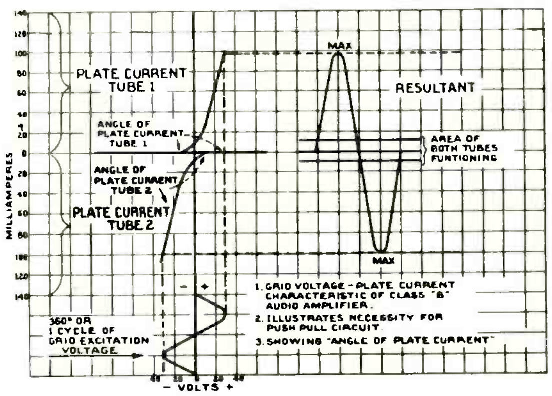

Fig. 15.

General Data . . .

Sparton 538, 538X, 628, 628X, 668, 668X, 678, 678X

THE SPARTON RECEIVERS EMPLOYING this chassis are conventional superheterodynes using MG type tubes in the circuit given in Fig. 1. A frequency range from 530 to 17,000 kc is covered in 3 bands. The total power drain is approximately 60 watts.

A 6E5 tuning-eye tube is used in the models 628, 668 and 678, but not in the 538. The 538 is a table model using a 6-in. speaker. The 628 is also a table model, but employs an 8-in. speaker. The 668 and 678 are consoles and use 10-in. speakers. Models with the letter X after the usual numerical designation are for export and are equipped with special power transformers.

The tubes used and their functions together with the various voltages encountered on the socket prongs are lettered on the circuit diagram given in Fig. 1. The voltages were measured with a 1000-ohm-per-volt voltmeter with the volume control on full and the antenna disconnected. The line voltage was 115 at the time the measurements were made. A variation of (plus or minus) 15 percent is permissable in the field.

Alignment Procedure

The necessary operations for alignment of these receivers are given in the accompanying table. The condenser or resistor listed under dummy antenna should be connected in series with the generator output lead and the position on the receiver designated under signal generator connection. The adjustments must be made in the order given. For

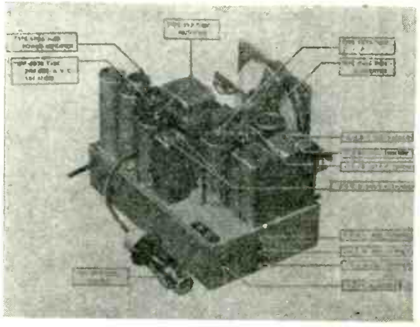

Fig. 2. Sparton 538 chassis showing trimmer locations.

SPARTON 538, 628, 668, 678 ALIGNMENT OPERATIONS

Signal Generator Connection	Dummy	Signal Generator Frequency	Band Swith Position	Dial	Peak Trimmer	Alignment
I-F ALIGNMENT						
6A8G Grid	0.1 mfd	456	BC	1700	C3B, C3A	Second i-f
6A8G Grid	0.1 mfd	456	BC	1700	C2B, C2A	First i-f
Antenna	200 mmfd	456	BC	540	C4	Wave trap
Adjust this trimmer for a minimum indication on the output meter. It may be necessary to increase the signal generator output to obtain a suitable adjustment.						
R-F ALIGNMENT						
Antenna	200 mmfd	1500	BC	1500	C8	Brdcst osc
Antenna	200 mmfd	1500	BC	1500	C5	Brdcst ant[1]
Antenna	200 mmfd	600	BC	600	C9	Brdcst pad[1]
Repeat the 1500 kc adjustments.						
Check calibration and sensitivity at 1500 kc, 900 kc and 600 kc.						
Antenna	100 ohms &	15 mc	SW	15 mc	C7	SW osc[1]
Antenna	200 mmfd[2]	15 mc	SW	15 mc	C6	SW ant[1]
Check calibration and sensitivity at 15 mc and 6 mc.						
Antenna	See above	...	Plce	Check at 6 mc and 1.95 mc, no trimmers		
Repeat alignment operations for greater accuracy.						

[1]Rock dial slightly while adjusting these trimmers.
[2]The resistor and condenser should be used in series.

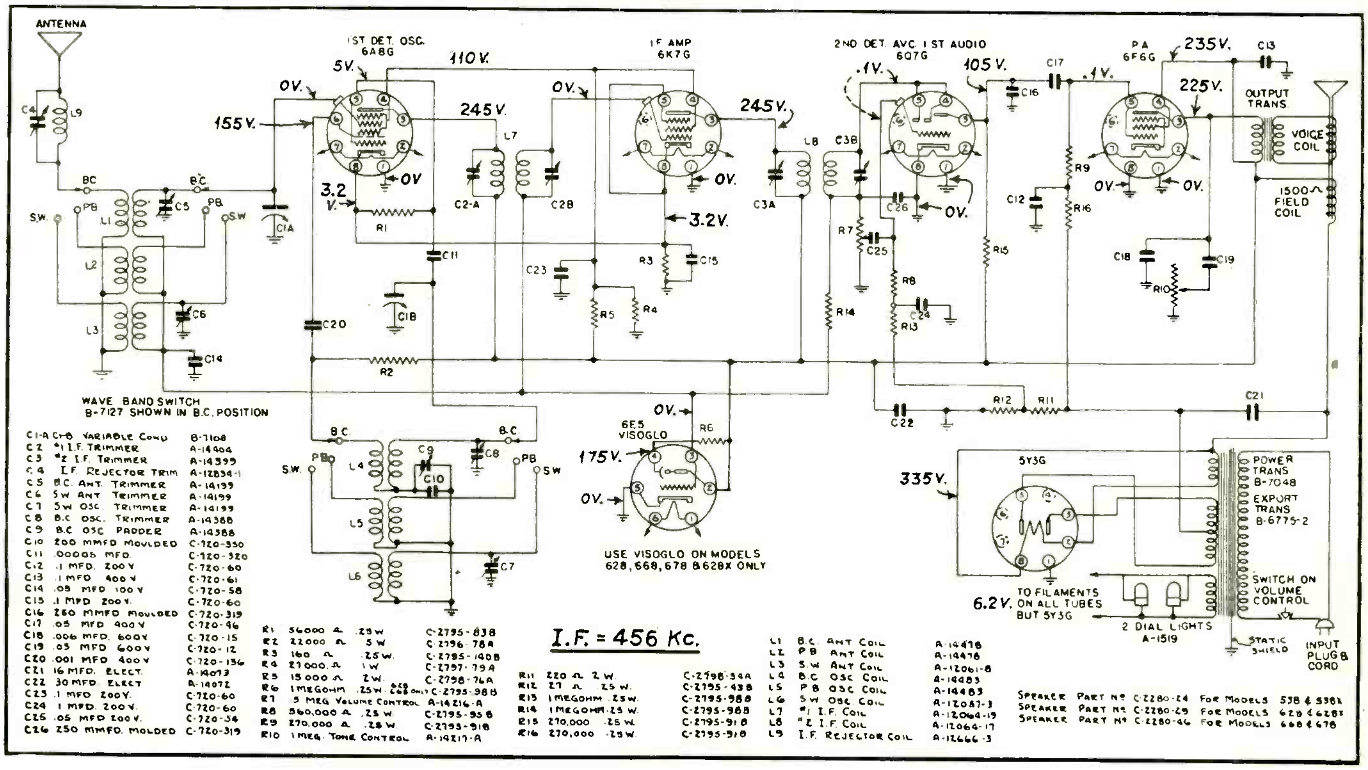

Fig. 1. Sparton 538, etc., circuit diagram.

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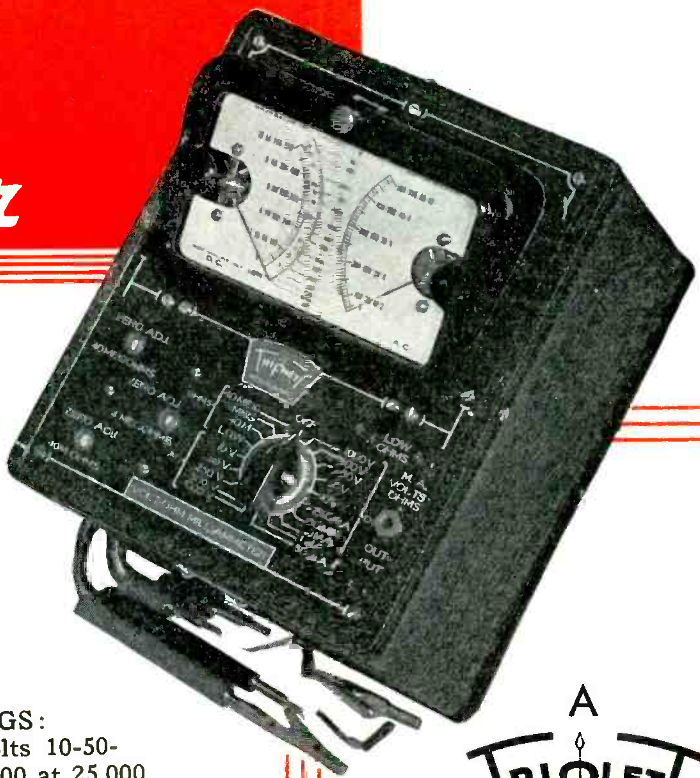

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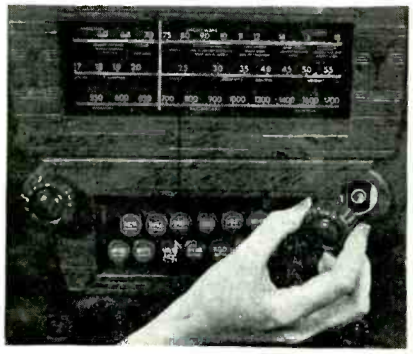


Fig. 1. A small set-up knob is located behind the tuning selector knob.

accurate results the entire alignment should be repeated. All trimmers, with the exception of the wave-trap trimmer, should be adjusted for a maximum reading on the output meter. The receiver volume control should be on full, throughout the entire procedure, and the output meter kept below half scale by means of the attenuator provided on the signal generator.

The wave-trap trimmer should be adjusted for a minimum reading on the output meter with a strong signal from the generator. The attenuator may be increased to insure proper adjustment.

The output indicating device should be connected across the voice coil or across the primary of the speaker transformer. Both the receiver and signal generator should be allowed at least 15 minutes to warm up before adjustments are attempted.

•

Stewart-Warner Magic Keyboard

THE STEWART-WARNER Magic Keyboard provides 15 keys or buttons which may be set-up and labeled to tune a desired selection of broadcasting stations or favorite programs. As many buttons as desired may be set-up for a particular station, each labeled for the entertainer, hour and day. A circuit diagram of the device is given in Fig. 8.

With the Magic Keyboard set up, press any one of the buttons and the station selector will travel by the most direct route to the station for which that button is tuned. Automatic frequency control assists in keeping the station tuned exactly. If another button is depressed the first button will snap out and the station selector will move to the new station. If more than one button is depressed at the same time no damage will occur. The station selector will merely move to the first station reached.

To tune manually for stations not set up on the Magic Keyboard simply spin the station selector knob in the usual manner. No switching of any sort is required to change over from automatic to manual tuning. While tuning manually afc automatically clicks out. It is only necessary to depress the desired station button, in order to return to automatic tuning—no additional switching is required to change over from manual to automatic tuning. When the desired button is depressed, afc is automatically connected and the word "Automatic" will appear illuminated on the small indicator at the right side of the dial.

Fig. 5. The stations are preset by tuning them with the set-up knob.

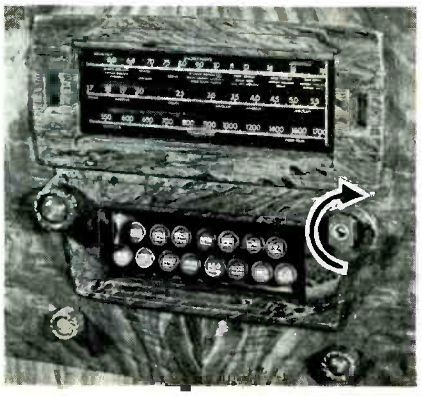


Fig. 3. A definite stop is reached at the extreme end of the clockwise rotation of the set-up knob.

Fig. 4. The word "Automatic" will become illuminated if any button is depressed.

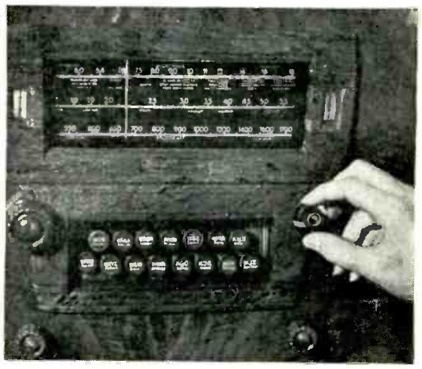


Fig. 2. Rocking the set-up knob while pulling it out will mesh the gears.

Setting Up the Buttons

Before setting up the Magic Keyboard, it is advisable that the receiver be operated from ten to twenty minutes in order that all internal parts reach a constant temperature and all operating conditions be fully established.

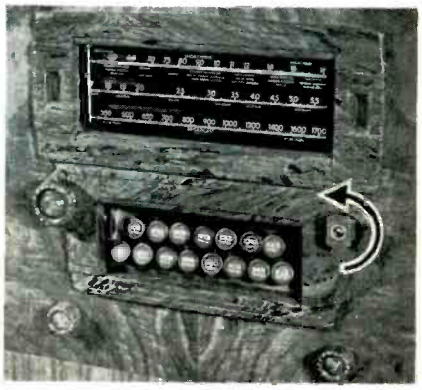
Remove the large tuning selector knob on the upper right hand section of the receiver panel. This knob may be removed by simply pulling it out from the panel. As this knob is removed a small set-up knob on the same shaft, partly hidden behind the panel face, will appear (see Fig. 1).

Grasp this set-up knob and pull it out as far as it will go, rocking it slightly at the same time so that the gears in the mechanism at the rear will mesh properly (see Fig. 2).

The set-up knob should next be turned to the right (clockwise). The knob will turn rather stiffly and the dial pointer will travel over to the right side of the dial scale. After the dial pointer reaches the right extremity of the dial scale continue to turn the set-up knob clockwise about ¾ of a turn until a definite stop is reached (see Fig. 3).

Push any button you wish to set up for a station. There need be no relationship between the position of the but-

Fig. 6. A definite stop is reached at the extreme end of the counter-clockwise rotation of the set-up knob.



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Grasp the set-up knob again and tune the receiver to the desired station. Tune

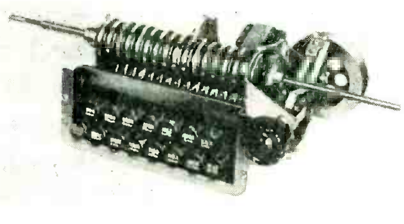

Fig. 7. The Magic Keyboard mechanism.

carefully and watch the visual tuning indicator for the point of minimum illumination so that the receiver will be correctly tuned to the station. (See Fig. 5.)

The depressed button is now set to the station and should be labeled at once with the proper tab. The next step is to release the button set-up; this is done by pushing in the next button you desire to set-up.

Then tune in with the set-up knob the next station you wish to receive for the button that is now depressed, again making use of the visual tuning indicator to be sure that you are correctly tuned to the station.

Continue to set up as many other buttons as desired in the same manner; that is, push in the button, tune in the desired station, then push in the next button, etc. All or only part of the buttons may be set up.

In order to release the button which last remains depressed (the last one you desire to have set up), grasp the set-up knob and push it back into the cabinet as far as it will go and then pull it out again. Do not forget to rock the set-up knob slightly when pulling it out again, in order that the mechanism gears may mesh properly (see Fig. 5).

Then turn the set-up knob to the left (counter clockwise). The knob will turn rather stiffly and the dial pointer will travel over to the extreme left side of the dial scale. Continue to turn the set-up knob to the left even after the pointer reaches the end of the dial scale. Apply a firm pressure until the knob reaches a definite stop. (See Fig. 6.)

Push the set-up knob back into the cabinet again and put on the large knob that was originally pulled off. The Magic Keyboard is now completely set up for operation.

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Emerson AA-131 (Chassis AA)

THIS MODEL IS AN a-c, d-c receiver for operation on the 105 to 125 volt power lines. A frequency range from 150 to 375 kc, 540 to 1600 kc and from 5.7 to 17.5 mc is covered in three bands. The power consumption is approximately 50 watts.

Two circuit diagrams are given, one for models with serial numbers below 1,266,501 and the other for those with serial numbers above 1,266,501. The various voltages encountered throughout the chassis are lettered on the diagram. These voltages were measured with a 1000-ohm-volt voltmeter with a line voltage of 117.5 volts, on an a-c line. The volume control was on full with no signal input.

Alignment Procedure

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

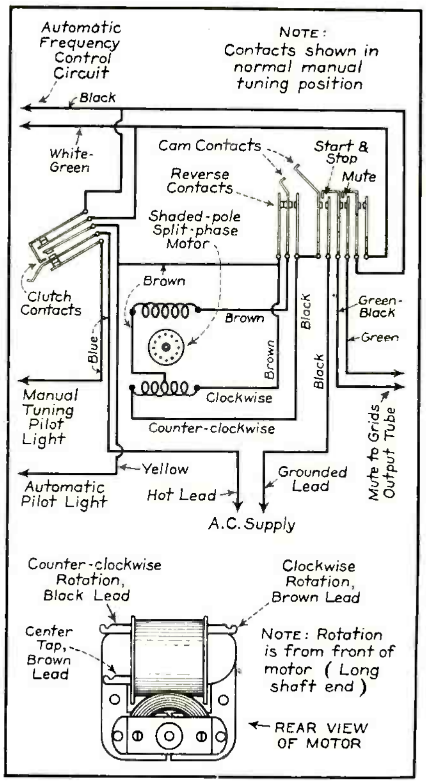


Fig. 8. Circuit arrangement of the Stewart-Warner Magic Keyboard.

Use a standard dummy antenna when aligning either the long-wave or medium-wave bands. A 0.0002-mfd condenser may be used as a substitute. When aligning the short-wave band use a 400-ohm dummy antenna (a 400-ohm resistor in series with antenna lead).

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

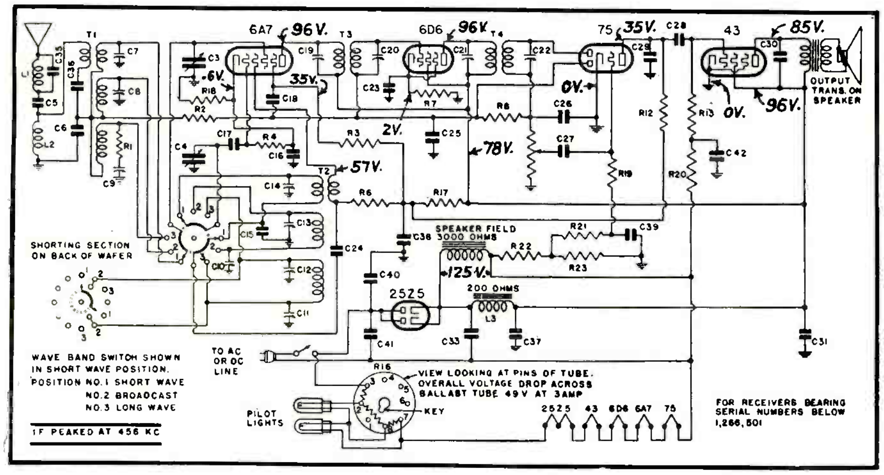
Always choose the minimum capacity peak on oscillator trimmers and maximum capacity peaks on antenna trimmers. The last motion in adjusting trimmers should always be a tightening one, not a loosening one.

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.

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

Trimmer Location

The antenna coils for the three bands are wound on one form and 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 farthest from the front of the chassis is for the long-wave antenna coil. The trimmer closest to the front of the chassis is for the medium-wave antenna coil, and the cen-



Emerson AA-131 schematic for serial numbers below 1,266,501.

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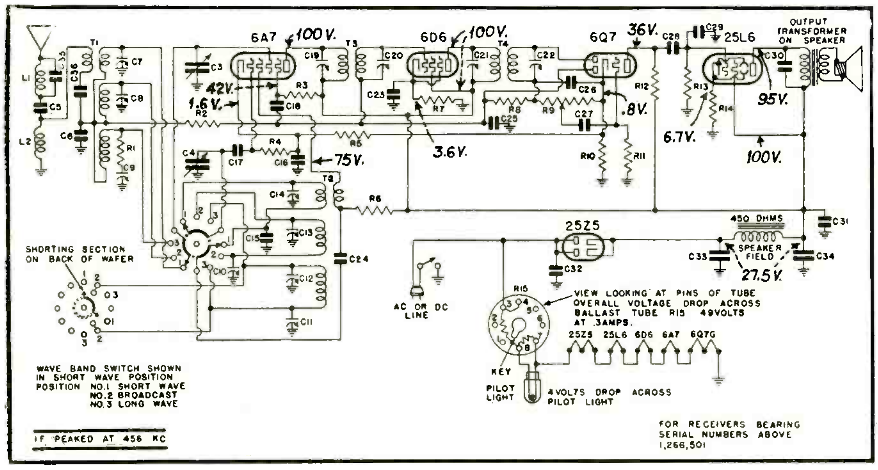


Emerson AA-131 schematic for serial numbers above 1,266,501.

tral trimmer is for the short-wave antenna coil.

The oscillator coils for the three bands are wound on one form and mounted on the inside of the rear chassis wall. The trimmers for these coils are accessible through holes in the rear chassis wall. The trimmer farthest from the end of the chassis is for the long-wave oscillator coil. The trimmer nearest the end of the chassis is for the medium-wave oscillator coil, and the central trimmer is for the short-wave 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 series padding condensers for the long-wave and medium-wave bands are located on the rear chassis wall below the 6A7 tube.

I-F Alignment

Rotate the wave-band switch to the medium-wave (central) position and set the variable condenser to minimum. Feed 456 kc to the grid cap of the 6A7 tube through a 0.02-mfd paper condenser, (do not remove the grid clip from the tube). Adjust the four i-f trimmers for maximum response.

Long-Wave Alignment

With the wave-band switch at long-wave (clockwise) position set the dial pointer at 15 and feed 150 kc to antenna. Adjust the long-wave series padder (hex nut on dual padder) for maximum response. Move pointer to 35 and feed 350 kc to antenna. Adjust the long-wave oscillator trimmer, then the long-wave antenna trimmer for maximum response. Reset pointer to 15, feed 150 kc and rock (rotate back and forth through a small arc) the variable condenser while adjusting long-wave series padder for maximum response. Reset pointer to 35, feed 350 kc and check alignment. If readjustment is necessary return to 150 kc and repeat entire procedure.

Medium-Wave Alignment

Set switch at medium-wave (central) position and dial pointer at 60. Feed 600 kc to antenna and adjust medium-wave series padder (slotted screw on dual padder) for maximum response. Move pointer to 150, feed 1500 kc and adjust medium-wave oscillator trimmer and then the medium-wave antenna trimmer for maximum response. Reset pointer to 60, feed 600 kc and rock variable condenser while readjusting medium-wave series padder for maximum response. Reset pointer to 150, feed 1500 kc and check alignment. If readjustment is necessary return to 600 and repeat entire procedure.

Short-Wave Alignment

Set wave-band switch at short-wave (counter-clockwise) position. Set pointer at 15, feed 15 megacycles to antenna and adjust short-wave oscillator trimmer and then short-wave antenna trimmer for maximum response.

EMERSON AA-131 PARTS LIST

Item	*Resistor Ohms*	*Item*	*Condenser Mfd.*
R1	3000	C5, C24, C27, C36	0.02
R2, R12, R21	250,000	C6	0.0025
R3	60,000	C15	0.0024
R4	100,000	C16, C23, C31, C39	0.1
R5	310	C17	0.00005
R6	20.000	C18, C40	0.01
R7	410	C25	0.05
R8, R11	1 meg.	C26. C29	0.00025
R9	250,000	C28. C42	0.02
R10	240	C30	0.015
R13, R19	500,000	C32	0.05
R14	140	C33, C37	20.0
R15	Ballast	C34	40.0
R16	Ballast	C35	0.0015
R17	5000	C38	4.0
R18	300	C41	0.1
R20	25,000		
R22	230		
R23	20		

Crosley 5A1 Roamio

Distortion: Distortion in these receivers is often caused by a partial short circuit in the small plate-to-ground by-pass condenser in the 41 output tube circuit. Replace the condenser if necessary; value 0.01 mfd, 400 volt rating.

Poor sensitivity and low volume: If the sensitivity and output of these receivers is reduced check the control grid lead from the tuning condenser to the 78 tube in the first r-f stage. This lead sometimes breaks off under the insulation. A very flexible lead should be used in this position and some slack should be allowed. The gang condenser moves considerably, on its rubber mountings, when jarred.

RCA Service Tip File

•

RCA 9U2, 15U

Dial scales: The dial scales on the larger RCA models discolor badly from the heat radiated by the dial lights. This is particularly noticeable on the lowboy models 9U2 and 15U. Use only brown bead 6.3 volt dial lights and keep them as far from the scale as possible. On the low boy models, it pays to check them when first installed.

Charles Seeger

•

Wells-Gardner 6J, 6C1, A1, A2, A3

Reduced volume, noise: In a few of the volume controls used on the early 1937 radios of the series mentioned above, the manufacturer used a plating which under certain conditions can develop a whisker. This whisker, which can be seen only under a microscope, may short circuit the element.

When this occurs in auto sets, it usually manifests itself by a reduction in volume. The resistance of the control element when measured will be found to be much less than the rated value—sometimes as low as 1000 ohms.

This condition is easily remedied by connecting a 45-volt battery, momentarily, from the movable arm to ground. The movable arm may be at any point between the high potential (high volume) end of the control and the center position. Do not move it below the center position to avoid damaging the control. Any whisker touching the element will be burned away. In the case of the Series 6J auto set, the movable arm connection may be made at the control grid of the 6B7 tube.

This same condition is much less likely to happen in house sets because of greater spacing in the volume control. However, if it does occur, it will usually manifest itself in low volume, the set cutting out entirely, or noise when the control is turned.

Auto-Radio . . .

Philco 821P, 821PV

THE PHILCO MODEL 821P is a fixed-frequency, crystal-controlled receiver designed for the medium-high frequencies. These are the frequencies used by the Municipal Police, State Police, Marine Fire, Geophysical and Temporary Service and the Forestry, Forest Fire Control, Flood Control, National Park Service, Coast Guard Service, etc. (1550 kc to 3600 kc). A circuit diagram is given in Fig. 2.

The Model 821PV is a variable-frequency receiver, designed for use in these same services when it is necessary to receive signals from transmitters operating on different frequencies within these bands. The Model 821PV normally covers the frequency band of 1550 kc to 2550 kc. It can be obtained for use on the higher frequencies, 2300 kc to 3600 kc on special order. A circuit diagram of the Model 821PV is given in Fig. 5.

These receivers are equipped with a high-impedance, universal-antenna transformer designed to operate at maximum efficiency on recognized types of car antennas. This feature facilitates the interchange of receivers for service in cars equipped with different kinds of antennas. No antenna adjustment is required.

The circuits of these models are practically the same. Both are superheterodynes using seven tubes, including the full-wave rectifier. The coils, condensers and all component parts are designed to minimize any change in the electrical characteristics, due to changes in temperature and humidity.

The Model 821P, in addition to utilizing all the precautions requisite for circuit stability, uses a sealed quartz crystal to control the oscillator circuit

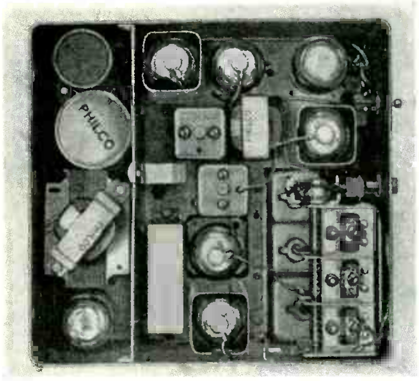


Fig. 1. Under-chassis view of receiver.

PHILCO 821PV ALIGNMENT OPERATIONS

Signal Generator Connection	Dummy	Signal Generator Frequency	Dial Setting	Peak Trimmer
78 I-F Grid	0.1 mfd	260 kc	open	24-26
6A7 Grid	0.1 mfd	260 kc	open	21-23
6A7 Grid	0.1 mfd	260 kc	open	24-26
FOR FREQUENCIES BETWEEN 1550 KC AND 2550 KC				
78 R-F Grid	0.1 mfd	2550 kc	open	14-11
78 R-F Grid	0.1 mfd	1650 kc	1650 kc	18[1]
78 R-F Grid	0.1 mfd	2550 kc	open	14
Antenna	55 mmfd	2400 kc	2400 kc	7-11
FOR FREQUENCIES BETWEEN 2550 KC AND 3600 KC				
78 R-F Grid	0.1 mfd	3600 kc	open	14-11
78 R-F Grid	0.1 mfd	2400 kc	2400 kc	18[1]
78 R-F Grid	0.1 mfd	3600 kc	open	14
Antenna	55 mmfd	3400 kc	3400 kc	7-11

[1]Rock the tuning condenser while adjusting the low-frequency padder. Tune the condenser to the signal and adjust for maximum output.

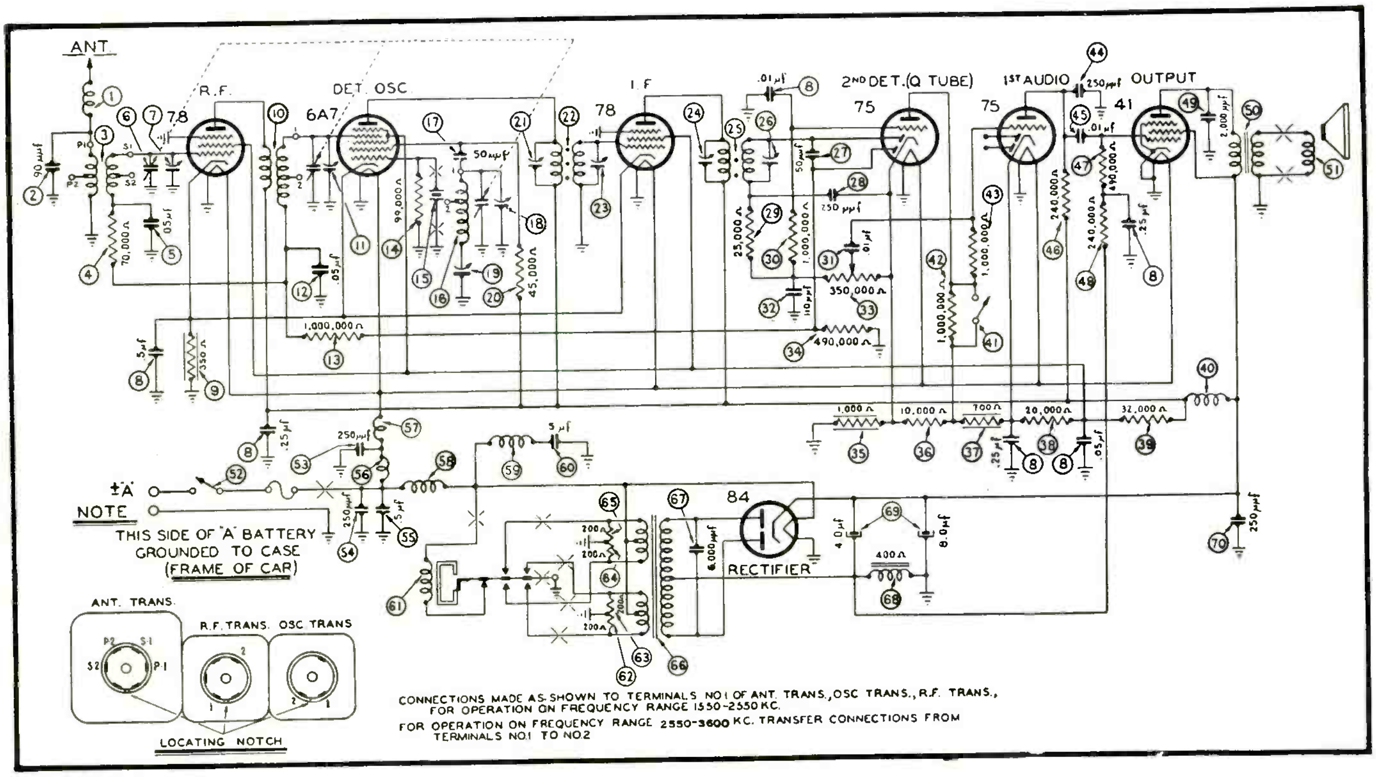
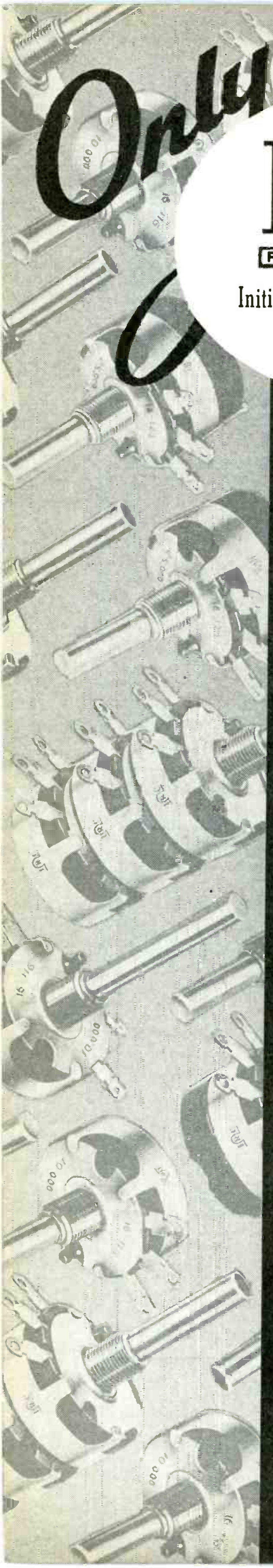


Fig. 2. Philco 821P circuit diagram.



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and hold it on the required frequency.

Both the r-f stage and the first-detector, oscillator-modulator stage have full, automatic volume control supplied by the diode detector.

The receiver also has a Q or carrier relay circuit. The function of this circuit is to completely silence the receiver when tuned off carrier, or when the carrier goes off the air. The correct values of the resistor network have been determined and used for satisfactory

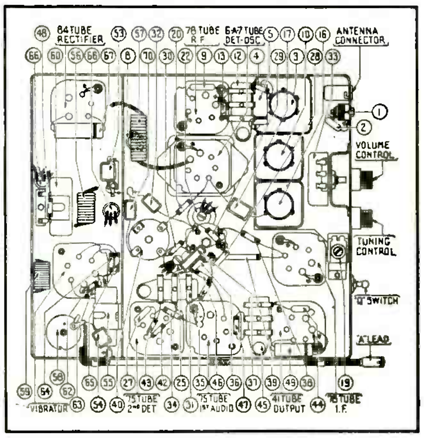
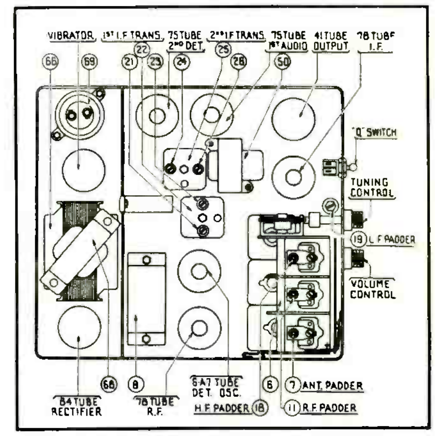


Fig. 3. Philco 821P parts and tube layout.

Fig. 4. Philco 821P top view.

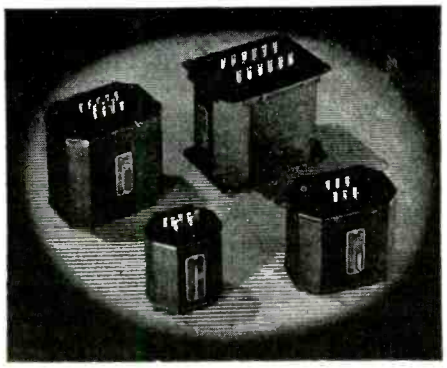


city operation where it is desirable to exclude street car noises, etc. A switch is provided on the end of the receiver housing to open or close this circuit, since, when in remote sections of the territory, where the police transmitter signal signal might be very weak, a slight additional sensitivity can be obtained from the Q circuit cut out. The Q relay circuit operates on a carrier field strength equivalent to approximately five microvolts in the antenna. A carrier below this strength is almost of insufficient strength to give satisfactory reception, especially in noisy locations.

The operation of the Q circuit is en-

UTC VARIMATCH PA TRANSFORMERS

The VARIMATCH transformers will not only match PRESENT available power tubes but any tube that may be released at a FUTURE date. VARIMATCH OUTPUT transformers are available from 12 to 300 watts rating. THE VARIMATCH TRANSFORMER NEVER BECOMES OBSOLETE.



VARIMATCH INPUT TRANSFORMERS

PA-233 From two 56, 6C6 triode, 6C5, or similar tubes to push pull 45's, 2A3's or 6L6's self or fixed bias. PA-1. Net **$3.60**

PA-333 This input transformer is designed to operate from 6C5's, or similar driver tubes to two 6L6's fixed bias. PA-1. Net **$3.60**

PA-433 From 45 or 2A3 plates to two or four fixed bias 6L6 grids. PA-2. Net **$3.90**

PA-50AX Single 53, 56, 6C5, 6C6 triode, 6A6 to Class B 53, 6A6 or 6E6 grids or single 89 to Class B 89 grids. PA-1. Net **$3.30**

PA-51AX Single 46 or 6L6 to Class B 46 or 59 grids. Single 45, 59, 2A3 or 6L6 to Class B 46 or 59 grids. Single 49 to Class B 49 grids. Single 37, 76, 6C6 or 6C5 triode to Class B 19 or 79 grids. Single 30 to Class B 19 or 79 grids. Single 89 to Class B 19 or 79 grids. Single 2A5, 42, 45 triode plate to A prime 45's, 2A5's or 42's. PA-1. Net. **$3.30**

PA-52AX Push pull, 45, 59, 2A3 or 6L6 plates to 2-46 Class B grids. Push pull 45, 59, 2A3 or 6L6 plates to 4-46 or 59 Class B grids. Push pull 2A3's to 2-841 Class B grids. PA-2. Net **$3.90**

PA-53AX Push pull 42, 45, 50, 59, 2A3 or 6L6 plates to two 210, 801 RK-18, 35T or 800 Class B grids. Push pull 2A3 plates to two 838, 203A, 50T, 35T, 211A, 242A, 830B, 800, RK-18, 801 or 210 Class B grids. PA-2. Net **$4.50**

PA-59AX 500, 200 or 50 ohm line to two 805, 838, 203A, 830 B, 800, RK-18, 801 or 210 Class B grids. PA-2. Net **$4.50**

PA-238AX Push pull parallel 2A3, 45, 50, 59 or 6L6 to four 805, 838, or 203A Class B grids. Push pull parallel 2A3, 45, 50, 59, 6L6 or two 211A, 845 plates to Class B 204A, HF 300 or 849 grids. Push pull parallel 2A3, 45, 50 or two 50T, 211A, 845 plates to Class B 150T or HF-200 Class B grids. PA-3. Net **$10.50**

PA-512 500, 200 or 50 ohm line to two 150 T, HF-300, HF-200, 204A or 849 Class B grids. PA-3. Net **$12.00**

PA VARIMATCH TRANSFORMERS

PVM-1 For all audio tubes up to 12 watts audio. Output 500, 200, 15, 8, 5, 3, 1½ ohms. Some typical tubes single or push pull: 19, 31, 33, 41, 42, 43, 45, 47, 48, 49, 53, 59, 71A, 79, 89, 2A3, 2A5, 6A6, 6F6, 6V6, 25A6, 25L6. PA-1. Net price **$3.00**

PVM-2 For all audio tubes up to 30 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Some typical tubes for single, push pull, or push pull parallel: 19, 31, 33, 41, 42, 43, 45, 46, 47, 48, 49, 50, 52A, 300A, 53, 59, 71A, 79, 89, 841, 843, 1602, 2A3, 2A5, 6A6, 6F6, 6L6, 6V6, 25A6, 25L6. PA-2. Net price **$4.80**

PVM-3 For all audio tubes up to 60 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Some typical tubes in push pull parallel: 42's, 45's, 46's, 50's, 52's, 300A's, 59's, 2A3's, 2A5's, 6F6's. In push pull self or fixed bias: 6L6's, 10's, 807's, 801's. PA-3. Net price **$7.50**

PVM-4 For all audio tubes up to 125 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Some typical tubes push pull parallel: 6L6's, 10's, 807's, 801's, push pull 845's, 800's, etc. PA-4. Net price **$12.00**

PVM-5 For all audio tubes up to 300 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Typical tubes: 211, 242-A, 203A, 830B, 852, 838, 4—800's, 4—845's, ZB 120, etc. PA-5. Net price **$19.50**

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LVM-1 15 Watt Line Varimatch unit. 500 ohms to variable voice coil winding of .2 to 75 ohms. PA-1 case. Net price.... **$2.70**

LVM-2 40 Watt Line Varimatch unit. 500 ohms to voice coil winding of .2 to 75 ohms. PA-2 case. Net price **$4.20**

LVM-3 75 Watt Line Varimatch unit. 500 ohms to voice coil winding of .2 to 75 ohms. PA-3 case. Net price **$6.00**

LVM-10 Line Varimatch Autoformer. 500, 250, 167, 125, 100, 83, 71, 62, 50 ohms. 12 Watts. PA-1 case. Net price **$2.70**

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LVM-12 Line Varimatch Autoformer. 500, 250, 167, 125, 100, 83, 71, 62, 50 ohms. 60 Watts. PA-3 case. Net price **$6.00**

LVM-13 Line Varimatch Autoformer. 500, 250, 167, 125, 100, 83, 71, 62, 50 ohms. 125 Watts. PA-4 case. Net price **$10.80**

LVM-14 Line Varimatch Autoformer. 500, 250, 167, 125, 100, 83, 71, 62, 50 ohms. 300 Watts. PA-5 case. Net price **$15.00**

***PA-2L6** 6600 ohms plate to plate for push pull 6L6's self bias, 35-40 watts output, to 500, 200, 16, 8, 5, 3, 1.5 ohms. PA-3 case. Net **$6.00**

***PA-4L6** 3800 and 3300 ohms plate to plate, for 3800 ohms, two 6L6's fixed bias, 60 watts output; for 3300 ohms, four 6L6's self bias, 60-80 watts output, to 500, 200, 16, 8, 5, 3, 1.5 ohms. PA-4 case. Net **$9.00**

*These transformers incorporate the new UTC Feedback Winding, which reduces harmonic distortion, increases available power and reduces resistance tremendously. No resistors or condensers are necessary.

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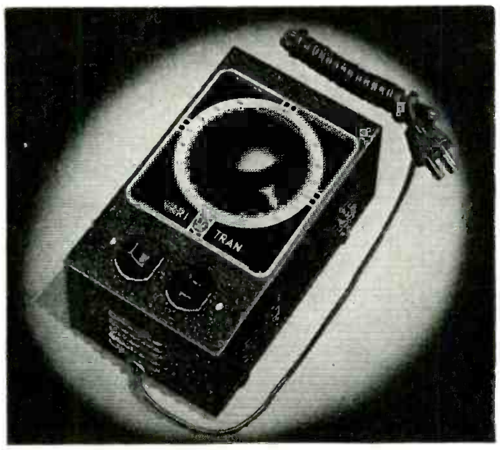

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★ Line voltage control	★ Smooth control
★ Rectifier control	★ High efficiency
★ Motor control	★ Excellent regulation
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Model V-1. 570 watts—5 amp. maximum rating, complete with cord, plug and switch, net **$10.00**

Model V-2. Same as V-1, but uncased, with terminal strip for rack or panel mounting, net **$9.00**

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EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB" tirely automatic and is accomplished solely through the use of circuit and tube arrangements. No mechanical relays are used.

The tuning condenser plates are double spaced and low-loss insulation is used on the stator sections. The tuning condenser is mounted inside the housing, on live rubber. The condenser worm-drive gear ratio (Model 821PV) is 16 to 1.

In the Model 821P, a self-locking

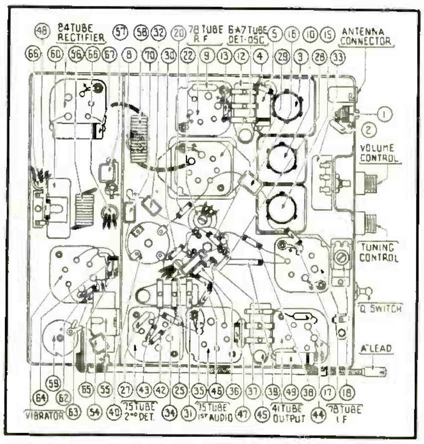
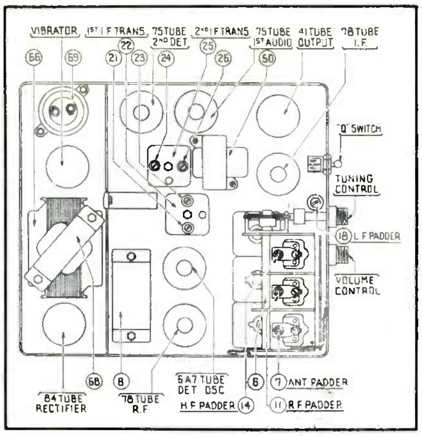


Fig. 6. Philco 821PV parts and tube layout.

Fig. 7. Philco 821PV top view.



worm drive with a gear ratio of 48 to 1 permits accurate adjustment of the tuning condenser and eliminates the necessity of using any other locking device on the condenser.

Model 821P.

The receivers, when used with the proper crystals, can be adjusted for any specified frequency between 1550 kc and 3600 kc. Different crystals are used to obtain these frequencies. The crystal frequency, however, is no indication of the receiver frequency adjustment.

The i-f stages can be tuned to any frequency between 242 kc and 278 kc.

The i-f frequency used in each receiver is the difference between the frequency of the crystal in the receiver and

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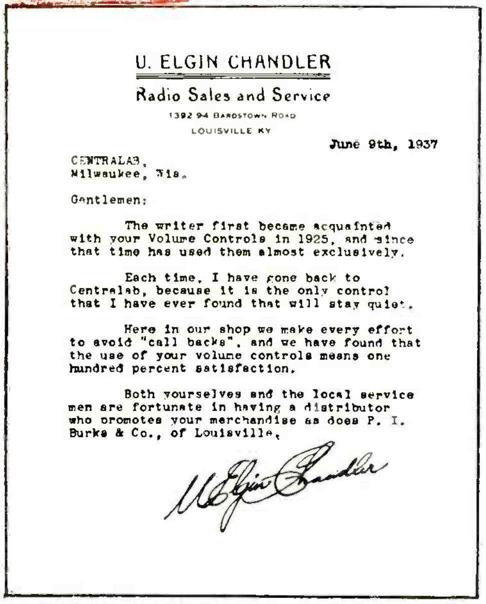
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1392 94 Bardstown Road

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June 9th, 1937

CENTRALAB,
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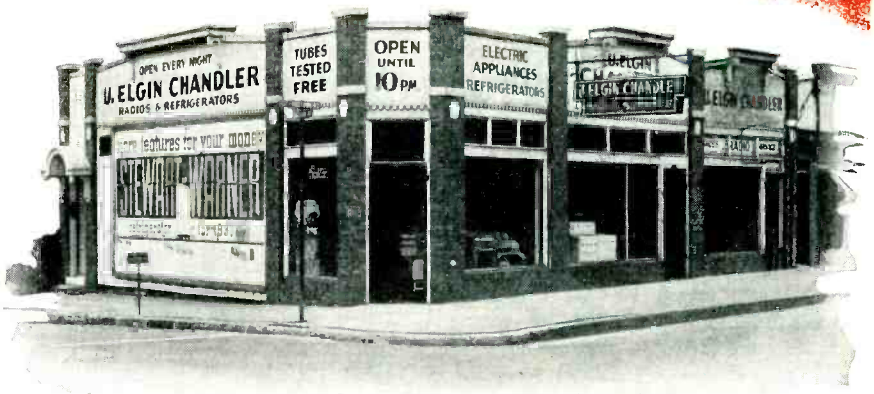
Gentlemen:

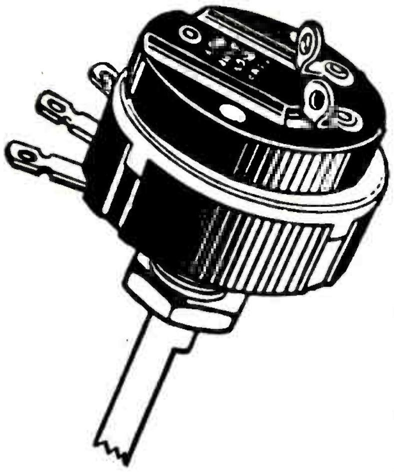
The writer first became acquainted with your Volume Controls in 1925, and since that time has used them almost exclusively.

Each time, I have gone back to Centralab, because it is the only control that I have ever found that will stay quiet.

Here in our shop we make every effort to avoid "call backs", and we have found that the use of your volume controls means one hundred percent satisfaction.

Both yourselves and the local service men are fortunate in having a distributor who promotes your merchandise as does P. I. Burke & Co., of Louisville.





The QUIET CENTRALAB CONTROL

offers maximum resistor length for case diameter . . . close uniformity between resistors . . . accurate tapers . . . uniform current distribution . . . better power dissipation and longer life.

● Fine phrases seldom fool a radio man. Graphs, curves and self-praise may read well . . . but customer complaints put a "negative-bias" on such bouquets.

So, when an "old timer" like Mr. Chandler writes . . . "Since 1925 I've used your controls almost exclusively, in fact each time I have gone back to Centralab, because it is the only control that I have ever found that will stay quiet." . . .

There's proof for manufacturer . . . for experimenter and for the serviceman. Specify Centralab.

CENTRALAB—Division of Globe-Union, Inc., Milwaukee, Wis.

Centralab

Canterbury Rd., Kilbourn, London, N.W., England — 118 Ave Ledru-Rollin, Paris the frequency of the transmitter, i. e., if the transmitter frequency is 2422 kc, the crystal used is 2696 kc, the difference is 274 kc, which is the frequency to which the i-f amplifier must be tuned.

The receiver must be padded while warm and repadded after it has been operated for several hours.

The receiver Q switch must be in the off position, cutting out the carrier relay circuit.

The signal generator must be set exactly to the predetermined frequency and the generator lead connected to the grid cap of the 6A7 detector-oscillator tube in series with a 0.1 mfd condenser. Adjust padders 21, 23, 24, and 26 on the first and second i-f transformers for maximum reading on the output meter.

Tune the signal generator to the frequency of the transmitter and connect the output of the signal generator to the grid cap of the r-f tube in series with a 0.1 mfd condenser. Turn the tuning condenser to the input frequency and adjust padders 18 and 11 for maximum reading on the output meter. Notice the position of the padders. They should be out as far as possible, yet with sufficient tension to keep them firmly in place. If the padders are too tight, turn the tuning condenser plates out of mesh slightly and repad 18 and 11. Repeat these adjustments until the correct padder settings are obtained.

The low-frequency padder 19 must be adjusted to a position where padders 11 and 18 are not too tight or too loose, i. e., if padder 18 is too tight and padder 11 too loose, turn the tuning condenser plates out of mesh slightly and screw in a little on padder 19. If padder 18 is too loose and padder 11 too tight, turn the tuning condenser plates in mesh, slightly, and loosen the padder 19 somewhat.

For any given frequency padder 19 should be screwed in almost tight (approximately a ½ to ¾ of a turn from tight) for best results and at the same time obtain the correct tuning condenser setting and adjustments of padders 11 and 18.

Special attention must be given to the adjustment of the oscillator padder 18, which should be backed off the peak slightly to obtain stable crystal operation.

Connect antenna lead, to the antenna receptacle on the receiver in series with a 55-mmfd condenser and set the signal generator to the frequency of the transmitter. Adjust padders 7, 21, 23, 24, and 26 for maximum reading on the output meter.

If for any reason whatever it has been opened, the crystal plate should be very carefully cleaned with carbon tetrachloride. After cleaning, the crystal must not be touched by the fingers. Use a clean cloth for handling.

ALIGNMENT PROCEDURE MODEL 821PV

An output indicating device should be connected across the primary of the speaker transformer or across the voice coil. The various trimmers should be adjusted for a maximum indication on the device.

Throughout the alignment procedure the volume control on the receiver should be on full and, as the stages are brought into alignment, the signal generator output should be kept low by means of the attenuator provided. The location of the aligning trimmers are shown in Figs. 6 and 7.

Both receivers and signal generator should be given at least 15 minutes to warm up before attempting adjustments. The Q switch should be in the off position.

The alignment operations are given in the accompanying table. The condenser indicated under dummy antenna should be connected in series with the generator output lead and the position on the receiver chassis designated under generator connection. The operations must be made in the order given.

Motorola 65

Installation: When installing the model 65 the A lead should be dressed away from the right-hand breather screen, otherwise interference may be fed directly through this screen into the antenna stage of the receiver. This can only occur, however, where the interference intensity on the A lead is extremely high.

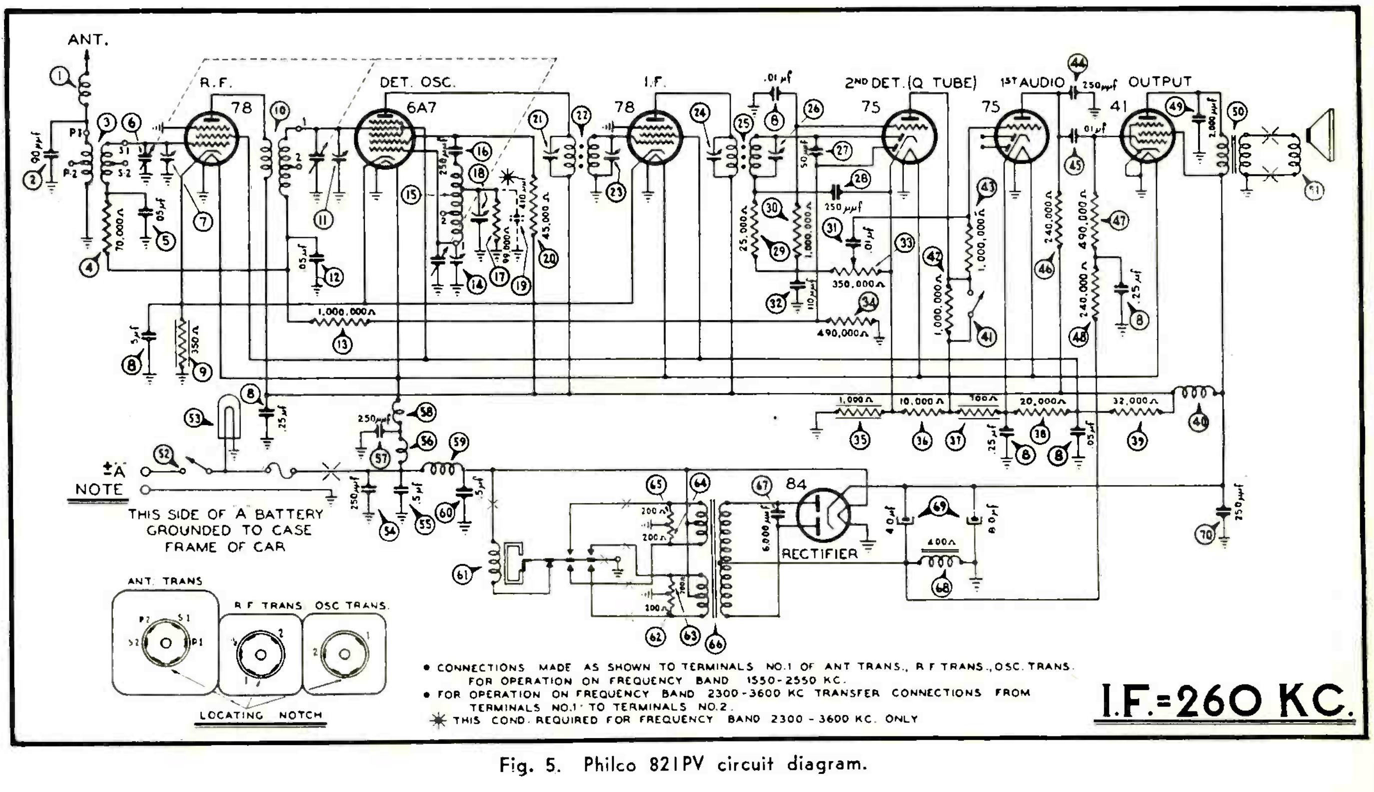


Fig. 5. Philco 821PV circuit diagram.

Sound Service . . .

INDUSTRIAL PUBLIC ADDRESS

By H. C. ROLLS

WHAT MAY be called the secondary p-a market, the industrial market, seems to be growing toward the point where it will rival or exceed the demands of the entertainment field. P-a can now be found in almost every type of industrial plant. Factories use it extensively, but it is not confined to factories. It is found in repair shops, in warehouses and all organizations where goods are stored for re-shipment, in newspaper press rooms and in large offices—in short, in all places where numbers of persons must work in coordination in spite of being separated by distance, partitions or noise. In such activities p-a has proved its ability to meet the basic business requirements of promptness and efficiency. The majority of industrial sales that have come to the attention of the writer in recent months did not originate with the seller, but with the buyer—with business men who were convinced by the experiences of other plants that p-a would help them meet their own problems, and merely wanted to be told what to buy.

Maximum coordination between departments, and instant transmission of information or instructions, are the basic though not the only uses of p-a in industry. These services are performed efficiently even under such unfavorable conditions as noise, inability of men to leave their work to answer a telephone or to release their hands to lift a telephone instrument, scattering of personnel over large areas indoors or outdoors, and so on. Normal industrial processes impose many handicaps on the transmission of information—handicaps that p-a overcomes better than any other device.

When used in this way, p-a is always inexpensive. The cost of even a large and elaborate installation, which very often seems formidable to such entertainment users as jazz bands or small restaurants, is insignificant to an industrial plant with large expenses for rent, payroll and raw materials. Even a slight increase in operating efficiency justifies the expenditure involved, many times over.

Further, wherever p-a fits into a plant and becomes an integral part of the day's operations, the cost of emergency channels or of periodic servicing also becomes a very secondary consideration to the user, who commonly will welcome any reasonable expenditure that insures him against any slackening of speed in work.

Minor uses of p-a in industry revolve around employee relations, and call for modifications of equipment. It frequently happens that an industrial buyer who is contemplating an installation for one purpose only, can be shown that the same apparatus, with minor modifications, will serve other functions as well. The system finally decided upon may prove considerably more elaborate than the one first contemplated. Definite uses should always be suggested in selling or advertising p-a in the industrial market.

FIVE GENERAL APPLICATIONS

The simplest of all services performed by p-a in the industrial field is that of paging—finding some individual who is wanted in the office or at the telephone. In very small plants a system of bells may serve; but wherever there are more than three or four individuals who may have to be paged bell signals are merely confusing. Furthermore, the loudspeaker tells the man called exactly what is wanted of him—to answer the phone, or to go to another department, or whatever the case may be.

Loudspeaker instructions are even more valuable than loudspeaker paging. They very often turn out to be the sort of thing of which people say: "Don't know how we ever got along without it." This is especially true where conveyor belts or chutes of any kind are used in automatic or semi-automatic processes. Every system of that kind gives trouble when the two departments involved fail to keep step. P-a allows the department at one end of the conveyor to advise the people at the other end to speed up, or to slow down, or to suspend operations entirely until some snarl is straightened out. The telephone is impracticable for this purpose whenever the surroundings are noisy, or when it takes some one away from his work. Bell or light signals are more subject to confusion, and do not convey information with the same fine degree of accuracy.

A clear distinction must be drawn, however, between use of p-a for such communicating purposes as those just named, and the use of standard loudspeaker communicating systems. Each has its proper field. For communication between persons permanently seated at desks or other locations, in relatively quiet surroundings, the factory-built communicating system represents the logical solution, and a p-a system custom-tailored to the job is out of place. This article confines itself to those needs for communication where the usual desk system will not serve, which are many. The desk system is comparatively useless in highly noisy surroundings, and in places where high loudspeaker power is needed because the person called is moving about and must be reached anywhere in a large room without taking him away from his occupation. Again, p-a communication is sometimes preferable in plants where p-a must be used anyhow, for paging or for one of the other purposes to be described presently. In such cases, while p-a may be used to serve its own proper function, and a communicating system for conversation, it will sometimes be found simpler and less expensive to make the same installation handle both jobs.

Many plants exhaust human ingenuity in trying to talk the help into greater accuracy, or greater speed, or both. In such organizations p-a is used for pep talks which are the more effective because they are delivered when the people concerned are actually at their machines or benches, and a suggestion is tied in with instant action. There are also certain natural human handicaps to extreme efficiency—one being fatigue and another boredom with the monotony of repetitive operations. Both lead to mistakes and to slowness; and industrial managers have found that even piecework pay and bonuses for accuracy are not always enough to overcome human inertia. A few phonograph records have been found more effective than many bonuses. They are used particularly during "slow" times and "inaccurate" times—just before lunch, just after lunch, and just before closing. However, this use for p-a is still less widely appreciated than the obvious advantages of paging and intercommunication. Suggested by a Service Man, it may not receive any too favorable reception; on the other hand, business men who have heard of the results obtained in other plants often ask for it.

Still another industrial use for p-a is in employee entertainment. Athletics and social events are actively promoted by many employers as good business. The uses of p-a in connection with such activities are obvious.

Combinations systems that are capable of serving several or all of the above

functions are quite common, and often suggested by the user himself. Thus, a man who is primarily interested in a paging installation may ask incidentally if the same horns can be used in the shipping department for the Christmas dance, and very likely wind up by buying a few extra speakers and a record player.

Selection of Industrial Equipment

The first step in planning a p-a installation is, of course, consideration of the loudspeakers. Requirements for paging, instruction, communication, employee relations and employee entertainment will vary somewhat according to the functions to be served. Paging merely calls for speakers that will deliver sufficient sound to fill the area to be covered, against the competition of whatever background noise may have to be overcome. In very noisy locations it is advisable to use several small units rather than one large one, since even a powerful trumpet, painful to the eardrums of those that are closest to it, may prove inaudible at the other end of a large room, while the same acoustic power, divided among a number of smaller units, will provide full coverage. If a paging speaker is to be located in the same room with the paging microphone—usually placed at the telephone switchboard—it should have a flat response characteristic to reduce the possibility of acoustic feedback. No other speaker used for paging alone need ever be of more than medium quality—the essentials of intelligible speech are confined to a comparatively narrow band of frequencies. The use of very poor speakers, however, should be avoided, as it may lead to confusion between names of similar difficulties that impair the value of the installation.

Speakers used for instruction alone can be considered the same as paging speakers, but units for intercommunication may involve a special problem. It is very often desirable to use the same apparatus as both speaker and microphone. This is entirely practicable with most small dynamic or permanent magnet dynamic speakers, and with some of the newer crystal speakers. The switching arrangements are simple in principle, although the wiring diagrams sometimes seem to be complicated when a number of speaker-microphones are used. A two-pole double-throw switch will of course suffice to swing any speaker-microphone from the amplifier output to the amplifier input terminals. But in most systems provision to maintain impedance match in the output circuit is desirable, and this is taken care of by using a three-pole switch, and wiring a resistor of proper value to the third pole in such a way that when the speaker is working as a microphone the resistor substitutes for it in the output circuit, and the load on the amplifier undergoes no change. In very large systems this precaution is sometimes omitted, with the idea in mind that one speaker more or less will make no great difference.

Speakers chosen for employee entertainment, either during or after working hours, are essentially p-a entertainment speakers of the usual kind, and of better quality than the minimum which is acceptable in communication units used for speech alone.

The foregoing refers, of course, only to selection of suitable *types* of speakers. A practical method of determining the speaker power needed in each location, and hence the power ratings of the speakers and of amplifier, is given later in this article.

The microphone for paging is commonly placed at the switchboard and used by the switchboard operator. It is either suspended from the ceiling or mounted on a floor stand. There should be no push-to-talk switch or other device that will take the operator's hands away from the cords of her switchboard, and it should not be necessary for her to turn her face sideways and thus miss seeing her signal lamps. One practical arrangement is to use a close-talking microphone that will not pick up what the operator says to her telephone transmitter, but will function when the operator leans toward it. Another is a microphone switch that can be mounted on or under the switchboard and operated by a knee or foot. Some of the smaller telephone companies will allow coupling of the microphone to the switchboard itself, and operating it through a switchboard key, but that arrangement is impracticable in most communities.

Microphones for transmission of instructions may be treated as if they were paging microphones, except that a switch must be used in noisy locations. Its operation may be by hand, foot or knee, according to the convenience and efficiency of the employee who will use it. Desk microphones, for use by executives, always have push-to-talk switches, and are usually ornamental.

Communication microphones are often, as said, loudspeakers working backward. In all other cases they may be treated the same as paging microphones, with, however, suitable precautions against acoustic feedback, such as the use of close-talking or directional instruments, and, above all, instruments with a flat response curve.

The complexities presented by choice of speaker-microphones for such purposes, and the proper matching of them to the balance of the p-a system, are such that under some conditions it will be found preferable to use a communicating system for this purpose, in addition to but completely separate from, the p-a installation, which is then confined to other functions. Of course, where communication needs call for high loudspeaker volume, the combination p-a—communicating installation is a necessity.

Microphones for employee entertainment, when this includes singing or pickup of band or orchestral music, are in all respects p-a entertainment microphones, and are selected accordingly.

All amplifiers of course must match the input and output power, impedance and quality requirements of the circuits with which they are used. In any system where acoustic feedback is possible the amplifier should have a flat response characteristic, and be equipped with an efficient tone control.

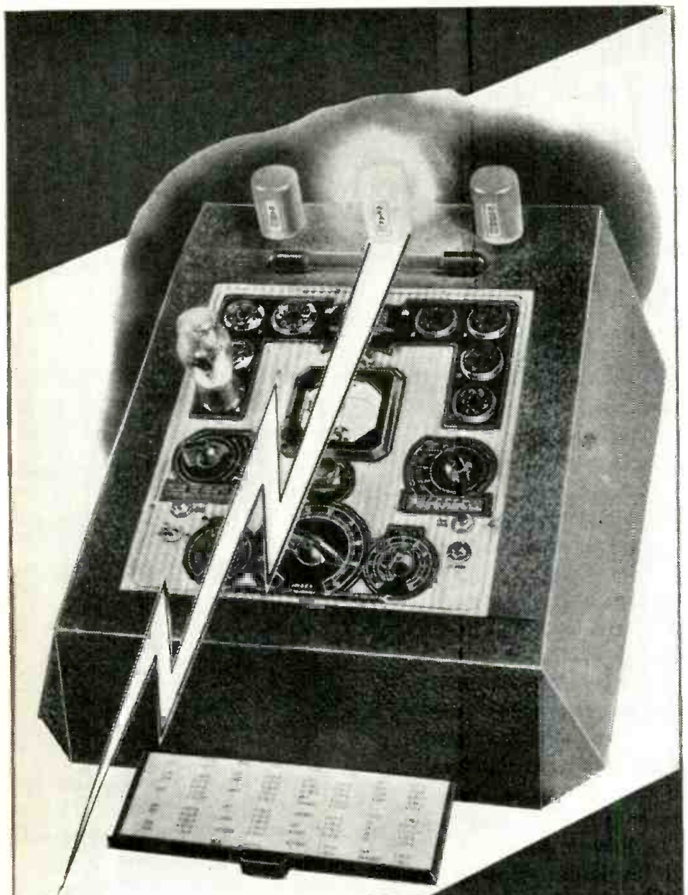
In paging systems the amplifier needs only a single input circuit. In some instruction and all communication systems, two or more microphones are used, and switching and wiring are sometimes simplified if the amplifier is equipped with mixer input. Entertainment systems may require auxiliary mixer inputs for use with record players or radio tuners. These last are always conventional p-a entertainment apparatus, and chosen accordingly.

Selector Systems

An interesting complication is introduced into industrial p-a requirements by the desirability, in some cases, of incorporating speaker selection—that is, means for paging or entertaining through a limited number of speakers only. This may be a matter of economy. For example, if a very large amplifier is needed to page an entire plant, the speakers may be wired in two separate circuits. The operator calls twice, once into each speaker line, using a foot switch between calls. This arrangement eliminates the need for an unusually powerful and correspondingly expensive amplifier.

Similar selector arrangements are sometimes used to confine paging, or

(*Continued on page* 651)



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Peak Performance

WE MUST ALL AGREE with Ralph Waldo Emerson; superior workmanship will be rewarded with increased patronage. This is especially true of service work.

The Service Man should endeavor to return every receiver performing at its best. Although the average household set is seldom called upon to deliver maximum undistorted output, the auto radio, operating in a field of constant acoustical interference caused by the car, may often be required to do so. However, in either case no less than peak performance should be tolerated.

With age the receiver refuses to respond to the heavy demands upon it. The sensitivity it had decreases, the distortion increases. In many cases the tone control, if available, is turned to the deep position. This aggravates the existing condition.

The causes? While it may be easy to say there are several, it is difficult to announce one factor as the sole cause. The close alliance of the components in the receiver makes it hard to define the actual loss occasioned by each. It is essential, therefore, that the set be examined thoroughly.

Step-by-Step Procedure

The first step in the improvement of the auto radio is the removal of the set from the car. Allow it to warm up on the test bench, using a reliable source of six volts. When the case of the set becomes warm, begin the test. First check the output voltage of the vibrator. In any fairly up-to-date receiver it should be at least 200 volts. It should maintain that voltage, while the set is tuned to a station carrier with heavy modulation, throughout the peaks.

If the voltage fluctuates, look for abnormalities in the vibrator unit. One cannot be too critical in looking for flaws in the vibrator performance. Be sure that the vibrator is not receiving more than six volts input. Some vibrators give normal performance at 6.5 or 7 volts and fail to deliver at 6 volts. It is not unusual to find a vibrator delivering 200 volts at 7 volts input and only 20 volts at 6 volts input. We recognize the fact that a receiver operates at about 7.5 volts or better in a car, but we should also remember that the receiver is often operated while the motor is idling and the voltage can drop to 5.5 volts. The owner of the set can rightfully require that there should be no perceptible change in volume throughout the speed range of the car. Therefore it is important that the vibrator deliver full output at six volts. A new vibrator will hold the output constant under these normal conditions, will increase the output from 25 to 60 volts and, in many cases, will accomplish the job of raising the undistorted power output of the set.

We now check the output tube. It should draw normal plate current in the set provided that it checked normal in a tube tester. Any deviation from normal value requires further inspection in the set. Be sure the proper bias voltage is reaching the tube. Always check high-capacity low-voltage condensers in the bias circuit. After determining that the output system is working normally, proceed to our next step.

Alignment

This is the complete alignment of the receiver. Alignments have been discussed in many pieces of service literature. While the step-by-step descriptions may have become slightly nostalgic to most of us, we find that new devices for assuring alignment are hidden through those descriptions and it behooves us to again read through the alignment procedure. For this reason, the tune-up should be reviewed once again.

Never align a receiver without using the set manufacturer's instructions. That shall be the theme of our procedure. In the alignment of a set without the use of an oscillograph the curve must be visualized in the mind while adjusting any trimmers in the set. With the common output indicating device found in the average service shop, it is difficult to determine the individual selectivity of each tuned circuit in the set and achieve symmetry of the selectivity curve. If the time allowed would permit, a plot of output voltage against test oscillator frequency above and below the i-f frequency on a curve chart would reveal it. Since that takes too long to do we must try to visualize the curve.

To do so, swing the test oscillator above and below the i-f frequency, as mentioned, and notice the output reading comparing the output at an arbitrary point each side of resonance. The reading must be taken for the same amount of deviation on each side. Recalling that symmetry of the curve will exist when for each set of deviations the two readings are equal, a good picture of the response can be visualized.

Proceed with the manufacturer's instructions. Sometimes the directions specify that the test oscillator be fed to the grid of the mixer tube. This point to be used for the full i-f alignment. In these cases, care should be exercised in repeating the i-f alignment to avoid the effects of interaction between stages and possible staggering of the i-f stages when the signal is fed in from the first stage. Staggering, as it might be termed, is the result when two i-f stages are peaked so that they overlap one another at the i-f frequency and give more or less response at side frequencies to that desired. This will often result when, it is again noted, the i-f stages are peaked with a common input signal and a common output reading to the stages.

Completing the Job

After the alignment of the i-f, trim the r-f padders repeating that process also. When the complete job is arrived at listen to a program on the set at full volume. Correct all buzzes and rattles if possible. Replace the speaker cone when the set serviced is over a year old. With the low prices prevailing we need not hesitate in replacing worn cones.

It is wise to keep a supply of felt pads such as are found in old vibrators. These can be used to correct spurious noises in the receiver when it is played at loud volume. Gratifying results will also be obtained by soldering loose or flimsy metal parts and sections in the receiver.

Eugene Triman

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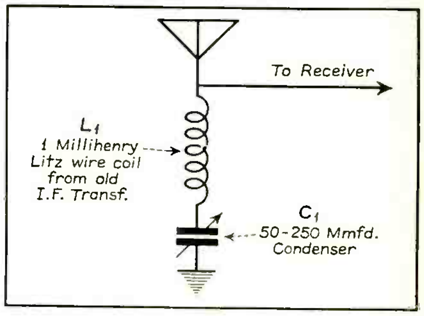
Wave Trap

Code interference on the i-f frequency can be reduced and often eliminated through the use of a wave trap connected as shown in the accompanying diagram.



The coil indicated may be the primary or secondary of a discarded i-f transformer of approximately the same frequency as the receiver's i-f. The condenser should be of the semi-variable type, tunable through the range from 50 to 250 mfd.

Mark Glaser

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WHEN MICRODYNE'S astonishing *facsimile* performance was first demonstrated, skeptical sound experts exclaimed, "That's THE answer to the wide-range problem!" Throughout the industry spreads the fame of this inspired reproducing system that makes recording-microphone fidelity at the pick-up an accomplished fact. Not since pick-ups became commercial in 1926 has there been so startling an evolution. *Look to a leader for leadership!*

AUDAX MICRODYNE RF-1 . . . . **List $40.00**
This model, built for records up to 12 ins., differs in no way from RF-2 below except that its range is not quite so high. Center to needle 9½ ins.; overall length 11 ins.: shipping wt. 4 lbs.

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AUDAX MICRODYNE RF-4 . . . . **List $125.00**
Most remarkable wide-range development since the advent of pick-ups in 1926! For records up to 18 ins. Special arm has ball-bearing compound movement. Feather-touch on record. Low or high impedance. 14¼ ins. overall length; center to needle 12 ins.; shipping weight 5 lbs.

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ASSOCIATION NEWS . . .

RADIO SERVICE ASSOCIATION OF CALIFORNIA

At the meeting which was held on September 20, the following were elected as officers for the next year:

Morris Knox .... President
Wil Styles .... Vice-Pres.
H. R. Anderson .... Secretary
Don Caples .... Treasurer
Wm. Bufton .... Sgt.-at-Arms

In addition, Wm. Appleton and Al Grabau were named to the executive board, as was Richard Van Etten who will complete the unexpired term of Wil Styles.

Reports of a picnic were current—everyone had a good time according to our reporter.

October 4 was the date of another meeting at which, according to an advance announcement, fireworks were to be the order of the day (or evening). So far, at least, no casualties were reported, but then there may have been too many to look well in print. What's the dope?

The inaugural address of President Morris Knox was in the nature of a travelog entitled "How to See New York in Two Days and How to Get Lost in the RCA Victor Factory at Camden." (We've been living in N'Yawk for years and we can't see the damn place for dust—mebbe Morris can give us a tip. As far as getting lost at RCA is concerned, that's easy. The big question is, how *not* to get lost.—The Editors.)

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PRSMA

At our September 7 meeting we had as our gracious host, the General Electric Company. The meeting was very well attended, and every minute presented a wealth of interesting and pertinent information. From the Field Technical Section in Bridgeport, Conn., came Engineer Ed Hayes, who explained in detail, with the aid of slides, the principles of degeneration, or audio feedback, which is incorporated in all of the new General Electric receivers under the name of "Tone Monitor." He pointed out that with the use of this amazing circuit it is possible to secure the same undistorted output from a 6L6G, with a gain of only 4.5. In other words, the Tone Monitor circuit permits the use of a high gain output tube without the customary difficulties with distortion, etc.

The second portion of the evening was under the direction of Horace W. Royer, Field Engineer, General Electric Company, in Philadelphia. Mr. Royer's topic was "The Set-up and Operation of Electric Touch Tuning Mechanisms" and he explained in detail the newly developed electric motor-driven tuning mechanism utilized on the 1938 General Electric receivers.

The evening was topped off with a fine array of sandwiches, coffee and beer, and judging by the appetites of some of those present, the combination must have been right.

Last month there was a lot said about spaghetti dinners, who ate this and that . . . and no one mentioned anything about the little lady who was responsible for all the stuff! Psst! We had better tell 'em that the lady in person is Mrs. Kranz . . . and if we don't there ain't gonna be no more chow. And what would Guthrie do for some of that swell cake?

Seemed like just about everybody turned out for the G-E meeting last month. Old familiar faces that we have missed for many a day made their appearance. And the boys sure got the dope on audio feedback—"Tone Monitor" to you! Doggone—the refreshments were sure swell. What a rush there was for the kennels when those perspiring puppies were unleashed. One of those present—not mentioning any names—was seen with two hot dogs in either hand . . . greatly perplexed by the problem of obtaining a pitcher of beer!

The fable of the early bird and the worm has a bit of truth attached to it. Bob Thorn, winner of the Hickok Tube Checker awarded as a door prize at the G-E meeting was almost run in on a vagrancy charge at 429 North 7th Street early in the morning of September 8. The entire office force was obliged to step over his slight figure as it reposed on the front doorstep, expectantly awaiting the opening of the doors in order that he might claim his prize.

From PRSMA News.

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RTG

The second annual RTG Exposition and Convention was held at Boston in the Hotel Lenox on September 20, 21, and 22. Scheduled speakers included engineers and scientists; displays of test equipment and other material of interest and importance to the Service Men were on hand.

During the convention, a meeting of all the secretaries was held and matters of importance were thoroughly discussed.

The convention closed with a concert and dance.

With September on hand the boys are making the meetings again. Good going boys. Now that Sergeant Sanborn is back in harness again, after his sojourn with the Commonwealth Armory Expeditionary Forces, we expect he will be around to argue with that member from Brookline Ave. Watch out, Sandy, he is laying for you. It seems he has picked up some reading matter on afc and avc. They tell me it has something to do with radio. Perhaps somebody could tip a fellow off what it is all about, over a cup of coffee.

Bill Whiteacre should be back soon after spending a few weeks in Maine. Say! can someone put me wise to where they get it to spend? Tell me, Bill, have they heard about radio up there yet? If I had your address I would have sent you a card so that you could have got out one night a week anyway. Good old R. T. G.

They tell me that Leo Fennessy is working on a short wave job. It must have been an awful dry day when you bought the parts, Leo.

We thought it was a pinch last meeting when Bill Farnsworth, the radio cop, walked in on us. We hadn't seen him for quite a while. How do you like keeping bachelor's quarters, Bill?

Will somebody please donate a No. 12A7 to a certain member so that he can get his code oscillator working.

Ed Parsons, in RTG News.

ASSOCIATION OF RADIO SERVICE ENGINEERS

The Buffalo gang was probably on its best behavior on the evening of September 21—Police Commissioner Higgings was one of the speakers. We haven't heard of any riot calls from that end of the state; possibly what the boys learned about "Cops and Robbers" held the meeting within bounds. Or did it?

Sam Scheer, the One and Only, was also on the program.

So were door prizes and refreshments.

It should've been good. How about it, Buffalo?

Another schedule called for a talk by George Connor of Sylvania on October 6. George's talks are worth a couple of hours of any man's time. We ought to be getting word of some excellent attendance records.

Brother Harold Rosenthal of Harold's Radio Service must have hit the jack pot. We notice his recent purchase of a new Studebaker truck and pleasure car. Nize going.

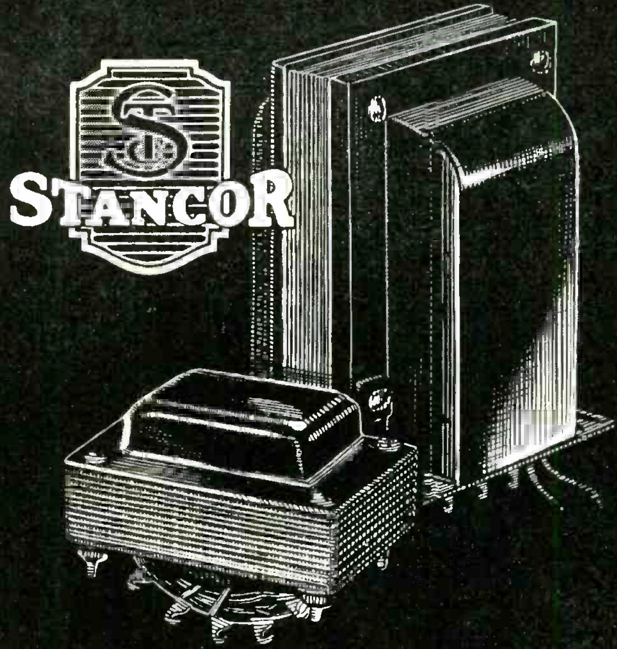
Miss Rochelle Susan Slepian, daughter of brother Edw. Slepian (the radio doctor), has the distinction of being the youngest passenger to ever fly the American Air Lines. Little Susan arrived while Mrs. Slepian was visiting at Glen Cove, Long Island. At the tender age of 19 days she suffered an illness that necessitated her being removed to Buffalo immediately. A plane was chartered at Newark and little Susan arrived in Buffalo where immediate treatment combated the illness.

Vote for Joe Mruk is the slogan along the East Side. Joe, who is an associate member of the Assn. is a candidate for councilman from the Walden district which comprises the 10th, 14th, and 15th wards. Joe was defeated for the same position last election by the narrow margin of 97 votes. Lots of luck, Joe.

Your President, Ted Telaak, and Tony Schreiber appointed themselves a delegation of two from the Assn. to attend the dinner held by the Jamestown Assn. at the Lenhart Hotel, Bemus Point. We had an excellent journey until we suddenly found ourselves in the middle of some farmers corn field and in getting untangled from the corn we discovered we were on a detour to Bemus Point. Finally we reached our destination and after meeting the Jamestown group we sat down to a wholesome meal and then listened to a gentleman named Jos. Marcey, who is an up and coming orator. Next we heard an extremely interesting talk by Sam Scheer of Philco and as usual, plenty of new jokes. Incidentally, while Sam was attending this meeting, Mrs. Scheer presented him with a seven pound baby boy. Congratulations.

We found the Jamestown boys a real congenial lot and we not only hope to see some of them at our first meeting but we fully expect them. Their president, Norm Smith, is a live wire and we are sure they will go right to town.

Other members from Buffalo who attended this Jamestown meeting were Nate Abelson, Benny Adel (alias, in China), Marty Feigenbaum from Bergmans and a guy named Jack Eimer.



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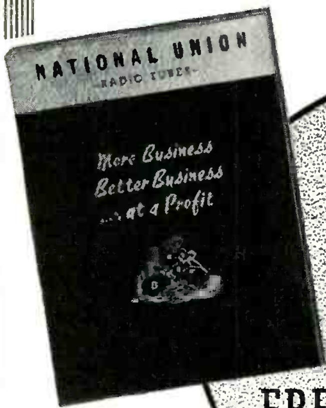

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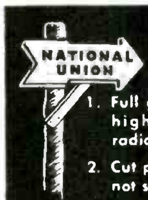

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THE MANUFACTURERS . . .

MALLORY 12-VOLT VIBRATOR POWER SUPPLY

The success of the standard 6-volt series of Mallory Vibrapacks has resulted in an insistent demand for a 12-volt vibrator power supply to be used on airplanes, busses and motor boats for powering radio transmitters, receivers, direction finding equipment and other scientific apparatus.

To meet this demand P. R. Mallory & Company, Inc., of Indianapolis announces their new Vibrapack, Model VP-G556, which is designed for operation from a 12-volt storage battery, and delivers a nominal maximum output of 300 volts at 100 milliamperes, with three lower voltage outputs of 275, 250 and 225 volts instantly available at the turn of a switch. A special synchronous or self-rectifying vibrator is employed which is said to provide excellent voltage regulation, long life and high efficiency.

In appearance the Vibrapack VP-G556 is very similar to the equivalent 6-volt Model VP-552, and all installation and operating instructions apply equally to both models, with the exception that the current drain of the VP-G556 is one-half that of the VP-552 because of the higher operating voltage.

An interesting technical data sheet on Mallory Vibrapacks called Perfect Portable Power may be obtained without charge from any Mallory-Yaxley Distributor, or from the factory.—SERVICE.

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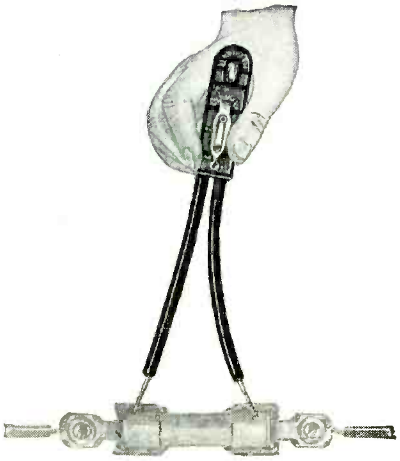
IMPROVED TEST-O-LITE

For a number of years the Test-O-Lite has been widely used by electricians, mechanics and householders for testing electrical circuits. Today it is a standard tool in almost every shop. Recently, an improvement has been made in this product which includes a pocket clip for holding the Test-O-Lite firmly in the pocket, preventing its being readily lost. This pocket clip was added at the request of many users. Another improvement is increased sensitivity so that it more easily detects the presence of voltage from 90 volts to 500 volts a-c or d-c by the small neon lamp located in the body of the tester. It is found extremely useful in locating burnt-out fuses, leaks, short or open circuits, or defects in wiring. Test-O-Lite is a product of the L. S. Brach Mfg. Corp., 55 Dickerson St., Newark, N. J.—SERVICE.



HICKOK SIGNAL GENERATOR

This new Hickok instrument has the output calibrated in microvolts. Sensitivity, gain per stage and selectivity are standardized by a self-contained vacuum tube voltmeter.

Output ranges are as follows: R-f, ½ microvolt to 100,000. A-f, 0 to 2.0 volts. There are three decibel ranges: —10 to +6; +6 to +22; +22 to +38. Radio frequency ranges are calibrated directly, 85KC to 28 megacycles. Complete built-in power supply consists of transformer, rectifier and filter system. Case is 13″ × 10″ × 7″, made from steel with etched aluminum panel.

The many other features of this instrument may be learned from the maker, The Hickok Electrical Instrument Co., Cleveland, Ohio.—SERVICE.

OPERADIO AMPLIFIER

Operadio Mfg. Co., St. Charles, Ill., have announced an amplifier, model 835, which is rated at 35-52 watts output. Beam power tubes are used; three input channels with electronic mixing are provided. Practically any type of the microphone or phono pickup may be used. Non-resonant equalizers are employed for tone control.

Specifications and further details may be obtained by writing to the manufacturer. —SERVICE.

•

NATIONAL UNION ANNOUNCES CONDENSER LINE FOR SERVICE FIELD

H. H. Peters, President of the National Union Radio Corporation, announced from the company's N. Y. C. headquarters this month the entry of his company into the field of condensers for radio service specialists.

The N. U. condensers will be handsomely boxed in gold, black and green containers and cartons. The line will include standard and junior cardboard-box types, standard and junior inverted-can types and tubular types in electrolytics, tubular papers, automobile radio papers, uncased condensers, auto vibrator condensers, and oil filled transmitting condensers.

Complete stocks will be warehoused at strategic points throughout the country for quick delivery to N. U. Distributors.—SERVICE.

STANLEY POCKET "FLASH-LITE" SCREW DRIVER

Stanley Tools now offers a small size Pocket "Flash-Lite" Screw Driver with a clip. It has been designed for use by householders, car owners, auto mechanics, radio, refrigerator and oil Service Men who need a handy sized screw driver for working in dark places. The handle, octagon shaped, is made of brass and is finished a crystal black with a contrasting orange stripe. It holds one standard battery and light bulb. The screw cap and clip are nickel plated. The blade, two inches long and ⅛-inch in diameter, is made of tempered steel and has an accurate machine cross-ground tip. Battery and bulb can be replaced easily when worn out. Manufactured by Stanley Tools, New Britain, Conn.—SERVICE.

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CO-X

For use as antenna lead-ins, transmission lines and feeders; inter-connection of photo cells and amplifiers; in circuits where high-frequency and leakage losses must be at a minimum; and where radiation or pickup must be held low, CO-X, a new coaxial cable is recommended by its manufacturer.

The cable is made up of an inner braided conductor, a separator layer made of a new material, Anhygron, and an outer conductor braid.

In addition to favorable electrical characteristics, CO-X is said to have light weight and flexibility. Further details are available from the manufacturer, the Transducer Corp., 30 Rockefeller Plaza, New York City.—SERVICE.

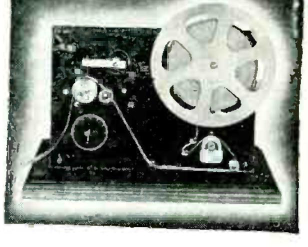
•

CODE READER

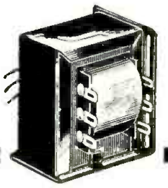
For use with conventional radio receivers, standard telegraph key, or other source of code signals, the American Code Reader should appeal to the person interested in learning to read code.

The code message is recorded chemically on a paper tape; provision is made for either a temporary or permanent record. Speeds to 50 words per minute can be handled by the standard model; others are available for speeds as high as 300 words per minute.

Complete details of this equipment may be obtained by writing to American Communications Corp., 1650 Broadway, New York City.—SERVICE.



MULTI TAP



Available with lugs (as shown) or with covered wire leads.

Stock Only ONE Unit ... Service MANY Sets

Don't tie up a small fortune in stock! But be prepared, nonetheless, for almost every service need . . . with MULTITAP. Although the primary is untapped, it matches almost any single tube or push-pull output stage. For push-pull operation, correct primary matching is obtained when 71A, 45, 50 or 43 type tubes are used. For single tube output using the total primary, correct matching is obtained with the 33, 47, 41, 42, or 2A5 tubes. One-half of the primary can be used to match a single 48 tube.

PULL PUSH — The secondary is tapped to accomplish with the least number of terminals a most uniform range of load inpedances from 1 to 30 ohms.

MOISTURE PROOFED — All coils are vacuum-baked to extract every last trace of moisture, and then impregnated with special 9X Moisture-Proofing Compound, forced into windings under tremendous pressure. This is essential in humid seacoast climate or where hot days followed by cool nights causes condensation on the coils. Ask your jobber or write for FREE Bulletin, Form 41.

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FOR ten years radio testing equipment had just gone along . . . then it was suddenly revolutionized by the Simpson line.

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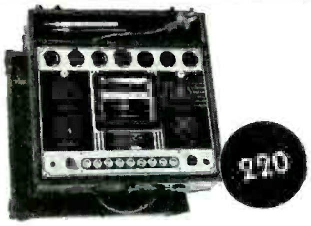
See them at your jobber's—and your next servicing equipment will be Simpson.

SIMPSON ELECTRIC CO.
5218 W. Kinzie Street, Chicago, Ill.

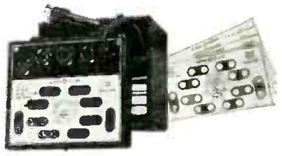


Model 220 Roto-Ranger Tube and Set Tester

The fastest selling instrument in its price class. Roto-Ranger feature places twelve separate scales at your finger tips. Has latest tube testing circuit — filament return selector—separate resistance scales of 0-100—100,000 ohms, and 100 megohms. Three D. C. scales 8-300-1000 volts (2500 ohms per volt).
Net price.................. **$62.75**
Time price: $12.50 down and six $9.60 payments.

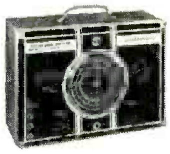
Model 201-202 Roto-Ranger Volt-Ohm Milliammeter

Convenient Roto-Ranger gives following ranges: Model 201 (D.C.) Ohms, 0-20-200-2,000-20,000-200,000-20 megohms; Microamps, 0-200; Milliamps 0-10-150; Volts, 0-8-300-1,000. Model 202 (A.C. and D.C.) A. C. volts, 0-8-130-1,000; D. C. volts 0-8-300-1,000; D. C. Milliamps, 0-1-8-130; Ohms, 0-100-0-50,000-2 megohms.
Net prices: Model 201...... **$32.50**
Model 202.................. $35.75
(Sold on deferred payments)



The New "Anal-O-Scope"

Ingenious time-saver for use with any set tester or Volt-Ohm-Milliammeter. Just select card corresponding to tube under test, place it on Anal-O-Scope and you have complete picture of elements and connection while tests are being made. Combines cord and plug analysis with "Free Point" method. Ask for interesting facts.

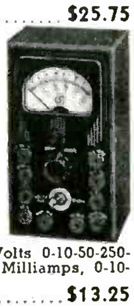


Model 210 All-Wave Signal Generator

The last word in signal generators. Ask for description and prices.

Model 215 A.C.-D.C. Volt-Ohm Milliammeter
5000 Ohms Per Volt

The small instrument with the big, easy-to-read dial. 0-2.5 - 10 - 50 - 250 - 1000 volts. A.C. or D. C. 0-10-100-500 Mils. 0-250 Microamps. 0-4,000-400,000 ohms. 0-4 megohms. Five decibel ranges — 12 to + 55.
Net price.................. **$25.75**



Model 205 Volt-Ohm Milliammeter
5000 Ohms Per Volt

Pocket size but highest quality. Highest resistance ranges ever provided in an instrument of this size—0,2000-200,000 ohms-2 megohms; Volts 0-10-50-250-1,000 (D. C. only); Milliamps, 0-10-500.
Net price.................. **$13.25**

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☐ Model 220 ☐ Model 201-202 ☐ Model 215
☐ Model 205 ☐ Model 210 ☐ Anal-O-Scope

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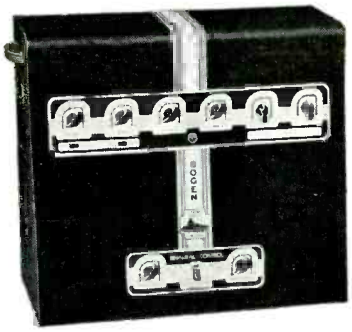

AUDITORY PERSPECTIVE SYSTEM

This is actually two complete amplifiers in one, dual-channel throughout. There are two separate power output stages, each capable of delivering 35 watts of undistorted power with less than 4 percent harmonic content. Combined, a total of 70 watts is available. Either channel may be operated separately or both simultaneously and in addition to the binaural effect other advantages are included, according to an announcement by the manufacturer.

One channel may be run at a high volume level for outdoor speakers while the other is operating at a lower level for indoor speakers. As an emergency feature one channel may be cut out in case of tube failure as the "Show Must Go On."

Electronic tone correction, said to be an exclusive Bogen feature, is also included in this model. Electronic tone correction permits the operator to create any degree of high or low tones without loss or distortion, and to compensate for acoustic deficiencies of the hall.

The CX70 amplifier has 6 input channels; 4 are high gain for microphone and 2 are low gain for phono pick-up. Electron mixing between channels permits any four to be operated simultaneously.

Built-in rack and panel style with handles for portability are available. Dimensions: 19" long, 17" high, 9½" deep.—Manufactured by David Bogen Co., Inc., 663 Broadway, New York City.—SERVICE.

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VIBRATION PICKUPS

The Brush Development Company recently announced its complete line of vibration pickups. These devices are of typical piezoelectric Rochelle salt crystal design, and are applicable to the study of noises and vibrations in various industrial applications. Three types known as VP-1, VP-5, and DP-1 are now available. Characteristics of the various pickups are said to be such that they cover the complete frequency range. Literature describing these crystal devices is available upon request. Address the manufacturer at 3311 Perkins Ave., Cleveland, Ohio.—SERVICE.

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SOLAR TRANSMITTING CAPACITORS

Solar Mfg. Corp., 599 Broadway, New York City, has prepared its complete line of transmitting capacitors, which, we understand, are now ready for the trade. This line embraces both oil-paper and mica types, in ratings suitable for every purpose. A complete new catalog showing the Transoil, Solarex and Transmica families which comprise this new line, is now ready for distribution. Write the company, please.—SERVICE.

RCA VICTOR ENTERS INTER-OFFICE FIELD

Two new inter-communicating call systems, one of which requires no wires, were announced by the RCA Manufacturing Company, signaling the entry of the company into the rapidly expanding inter-office communication field.

The new systems are to be known as RCA Victor-Phones. The larger of the two systems includes a master unit which incorporates an amplifier, volume control and station selector switch feeding into five remotely operated units. Power for the master unit is obtained from any 110-volt a-c or d-c circuit, while the remote units require no power. Each remote unit is connected to the master unit with a simple individual wiring system which insures secrecy of communication. The remote units may be placed as far distant as 1,000 feet from the master unit.

The system is so built that any one of the remote units can be used to talk with the master unit, and after the contact is made one may both listen and talk without turning the switch or holding it open with the hand. Each unit is housed in a small, attractive walnut-finished cabinet.

The master unit has three controls. A selector adjusts the unit to communicate with the remote units, and a volume control insures convenient operation. The third switch is pressed for talking. The system was built for service in factories, offices and homes.

The second RCA Victor-Phone system, illustrated here, requires no wires. The communication units of the system are placed in service by merely plugging them into the electric light socket. The system operates on the carrier-frequency principle, each unit being a miniature transmitting station sending high-frequency signals along the electric wires. There are no wires or batteries, no installation costs.

The carrier frequency of 100 kc may be adjusted to plus or minus 25 percent, thus permitting as many as three systems to operate in close proximity without interference. Voices up to 10 feet from the unit will be picked up and reproduced at the receiving end with sufficient volume to fill an ordinary room. Each unit is provided with a volume control.

The system is adapted for inter-communication between offices, hotel rooms, factory buildings, homes or any of the many places where a simple, reliable means of communication is required. The system can be disconnected and moved as simply as moving a light, and re-installed with the same ease.—SERVICE.

•

KEN-RAD 6F8G

Ken-Rad has developed a new tube known as 6F8G which is a cathode-type twin-triode designed to be used as a voltage amplifier and phase inverter. Electrical characteristics of the individual sections of this tube are identical to those of type 6J5G. The 6F8G is a glass tube equipped with an octal base. Ratings and characteristics are as follows:

Heater voltage..................6.3 volts
Heater current................0.6 ampere
Class A Amplifier Operation (One Triode)
Plate voltage..............250 volts max.
Grid voltage....................—8 volts
Plate current.............9.0 milliamperes
Plate resistance.......7,700 ohms approx.
Amplification factor..................20
Mutual conductance
2,600 micromhos approx.
—SERVICE.

•

MULTI-TEST SPEAKER

Wright-DeCoster, Inc., 2233 University Avenue, St. Paul, Minn., have announced a Nokoil Multi-Test Speaker with which all a-c and d-c sets may be tested. The speaker used in this equipment requires no field current.

All leads are brought out to selector switches; a universal output transformer permits matching the speaker to any tube, and a universal voice-coil transformer is also provided to enable the user to connect directly to the voice-coil leads of the set under test.

Further details are available from the manufacturer.—SERVICE.

(*Continued on page* 654)

Solar Condensers.

VISUAL ALIGNMENT

(*Continued from page* 608)

signal receive essentially the same amplification, so that the loss of the higher audio frequencies with its attendant distortion is prevented. However, as far as the adjustments on the short-wave ranges are concerned, there is ordinarily no sideband discrimination because the selectivity of the r-f circuits is extremely small in comparison with that of the i-f amplifier, and there is only one adjustment of the several trimmers which will give the greatest output. The alignment of the short-wave bands can thus be made using an ordinary audio-modulated signal generator and output meter, taking due precautions to overcome the effects of interaction between the r-f and oscillator adjustments (if any), and to avoid aligning the oscillator to the image frequency.

A second reason why the visual alignment method should not be used for the alignment of the high-frequency bands is that all frequency-modulated signal generators produce not only the dial frequency, but in addition produce two other frequencies; on the high frequency ranges these are appreciably close to the alignment frequency. Since there are thus three input signals of the same order of intensity rather than one, and since there are two possible settings of the oscillator trimmer for each, it follows that there will often be as many as six different settings of the oscillator trimmer which will produce a maximum output reading.

To eliminate these interfering frequencies, the frequency-modulated signal generator can be used for high frequency alignment work as a conventional audio-modulated signal generator. In this application it is convenient to cut out the fixed-frequency oscillator to remove the sum and difference frequencies from the output. In some instruments it is possible to do this by inserting an open-circuited plug in the external modulation jack; in others, a switch can be used to disconnect the fixed-frequency oscillator; in still others, where the frequency modulator is a separate unit, it is of course only necessary to disconnect the frequency modulator for high-frequency alignment work. In every case due allowance must be made for the fact that some instruments are calibrated for the sum frequency, others for the difference frequency, and still others for the variable-oscillator frequency; for a given instrument, the difference frequency may be used on the low-frequency bands, while the sum frequency is used on the high-frequency bands.

Commercial Equipment

The remainder of this article describes briefly a number of the commercial frequency-modulated signal generators and frequency modulators which are available on the market. Because of space limitations, the descriptions are by no means complete nor are the instruments mentioned the only ones which are being manufactured. More complete specifications of these and other instruments can be obtained by writing to the manufacturers, who will be glad to furnish detailed information concerning their products. An alphabetical order is followed in the presentation of the descriptions.

Clough-Brengle Model 111
Frequency Modulator

This unit, illustrated in Fig. 10, is designed to be used in conjunction with any signal generator to provide a frequency-modulated output signal. An electronic method of frequency modulation is employed which is similar to that used in the oscillator control circuits of afc-equipped receivers. The frequency modulator consists of a 6C5 oscillator stage, a 6K7 frequency-modulator stage, and a balanced detector employing a pair of type 76 tubes. The 6C5 oscillator generates a fixed frequency of 1650 kc, which is frequency modulated by an amount which can be varied from 0 to 50 kc. This frequency is mixed with the output of an external signal generator, so as to produce a frequency-modulated signal. Synchronization of the sweep is accomplished by means of a voltage taken from the power supply of the modulator unit.

Hickok Model OA-5
Frequency Modulator

This frequency modulator, illustrated in Fig. 11, is designed to be used in conjunction with any signal generator to provide a frequency-modulated signal. An electronic method of frequency modulation is employed, the action of which depends upon varying the grid-to-plate capacity of a screen-grid tube which is shunted across the oscillator tuned circuit. The fixed-frequency oscillator works at 725 kc and the bandwidth of the frequency modulation is variable from 0 to 40 kc by means of a panel control. A winding on the power transformer supplies approximately 70 volts; this voltage can be used to supply the horizontal sweep voltage when the unit is used in conjunction with an oscillograph which has no internal provision for a 60-cycle sweep. Since the same supply voltage is used for both frequency modulator and the horizontal sweep, no external provision for synchronization is necessary.

The frequency-modulated oscillator employed in the Hickok Model RFO-4 oscillograph is similar in operation to that employed in the Model OA-5 frequency modulator. However, the frequency of the fixed oscillator is 665 kc, and the extent of frequency modulation is variable up to 30 kc rather than 40 kc.

Jackson Model 420 *Frequency-Modulated Signal Generator*

This signal generator, illustrated in Fig. 12, employs an internal electronic frequency-modulator circuit, which makes it possible to obtain a frequency-modulated signal without any additional equipment. The internal fixed-frequency oscillator operates at 1100 kc, the band-width is variable from 0 to 40 kc, and the synchronization is automatic since the same power supply voltage excites both the frequency modulator and the horizontal sweep. The frequency range of the signal generator is from 100 kc to 34 mc in six bands and the dial is calibrated directly in terms of the variable-oscillator frequency. On the frequencies which are commonly used for visual alignment work, the dial is also calibrated in terms of the frequency-modulated output, so that no addition or subtraction of the fixed oscillator frequency is required.

RCA Model 150 *Frequency-Modulated Signal Generator*

This signal generator, illustrated in Fig. 13, employs an internal frequency modulator circuit which makes it possible to obtain a frequency-modulated signal without any additional equipment. The internal fixed-frequency oscillator operates at 800 kc, and is frequency modulated by a type 6C6 frequency-control tube; the action of this circuit is similar to that used in a number of afc-equipped receivers. Another type 6C6 tube produces a pyramid-shaped voltage which varies the characteristics of the type 6C6 frequency modulator so as to provide a band width of frequency modulation variable from 0-40 kc. Synchronization is effected by locking the linear sweep at 120 cycles by means of a correctly-phased pulse which is provided on the signal generator panel. The frequency range covered is from 90 kc to 32 mc in six bands; on the first four bands the dial calibration is at the difference frequency, whereas on the last two bands the calibration is at the sum frequency.

Supreme Model 580 *Frequency-Modulated Signal Generator*

This signal generator, illustrated in Fig. 14, employs an internal frequency-modulator circuit which makes it possible to obtain a frequency-modulated signal without any additional equipment. The action of the frequency-modulator circuit is based on the variation in the inductance of the fixed-frequency oscillator coil. This latter inductance contains an iron core, the permeability of which is varied in accordance with the amount of d-c which is passed through the winding. Since the frequency of the saturating current is 120 cycles, and a 60 cycle voltage is used for the horizontal sweep, it follows that four resonance curves are traced out during each cycle. Two of these resonance curves appear collapsed at the end of the sweep, while the other two curves appear folded over each other in the middle of the screen; the dial is calibrated directly in terms of the variable-oscillator frequency. The fixed-frequency oscillator operates at 600 kc, and the bandwidth is fixed at 24 kc.

Triumph Model 180 *Frequency-Modulated Signal Generator*

This signal generator, illustrated in Fig. 15, employs an internal frequency-modulator circuit which makes it possible to obtain a frequency-modulated signal without any additional equipment. The internal fixed-frequency oscillator operates at 840 kc and is frequency modulated over a fixed band-width of 30 kc by means of the dynamic input capacity of a type 76 tube shunted across the tuned circuit of the fixed-frequency oscillator. A sweep circuit using a type 885 tube provides the sweep voltage for the control grid of the 76 control tube, so that the d-c bias for this tube is varied at a 30 cycle rate. Since a 60-cycle sweep voltage is used for the horizontal spot movement, the resonance curve is traced out twice in each cycle. In practice only one of these patterns is used for alignment purposes, the beam being shifted over to one side of the screen. Since the fixed-frequency oscillator is in the circuit under all conditions, the dial is directly calibrated in terms of the beat output.

Triplett Model 1631 *Frequency-Modulated Signal Generator*

This signal generator, illustrated in Fig. 16, employs an internal frequency-modulator circuit which makes it possible to obtain a frequency-modulated signal without any additional equipment. A fixed-frequency oscillator operating at 2000 kc is frequency modulated over a band width which is variable from 0 to 40 kc. The range from 100 kc to 30 mc is covered in six bands.

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TRAINING THE EAR FOR RADIO SERVICE

(*Continued from page* 617)

ing, and the conversion of direct to alternating current is accomplished with a higher degree of efficiency.

Class "B" audio amplifiers, however, must have two tubes connected in a push-pull circuit. This condition results from the fact that due to the biasing of the Class "B" amplifier tubes to cut off, there will be no plate current flowing during the negative half cycle of grid excitation. Thus, tubes in push-pull must be used so that one tube will function on one-half cycle and the other tube on the other half cycle, delivering energy to the plate load for 360 degrees of grid excitation.

Class "B" amplifiers require a certain amount of driving power, due to the fact that the grids of the Class "B" amplifier tubes are operated at a positive potential, to produce a much more rapid increase of plate current, and as the grid current flow decreases the impedance of the circuit and consumes power, a certain amount of power must be supplied from the preceding stage. Generally the preceding stage is termed a "driver stage" instead of a "voltage amplifier stage," and must be so designed that it can supply sufficient power to overcome the grid losses and maintain the normal wave form, which would not result if the voltage across the secondary of the transformer supplying these grids were to "drop" at any period during the operation of this stage.

Due to the fact that the plate current of the push-pull stage varies during the excitation cycle, the power supply equipment for Class "B" operation must be capable of withstanding large variations in output and at the same time maintain a reasonably constant voltage. It is good engineering practice to have a separate power supply for the Class "B" final amplifier stage. This prevents common coupling and feed-back into the preceding stages of the amplifier during the period of maximum current drain upon the power supply, which would produce a feed-back voltage in the preceding stages if a common power supply were used. Common coupling would also result from the fact that the power supply would be common to the plate impedance of the final as well as preceding stages.

Class "AB"

The Class "AB" or "A Prime" amplifier might be defined as an amplifier having an irregular angle of plate current. The angle of plate current will fall between 180 and 360 degrees, depending upon the magnitude of the excitation voltage. At low operating levels, the Class "A Prime" amplifier functions as a Class "A" amplifier, with 360 degrees of plate current. As the degree of excitation increases, however, and the voltage at the grids exceeds the bias voltage, the angle of plate current decreases, while the rate of change of plate current increases, resulting in an higher degree of efficiency. It is decidedly useful where small amounts of distortionless power are normally required, and yet at the same time a large output may be necessary from time to time, and under conditions that the degree of distortion is relatively unimportant. It is by no means a distortionless amplifier, yet on the other hand it is reasonably efficient during its Class "A Prime" operation.

Our discussion on the subjects of hearing, nature of sound, and audio circuits, has been presented with a view of assisting the Service Man in his capacity of rendering service to reproducing systems, but due to constant contact with numerous radio sets and amplifiers, it becomes difficult to keep in mind the desired type of reproduction. To overcome this listen often to good full-range reprdouction, and be able to detect faulty reproduction. Service Men are specialists and can provide the type of reproduction most desired by your customers, and the fact that all customers do not hear alike should be given considerable thought. Hearing deficiencies may result in not being able to ascertain the customer's complaint, while on the other hand the customer's hearing may be impaired.

The chief hearing impediment is that of nerve deafness. Nerve deafness results in missing frequencies, such as no hearing from 2,000 to 3,000 cycles, 5,000 to 7,000 cycles, 11,000 to 13,000 cycles, and so on. Use your beat frequency oscillator to check your hearing.

Another common hearing defect is known as "tinnitus," pronounced "tin-i-tus," which means the hearing of constant or varied singular tones which do not exist, and is a form of nerve disease. Perhaps the customer does not hear a buzzing from the radio receiver but from his own hearing system. Such buzzing, or constant frequency, is started, however, by an external sound of some particular frequency. Perhaps by use of a beat frequency oscillator and running through the range 30 to 15,000, using the amplifier or set in question, the customer's "tinnitus" will be "set up" and thereby your solution. A check on the loudspeaker adjustment at various frequencies may be accomplished thereby.

In the above article, asterisks indicate parts that have been deleted due to lack of space. References to the oscillograph obviously mean the one used in the demonstration.

instructions, to selected groups of speakers for the purpose of avoiding annoyance or distraction to those not concerned, or of confining plant information to departments that properly should have it. Such switching circuits are extremely simple—double-throw switches are used, and whenever any speaker or speaker group is cut out of service a resistance of proper value is substituted in the line by the action of the switch.

Speaker selection is often used for employee entertainment during working hours. It is obvious that what is entertainment for persons engaged in monotonous operations may be a very disturbing distraction to those whose work needs attention and thought. Where the paging system does double duty in providing such entertainment it is always equipped for speaker selection. The entertainment is interrupted, and all speakers cut in back into line, when paging is necessary. The wiring is simple, and a single master control switch can perform both operations simultaneously. Where paging is very frequent, the entertainment system, if used, is entirely separate.

One plant may have several systems, for paging, for instruction or communication between specific departments, for employes relations during work, and for employee entertainment in a plant restaurant or athletic field. Satisfaction with the first installed may lead to the sale of others. Single systems that at first serve two or more functions may later be restricted to only one service and a new system bought to take care of the others. Systems are often expanded as they prove their worth, additional loudspeakers being installed, and this again sometimes calls for replacing the amplifier with another more powerful.

The system in some plants will be maintained by the plant staff, while in others periodic service visits will be preferred; but even in the former case it will usually be practicable to arrange for less frequent service visits at somewhat lower cost to the user. It is always to the advantage of the Service Man to maintain contact with an industrial customer, even if the terms of the servicing contract are not exceptionally attractive. Familiarity with plant operations and personnel, arising out of repeated visits, will almost always help him to suggest other departments or operations that can benefit by extension of the p-a facilities; and repeated discussion of service problems with the executives will help him in suggesting, from time to time, the desirability of replacing existing apparatus with later and more improved models.

HIGHLIGHTS . . .

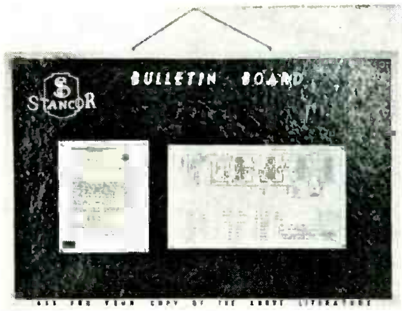
NEW JOBBER TIE-IN FOR STANCOR

A new bulletin board available to distributors carrying a representative stock of Stancor products has been announced by the Standard Transformer Corporation. This board has been designed for prominent display in the distributor's store and will be supplied monthly with up-to-date literature exploiting new developments in the Stancor line. This sales help has been in demand by jobbers for some time and will therefore be the more welcomed by Stancor distributors.

Stancor also announces the appointment of a new representative, H. A. Roes of 2002 Grand Avenue, Kansas City, Missouri, to cover Western Missouri, the state of Kansas, and Fort Smith, Ark.

Additional territory has been granted the Roye Sales Agency of New York City, to extend their travels for Stancor into Philadelphia, Delaware, Maryland, New Jersey and Washington, D. C.

These two new appointments are replacing former affiliations in those territories.—SERVICE.



"RADIO MONTH"

A plan for a nation-wide coordinated effort of the various divisions of the electrical industry of the country to make the American public radio-conscious through the observance after the first of the new year of "Radio Month," was placed before the closing session of the Second Annual Conference of the International Association of Electrical Leagues.

The recommendation was made by Harry Boyd Brown, national merchandising manager of Philco Radio and Television Corporation, one of the speakers, in the interest of the entire radio and electrical industries, with Philco remaining anonymous.

The purpose of "Radio Month" and the programs for its observance would be to focus public attention upon the imperfect performance of some 10,000,000 obsolete sets now in use in American homes and automobiles; stimulate a desire for service with its energizing effect upon the business of some 40,000 Service Men and, with improved reception, air audiences will increase with beneficial results to commercial programs and to electric power lines which now supply about 15 billion kwh of current to domestic users in a year.

The Board of Governors of the Association appointed George R. Conover, managing director of the Electrical Association of Philadelphia, the new president, as chairman of a special committee to investigate the possibilities and to prepare a complete program. On the committee with Mr. Conover are John C. Bartlett, managing director of the Electrical Institute of Washington, D. C., and Ralph Neumiller, the retiring president and executive vice president of the Electrical and Gas Association of New York, Inc.

Mr. Conover's committee will report its findings and make its recommendations to the Association's board of governors.

Through Mr. Brown, Philco offered complete cooperation in an anonymous capacity and also offered to provide quantities of envelope stuffers or circulars of a general nature and without Philco identification for use by the public utilities of the country.

It was brought out at the meeting that even a slight response by the public will tend measurably to increase the present $150,000,000 annual utility revenue accruing from current consumption by the more than 24,000,000 radio sets now in use.

Mr. Brown estimated from sample surveys that fully 5,000,000 home radios are now so badly in need of servicing that they are being used only for "emergency" use, such as prize fights and other dramatic events. He also pointed out that servicing will result in the replacement of many millions of poorly performing tubes.

"After a new radio has been in use a year," he said, "anywhere from one to three tubes in a 10-tube set will need replacing and this potential new tube business is enormous and this business can be very definitely stimulated by a nation-wide program such as 'Radio Month.'"

Robert F. Herr, manager of Philco's Parts and Service Division, also pointed out that continuing perfect performance can only be attained by yearly replacement of the aerial, a statement which was received by the delegates with astonishment.

"No matter how good and durable an outside aerial may be," he said, "it will deteriorate at the point where the twisted wires are attached to the flat top and this very decidedly affects reception."—SERVICE.

HELP!

In order that we may better serve you, will you help us to this extent—indicate, on a penny post card, whether you prefer schematic circuit diagrams, or layout wiring diagrams? Does it help you to have the d-c resistances of coils, etc., indicated on circuit drawings?

Information on these points will be helpful to the editors, and it will be passed on to manufacturers for their guidance in the preparation of servicing notes.

THANKS

RAYTHEON'S NEW DATA CHART NOW AVAILABLE

Off the press recently, was Raytheon's 11th edition of their characteristic data chart. More complete than ever before, it is said the new edition contains all and every characteristic data necessary to the interests of good servicing—facts that will be extremely valuable to distributor's salesmen, dealers, and servicemen. A free copy can be obtained from a Raytheon jobber or by writing direct to Raytheon Production Corp., 420 Lexington Avenue, New York City.—SERVICE.

CLAROSTAT SERVICE MANUAL

An entirely new Clarostat Service Manual is announced by Clarostat Mfg. Co., Inc., 285-7 N. Sixth St., Brooklyn, N. Y. Containing well over 200 pages, this handy pocket-sized manual should prove valuable to the Service Man. It provides an extensive listing of exact-duplicate and standard volume controls and resistor-tube replacements for all standard types of sets, as well as circuit diagrams, servicing hints, ballast data, attenuator data, and other information. The compilation has been under way for many months. Clarostat engineers have contacted set manufacturers and reviewed all existing service manuals, data sheets and other sources. A copy of the manual is free to any Service Man writing on his business stationery, or asking his local jobber.—SERVICE.

CLEAR RECEPTION

Under the title of "Clear Reception," an attractive and interesting folder is offered by Aerovox Corporation, 70 Washington St., Brooklyn, N. Y., on the subject of background noise suppression. This literature deals with the several ways in which noises reach a receiver, and how they may be stopped either at the set itself or preferably at the noise source. Also featured are the several types of noise eliminators or filters now available. A copy may be had through any Aerovox jobber or from the manufacturer direct.—SERVICE.

JEFFERSON TRANSFORMER CATALOG

To facilitate easy selection of radio transformers and chokes, Jefferson Electric Company, Bellwood, Illinois has just published a complete catalog of 16 pages—augmented also by a similar number of pages on public-address system amplifiers, diagrams and equipment. This catalog, No. 372-R contains data on all types of transformers, and filter, swinging and plate chokes. Tables are included also giving dimensions for radio replacement power transformers with a guide giving transformer requirements for nearly 2,000 receiver sets. Copies of the catalog are free to those interested in radio.—SERVICE.

NRPDA

A meeting of the National Radio Parts Distributors Association was held recently. The Association, which now has a membership of 150, continued in office those who were elected last June; these are: President, Leslie Rucker; Vice-President, Joseph Denambro; Secretary-Treasurer, Blakeley Cross.

No policies were formulated at the meeting, it having been decided to await the outcome of a membership drive shortly to be launched.

The Association, however, designated sixteen regions, each of which will have its own organization and select a director who will serve on the board of directors.

Headquarters of the Association are at Room 1701, 1270 Sixth Avenue, New York City.—SERVICE.

(*Continued on page* 654)

All Radiart Vibrators Got Rythm

● *"They don't mean a thing if they ain't got that swing."*

● **Unless vibrators are correctly designed so that in the proper circuit they immediately break into a full swing and continue to act that way through minimum starting voltage, they will arc, burn and sputter on starting. Don't risk a poor vibrator spoiling a good set.**

● **Play safe—insist on Exact Duplicate Radiart Vibrators from your dependable Radiart Jobber.**

New ACRO SAFETY SEALS

Every New and Old Set Needs This Protection —Extra Profit to You

The Acro Safety Seal—Connect in B-Circuit and set cannot burn out.

● Put Acro Safety Seals on your repair jobs. Then the set is safe from shorts and burn-outs. Set owner will readily approve their installation at a price that gives you real profit.

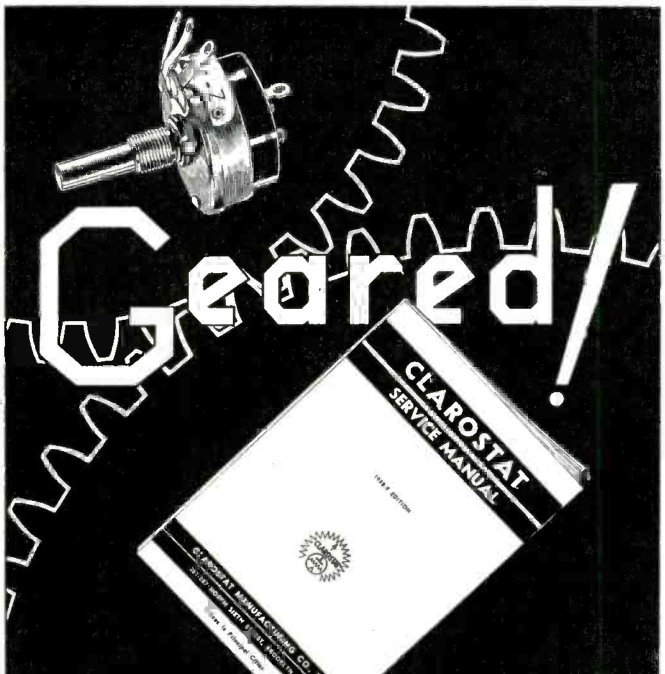
Acro Safety Seals are installed in a few seconds. Simply wire into B-circuit and solder—the set is then sealed for safety. No comebacks from jobs that have shorted due to no fault of your work. Brings you sure calls when Safety Seals burn out—a quick repair job at a good profit and a pleased customer.

Your distributor has Acro Safety Seals. The cost $1.25 per box of 10, packed 2 each of 5 sizes that will handle every make and size of set. Installed, you should receive a total of $15 from them.

Ask your distributor for Safety Seals—if he has not yet received his supply, write us direct.

ACRO TOOL & DIE WORKS

1401 WILSON AVENUE, CHICAGO, ILL.



SEND for your copy of new manual, backed by complete line of CLAROSTAT exact-duplicate replacements stocked by your jobber.

CLAROSTAT *Manufacturing Co. Inc.*

285-287 NORTH SIXTH STREET

BROOKLYN, NEW YORK, U.S.A.

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GIANT NEW METER

FOR YOUR TEST BENCH

Measuring 8⅜ inches across the case, this giant size Volt-Ohm Milliammeter is designed for installation over the service man's bench. Good, clear, accurate readings may be taken at five feet or more. This meter will impress your customers.

This "Cyclops" moving-coil, jewel bearing meter has an accuracy of 2% and is ruggedly built. Due to special construction it mounts through a 3-inch panel hole. A diagram is furnished with each meter for the service man who wishes to supply his own resistors. Meter No. 583 and diagram $15.00. Meter and switching unit No. 83 including resistors and A.C. ranges $25.75. For full information, use the convenient coupon below.

THE BURTON-ROGERS CO.

755 BOYLSTON STREET BOSTON, MASS.

Sales Division of the Hoyt Electrical Instrument Works

Gentlemen:
Kindly send me full information regarding the New "Cyclops" meter No. 583 . . . regarding the complete line of Hoyt Radio Meters . . .

Name ....

Street ....

City .... State ....

NEW C-D CATALOG

A new complete listing of the various types of radio capacitors now in demand has just been released by Cornell-Dubilier. Known as Catalog 151A, this booklet may be obtained by writing to the Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.—SERVICE.

•

RADIO STORES MERCHANDISING MOVIE OUTFITS

Radio stores all over the country are giving considerable thought to increasing promotions on movie cameras and projectors, says F. G. Klock, Sales Manager of the Universal Camera Corporation, manufacturers of UniveX Movie Outfits. He stated that radio stores realize that this profitable type of merchandise is ideally suited to their requirements, that its promotion will do much to level out seasonal sales curves.—SERVICE.

•

SUPREME OFFERS FREE WINDOW POSTER

To all new users of Supreme test instruments, the Supreme Instruments Corporation is presenting a 13¼"x18½" window poster. Write Supreme Instruments Corporation, Greenwood, Mississippi, for full information on their new 1938 instrument line.—SERVCE.

•

VIC MUCHER ELECTED TO RMA CREDIT COMMITTEE

Announcement is made of the election of Victor Mucher to the office of Vice-Chairman of the Eastern Credit Committee of the Radio Manufacturers Association, succeeding Ed Metzger. "Vic," the genial business manager of the Clarostat organization, has long been known for his thorough grasp of the radio credit situation.—SERVICE.

•

JOHNSON JOINS HYGRADE SYLVANIA

The appointment of Henry C. L. Johnson as Assistant Advertising and Sales Promotion Manager of the Radio Tube Division of Hygrade Sylvania Corporation has been announced by Paul S. Ellison, Manager of Renewal Sales and Advertising. Mr. Johnson was formerly advertising manager of Thordarson Electric Corporation, prominent transformer manufacturers of Chicago, where he made an excellent reputation with the trade.

Mr. Johnson will be attached to the executive sales office of Hygrade Sylvania at 500 Fifth Avenue, New York City, where he will work directly under Mr. Ellison both in creative work and in a liaison capacity with the company's office at Emporium, Pennsylvania.—SERVICE.

•

PHILCO MANUAL

A very complete radio tube manual has been published by the Philco Radio & Television Corporation under the auspices of the Radio Manufacturers Service. The 64-page volume printed on coated paper and measuring 6¼" by 9" will be ready for distribution to the trade within a short time. Thirty-four pages are devoted to socket layouts of home sets listed numerically by models; seven pages to socket layouts of auto sets; nine pages to characteristic tables, bulb sizes and types; four pages to base views and schematics; two pages to tables of bases and types, and four pages to tube complement list for all Philcos ever produced.

A convenient cross-reference model-locating table appears on page two, to be used to find models listed under others which have the same socket layout. More than 200 illustrations are embodied in the volume.

The 1937 edition of the Philco Auto Radio replacement parts chart is off the press and is being distributed to the trade. The chart lists every auto radio, standard as well as custom-built, ever turned out by Transitone Automobile Radio Corporation, Philco's auto radio division.—SERVICE.

•

BOOK REVIEW

AUTOMATIC FREQUENCY CONTROL SYSTEMS, by John F. Rider. 144 *pages,* 101 *illustrations, hard cloth cover,* 5¼x7¼. *Price,* $1.00. *John F. Rider, Publisher, New York.*

The first book to make its appearance on the important subject of automatic frequency control, John F. Rider's "Automatic Frequency Control Systems" should receive a warm welcome from those interested in the subject. Written primarily for Service Men, the book presents an unusually complete treatment of a-f-c circuits, with special emphasis on their application in American radio receivers.

The first chapter of the book is an introduction to the subject and explains briefly but clearly what a-f-c is, how it works, and why its action is desirable in radio receivers. In the second chapter, those principles of electricity which are of special importance in the understanding of a-f-c circuits are reviewed for the benefit of those who may be a bit hazy on their radio theory. The third chapter explains the manner in which the various types of discriminator circuits operate, while the fourth chapter deals with the different types of oscillator control circuits. In both these sections, the emphasis is on the explanation of the fundamental principles of operation, and the function of the different components which are used in the circuits.

The circuits which are being used in this and last year's radio receivers come in for their full share of attention. In Chapter V, these circuits are broken down, and it is clearly demonstrated how their operation is related to the basic action explained in the early chapters. This section is of special importance to the reader, because the circuit variations used by many manufacturers are often different enough to make it difficult to analyze their operation. Here again the treatment is unusually complete, the various types of discriminators and control circuits—both single ended and push-pull—being broken down in detail.

Service Men will be especially interested in the last two chapters, which deal with the methods of aligning a-f-c-equipped receivers, and with the servicing problems peculiar to these circuits. A significant point brought out by the author is that the servicing of receivers equipped with afc does not revolutionize servicing problems, but rather adds the problems of afc to those already confronting the Service Man. Such problems as a-f-c hum, motorboating, the checking of discriminator and control circuits, faulty oscillator operation, poor dial calibration, and loss of signal control are taken up in detail.—SERVICE.

MANUFACTURERS—continued

UNITED ELECTRONICS 966

Claimed to be exceptionally quick starting, the United Electronics rectifier, type 966, should be of interest to those requiring a mercury-vapor rectifier tube. This tube is interchangeable with the 866.

Further details may be obtained from the manufacturer, United Electronics Co., 42 Spring St., Newark, N. J.—SERVICE.

•

WEBSTER "TELETALK"

The model 105 Teletalk is a loudspeaker inter-communication system for use in office, factory, home, etc., where inter-communication between one point and one to five remote points is desired either as a group or selectively. A system consists of one master station which is selective and which controls the direction of the conversation and originates the call to the remote speaker stations which can answer the master station only when called. No communication is possible between the speaker units.

Cabinets are solid walnut with a hand-rubbed finish. Communication with 14 gauge wire can be carried on over a distance of 3,000 feet. Teletalk is manufactured by Webster Electric Company, Racine, Wisconsin.—SERVICE.

SUPREME MODEL 581 SIGNAL GENERATOR

The Supreme Model 581 Signal Generator and Frequency Modulator employs a 340-degree dial which has an actual scale length of over 8 feet. New hairline indicating shadow-tuner "spot lights" the individual range and frequency desired eliminating parallex. The 38-to-1 ratio between tuning knob and condenser results in micrometer tuning and real accuracy. Emits (1) Unmodulated rf, (2) 400-cycle amplitude modulated rf, (3) 24-kc band-frequency-modulated rf, (4) Fixed 400-cycle af, (5) Variable 0 to 10,000-cycle af. Use with any scope for visual alignment. Send for full particulars to Supreme Instruments Corporation, Greenwood, Mississippi.—SERVICE.

•

AUTO RADIO AIDS

Designed to assist the dealer in the display of auto radio accessories, the cabinet by the Ward Products Corp. should prove of value. In addition to the cabinet, the price includes an assortment of aids such as suppressors, ammeter condensers, wheel static collectors, etc.

Complete details are available from the company whose address is Ward Bldg., 1523 E. 45th St., Cleveland, Ohio.—SERVICE.

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BALLAST TUBES

(RESISTOR UNITS)

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ALSO A COMPLETE LINE OF RADIO RECEIVING TUBES

A Profitable Line to Handle

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TRIAD MANUFACTURING CO., INC.
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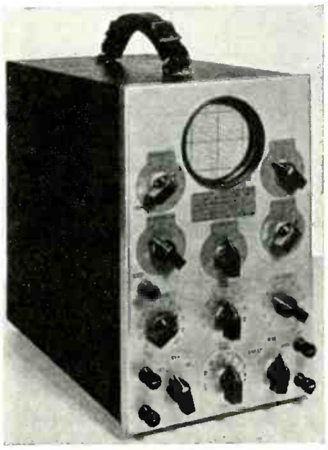
RUGGED — DEPENDABLE — ACCURATE

DU MONT TYPE 164

3-INCH SERVICE OSCILLOGRAPH



$64.50

COMPLETE

A real service instrument built especially for the service engineer with the same skill and care that has made Du Mont instruments the choice of the leading industrial and college laboratories of the world. Complete in every detail the 164 offers the desirable features of vertical and horizontal ampilfiers, amplified sweep, internal or external positive synchronization and separate positioning controls on the front panel. The 164 is designed to operate with any standard type of frequency modulated oscillator.

Ask Your Jobber

Allen B. Du Mont Laboratories, Inc.
Upper Montclair, New Jersey

UNIVERSAL DUPLICATE

THORDARSON

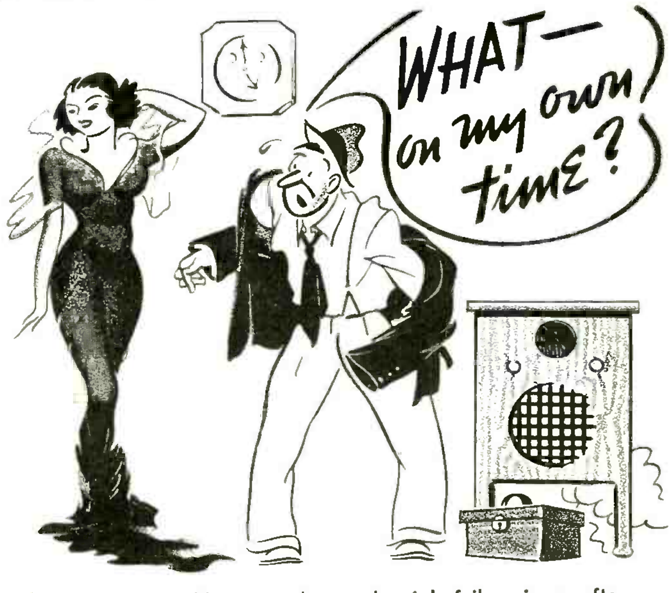
REPLACEMENT TRANSFORMERS

SPOT that Replacement Transformer in a flash with Thordarson Replacement Encyclopedia No. 243. FREE at your Parts distributor, or 15c postpaid from factory.

for 99.8% of all radio receivers listed in Ryders 7 volumes. NOW!! Perfect matching, plus Thordarson quality for long life, trouble free, service.

THORDARSON ELECTRIC MFG. CO.
500 W. HURON ST., CHICAGO, ILL.

Demand "Power by Thordarson"



No service man likes to make good a job failure in or after working hours. That is why so many radio repair men are using Ward Leonard Replacement Parts. These parts are conservatively rated and thoroughly tested before you get them. Send for data shown in Price List No. 507A.

WARD LEONARD ELECTRIC COMPANY
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Please send me service man's price sheets No. 507A.

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RACON P. M. Units

An efficient permanent magnet horn unit requiring no outside excitation. Aluminum nickel steel magnets are used to supply maximum flux density in the air gap. Cast bronze case, completely enclosed, making Unit water tight.

15 ohm impedance at 1000 cycles. Continuous operating capacity 10 watts.

Peak load capacity 30 watts.

RACON'S catalog S-10 describes the complete line of Horns, Electro-dynamic Units and Acoustical Sound Projectors.

RACON ELECTRIC CO., INC.
52 EAST 19th STREET NEW YORK CITY

Model NKM 3600

ESSENTIAL

To All Radio Technicians

Nokoil Multi-Test Speaker Tests all AC and DC Radios

- Tests automobile radios without removing Speaker
- Easily locates a faulty speaker in a line of PA units
- Checks approximately the impedance into which an amplifier is designed to operate.
- Handsome Steel Carrying Case with soft Suede finish

List Price $36.00

Write for complete description and name of our nearest distributor. Wright-DeCoster Distributors are always anxious to cooperate.

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Taylor & Pearson, Ltd., Edmonton, Alta.

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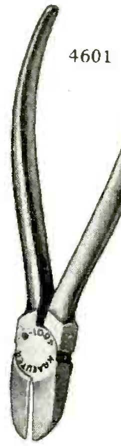

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IF IT'S *QUALITY* YOU'RE LOOKING FOR, REMEMBER THE NAME KRAEUTER

That's because Kraeuter Pliers do the job quicker and better. As, for example, the diagonal cutting pliers 4601 shown here, made especially for close cutting and precisely fitted for exact work.

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(Pronounced KROY-TER)
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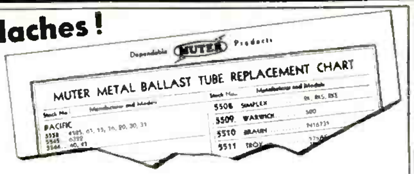
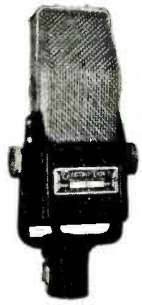
No More Headaches!

This *NEW* MUTER Chart Simplifies Ballast Tube Replacements.



Jobbers told us, "this ballast tube replacement business is a headache, why doesn't somebody do something about it!" So we did. The new MUTER chart shows the correct replacement unit for every make and model of set. In addition, a cross-reference listing simplifies your inventory. With just a few MUTER ballast tubes, you can meet practically every replacement requirement. No more disappointed customers! No more lost profits! No big slow-moving inventories! And remember, the MUTER line of metal ballast tubes is the sweetest you ever saw. They are standard equipment by many leading set manufacturers. Take this easy step to bigger profits! Get this MUTER Ballast Tube Chart. Your copy is ready. Address Dept. S-10 TODAY!

THE MUTER COMPANY
1255 South Michigan Ave., Chicago, Illinois



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"V" Series Velocity Microphones

The smooth trim lines and screen housing are more than just style. They contribute to the top performance that typifies the "V" Series. No side-wall reflection. No resonance.

Priced from $25 to $75 list.

Write for catalog. See your jobber.

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★ ALWAYS CARRY Ken-Rad Radio Tubes

Ken-Rad genuine *all-metal* radio tubes are dependable. They give outstanding performance. Write for information.

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MILLION TUBE AND CONDENSER TESTERS

MODEL CP Net Cash Dealer **$13.95**

D'Arsonval Good-Bad meter test all types and leaks, hot with neon. Line voltage adjustment. Bypass and electrolytics.

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Large square meter and continuous line voltage adjustment.

MILLION RADIO AND TELEVISION LABORATORIES
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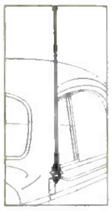
FOR MAXIMUM EFFICIENCY, STREAMLINED BEAUTY



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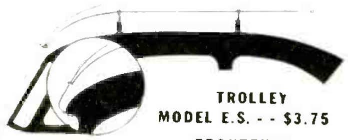
MODEL C.O. $2.45



TROLLEY
MODEL E.S. - - $3.75

FRONTENAC
(Inset) MODEL F.R. - - $3.50

MAINLINER
MODEL M.L. $2.95

PROMPT DELIVERIES GUARANTEED

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The WARD PRODUCTS Corp.
WARD BUILDING CLEVELAND, OHIO

RADIO IN IT S ENTIRETY!

B-A HAS IT!

"B-A" serves the trade with every need in radio. Complete 160-page catalog of radio receivers, public address systems, parts, supplies and equipment is now available. You will find your favorite nationally known lines represented in this big book. Orders will be shipped the same day as received.

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Write for complete catalog

SOLAR MFG. CORP., 599-601 BROADWAY, NEW YORK, N. Y.

For the First Time!

Complete RCA ANTENNA

FOR ONLY $3.95

Here's a performance ace—at a price everyone can afford! Tell your customers about the New RCA 395 Antenna!

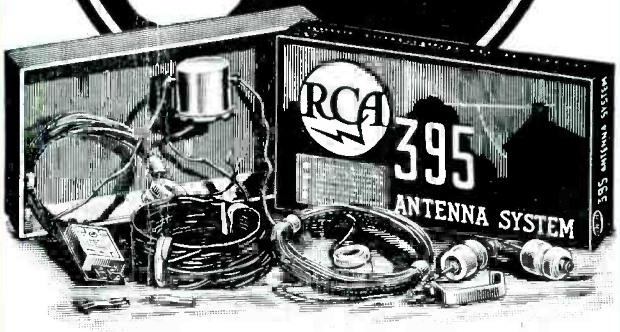
Never before has a genuine RCA Antenna been priced so low! Now you can offer your customers RCA quality PLUS rock-bottom price. That's a combination that will bring you extra profits! The RCA **395** Antenna System is scientifically designed and operates perfectly with all receiving sets, regardless of type or make.

Easy to Install

Easy installation is one of this antenna's many features. Two supports, 40 feet apart, are all that's required. No assembling or soldering necessary.

High signal strength is provided over a very wide frequency range (140 to 23,000 kcs.), with antenna proper serving as an efficient pick-up medium. Signals are sent to receiver by new type transmission line, which is matched to the radio's input circuit by coupling unit. Start pushing this fine new antenna system today! It's made to order for volume sales and profits!

See your RCA parts distributor for the complete line of RCA Antennas



Here's the new RCA 395 Antenna System! Comes completely assembled and soldered. Kit contains two 20-foot antenna wire coils, two strain insulators, one 45-foot transmission line, one junction box, one receiver coupling unit, two coupling unit links, two nail-on knob insulators, one ground clamp and one instruction sheet. Stock No. **395**, list price only **$3.95**

CHECK THESE FEATURES!

- √ Factory assembled—no soldering
- √ Easily installed—40 foot span
- √ Wide frequency range—140 to 23,000 kcs.
- √ Doublet type—efficient pick-up
- √ For use with all receivers

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