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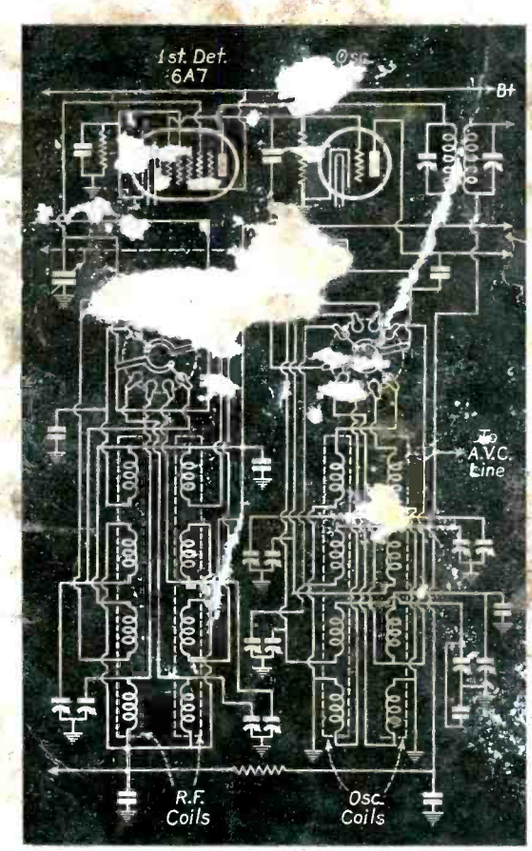

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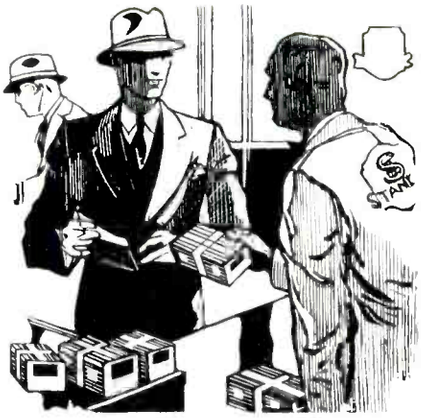

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

Vol. 3, No. 11
NOVEMBER, 1934

EDITOR
M. L. Muhleman

ASSOCIATE EDITOR
Ray D. Rettenmeyer

EDITORIAL CONTENTS

BRYAN S. DAVIS
President

JAS. A. WALKER
Secretary

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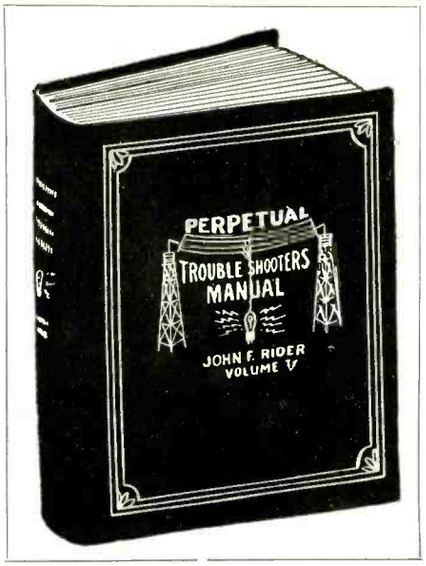

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Autocrat	6	Lewol	5
Balkeit	7	Mission-Bell	6
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Colonial	16	Noblitt-Sparks	11
Crosley	25	Philco	19
Detrola	7	Pilot	10
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THE ANTENNA...

SERVICING AS A BUSINESS—I

IS the Service Man about to become business-minded? Is he to sacrifice a certain amount of his technical superiority to the name of Business, or is he to remain a man with a profession? This is a question which not only requires an immediate answer but also requires more than the usual amount of thought. The time has come when the Service Man must choose the road he is to follow in the future.

Within the past few months a great number of Service Men have become acutely conscious of the business angle. No doubt this has been brought on by the numerous talks and articles on the subject which have recently been directed to the Service Man. Some of the talks and some of the articles have been remarkably good ones; others have been as remarkably poor for the reason that they are misleading.

We wish to record our own conceptions of the entire situation so that the reader may reflect upon them and make his own decisions. Moreover, since the subject is such a vital one, and may prove to be the turning point in the vocation of radio servicing, we respectfully request that our readers extend us the favor of their own opinions on the subject so that *all* of us can get to the bottom of the matter.

Summed up, the question seems to be this: Is radio servicing to be a business or a profession? Should the Service Man, for example, assume the status and the "consciousness" of a business man, or shall he remain a professional in the sense that a doctor is a professional man?

A contemporary publication has made the statement that if the Service Man is to get any place, he must learn to be a business man first and a Service Man second. The statement bears particular reference to the Independent Service Man who, it must be admitted, has had pretty tough sledding. The suggestion implied by this statement is that technical ability in servicing is of secondary importance in relation to the business end of it, and should therefore be taken with a lesser amount of seriousness than in the past.

Suppose we analyze this: First of all, if our memory serves us well, a good part of the depression was due to too much business and not enough service . . . too much paper work and not enough actual knitting. Likewise, it has been our impression that the real damage the radio servicing profession has suffered has been due to too much "business" and not enough servicing. We are not referring to the well-established and reputable service organizations, but rather to the high-pressure fellows who are more interested in closing a deal at any price than they are in the grade of work they do.

The same publication previously referred to also made the statement that no one but a moron will deliberately sell below cost. This may refer to the "business" fellow as we know him, or may again refer only to the poor Independent Service Man who must compete with the fellow who places "business" before service. Be that as it may, the answer to this problem would appear to be the elimination of the "business" fellow rather than a campaign of "big business to combat big business" which, as we know only too well, would end up in a wave of moronic competition that would put the gangster to shame.

If our contemporaries are referring only to the advantages of common sense in the conducting of a servicing business, then we heartily agree with them that it is obviously a good thing. Common sense is always a good thing. It takes only a bit of horse sense to realize that some servicing jobs are unprofitable and should therefore be left strictly alone.

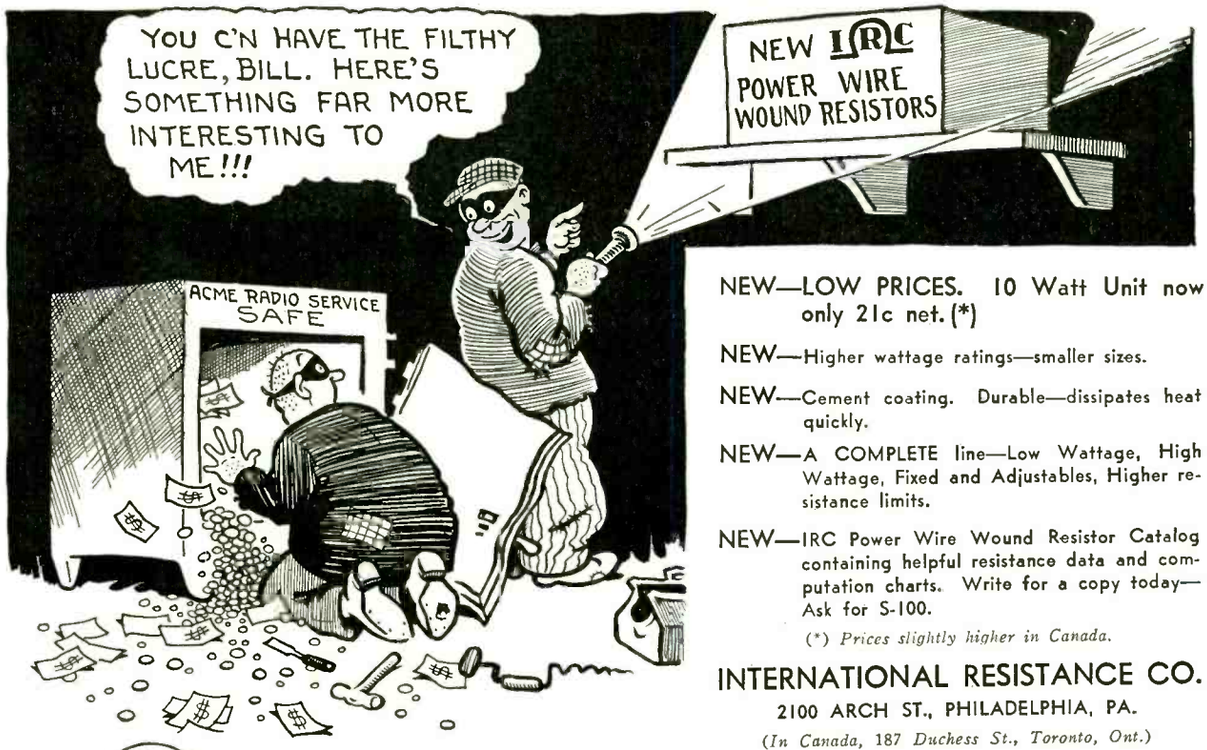
Now suppose we look at this matter of profit in radio servicing. J. P. Morgan would starve to death if he attempted to make a living out of radio servicing without resorting to the employment of good radio men, yet J. P. Morgan is a good business man. Let us call that the extreme in idiocy as an example, but it serves to indicate that something more than business knowledge is required to get along in this game. It also implies, or should imply, that no matter how good a business man the Service Man may be, he isn't worth much and can't expect to make his profession profitable over a long period of time, if he isn't an A-1 technical man. In other words, it is our impression that the most important thing in the radio servicing game is the capability of doing a good repair or adjustment job. If you do a good job, you'll get more business . . . if you do a poor job, you're through, and there are no two ways about it. You can't expect people to be suckers more than once.

We have listened to Mrs. Jones rave to her neighbors about Dr. So-and-So who cured her of her asthma and also pulled little Bobbie through a bad case of pneumonia, and we have seen Dr. So-and-So grow in importance, in popular respect, and in material wealth. Why? Because he is a good business man or a good psychologist? Hardly. He obtained the respect and the business of these people because they had faith in his knowledge, his judgment and his experience. Dr. So-and-So is a success because he knows his stuff. He can diagnose correctly and "repair" effectively because of his professional ability—not because he is a good business man.

How can you make a profit in radio servicing if you don't know your stuff? Profit hinges almost completely on the ability of a man to correctly determine a receiver fault and locate its source, all within a short space of time. If the job drags out for hours or days, there is no profit in the job no matter how much figures may be juggled.

It should be evident from the above that our interpretation of "business" in the servicing game is not the same interpretation given it by some others. When we speak of a Service Man as a Business Man we are referring to the fellow who is using his technical knowledge to forge ahead, not to the fellow who is attempting to make business take the place of good servicing.

Well, what do *you* think? Which should come first —servicing or business? And why? Let's thrash this out once and for all.



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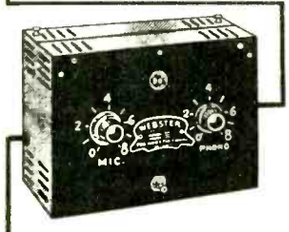

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR NOVEMBER, 1934

PUTTING THE CATHODE-RAY TUBE TO WORK

By S. S. Egert and J. Sadowsky*

Complete, self-contained cathode-ray oscilloscopes are now available for general service work. These devices provide a visual indication of circuit conditions and can be used to trace rapidly and effectively most any class of receiver fault.

The most important and interesting application is to the alignment of r-f and i-f circuits. One may "look in" on any circuit and determine its condition by the character of the waveform on the oscilloscope screen.

The oscilloscope is easy to use and if properly calibrated may also be employed for actual measurement aside from the study of waveforms. It permits the rapid determination of receiver faults and in this respect cuts down the Service Man's "time cost" or "time charge" which in either case makes the servicing of a modern receiver a profitable, yet inexpensive, procedure.

Further data relative to the use of the oscilloscope in servicing work will appear next month.—THE EDITOR.

IT IS interesting to review the general trends in the design of radio receivers along with the design of the test equipment for locating modern receiver faults.

Within the past two years innumerable complex circuits have entered into the design of broadcast, all-wave and high-fidelity receivers, with the result that it is not always possible for the Service Man to accurately measure all components or follow exactly just what is happening in any individual tube circuit. The very complexity of receiver design has, therefore, created a demand for test equipment which will meet all present-day requirements.

MODERN TEST EQUIPMENT

Modern test equipment has been designed with the thought in mind of providing the greatest amount of test coverage in the least amount of time. This has been the primary idea, coupled with the fact that some of the new units permit a more accurate check of circuit conditions and consequently permit of greater accuracy in alignment, etc.

The newly designed signal generators, set analyzers and special tube testers accomplish the desired results in most cases, although there has been a consistent demand for some device which would provide an actual visual indication of resonant conditions in tuned circuits so that even more accurate circuit adjustments could be made, with a consequent improvement in the over-all fidelity of receiver reproduction. The one device which will permit this is the cathode-ray oscilloscope which has been used by set manufacturers and research laboratories for many years. This device has finally emerged from its character as purely "laboratory equipment" and has, through simplification of circuit and mechanical structure, entered the field as a distinct and practical servicing device as well.

ADVANTAGES OF OSCILLOSCOPE

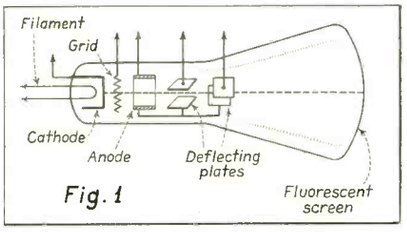
The cathode-ray oscilloscope has the advantage of giving an actual visual picture of, say, the resonance curve of an r-f or i-f transformer. If the adjustment of the tuned circuit is altered, the curve on the oscilloscope screen changes also. The adjustment is correct when the curve is *seen* to be correct. Since the curve may be seen, it is possible to judge: first, the selectivity of the circuit; second, the relative gain; third, distortion; fourth, the high-fidelity characteristics of the curve; fifth, the presence of low or high audio-frequency gain or attenuation, etc. Consequently, such factors as excessive regeneration, or oscillation, will also make their presence known.

The desirability of the oscilloscope as a servicing instrument would not be so great if its application were limited to those points discussed. It so happens that the device may also be applied to the test of practically any type of radio circuit or radio component. But, before going too deeply into this, let us analyze the cathode-ray tube and see how it fits into the picture.

THE CATHODE-RAY TUBE

Fig. 1 shows the main elements of a cathode-ray tube. They are: a filament, a cathode, a grid, a focusing arrangement, an anode plate, and two sets of deflecting plates which are at right angles to each other. Describing the action of the tube briefly: the filament heats the cathode which in turn emits a stream of electrons, just as in an ordinary vacuum tube. This stream of electrons is drawn to the anode plate by means of a high positive potential impressed upon it. The focusing plate, which completely surrounds the stream of electrons, has a negative potential which repels the electrons and concentrates them into one single, narrow beam. The beam is directed to a fluorescent screen and results in a spot of visible light.

There remains two sets of deflecting plates to be accounted for, and in a sense they are the most important part of the tube. As the beam of electrons



Details of typical cathode-ray tube.

*Egert Engineering Co.

requires no inertia to bend it, it can be attracted and repelled by either set of deflecting plates. The degree of attraction or repulsion is dependent upon the voltages impressed on the deflecting plates, whether these voltages are positive or negative, and the frequencies. As the pairs of plates are at right angles to each other, one pair can pull the beam one way and the other pair of deflecting plates can pull the beam the other way, with the result that the picture viewed by the naked eye on the screen of the cathode-ray tube may assume most any imaginable pattern. In other words, two coordinate pictures can be drawn on the screen by means of synchronizing the time action of the signal under inspection as against its voltage.

The Sweep Circuit

The most common use to which the cathode-ray tube is put is the analyzation of single sine-wave forms. In order to do this, a varying voltage at a predetermined frequency is placed on one set of deflecting plates (this is called the "sweep circuit") and an alternating voltage of the same frequency is placed on the other set of deflecting plates. By timing these two actions, a single sine wave can be shown on the face of the tube.

In the last five years there has been considerable research work done in an attempt to obtain a direct selectivity curve of any single resonance or multiple resonance circuit of a radio receiver on the screen of a cathode-ray tube. This is not easily done.

Selectivity in a radio receiver indicates the overall resonance response of the receiver over a 5-kc range either side of any definite setting of the main tuning control. Fig. 2 is an illustration of an overall selectivity curve of a radio receiver, when set at 760 kc. Note that the zero reference on the chart is placed at 760 kc, and abscissa readings vary 5 kc either side of 760 kc, or to 755 kc on one side and 765 kc on the other side, respectively. The ordinate or vertical coordinates of the selectivity diagram is voltage or sensitivity response of the radio receiver at the intermediate points of the 5-kc sidebands.

Selectivity Curves

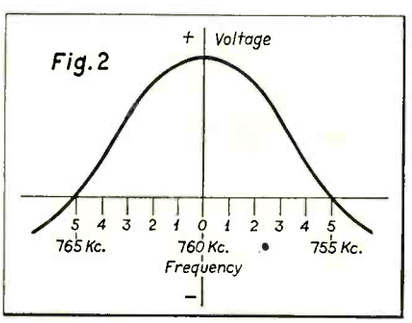
Now apply this problem to a cathode-ray tube. The first thing is to obtain a constant voltage varying at a predetermined frequency of 5 kc either side of some frequency, as for example, 760 kc. Then apply this varying frequency and constant voltage component to the antenna of a radio receiver and at the same time, from the same source which is producing this frequency variation, a voltage is impressed across the horizontal deflectors. Then take the output voltage after rectification in the receiver and place it across the vertical set of deflectors of the cathode-ray tube. If the voltages applied across the two sets of deflecting plates of the cathode-ray tube are properly synchronized as to frequency, the resultant pattern which will be obtained on the screen of the cathode-ray tube is the overall selectivity curve of the radio receiver at 760 kc. In other words, the pattern obtained shows the overall resonance characteristic response of the numerous radio-frequency resonance circuits in the receiver to the constant voltage and varying frequency component fed into the antenna.

Complete Circuit Picture

The ability to do this is of inestimable value for general practical service work. Remember that you have shown to you directly on the face of the screen, not only the voltage gain, or selectivity of the set, but an instantaneous picture of the selectivity and fidelity characteristics of the receiver. Once this pattern is obtained, every circuit in the receiver is under control. The cathode-ray tube here will show the effect of any variation of any circuit or part in the receiver. This holds true for any change in capacity, inductance or resistance.

Other Resonance Pictures

Applying the above mentioned principle of the constant-voltage, varying-frequency component, it is not only possible to check the overall resonance characteristic of a radio receiver on the cathode-ray tube, but it is also possible to obtain an instantaneous picture of any single or multiple resonance circuit as well. This holds true even for a single coil and condenser combination. When applied to the set, it will check single or multiple sets of i-f stages as well as single or multiple sets of r-f stages, if the constant-voltage, varying-frequency component is available over the entire frequency spectrum. In fact, it would be most useful if it were available over a range of 100 kc to 22,000 kc as with this range it would be possible to check either i-f circuits, r-f circuits or general overall r-f and i-f circuits at any frequency setting of any modern all-wave radio receiver being built today.



Overall selectivity curve of a radio receiver.

Types of Patterns

As there are an infinite number of types of patterns that can be obtained on the screen of the cathode-ray tube when the receiver in question is being subjected to various tests, it will be necessary for the Service Man to learn just what the various types of patterns are in order to properly analyze what is happening in a receiver.

A series of standard patterns are shown in Fig. 3 in order to acquaint the Service Man with the various types of selectivity curves which will be obtained for various conditions existing in the radio receiver.

Patterns 1 to 16 are being analyzed on the following basis: Assume that a signal of 760 kc is being fed into the antenna of a radio receiver and the output signal after rectification is fed to the vertical deflector plates of the cathode-ray tube.

Pattern No. 1 shows definite cut-off, 3 kc either side of the 760-kc tuning position of the set. This means that all audio frequencies transmitted by the broadcast station will be cut off at 3 kc by the receiver.

Good and Poor Selectivity

Pattern No. 2 shows one sideband being cut off at 3 kc and the other sideband extending over 6 kc. Very bad distortion will enter here on one sideband due to the 3 kc cut-off. Also selectivity will be poor in the other sideband as the resonance of the set will extend into the next broadcast channel.

Pattern No. 3 shows an almost perfect overall resonance characteristic of a set. Note that full strength signals are obtained almost over the entire sideband width of 5 kc either side of the 760-kc tuning position of the receiver.

Pattern No. 4 shows a condition similar to No. 2 except that here there will be a more serious condition of distortion and poorer selectivity. In this case the broadcast station operating in the channel next to 760 kc will undoubtedly come through the loudspeaker.

Pattern No. 5 shows a very much worse condition of selectivity than Nos. 2 and 4, as there is a definite overlap into the broadcast channels both sides of the 760-kc broadcast channel.

I-F Curves

Pattern No. 6 shows an excellent alignment when two stages of intermediate frequency are employed. Note here that the amplification over the entire 5-kc band-width each side of 760 kc are amplified to almost full signal strength. Also note the two double bumps on top of the curve which are obtained by slightly staggering the resonance points of the two i-f stages.

Pattern No. 7 shows a condition

somewhat similar to No. 6 except that one of the i-f stages should be adjusted to give slightly more gain.

Gain Curves

Pattern Nos. 8 and 9 show a condition of staggering two i-f stages but also, as in No. 7, with one of the stages having a lower resonance gain than the other.

Pattern No. 10 shows the effect of staggering three i-f stages. Note that this very much better selectivity curve gives almost full amplification of both sidebands over the entire sideband range.

Pattern No. 11 shows another condition of a three i-f stage staggering effect, but with a somewhat added amplification of the lower frequencies.

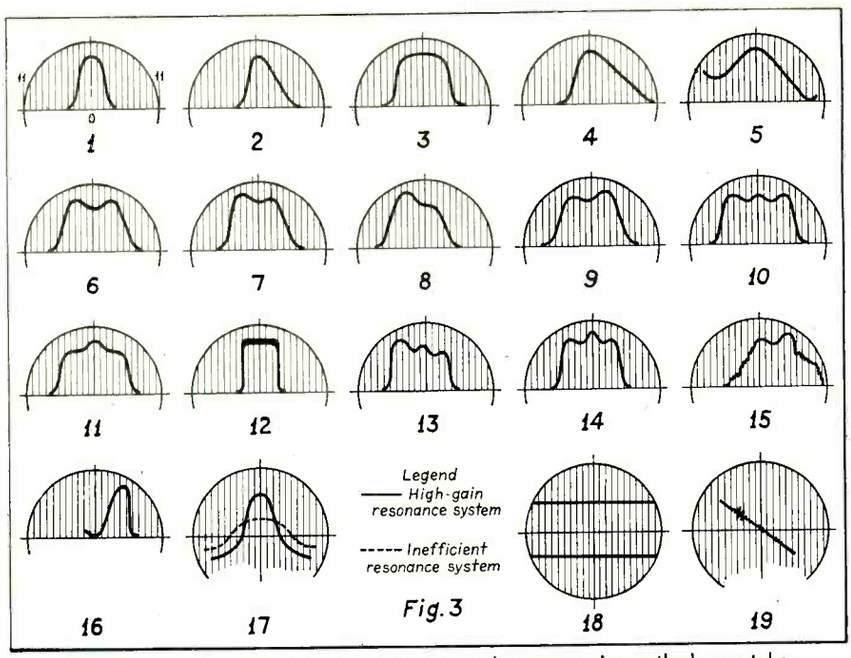
Pattern No. 12 shows the discrimination against a very powerful signal when the set is tuned to a very sensitive point. In other words, it shows how well the set will respond to a distant signal in an adjacent channel with a local station transmitting full blast. In this case the set has excellent selectivity.

Pattern Nos. 13 and 14 show various effects that might be obtained when attempting to stagger three i-f stages.

Pattern No. 15 shows a definite condition of oscillation. Oscillation is indicated in an instrument of this type by means of wave formations on the selectivity curve itself.

Pattern No. 16 shows the tuning of a single resonance circuit with definite cut-off on one sideband and at the same time slightly off frequency.

Pattern No. 17 shows the difference between the high-gain and low-gain resonance circuits.



Various types of resonance curves as seen on the screen of a cathode-ray tube.

Auto-Vibrator Patterns

Pattern No. 18 shows an ideal condition for a mechanical vibrator used in an automobile "B" eliminator when the sweep frequency is different from the vibrator frequency.

Pattern No. 19 shows the effect of a mechanical vibrator when the voltages for the deflector plates are taken off the primary and secondary of the power transformer, with voltage divider on the secondary attenuated so that the resultant secondary voltage is equal to the primary voltage. The areas that appear like smudges show the effects of transients.

MODERN TUBE CHARACTERISTICS

The various tubes in the 2.5- and 6.3-volt groups may be compared one with the other and with each other in well-defined groups. Starting with the small triode tubes, one finds in the 2.5-volt line the 27 and the 56. The corresponding types in the 6.3-volt line are the 37 and 76. While the 56 and the 76 have identical electrical characteristics, excepting for the heater voltage and current, the 27 and 37 differ slightly. The 37 has a smaller cathode, using less wattage than the 27, and has somewhat reduced mutual conductance and plate current, but for all practical design purposes may be considered as essentially the same.

Diode-Triodes

Also, in this group of small triodes, one might add the several tubes which have, in addition to the triode, a pair of diodes. In the 2.5-volt line are types 55 and 2A6. The 6.3-volt line has types 85 and 75 corresponding respectively to the 55 and 2A6. Type 55 has an amplification constant of 8.3, while that of the 2A6 is 100, thus accounting for the differences in voltages and currents used to get the same mutual conductance of 1100. Where power is not needed, but high gain and high output voltage is desired, the 2A6 is usually used.

Tetrodes and Pentodes

The sharp cut-off tetrodes and pentodes which find service mainly as first and second detectors in superheterodynes may be put in one group. In the 2.5-volt line are the 24 and 57 tubes, with the corresponding tubes in 6.3-volt line being the 36, 6C6 and 77. Types 36 and 24 are tetrodes, whereas 57, 77 and 6C6 are pentodes. The 36 has a smaller cathode than the 24, but with characteristics which very nearly coincide excepting for less wattage in the heater. Type 77, while having a structure quite different from the 6C6, has essentially the same electrical characteristics. The 77 has a shield around the plate, while the 6C6 has a shield above the plate. The use of this outer shield makes the 77 require less shielding in a radio receiver, while, on the other hand, it increases the output capacity, which may prove a disadvantage in certain high-frequency circuits.

Variable-Mu R-F Tubes

Tubes recommended for service in the i-f stage, r-f stage and sometimes first detector, form a group of pentodes and tetrodes which has a remote cut-off control grid characteristic, thus enabling one to control gain without introducing distortion or cross-talk. Here again one finds that the 2.5-volt line has fewer types than the 6.3-volt line. In the former group are found only the 35 and the 58. The 35 is essentially a type 24 having a remote cut-off type grid; the 58 bearing the same relation to the 57. Corresponding to these tubes in the 6.3-volt line are the 39, 44, 6D6 and 78 types. The 39 has less remote cut-off than the 35, having been designed for use in automobile radios where the input signals never reach the value encountered in home sets using large aerials. Type 78 has characteristics lying about halfway between the 39 and the 6D6, while the 44 is so similar to the 39 that a tube is now made which replaces either the 39 or the 44 and is designated type 39/44. All of these tubes, with the exception of the 35, are pentodes, some of them having the suppressor grid brought out on a separate pin. Another structural difference is that types 58 and 6D6 have a shield above the plate, while types 39/44 and 78 have a shield around the plate.

(*Continued on page* 433)

WHY HE SUCCEEDS IN SERVICING

By R. C. PENDER

IT was in his little display room that I had an interesting talk with "Al," as his two employees call him, about the present and future of radio servicing. His smile was so beaming, and he seemed so good natured that I was soon calling him "Al" myself.

His place is on the main street of Lakewood, a residential suburb of Cleveland, Ohio, and about five miles west. His business is incorporated as "Lakewood Radio Service."

"Do you do radio servicing exclusively?" I asked. "Not exactly," was the ready answer, and he went on: "That mostly, but two other things: I carry about ten receivers on my floor, and sell my share. Being an experienced Service Man, and having been here 12 years, people believe I know something about receivers, and they take my word when I recommend what I carry, and that goes farther than the word of a clever salesman, who is a salesman only."

"What is your other line?" was my next query, although I could see by looking on the shelves and in his showcase.

"I also carry a line of tubes, and a line of parts and get quite a little business from other Service Men hereabouts. This is profitable, but it also brings me some of their jobs when they get stuck, which is common with fellows who don't keep informed."

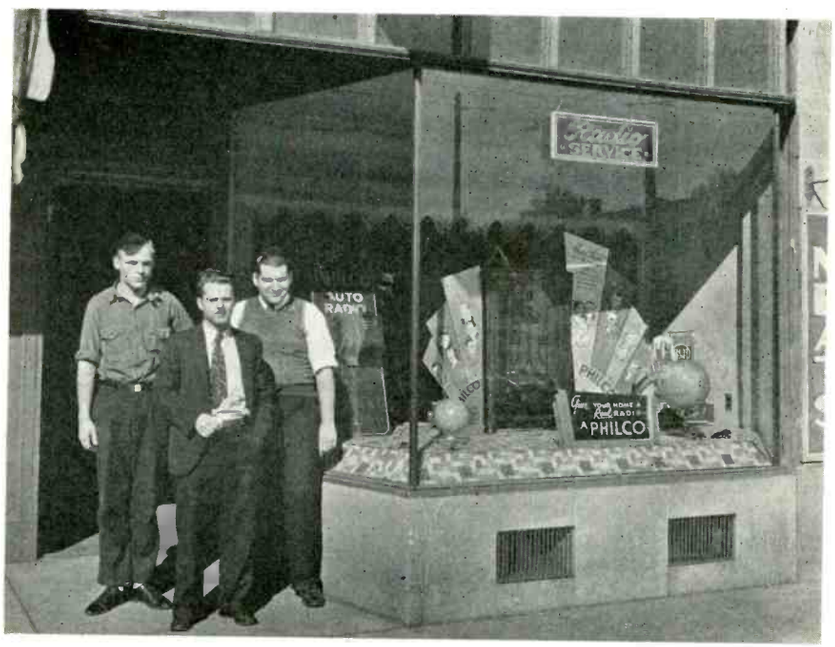
"How do you keep informed?" I shot at him. Right back he came with: "By reading radio publications each month, where I get a world of time- and money-saving ideas, and actual help in handling the toughest sets. Then I read, and have on hand various books on the subject, and of course I have the manuals. I look for a great reduction in the number of Service Men, because the work will revert to the men who are keeping up-to-date on radio theory and operation, and the handy neighbor, who at one time or another built a set, and calls himself a Service Man, will be unable to repair the more complicated sets of the future. This will be particularly true in the larger cities where factory representatives, or distributors will get the work, just as it is in the automobile servicing field."

Inside the front door, but showing only a part of the stock of receivers. Tube testing for a customer. Door to shop at left.

Then I asked "Al" this: "How do you get business, and what is your policy on charges?"

"Service is strictly cash except to those who have established a credit rating with us from past dealings. Before making a call we look up the name in the city directory which tells if the party is a home owner or renter, and for how long he has lived at the address. No price is given until everything is absolutely checked. Once a price is given, we do not change. Our men are schooled in deportment in the customer's home. They are pleasant and orderly, and always clean up. We do not go from house to house soliciting, but we do advertise in the telephone directory, spending about $50 a month for display advertising. We use direct mail to prospects and old service customers who should be ready for more service or a new radio. Newspaper advertising was tried, but does not seem to pay. People don't think of Service Men until their radio stops; then they look in the phone book for the nearest one.

"Our Service Men do not rush in and rush out. We get acquainted, if the customer is a new one. Then we check the radio, tubes, antenna and ground. We even dust out the receiver. This produces a great effect on the customer



"Al" is in the middle, the sun slightly neutralizing his smile.

One side of the shop—light, clean, business-like. Everything convenient and handy.

who, when he apologizes, is assured by us that there are plenty that are dustier."

And "Al" was indulging in one of his smiles.

Just then the telephone rang. He listened, and interjected a word or two that carried conviction that he would soon call, see what was wrong and fix it right. He wrote down the name and address, stepped to the shop and handed the slip to one of the men without a word. The man was soon on his way. Then he continued: "Half of the work in getting a radio job is proper telephone conversation, by creating a good first impression, if they are strangers to us. I try to say just enough, not too much.

"We belong to our local Chamber of Commerce and cooperate with them as much as we can. That brings business. We also go after the business of people moving to our town; the real estate fellows help us here, as well as the Chamber of Commerce."

"Let me look in your shop," I asked.

"Surely—we don't have everything imaginable, but we are thoroughly equipped to make tests on all receivers according to the data furnished by the manufacturers and data furnished by the manuals. We have both Hickok and Jewell receiver analyzers, a Hickok ohmmeter and a Jewell oscillator. We handle Philco receivers. They are good sets and we want to cash in on their aggressive national advertising, and of course we stock both senior and junior sizes."

I didn't ask what tubes, because on the neat shelves I saw them—Radiotrons and Arcturus.

"Where did you learn servicing?" I asked Alexander Kovatch, for that is his name in full.

"Back in 1914 I graduated from the Marconi Radio Institute, then of Cleveland, and was a radio operator for two years, first on the *U.S.S. Wolverine,* a revenue cutter on the Great Lakes, then on the passenger ship *City of Erie.* I wanted to improve, and as I was able to do it, took an Electrical Engineering course at Ohio State University, at Columbus. Then in business here, and I surely like it."

ALL-WAVE MIXER STAGE

(*See Front Cover*)

FROM the viewpoint of actual circuit connections, there is nothing particularly unusual about the schematic of the mixer and oscillator section of the Sparton Model 104 receiver shown on the front cover. It is illustrated more to indicate good design than anything else.

It should first be noted that separate coils are used for each of the four wavebands covered. The coils are shielded one from the other in order to eliminate the effects of stray coupling and mutual inductance. Moreover, the use of separate coils or, better said, transformers, for each band, also eliminates dead-end losses quite often encountered in all-wave or dual-wave designs employing tapped coils.

Separate Tubes Used

However, of particular note in the portion of the circuit shown, is the use of separate tubes as mixer and oscillator, rather than the more common method of employing a single pentagrid converter for both functions.

It has been learned through experience that unless special precautions are taken in a circuit employing a pentagrid converter as both mixer and oscillator, the signal on the control grid will have a tendency to change the frequency of the oscillator portion of the tube. Furthermore, because of the capacity existing between oscillator plate and control grid, the oscillator induces a voltage on the signal control grid causing forms of degeneration.

The above effects are apt to be particularly obnoxious in an all-wave receiver, so that the use of separate tubes for mixer and oscillator is a real step ahead.

By reference to the diagram on the front cover, it will be noted that the 6A7 tube is connected to function as a pentode converter, with high gain and minimum reaction on associated circuits. The type 76 triode oscillator tube uses a shunt feed arrangement to the plate, the plate voltage being fed to the tube through an r-f choke (not shown) rather than through the oscillator coils. The plate of the tube is coupled to the oscillator plate coil in use through a fixed capacity, which arrangement isolates the plate coils from the high voltage. which reduces circuit noise, and likewise places the plate of the tube at effective r-f ground potential in respect to associated circuits.

The oscillator voltage is impressed on Grid No. 1 of the 6A7 tube and this voltage is taken off from the grid of the oscillator tube, rather than the plate. There are two advantages to this arrangement, namely, there are no appreciable loads involved, which might cause frequency shift or unstable operation, and there are no appreciable capacities present which might cause over-coupling and possible synchronism between the mixer and oscillator circuits.

It also permits the impression of larger oscillator voltage in the mixer tube with a consequent increase in sensitivity.

•

Repairing and Adjusting

Nowadays receiver manufacturers are anxious that their sets remain in good operating condition. There is a trend on the part of many companies to use parts of better quality, with the result that receivers using these parts are less subject to breakdown.

The day may come—and soon at that—when the average radio set will be almost foolproof insofar as breakdown is concerned. If this comes about the Service Man will do less repairing and more *adjusting.*

Modern receivers are of necessity set to very close limits. Mis-alignment, varying voltages, varying capacities, etc., cannot be tolerated as they could be in receivers of an earlier vintage.

There will be just as much work for the Service Man, but the work will be of a different nature. It will be a good thing for everyone.

General Data . . .

G. E. Model M-125

The Model M-125 is a 12-tube, 5 band ac receiver with a tuning range from 140 kc to 36,000 kc. There is a break (skip-band) from 140 kc to 540 kc in this tuning range—otherwise the coverage is continuous.

This receiver is being accorded more space than usual, since it contains some very interesting design features which will undoubtedly become common in the near future. For this reason, we believe it important to cover these features in full so that they will be clearly understood.

Socket-Voltage Layout

Before getting into the actual description of the circuit, we wish to call your attention to the chassis and socket layout shown in Fig. 6. This sketch, it will be noted, provides not only the locations of the tube sockets and the element numbers, but also the voltage readings. Thus it is possible to carry out measurements without referring to the schematic diagram or to socket layout charts. This system appears to have considerable merit. What do you think?

Circuit Description

Referring to Fig. 1, the signal enters the receiver through a shielded antenna lead and is applied to the grid of the r-f tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang-capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang-capacitor.

Combined with the signal in the first detector is the local oscillator signal, which is always at a 460 kc frequency difference (higher) from the signal frequency. A separate coil system and the third unit of the gang-capacitor are used in the oscillator circuit.

Eliminating "Dead Spots"

In conjunction with these three tuned circuits it is well to point out that five different groups of tuned circuits are used, one group for each tuning band. A five-position selector switch is provided for selecting the band in which the desired signal is located. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting the preceding lower frequency r-f and detector coils and the two preceding oscillator coils. This is to prevent "dead" spots due to absorption effects caused by the coils, the natural period of which without the gang capacitor connected falls in the next higher frequency band. This gang switch also has additional contacts for performing other functions which will be discussed.

The output of the first detector which is the i-f signal (460 kc) is fed directly through two tuned circuits to the grid of the automatic volume control i-f amplifier stage. A coupling coil adjacent to the secondary of this transformer is connected directly to the signal i-f stage, which is in effect parallel to the avc, i-f stage. Examining the signal amplifier further we find that the output of the first signal i-f stage is applied through a transformer to the second i-f stage and thence through a second transformer to the second detector. Both circuits of each transformer are accurately tuned to the i-f signal, which is 460 kc.

First AVC System

Further examining the avc, i-f stage it will be seen that the output of this stage is applied to the avc tube through an untuned i-f transformer. The avc stage, which uses a 76, is operated as a straight rectifier, its plate being grounded and only the grid being used. This tube is shielded in the usual manner. A small grid voltage, approximately 5.0 volts, is maintained so that rectification does not occur until the signal level exceeds this grid voltage. When this occurs, a portion of the rectified signal produces a voltage drop across resistors R-18 and R-19. The drop across both of these resistors con-

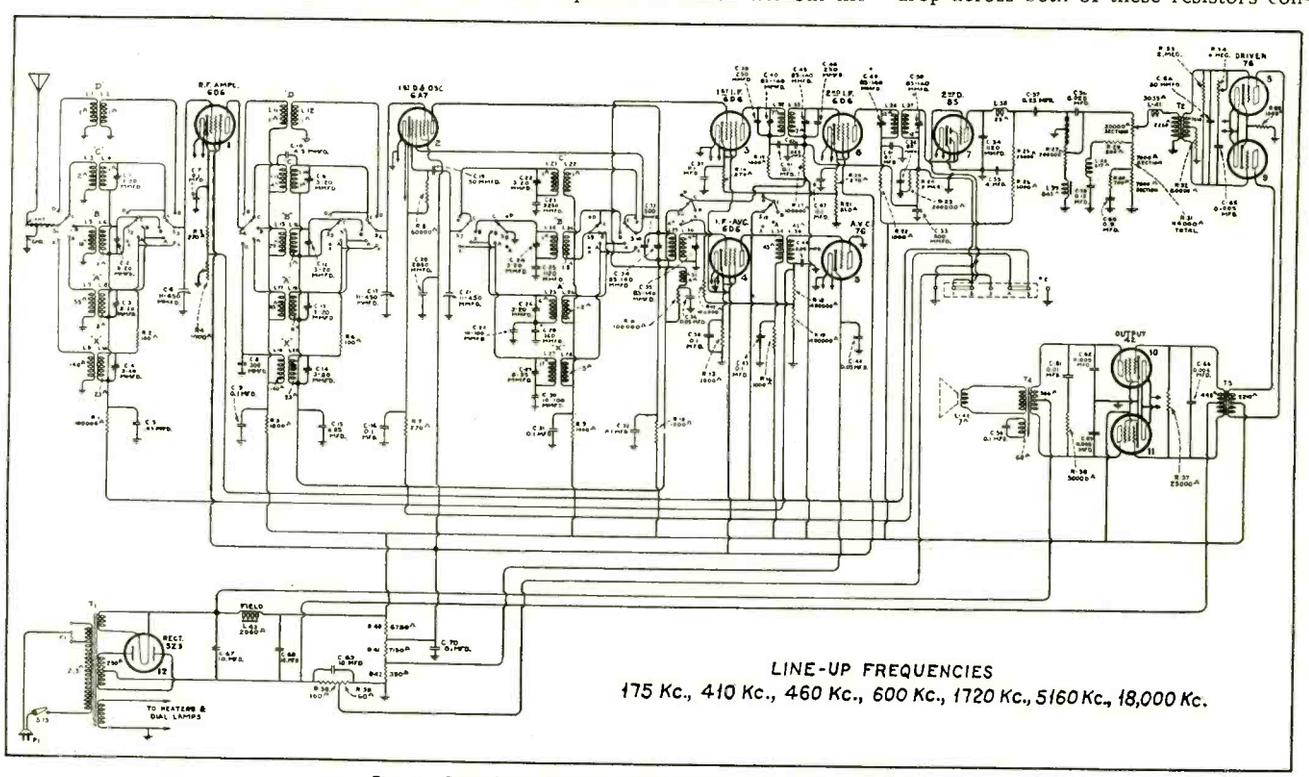


Fig. 1. Complete diagram of the General Electric Model M-125.

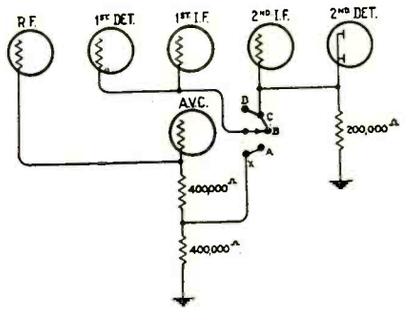


Fig. 2. Band D is similar to Band C except that no avc bias is applied to the r-f and 1st detector tubes, the grid coils being grounded.

stitutes the automatic bias voltage for the r-f stage. The drop across R-19 alone gives the automatic bias voltage for the first detector and first i-f stage on bands X and A.

Second AVC System

Examining the second detector, the diode electrodes provide the detector action while the grid and plate give audio amplification. A portion of the rectified signal also gives a voltage drop across R-23 which is a second automatic volume control system for the receiver. The voltage drop is applied to the second i-f stage in all bands and to the first detector and first i-f stage in bands B and C. The change in automatic volume control systems is made by an additional group of contacts on the band selector switch. Fig. 2 shows the switching arrangements for changing the avc system in the various bands.

Why Two AVC Systems?

At this point, an explanation as to why two automatic volume control systems are used and why the sensitivity control is changed in different bands may be in order.

Two automatic volume control systems are used because of the different receiving conditions in different bands. For example, in the broadcast and long-wave bands (X and A) signal levels are very high. Also due to the use of an aurally compensated volume control, a constant input to the second detector must be maintained. From this, it is evident that the double channel i-f automatic volume control is ideal. It maintains a constant input to the second detector and yet does not function on an extremely weak signal. In the short-wave bands, however, conditions are different. Signal strengths are always very low and fluctuate widely. For this reason it is important to have some automatic volume control action below the level at which the double channel system works. This is provided by the diode avc of the second detector, which functions on the first detector and two i-f stages on the short-wave bands. It should be noted that this action is present on the second i-f stage on all bands. This further flattens the action of the double-channel system in bands X and A.

Sensitivity Control

At this point it is well to examine the sensitivity control which also changes on different bands. The sensitivity control adjusts the residual bias on the r-f and first detector stages in bands X and A while it controls the r-f 1st detector and both i-f stages on bands B, C, and D. Fig. 3 shows the switching arrangement used.

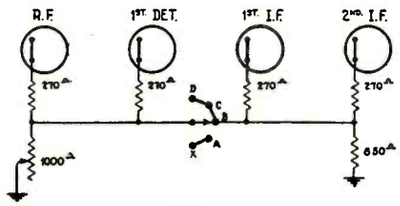


Fig. 3. The sensitivity control switching arrangement.

The sensitivity control is changed so that in bands X and A it controls the r-f and 1st detector while in bands B, C, and D it controls the r-f, 1st detector, 1st i-f and 2nd i-f stages. The reason for this is that for a given degree of sensitivity in bands X and A the residual bias will be considerably higher in the r-f and 1st detector stages than in the bands B, C, and D used. This is to prevent possible overloading of these stages due to the high-signal strengths encountered in bands X and A. Also, in bands B, C, and D, for a given degree of sensitivity the r-f stage operates at a higher gain, which gives an improved signal-to-noise ratio. This is caused by the paralleling of the sensitivity control with an 850-ohm resistor in these bands.

Compensated Volume Control

Returning to the second detector, we find its output circuit is coupled to the grid circuit of the driver stage through a compensated volume control system, tone control system and transformer. The volume control uses two stages of compensation, which serves to increase the high and low frequencies as the volume is reduced. This compensates for the natural loss in sensitivity of the human ear to the high and low frequencies at low sound levels. A low- and a high-frequency tone control enables the listener to alter the fidelity of the receiver to his individual taste.

Fixed Amplifier Bias

The driver stage, which is a pair of 76's connected in push-pull, is transformer coupled to a pair of 42's which are the output stage. A feature of the output stage is the use of fixed bias, which reduces distortion and increases the available output. This is accomplished by the use of the drop across R-38 and R-39, which carries the entire dc output from the rectifier. Naturally the output stage uses but a portion of the total rectified current and current variations in it will have but little effect on the drop across the resistor.

High-Frequency Cut-Off

The output of the power stage is coupled through a step-down transformer to the voice coil of the loudspeaker. A separate winding, which is shunted by a capacitor, has been provided in this transformer which gives a very sharp, high-frequency cut-off for the entire audio system. This greatly reduces the reproduction of any high-frequency interchannel interference or other disturbance of a high-frequency character which is outside of the useful musical range.

Line-Up Procedure

The line-up procedure of this receiver is somewhat involved and it is important that these instructions be carefully followed when making adjustments. Properly aligned, the receiver has outstanding performance; *improperly aligned, it may be impossible to receive signals on all bands.*

Equipment

To properly align this receiver, the following equipment must be used.

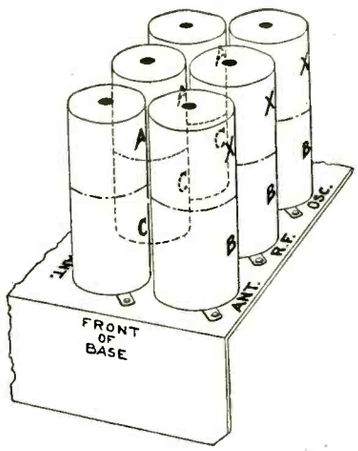


Fig. 4. The r-f coil gang, showing relative locations of Ant., R-F, and Osc. coils.

This is a modulated r-f oscillator having proper frequency range, an output indicator, an alignment tool, a tuning wand,

and a "dummy" 76 tube. The "dummy" 76, is obtained by removing one heater prong from an otherwise perfect tube.

Checking with Tuning Wand

Before making any r-f, oscillator or first detector adjustments, the accuracy of the present adjustments may be checked by means of the tuning wand (Stock No. 6679). The tuning wand consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this it is seen that unless the trimmer adjustment for a particular coil is perfect at alignment frequencies, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

The shields over the r-f coil assembly have a hole at their top for entrance of the tuning wand. The location of the various coils inside of the shield is shown in Fig. 4. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1720 and the signal tuned in. The avc tube would be replaced by the "dummy" 76 and the output indicator could be connected across the voice coil of the loudspeaker. Then the tuning wand would be inserted, first one end and then the other end, into the top of the three transformers at the left of the r-f assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when each end of the wand is inserted in each of the three transformers. If one end—for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is low. An increase in the trimmer capacitance would be the proper remedy.

I-F Tuning Adjustments

Although this receiver has three i-f stages, two for the signal and one for the avc, only three transformers having six adjustable capacitors require adjustment. The fourth transformer is in the avc circuit and is broadly tuned, not requiring adjustments. The transformers are all peaked, being tuned to 460 kc.

A detailed procedure for making this adjustment follows:

(1) Connect the output of an external oscillator tuned to 460 kc between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker. Replace the avc tube in the receiver with the "dummy" 76.

(2) Place the oscillator in operation at 460 kc; place the receiver in operation and adjust the station selector until a point is reached (Band A) where no signals are heard and turn both the volume and sensitivity controls to their maximum position. Reduce the oscillator input until a slight indication is obtained in the output indicator.

(3) Refer to Fig. 5. Adjust each trimmer of the i-f tuning capacitors until a maximum output is obtained. Go over the adjustments a second time.

This completes the i-f adjustments. However, it is good practice to follow the i-f adjustments with the r-f and oscillator adjustments due to interlocking which always occurs.

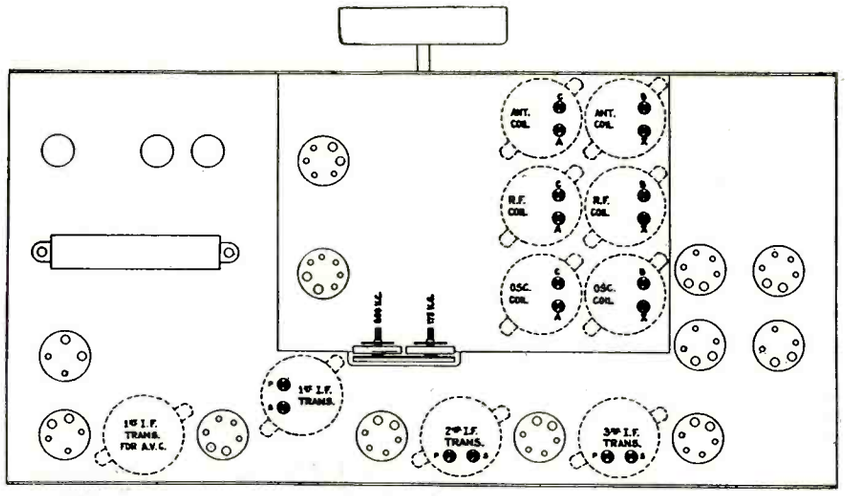


Fig. 5. Location of various trimmer capacities.

R-F, Oscillator and First Detector Adjustments

Four r-f, oscillator and first detector adjustments are required in bands "X" and "A." Three are required in bands "B" and "C" while none are required in band "D." Band "D" uses the second harmonic of the oscillator while the detector and r-f coils do not have trimmers.

To properly align the various bands, each band must be aligned individually in the order given. This is "X," "A," "B," "C," and "D." The preliminary set-up requires the external oscillator to be connected between the antenna and ground terminals of the receiver. The output indicator must be connected across the voice coil of the loudspeaker while the "dummy" 76 must be placed in the avc socket. The sensitivity and volume controls must be at their maximum position and the input from the oscillator must be at the minimum value possible to get an output indication under these conditions. In the high-frequency bands, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The dial pointer must be properly set before starting any actual adjustments. This is done by tuning the variable capacitor until it is at its maximum capacity position. One end should point exactly at the horizontal line at the lowest frequency end of band "A," while the other end should point to within 1/64" of the horizontal line at the highest frequency end of band "A,"

Fig. 5 shows the location of the trimmers for each band. Care must be exercised to only adjust the trimmers in the band under test.

Band "X"

(1) The oscillator series capacitor, marked 175 kc, Fig. 5, is first tightened to near its maximum capacity position (screwed "in").

(2) Tune the external oscillator to 410 kc, set the pointer at 410 kc and adjust the oscillator, detector and r-f trimmers for maximum output.

(3) Shift the external oscillator to 175 kc. Tune in the 175 kc signal irrespective of scale calibration and adjust the series trimmer marked 175 kc on Fig. 5, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 410 kc as described in (2).

Band "A"

(1) First the oscillator series capacitor,

marked 600 kc, Fig. 5, should be set at about the center of its range.

(2) Tune the external oscillator to 1720 kc, set the pointer at 1720 kc, and adjust the oscillator, detector and r-f trimmers for maximum output.

(3) Shift the external oscillator to 600 kc. Tune in the 600 kc signal irrespective of scale calibration and adjust the series trimmer, marked 600 kc on Fig. 5, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1720 kc as described in (2).

BAND "B"

(1) The detector and antenna trimmers should first be tightened to approximately ¾ maximum capacity (turned ¾ in.).

(2) Tune the external oscillator to 5160 kc, and set the pointer at 5160 kc. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(3) Check for the image signal, which should be received at approximately 4240 on the dial. It may be necessary to increase the external oscillator output for this check.

(4) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then aligned with the oscillator circuit and the 6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(5) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

BAND "C"

(1) The detector and antenna trimmers should first be tightened to approximately ¾ maximum capacity (turned ¾ in.).

(2) Tune the external oscillator to 18,000 kc, and set the pointer at 18M. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacity from minimum to maximum.

(3) Check for the image signal, which should be received at approximately 17,080 on the dial. It may be necessary to increase the external oscillator output for this check.

(4) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then aligned with the oscillator circuit and the 6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(5) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

BAND "D"

No adjustments are required for Band D.

MAGNETIC PICK-UP CONNECTIONS

A terminal board is provided at the rear of the chassis for adding phonograph facilities to this instrument. In general, it is best to operate the phonograph with its volume control at its maximum output position and use the radio receiver volume control for adjusting volume. The radio volume control is compensated and will result in much better tone quality at low volume than will be obtained if it is operated open and the volume adjusted from the pick-up volume control.

VOLTAGE READINGS

The voltages given in Fig. 6 are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made.

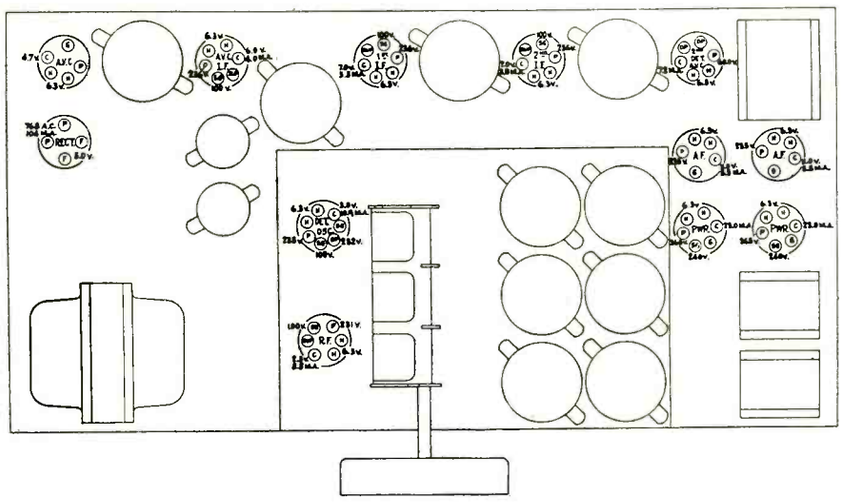


Fig. 6. Tube-socket layout and socket voltages. All voltages are to ground. Voltages marked with an asterisk cannot be measured with ordinary voltmeter.

Philco Model 45 Dial Drive

The new dial drive assembly in the Model 45 is somewhat different from that of previous Philco receivers. Like most dial assemblies, a certain amount of care must be exercised when placing the knob over the shaft not to force it into position with a heavy blow. Failure to observe this point may result in damage to the small micarta drive gear, or it may force the gear back far enough so that it does not ride in the groove of the drive shaft, resulting in the dial slipping.

Several recent improvements have been made in the dial-drive assembly which afford more positive operation. One of the items which has been added is a special spring which fastens to the drive bracket and fits down over the shaft of the fibre gear in such a way as to hold the fibre tight against the metal drive on the shaft. The method of installing the spring will be evident upon examining the drive assembly. On some of the earliest productions of the Model 45, difficulty may be experienced with dial slippage. This condition is traceable to a slightly undersized drive gear which does not make a tight contact against the drive shaft after several weeks operation. Installation of the new spring (Part No. 28-8252) will correct those few cases of this nature.

CHASSIS BOLTS

It has purposely been made necessary in the case of the Model 45 for Dealers and Service Men to remove the chassis hold-down bolts before placing the set in operation. The chassis bolts in this model are not countersunk into the bottom of the cabinet as in other sets. It is important, therefore, that they be removed. If the dealer or customer should forget, damage may result to a table or cabinet top on which the 45-C is placed. The important point, however, is to remove the bolts so as to afford the correct suspension of the chassis on the new flexible rubber supports.

Philco Models 34 and 34A

These are all-wave, battery-operated receivers, covering the frequencies from 520 to 22,000 kc.

Model 34 is intended for use with a 2-volt storage battery and dry B and C batteries. These receivers are shipped with a jumper wire across the filament contacts of the ballast tube socket.

Model 34A is intended for use with a dry A battery, and has in addition to the tubes in Model 34 a ballast tube (type 1-C-1). The chassis of the two sets are identical.

The Circuit

The complete schematic diagram is shown in Fig. 1. The output transformer is mounted on the receiver (under chassis) instead of on the speaker as indicated in the diagram. Also, the speaker magnet is *not* grounded.

There is a trap circuit in the antenna lead. This is tuned to 460 kc, the i-f of the set, and is used for the purpose of eliminating interference from code stations, etc., operating on or near 460 kc.

The new type 1C6 tube is used as modulator-oscillator. This tube was designed for all-wave, battery-operated supers. (See data on the 1C6 tube on page 334, September, Service.)

There are two stages of i-f, using type 34 tubes. A type 30 tube, with plate tied to the filament, functions as diode second detector.

The a-f amplifier is quite ambitious for a battery-operated receiver. The output of the diode feeds a type 30 tube employed as an a-f voltage amplifier. This is resistance coupled to a type 30 triode which is used as the driver for the type 19 push-pull tube. This last tube operates Class B and in consequence provides a large undistorted output.

The locations of the various trimmers and padders are given in the drawing of the chassis, shown in Fig. 2. *Do not attempt to adjust* the compensating condensers mounted upon the sections numbered 3 and 4 of the gang condenser. These have been adjusted, and sealed, at the factory and should not be disturbed.

I-F Adjustments

Remove the grid clip from the 1C6 tube and connect the antenna output terminal of the signal generator to the grid cap of the tube. Connect the ground terminal of the signal generator to the ground terminal of the receiver chassis.

Connect the output meter to the primary terminals of the output transformer. Set the signal generator at 460 kc and adjust each of the i-f compensating condensers in turn, to give maximum response in the output of the receiver. Each of these transformers has a dual compensating condenser mounted at its top, and accessible through a hole in the top of the coil shield. In the dual compensators, the primary circuit is adjusted by turning the screw; the secondary circuit is adjusted by turning the box-head nut.

Wave-Trap Adjustment

Replace the 1C6 grid clip and connect the output of the signal generator to the antenna and ground posts of the receiver. Set the Waveband Switch of the receiver to the standard broadcast band (Range 1) and the Station Se-

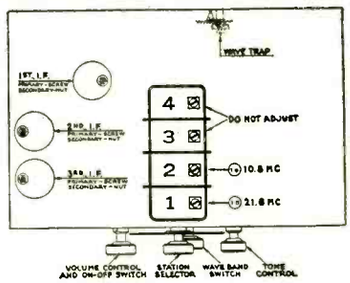


Fig. 2. Chassis layout showing location of trimmers.

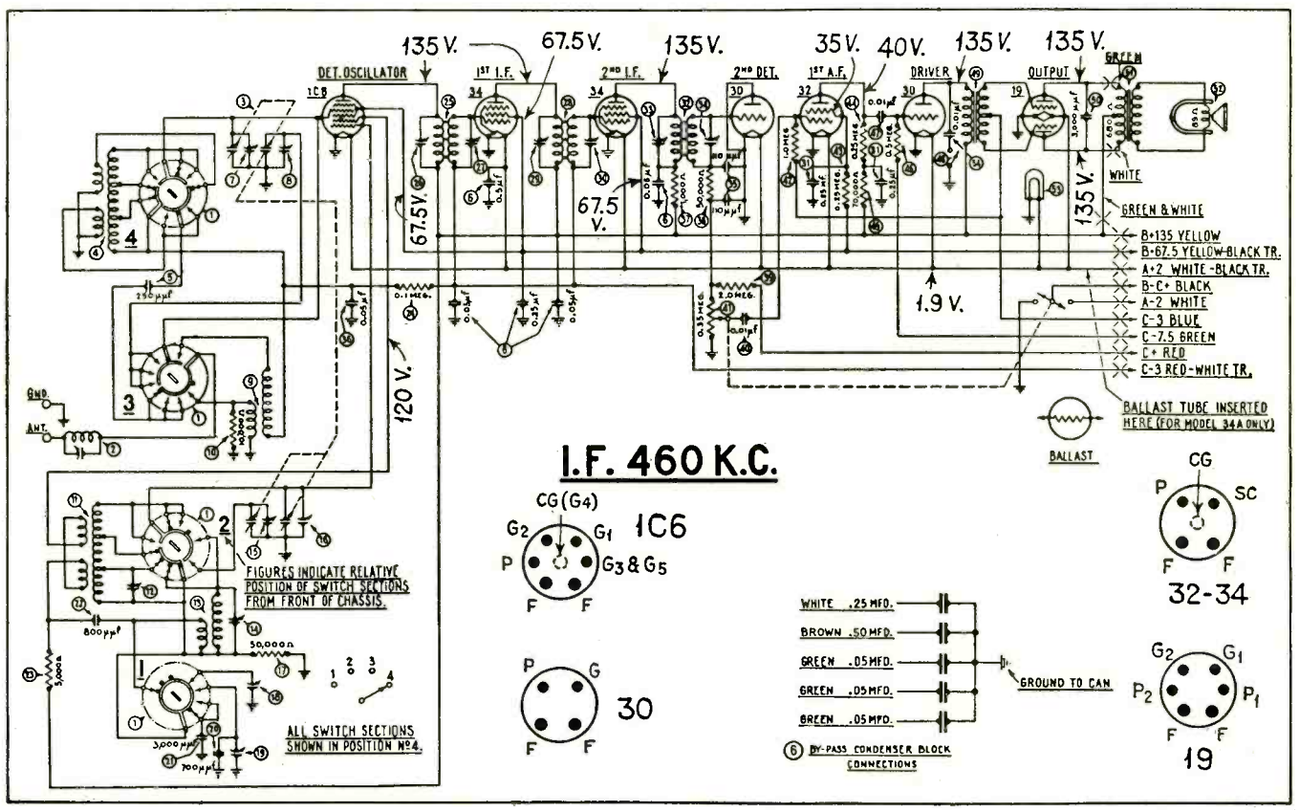


Fig. 1. Diagram and data on Philco Models 34 and 34A.

lector at the low-frequency (520 kc) end. Adjust the wave-trap condenser (2) to give *minimum* response to a 460-kc signal from the signal generator. The wave-trap condenser is located at rear and underneath the chassis, and is shown in Fig. 2.

ADJUSTING DIAL FREQUENCIES

There are four separate ranges, with a compensating condenser for each range. The ranges are as follows:

Range 1	520 to 1500 kc
Range 2	1.5 to 4.0 mc
Range 3	4.0 to 11.0 mc
Range 4	11.0 to 23.0 mc

Connect output of signal generator to input of receiver, with output meter connected to primary of output transformer. Set Waveband Switch to Range 4, Station Selector to 21.6 mc. Set signal generator to 21.6 mc and adjust compensating condenser (15) on section 1 of the tuning condenser for maximum response.

Switch to Range 3 and set Station Selector to 10.8 mc. With signal generator set to this frequency, adjust condenser (16) on section 2 of tuning condenser for maximum response.

Switch to Range 2, and set Station Selector to 3.6 mc. The antenna connection of the signal generator will have to be removed for this adjustment, otherwise the output of the signal generator will be too great. Adjust condenser (12) for maximum response. This compensating condenser is located underneath the chassis and is not accessible from above.

Now, leave switch at Range 2, reconnect the antenna lead of the signal generator to receiver, and set Station Selector to 1.5 mc. Set signal generator to 1500 kc and adjust condenser (19) located underneath the chassis.

Then set switch to Range 1 and Station Selector to 1400 kc. Set signal generator to same frequency and adjust condenser (14) which is also located underneath the chassis.

Finally, with switch at Range 1 and both Station Selector and signal generator set to 520 kc, adjust condenser (18). This condenser is also underneath the chassis.

With the chassis inverted, and facing the rear, condensers (14), (18) and (19) are to the right of the waveband switch. Condenser (18) is nearest the rear, (19) just behind it, and (14) a bit off to the right.

VOLTAGE READINGS

When taking voltage readings, set volume control at maximum and Station Selector at 520 kc.

Grunow Chassis and Models

The following data on chassis, model and speaker numbers, deals with the Grunow (General Household Utilities Co.) 1934-35 receivers.

CHASSIS TYPE 4A

Chassis Type 4A is used in receiver Model 450 together with speaker Type 8B1. There are 4 tubes, and the i-f peak is 455 kc. This is a dual-band set.

CHASSIS TYPE 4B

This chassis, also using 4 tubes, is quite similar to chassis Type 4A but is a single-band job. It is used in receiver Model 460, together with speaker Type 8B3. The i-f peak is 455 kc.

CHASSIS TYPE 5B

Chassis Type 5B is used in receiver Model 550 with speaker Type 5D. The set is ac-dc, uses 5 tubes, and the i-f is peaked at 455 kc. It is a single-band receiver.

CHASSIS TYPE 6A

Chassis Type 6A is used in receiver Models 650 and 651, with speaker Types 8A3 and 8C3, respectively. The set is an ac job, using 6 tubes and has dual wave-range. The i-f is 262 kc.

CHASSIS TYPE 6C

This chassis is used in receiver Models 660, 661 and 662, with speaker types 8B2, 8C4 and 8B2, respectively. The set is a two-band job, using 6 tubes, is ac-operated and the i-f is peaked at 262 kc.

CHASSIS TYPE 6D

Receiver Models 670 and 671, with speaker Types 8C6 and 10A5, respectively, use chassis Type 6D. This is a 6-tube, all-wave, ac set and is peaked at 455 kc.

CHASSIS TYPE 7B

See description of Type 7B Chassis in this issue.

CHASSIS TYPE 11A

This chassis is used in receiver Models 1151 and 1152, with speaker types 12A3 and 10A4, respectively. It is an ac-operated, all-wave receiver with 11 tubes. The i-f peak is 262 kc.

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Philco Model 200 Change

The center tap has been removed from the heater winding in the power transformer (85) in this model. (See page 377, October SERVICE, for circuit.)

In case of replacement of this transformer, it will be necessary to ground one side of the heater winding if the replacement transformer does not have a center tap.

•

Howard I-F Stages

The new Howard receiver Models D-16, W-6, F-17, F-18 and W-18 have *air-tuned* i-f transformers. In other words, the primary and secondary windings are tuned by variable air condensers and in consequence are not inclined to alter in frequency.

Since the peaking is more accurate in the first place, and not inclined to alter from the original calibration in the second place, Service Men should think twice before attempting i-f alignment. If there are difficulties in one of these receiver models, look every place else first, and turn to the i-f stages only as a last resort.

Incidentally, these are the first "home" receivers we have run into using air-tuned i-f stages.

Sparton I-F Peaks

Following is a list of the i-f peaks used in the latest Sparton receiver models.

Model	*I-F Peak*
53	456
57	456
65	456
66	456
67	345
68	345
691	345
80	456
83	456
84	456
85-X	456
86-X	456
104	456
65-T	456
66-T	456

Models 65 and 66 are ac-dc receivers; Models 65-T and 66-T are equipped with a power transformer for ac operation only.

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General Electric I-F Peaks

The i-f peaks of the latest General Electric receivers are given in the following table.

Model	*I-F Peak*
M- 61	460
M- 67	460
C- 70	460
M- 81	175
M- 86	175
M- 89	175
M-106	175
M-125	175
M-129	175

Model C-70 is a battery-operated receiver.

•

Philco 112 Audio Howl

Howl is caused by high-resistance contact in r-f or i-f coil where leads are soldered to lugs; also caused by vibration of tin-enclosed bypass condensers. Squeeze the tin covers until they do not vibrate when snapped with the finger.

E. M. PRENTKE.

ON THE JOB . . .

Paper-Condenser Leakage Tester

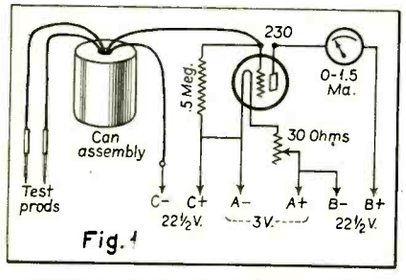
Some two years ago a young man from Dallas, Texas, made a trip through the central states selling a device for testing paper condensers, a schematic of which is shown in Fig. 1. As can be seen from careful observation, the principle of the unit is that of the well-known "vacuum-tube voltmeter" with an unusual application. Fig. 2 shows the same circuit after the "can" assembly has been debunked. This device is just about the most sensitive leakage tester for paper condensers that so far has been offered to the Service Man.

Disadvantages of Tester

A careful analysis of Fig. 2 will show that this instrument has a few drawbacks. First, a condenser should be tested under approximately the same voltage that it has applied to it under operating conditions. This circuit uses only 45 volts or, more probably, only 22½ volts on the condenser. Another weakness lies in the fact that it is battery operated and consequently is both awkward to handle and expensive to operate. It is common practice to use flashlight batteries for the filament to reduce the size and weight. These batteries require frequent renewal. The 30-type tube is not very stable when filament-type control is used and has a tendency to cause the milliammeter to drift up and down. The result is that it is difficult to tell when the condenser has taken a full charge. The 1- or 1½-mil meter is not always easy to obtain. Despite the drawbacks of this instrument, however, the fact remains that it is a very useful and versatile shop tool which offers many possibilities when correctly modified.

AC Operation

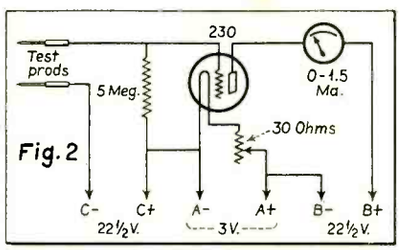
After using one of these outfits for a few months in the shop, I saw that it was hard to do without. However, about half of the time it was setting in the corner in need of batteries . . . no one seeming to have time to replace them. I decided to see what could be done about operating this set-up direct from the ac line. The results are shown in Figs. 3 and 4.



Original circuit of condenser tester which has been improved upon.

Glancing at Fig. 3 we see that the total rectified voltage is 460 volts, which is about all that can be safely used with dry electrolytic condensers of the conventional type. If the specifications are followed as listed, the 45 tube will draw a maximum current of 11 to 13 milliamperes. This makes a 10-milliampere scale just right to assure always being able to secure full-scale reading. Once the current is adjusted to full scale it will be found to be very stable. The grid bias or test voltage is developed by the old reliable filament-circuit, bias-resistor system.

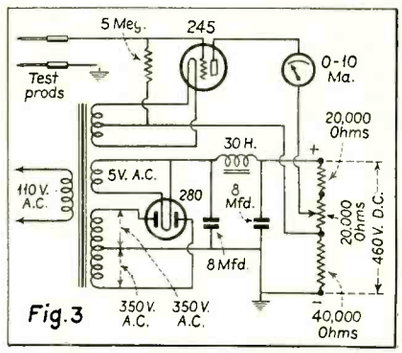
Since the plate to filament voltage is only about 40 to 50 volts and the drop from there to the output of the pack is roughly the same, we still have a voltage of about 300 volts applied to the condenser being tested. This voltage is sufficient to break down any weakness which may exist in the insulation of the condenser. Since a resistance of approximately 25 megohms will cause this meter to drop to zero and stay there, it will be readily understood that any sort of leak will prevent the needle from returning to its original full-scale setting. Perhaps it would be advisable at this point to explain briefly what causes this instrument to behave as it does.



Really the same circuit as Fig. 1, with the can "debunked."

How It Works

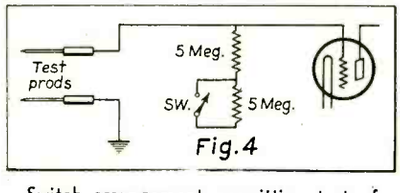
The five-megohm resistor in the grid of the 45 tube is put there for stabilization purposes and also to control the time required for the condenser to charge up. This resistor has the effect of putting a small permanent bias on the tube, due to and directly proportional to the grid current of the tube used. The grid current passing through this resistor produces a drop across the resistor. This action in a good tube is very small.



Complete circuit of the ac-operated tester.

When a condenser is connected across the test terminals it will draw a current from the bias supply completing the circuit through the grid resistor. When this condenser is first connected it has a relatively low resistance compared to the grid resistor, due to its being uncharged and drawing current. This results in a relatively large part of the bias voltage being effectively impressed across the grid resistor and applying a high enough bias to the tube to reduce the plate current to zero. Due to the very high resistance of the grid resistor the current which will flow through it will be very small. Consequently a definite amount of time will be required for the condenser to take a charge. As the condenser gradually becomes charged its plate begins to assume a voltage. This, in turn, gradually reduces the current flowing through and the voltage applied across the grid resistor. As this voltage drops the tube starts to draw plate current again. This cycle continues until the voltage across the terminals of the condenser becomes the same as that of the voltage supply. At this point the condenser is fully charged and, since the condenser and the voltage supply are the same, there is no current flowing between them through the grid resistor. Therefore, the drop across the resistor again becomes the same as it was before the condenser was connected, returning the plate current of the tube to its former value.

(*Continued on page* 431)



Switch arrangement permitting test of small-capacity condensers.

Auto-Radio . . .

Motorola Twin "8"

Referring to the accompanying diagram of the Twin "8," the signal is fed into the primary of the antenna coil, which is of the aperiodic type, and is induced into its associated secondary circuit tuned by the first gang of the variable condenser. The signal is then fed to the 78 tube used as the r-f amplifier.

The second r-f transformer is of the impedance-coupled type, feeding its energy into the grid of the 77 detector-oscillator tube. In the aperiodic type of antenna coil the gain drops slightly near the 500-kc end, while in the impedance-type coupling used in the second r-f transformer, the gain rises slightly at this point. It will be seen then that by using these two in combination an overall flat sensitivity curve is obtained.

The type 77 detector-oscillator tube feeds a 262-kc i-f to the 78 tube which in turn is coupled to the 85 detector-avc-amplifier tube.

In the 85 tube, full-wave rectification is used and avc bias is obtained by the voltage drop across the 200,000-ohm resistance connecting the secondary of the diode feeder to ground. Full avc voltage is applied to the grids of the r-f and i-f tubes and to the grid of the 85 tube. The audio component is amplified in the triode section of the 85, which is resistance coupled to the type 37 second a-f tube used as a driver. This tube is impedance coupled to a pair of LA tubes in push-pull, which operate as Class A Prime amplifiers.

Servicing

The audio end of the chassis may be easily checked by removing the grid cap of the 85 tube and, if normal, a loud hum will be heard.

Check the detector-oscillator circuit by tuning the variable condensers to the minimum position and touching the oscillator stator plates. If a click is heard when touching them, and also when removing the finger, it indicates that the tube is oscillating properly.

Condenser Alignment

Because of the necessity of aligning the variable condensers with the chassis out of the housing, it is important to use a definite point. Unless this is done the dial calibration will be incorrect when replacing the chassis in its housing. This point we may take as 1400 kc, which is exactly 32° of angular rotation from minimum condenser setting.

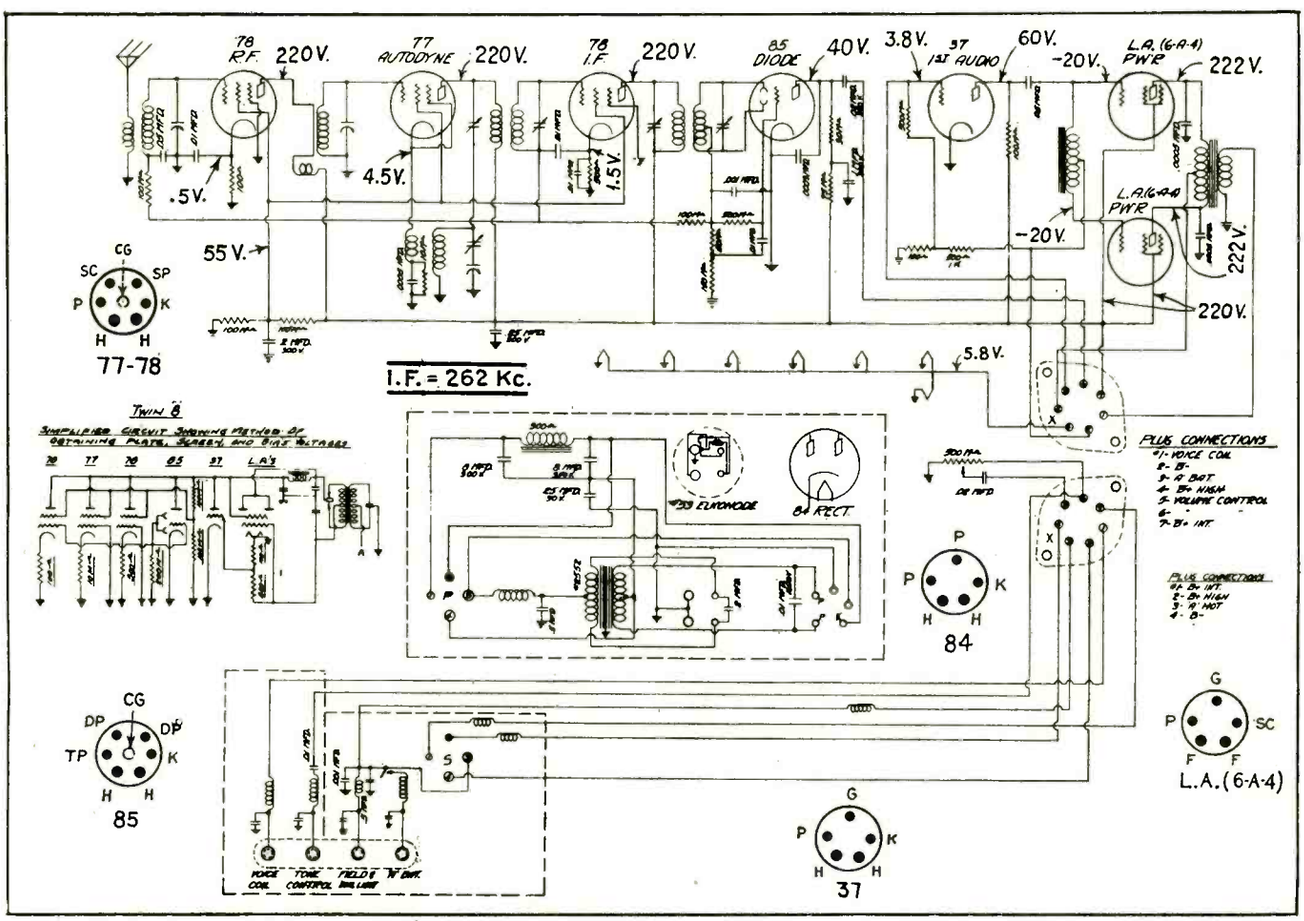
Connect the test oscillator feeder to the antenna pin of the chassis and set the oscillator at 1400 kc.

Carefully adjust the trimmers of the oscillator and r-f variable condensers for maximum reading of output meter.

Next set the test oscillator to 600 kc, rotating the variable condensers to a point 155 degrees, 30 min., from minimum condenser setting.

Adjust the 600-kc padder condenser (accessible from the front of the chassis) for maximum reading.

The 600-kc setting may also be found by setting the test oscillator to 600 kc. Tune in the oscillator signal and rotate the variable condensers back and forth while adjusting the 600-kc trimmer condenser for maximum reading. The variable condensers should now track perfectly and coincide with the dial calibration.



Circuit diagram of Motorola Twin "8"

I-F Alignment

Connect the feeder from the test oscillator to the grid of the 77 detector-oscillator tube. Remove the grid connection and connect a 500,000-ohm resistor from grid of the tube to ground.

Rotate the variable condensers to the full open position.

Set the test oscillator to a frequency of 262 kc and adjust the i-f and diode feeder trimmers for maximum reading in the output meter.

G-E Model C-61

This is G-E's latest 6-tube auto receiver, having a stage of r-f using a 6D6 tube, and a 6A7 modulator-oscillator. The cathodes of both of these tubes are common to the variable resistor R-2, which is the sensitivity control. Initial bias is supplied by a 330-ohm section of this variable resistor which cannot be contacted by the arm.

Bucking Coil

The 175-kc output of the modulator is fed to the 6D6 i-f tube through an i-f transformer with both circuits tuned. The output of the 6D6 i-f tube feeds the primary circuit of the second i-f transformer. The secondary circuit of this transformer is untuned and this winding is in two sections, wound in opposite directions. The purpose is to avoid vibrator pickup due to circulating currents in the chassis case.

This transformer feeds the diode of the type 75 tube, which functions as second detector and avc. The dc component of the rectified signal produces a voltage drop across resistor R-8 and also the volume control potentiometer R-9. The avc bias voltage is fed to the r-f and modulator tubes through the filter resistor R-6, and to the i-f tube through the filter resistor R-7.

The triode section of the 75 tube, biased by the resistor R-12, is resistance coupled to the type 41 driver tube. This tube is connected as a triode and is transformer coupled to the type 79 double tube which is operated Class B at zero bias. The driver is biased by resistor R-15.

The tone control—condenser C-21 and variable resistor R-16—is in the grid circuit of the Class B amplifier.

The speaker field is connected directly across the storage-battery terminals and is not a part of the power-supply filter. Plate voltage for all tubes is obtained through the vibrator inverter-rectifier unit and its associated transformer and filter circuits.

Voltage Readings

The voltages given in the diagram are based on a battery voltage of 6.3. Take readings with receiver set to maximum sensitivity and with no signal.

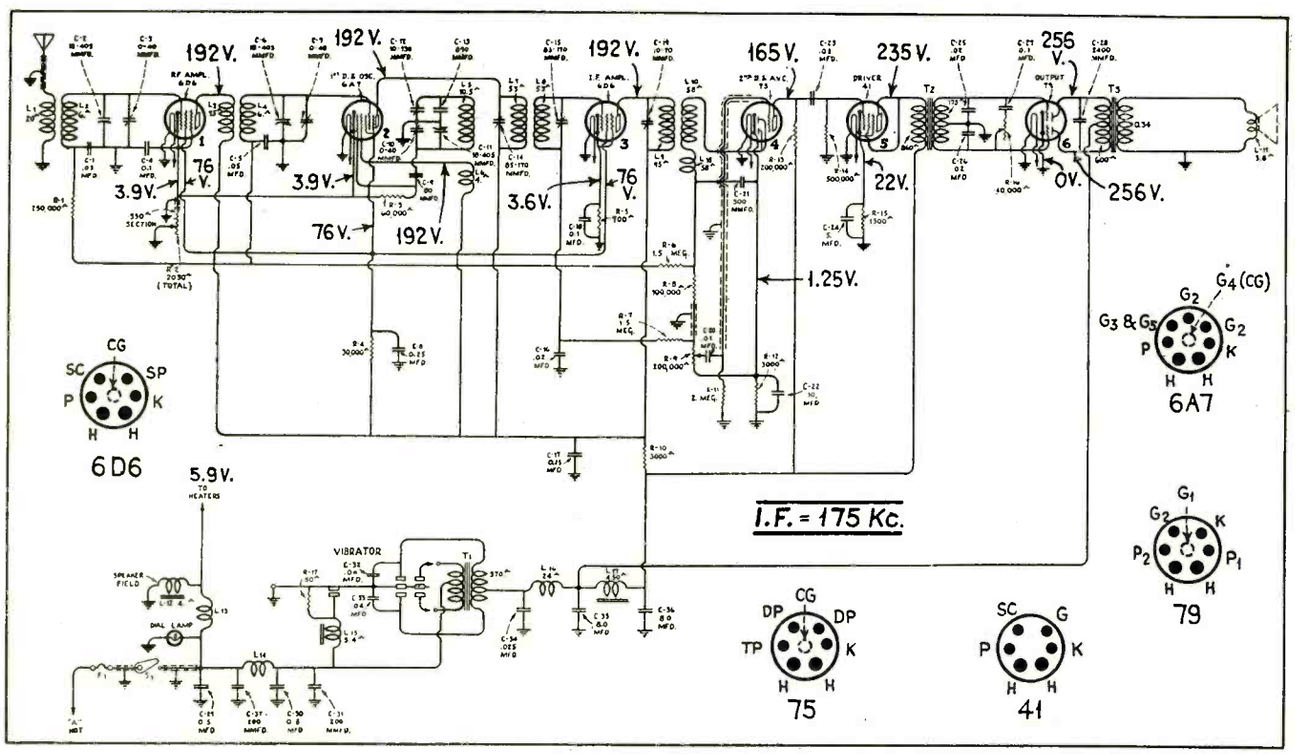
The battery current, with battery voltage at 6.3, is as follows: Speaker field (cold), 1.35 amps; tubes, 2.2 amps; dial lamp, 0.15 amp; power supply (no signal), 2.8 amps; total (no signal), 6.5 amps; total (maximum output), 8.0 amps.

Construction

The construction of the receiver unit embodies several new features of particular interest to the Service Man. The receiver proper is mounted to the front fire wall of the car by means of a single bolt. The case of the receiver is made in two sections so that the chassis may be dropped down for inspection or tube replacement, merely by removing and loosening several thumb nuts and screws. The receiver proper is divided into three units; the power supply including a plug-in type vibrator, a loudspeaker including the a-f transformers and the receiver chassis. Each of these several units may be removed for replacement or repair merely by the use of a screwdriver. Adequate terminal boards eliminate the need for a soldering iron when making such removals.

Adjustments

The line-up frequencies are 175 kc, 600 kc, and 1400 kc. The trimmer screws on top of the gang condenser are as follows, from front to rear: R-F, DET., OSC. The 600-kc trimmer is located at the left rear side of the chassis, back of the gang condenser. The



Complete circuit of General Electric Model C-61.

first i-f transformer, with two adjustors, is to the rear of the gang condenser; and the second i-f transformer, with single adjustment, is to the right of the first i-f transformer.

R-F Interference

In the event that r-f interference originating with the vibrator inverter-rectifier unit is encountered, check the following:

(1) Vibrator not properly seated. The vibrator must be pushed tight against its socket at all times.

(2) The clip from the top of the r-f tube shield to the gang condenser must be in place.

(3) The various bypass condensers, such as C-29, C-30, C-31, C-34, C-37, and chokes L-16 and L-14, L-13, must be properly connected, and in operating condition. It is well to remember that some of the interference produced by the vibrator is of a frequency as high as one meter and any replacement of condensers must always be made with ones of similar mechanical as well as electrical characteristics.

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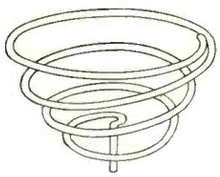
Front-Tire Static

Occasionally you make an installation that sounds fine in the shop, but as soon as the car gets out on a concrete highway, reception is ruined by a continuous static discharge. At first you think it might be some sort of motor interference or possibly an electrical storm in the offing, but you soon find out that applying the foot brakes eliminates the noise and also, standing still even with the motor running, there is no noise.

Front Wheels Only

As reported by the Philco *Service Broadcast*, when an installation shows these symptoms, the trouble is front wheel tire static. Static is developed on



HELICAL COIL SPRING

FIG. 1.

all tires on hard surface roads but the noise comes from the front two only. The rear wheels are grounded to the frame of the car through the axle and the rear. This provides a continuous discharge path for the static. The front wheels are grounded to the car frame through the front wheel bearings and the front axle. Since the bearings are packed in grease, the path to ground is very often a high resistance path or even intermittently open, resulting in terrific interference.

One of the early cures for this trouble was changing the grease used on the front wheel bearings. The sure and lasting cure for this trouble is to provide a continuous low-resistance circuit between the wheel and the axle.

Cure for Trouble

Fig. 1 shows a helical coil spring made from piano wire or some other good spring material which can be made in your shop. Fig. 2 shows how the spring is installed.

Make the spring about 1½ inches in diameter. To install, remove the hub cap from the wheel. Then remove the

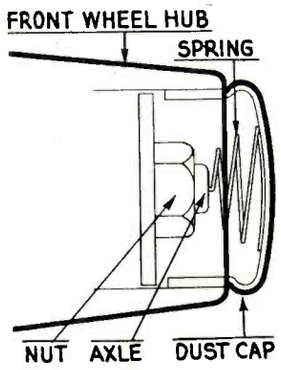


FIG. 2.

dust cap. On some cars, this can be pried off; in others it is threaded and must be taken off with a wrench. The tip of the spring must be placed in the centering hole which will be found in the end of the axle, and the dust cap replaced. Be sure the cotter pin is bent back so that it will not catch.

A trial on the road will convince you that the interference is eliminated.

•

CONDENSER LEAKAGE TESTER

(*Continued from page* 428)

If there is imperfect insulation in the condenser the current through it will never become exactly zero and the grid resistor will still have a drop across it, which in turn biases off the tube and prevents it from drawing the former or normal current. If the terminal resistance of the condenser is as low as 100 megohms it will prevent the meter from returning all the way; but if it is as low as 25 megohms it will cause it to remain on zero.

It is generally assumed that a condenser which has a terminal resistance of less than 100 megohms is not suitable for an r-f bypass, due to its tendency to act as a resistor and draw current which develops a voltage across its terminals. While this action is very small, it is often enough to cause trouble in sets having automatic volume control. Also bypass condensers in this condition in neutrodyne sets, due to their r-f resistance and consequent low-bypass effect, make it possible to neutralize the set. Often, remarkable improvement is produced in old sets by the elimination of all condensers which do not pass this test. All new condensers of reliable manufacture, which are being made at this time, will pass this test with a rating of about 99.5%; while many condensers which were made years ago would never pass it. The net result is that many sets having old condensers would never come up to normal performance.

Testing Dry Electrolytics

This device *will not* test leakage in dry electrolytic type condensers because of their low terminal resistance. Most of these condensers draw a current of about 0.1 ma per microfarad of capacity. The best way to test them is to insert a milliampere meter in series with the positive side of the condenser while the set is operating.

This tester, as shown in Fig. 3, will be satisfactory on all condensers between about 2.0 mfd and 0.0001 mfd. The simple change shown in Fig. 4 may be made in the grid circuit. This will materially increase the charging time so that a readable deflection will be obtained on extremely small condensers. This low-capacity change is useful in running down freaks in oscillator padding condensers, and the like.

Meter Reading Changes

When this tester is ac operated, there is a noticeable tendency for test leads to change the meter reading when touched by the operator. Efficient insulation of the leads will not correct this, although it can be almost entirely eliminated by connecting an actual ground to the points marked ground in Fig. 3. Since this instrument is entirely free from oscillation, it will not radiate and does not need to be shielded.

Eugene V. Parish,
1325 *S. 5th St.*,
Springfield, Ill.

(*The author will be pleased to answer any questions concerning this tester that may arise. All inquiries should be addressed directly to him, and a stamped and self-addressed envelope should be included for the reply.*—The Editors.)

Public Address . .

P-A SYSTEM WITH VELOCITY MIKE

By H. HOWARD RABE

Part II

THE amplifier is of conventional design and requires no particular explanation except for a few special features. A high-gain amplifier, such as this, requires thorough filtering. The high noise level of the carbon microphone makes a very low hum level useless. Not more than two plate circuits can be operated from one resistance-capacity filter. Separate cathode resistors should be used for every tube. Ordinary carbon composition resistors are satisfactory for voltage dividers, grid resistors, and plate resistors in the high-level stages. The plate resistors for the low-level stages especially must be very carefully selected.

Large coupling condensers and high ohmage grid resistors produce an amplifier that will pass the very low frequencies; they also increase the tendency to oscillate or motorboat and therefore larger filter capacity is required.

Frequency Control

When covering concentrated, noisy audiences, the high frequencies seem to be lost faster than the lows, and the output sounds boomy. The remedy is to cut off the lows in the amplifier. With the low frequencies out of the power stage and speaker, the medium and high frequencies can be raised to a much higher level.

The high-frequency tone control is of the regular fixed-condenser, variable-resistor type, the values depending upon the cut-off desired. The low-frequency tone control is simply a variable grid resistor. Decreasing the value of the resistor increases the impedance of the coupling condenser to the low frequencies resulting in their attenuation. The same thing can be accomplished by decreasing the value of the coupling condenser.

The small .00025-mfd condensers connected from plate (or grid) to chassis serve to stop r-f oscillation. If too large, they will also cut off the very high audio frequencies.

When using the speaker field in the negative power-supply lead, the first filter condenser should be quite large. About 2 mfd will take out most of the hum, but 6 or 8 mfd must be used to remove all of it.

The accompanying article provides the necessary data for the construction of the complete amplifying equipment to be used with the velocity microphone described last month. Some readers may wish to re-design the pre-amplifier for the newer tubes, such as the 77, 6C6, etc. In many cases it is found better to separate the pre-amplifier from the main amplifier. However, the arrangement described is satisfactory and has been in daily use for some time.

A few words regarding the velocity microphone—if the construction appears too difficult, as it may to many readers, one may resort to the purchase of a complete velocity microphone, or one of the kits on the market.

The author has described a microphone the ribbon circuit of which feeds directly a transmission line having an impedance equivalent to that of the microphone ribbon. This arrangement is satisfactory in a few cases where the transmission line is not too long. The line loss will be about 3 db, which is not excessive when it is considered that a ribbon mike is about 80 db down. However, it is highly desirable in practically all cases where the ribbon mike is to be used at any distance from the amplifier, to use both a ribbon-to-line transformer and a line-to-grid transformer, rather than a single ribbon-to-grid transformer. This is standard practice and the ribbon-to-line transformer is mounted directly below the microphone. In following such a procedure, it should not be necessary to use elaborate shielding for the line-to-grid transformer, if any shielding at all.

The ribbon microphone may be magnetically shielded without robbing the flux from the air gap, but care should be taken in shielding that both the front and rear of the microphone are fully open, else both the sensitivity and the frequency characteristics of the unit will be affected. Metal screening or metal grilling are satisfactory. Cast cases which form cavities should be avoided.—The Editor.

Level-Indicator Circuit

The level indicator circuit is quite helpful, especially when the loudspeaker is located at some distance from the amplifier. A 27-type tube is used for this purpose and the meters are used in the cathode circuit instead of the plate circuit, as is customary. The plate circuit of the tube draws current only when the set is modulated and therefore creates considerable disturbance in the amplifier; it must therefore be well filtered from the rest of the amplifier. The 2000-ohm resistor (a filter choke will do) and 2-mfd condenser are satisfactory.

The grid of the level-indicator tube receives its signal from the plate of one of the power tubes, through a .04-mfd condenser; and receives its bias through a 250,000-ohm resistor from a tap on the bias voltage divider. The value of this resistor is not critical, but if of low resistance, the resistor and the condenser will act as a plate-to-chassis tone control.

Maintaining Level

With the carbon microphone and its high hiss level it is sometimes a problem to keep speakers within proper range. With a level-indicator meter on the microphone, they are instructed to maintain a good deflection on the meter. With the circuit illustrated, the common circuit to the microphone is connected to the chassis, and this makes it possible to operate the microphone and level indicator with a four-wire cable. If the extension meter is not used, a switch on the set allows the set meter to be connected to the chassis. The cost and accuracy of the level indicator is largely dependent on the type of meters used. The Readrite 0-10 ma meters were used and proved satisfactory.

Adjusting Level Circuit

Full output on the amplifier will cause a deflection of 6 to 10 ma on the level-indicating meters. The amount of bias on the tube will depend on the plate voltage. The plate current should be practically zero with no signal in the amplifier. Conditions should be such that the power tubes are overloaded (draw grid current) before the level-indicator tube draws grid current. A resistor in the cathode circuit will have a voltage developed in it when the tube draws current and this voltage, added to the fixed bias, will help limit the plate and grid current in the level-indicator tube. The meters used have about 700 ohms internal resistance.

Adjusting Amplifier

In view of the fact that every amplifier built up from different parts and

to serve different purposes must be individually balanced or adjusted, it is impossible to give accurate design details. The foregoing discussion should enable the reader to rebuild his amplifier to accommodate the velocity microphone. The value of many of the parts will depend upon individual conditions.

The highly attenuated output of a phonograph pick-up connected to the first stage is very helpful in adjusting the value of the parts for best results.

A two-pole, single-throw, off-on switch was used. One pole being used in the 110-volt line and the other in the microphone battery line. The cost and weight of filter equipment necessary to take the button current out of the power pack is usually greater than that of batteries. The monitoring connections are helpful when the loudspeaker is at a distance from the amplifier.

If a high power-output stage is to be used, special care must be taken to keep the ribbon input transformer out of the field of the power transformer.

The p-a outfit is an old rebuilt screen-grid tuned-radio-frequency set, an extension having been added to the chassis to accommodate the extra tubes. This radio, phonograph, and microphone combination makes most any type of program service possible.

The absence of granule hiss and the presence of overtones gives the velocity microphone a tone that cannot be approached by the carbon transmitter.

MODERN TUBE CHARACTERISTICS

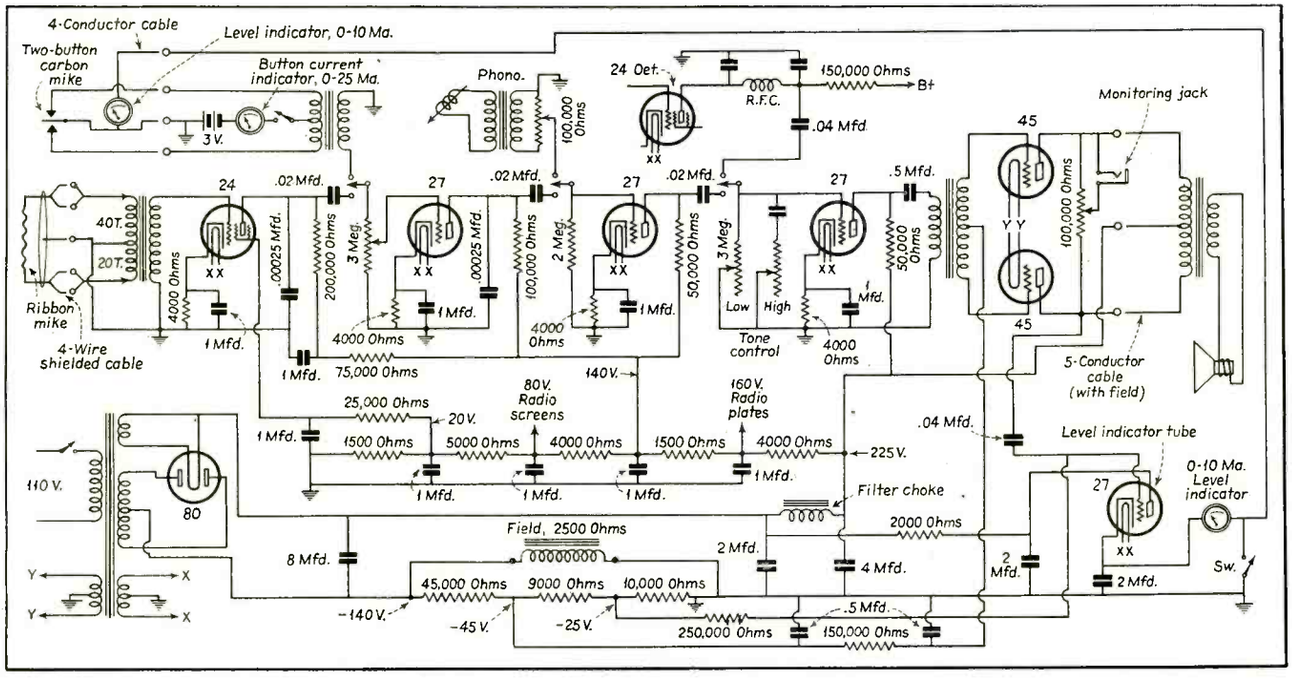
(Continued from page 419)

There are several tubes which must be classified as special tubes, or combination tubes—namely, the 2A7 and 2B7 and the corresponding tubes in the 6.3-volt line, namely, 6A7 and 6B7. The 6A7 is a tube for converter use in which certain of its elements constitute the oscillator source. In this tube, the mixing of the oscillator with the input signal is effected solely by virtue of its electron stream and requires no external coupling. The 6F7 is designed primarily for the same purpose as the 6A7, but must be used in circuits which couple together its triode oscillator with its pentode mixer section. Due to the complete separation of the pentode section and triode section, this tube can be used in other circuits, and so, in that way, has a wider field than the 6A7. Types 2B7 and 6B7 are 2.5-volt and 6.3-volt tubes, respectively, with a pentode section and a pair of diodes. The pentode section is neither a remote cut-off tube, nor a sharp cut-off tube, but lies between. Its use is mainly confined to diode detection and high gain pentode audio amplification, although, in other uses, such as pentode i-f amplifier and diode detection, it is sometimes a convenience.

Output Tubes

One finds a great variety of output tubes for use on 2.5 volts, while there are comparatively few for 6.3-volt service. For 2.5-volt service there is the type 45 which is a filament type triode of medium power output. The type 2A3 is a triode which, in many respects, may be classified as a "bigger and better" 45. In addition to its triode Class A service, the 2A3 is used in what is often called Class A Prime amplification with quite large available output and low distortion. The type 46 is another 2.5-volt filament-type tube which can either be used as a Class A amplifier, having somewhat smaller output than the type 45, or in Class B amplification with output far in excess of that of the 45's, but with more distortion than in the case of the 2A3's. Type 47 is a pentode tube having greater output than that of the 45, but with the inherent pentode disadvantages, that is, the greater importance of the proper load and somewhat higher distortion level. The 2A5 is an indirectly-heated cathode pentode tube whose characteristics are the same as the 47 and having the advantage over the 47 in that, being indirectly heated, hum problems are reduced and self-biasing may be effected without having the filament winding at an off-ground potential. This tube is also used as a triode amplifier by connecting the screen grid to the plate, and also as a Class A Prime amplifier with this same connection, but with different voltages applied.

Wm. M. Perkins, Engineer,
National Union Radio Corp.



Complete schematic diagram of the public-address system designed for use with the ribbon microphone described last month.

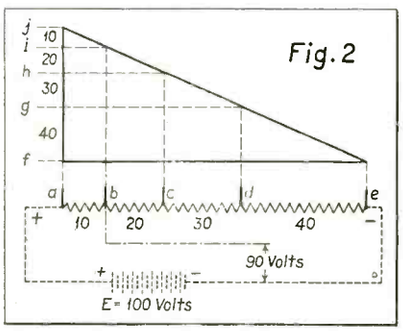
"VOLTAGE RELATION" AND ITS APPLICATION

PART II

"Voltage Relationship" is an interesting as well as an important subject. The ways in which voltage relations are taken advantage of in receiver design are covered in this article.

Voltage-Divider Calculation

A circuit similar to that of Fig. 2 may be used as a voltage divider. For example, suppose we wanted to impress 20 volts across some external circuit and have 20 milliamperes flow through it (disregard all values given in the diagram of Fig. 2 except that of the impressed voltage). Suppose also that the total current drawn from the battery was 160 milliamperes and that the connections were made at d and e. We now have to find the correct values for the resistances ad and de. Since there is 160 milliamperes flowing through ad



Here we have a voltage divider with a lot of lines indicating voltage relationships from point to point.

and producing an 80-volt drop, we can calculate the value of ad thus

$$R = \frac{80}{.16} = 500 \text{ ohms.}$$

Likewise, the resistance of de may be found in a similar manner. The current in this case is 160-20 or 140 milliamperes which is producing a 20-volt drop. Then,

$$R = \frac{20}{.14} = 142.87 \text{ ohms.}$$

In the preceding examples the negative terminal of the battery was assumed as the zero of potential. All values were, of course, positive with respect to this zero. Now let us see how use is made of a few of these facts by considering the following examples.

Grid Biases

Referring to Fig. 3-A, the grid and cathode connections of a tube have been shown. Now if current were to flow from the plate to the cathode and then to ground through the cathode resistor r_1, since the cathode is 5 volts positive, there would be a drop of 5 volts in r_1. The grid of this tube will be at 5 volts negative bias if there is no grid current being drawn, since it is connected at ground potential. If grid current were flowing, there would be a drop in resistor r_2 and the grid would be at a greater negative bias.

In Fig. 3-B, we have much the same situation as in Fig. 3-A with the exception that the grid, when no current is flowing in the grid circuit, is at the same voltage as the cathode, namely, 5 volts positive. Again, if grid current is drawn, the grid will be at a bias lower than five volts by the amount of the voltage in r_4. Tap N is shown merely to indicate that bias for other tubes may be taken from the cathode resistor, the bias in this case being less than five volts but still positive. The actual voltage would be determined in the usual way.

Fig. 3-C is practically the same circuit as that shown in part A with the exception that the cathode is connected to a voltage divider, the divider probably

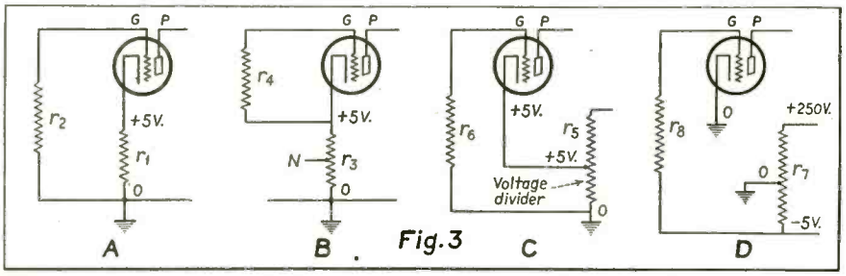


Fig. 3

There are bias systems and bias systems, as the above diagrams indicate. A study of these four circuits will disclose the fact that bias voltage is an obscure sort of thing which pops up and shows itself only when the cathodes and grids of vacuum tubes are connected to dissimilar points. It's all a matter of relative connections, which becomes evident in the case of "A" where the grid is at a negative bias even though it is connected to ground. The answer is: it is negative with respect to the cathode and not with respect to ground.

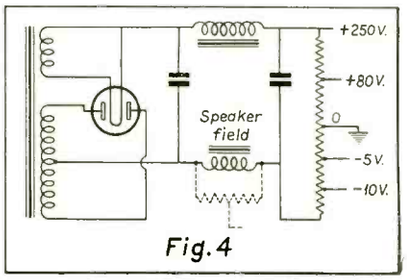


Fig. 4

Here is the well-known "bias obtained from negative leg of power-supply system" arrangement. This diagram also indicates that additional bias may be obtained from the drop across the speaker field or from a resistor shunting the speaker field.

being used for biasing other tubes. Fig. 3-D shows a variation of the circuit. Here the cathode is run directly to ground and is at ground potential. The grid is tied to ground through a voltage divider and a resistor. As can be seen from the diagram a negative bias will be applied to the grid of this tube.

Rectifier Circuit

In Fig. 4 is shown a rectifier tube, the plates of which are tied together through a transformer winding. Also shown in the upper lead is a choke, while two filter condensers are connected from either side to the return leg. The voltage divider permits biases of 200 and 80 volts positive, and 5 and 10 volts negative, as shown here. A speaker field is shown connected in the return leg. This is not uncommon procedure. Actually, bias for power tubes may be taken by tapping from the speaker field. The more general way to obtain biases of this sort, however, would be to parallel the field with a resistance, as shown by the dotted lines, and proceed to tap off from this resistance.

As the plates of the rectifier tube are in the high potential part of the circuit, it may cause some confusion to see the return leg go directly to the plate winding. However, the tap is at the center of the winding and hence is similar to the return of a lead to the negative terminal of a battery.

The qavc circuit of the Crosley 160, page 259, July, 1934, Service, has a very interesting way of obtaining bias voltages. In that circuit, the qavc tube is biased from the cathode of the 56 a-f tube. It is suggested that the reader again check through the text on that circuit.

LATEST TECHNICAL INFORMATION

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The Hygrade Sylvania engineers have given you helpful books that cover general service data on both home and automobile radio receivers. Now available is a convenient 104-page technical manual containing the essential information every user of tubes must have to secure the optimum performance from any device employing vacuum tubes.

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HIGHLIGHTS...

THE HOGAN SLOGAN

The boys in the Chicago area have been phoning Tom Hogan and asking him if they should throw away all radio receivers they can't fix, no matter what the customers may think. It's been fun for the gang, but Tom can take it any day in the week.

If you read the article, "The Radio Service Man Becomes a Radio Service *Business* Man," on page 373 of the October issue, you may have wondered at the slogan which was stated as, "If you can't fix it, throw it away."

Tom's slogan is, "If *we* can't fix it, throw it away," a good slogan incidentally, and one a customer could well abide by.

The slip was ours and we hereby extend regrets. Just the same, the telephone response Tom got proves that the Chicago boys sure read the article about him.

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P-A. DEALER-DISTRIBUTOR PLAN

Sound Systems, Inc., manufacturers of public address and associated equipment, announces a new dealer and dealer-distributor policy which is said to be more than just a "policy." There are several interesting angles for the dealer attempting to engage in the public-address business.

Sound Systems, Inc., was originally formed as a dealer and distributing organization and worked under the handicaps present for every other dealer of public-address equipment. Along with its present manufacturing activities it still maintains a local dealer outlet and a large public-address rental department and through these departments is in direct contact with the present market and its needs.

The smaller dealer, in bidding and supplying the larger installations, finds it necessary to assemble equipment from too many different sources. Complete portable systems must be obtained from one source and the higher type precision equipment from another. The large dealer or distributor with an engineering staff is in a position to specify as to its needs when ordering such equipment, but the many small dealer outlets who are the backbone of the public-address sales must spend their entire efforts on sales and they are not properly equipped to issue their own specifications on equipment.

In probably 75% of the public-address and sound systems in use today, there will be found mismatched units and in a high percentage of these there is an improper application of one or more units, especially the loudspeaker equipment.

Sound Systems, Inc., announces that it is now in a position to offer everything needed or in use today in public-address and sound systems. Each unit is built in the proper relation to the complete line. For instance, a 4½-watt or 7-watt amplifier is purchased. More power is needed at a later date and an input amplifier and from one to six output amplifiers may be added, by steps or at one time, raising the output to 15, 30, 45, 60, 75 or 90 watts. These units are stocked in standard containers, pack or panel style. Resistance-coupled or transformer-coupled amplifiers are available, offering a flexibility in price. This same general principle is followed throughout.

In order to enable the small dealer to work with the organization on a highly diversified line of equipment, a policy has been set up whereby any small dealer attempting to do a public-address business may represent Sound Systems, Inc., on an open territory basis. His next step is to obtain a dealer-distributorship with the company and upon application for such representation he is given his sales quota which is determined by the population in his county or counties. The quota is set on a reasonable basis and as soon as this dealer meets the quota he automatically becomes an exclusive dealer-distributor in the territory in which his quota was made. This entitles him to a higher discount and protection on all sales in the territory, which, after his quota is once made, enables him to retain it without great difficulty.

This plan in more detail is given in a specially prepared bulletin and it has been of particular interest to all dealers to whom it has been submitted. Copies may be obtained from Sound Systems, Inc., 1311 Terminal Tower, Cleveland, Ohio.

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CONDENSER AND RESISTOR CATALOG

The correct condenser or resistor for practically any standard radio need, can be found in the 1935 edition of the Aerovox General Catalog just issued. Electrolytic, paper, oil-filled, mica, tubular, bakelite case and other types of condensers are listed, as well as wire-wound vitreous enamel, carbon and other types of resistors.

The new edition features several new items, such as the high-voltage oil-impregnated oil-filled transmitting condensers, auto-vibrator condensers, ultra-compact general utility electrolytics for service work, and the exact duplicate replacement condensers, together with the Pyrohm Junior 10, 15, and 20-watt wire-wound vitreous enamel resistors. A copy may be obtained from the Aerovox Corporation of Brooklyn, N. Y.

•

"TROUBLE-SHOOTING GADGET"

An ingenious "gadget" to assist Service Men in trouble-shooting has just been designed by A. A. Ghirardi and B. M. Freed, authors of a forthcoming publication on "Modern Radio Servicing." This gadget is now on the market.

According to the symptom detected by the Service Man, the "gadget" lists according to source, 275 possible troubles in the receiver. Six general types of symptom are shown—Hum; Weak; Noisy; Inoperative (no signals); Intermittent Reception; Fading; Oscillation and Distortion. The trouble sources are classified according to whether their location is in the Power Unit; Receiver Circuits Proper; Tubes; Reproducer; Antenna Ground; "A" Battery (if used); "B" Battery (if used); and General.

The "gadget" is being sold by Radio & Technical Publishing Co., 45 Astor Place, New York,

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"RADIO RECEIVER MEASUREMENTS"

This is the first and, so far as we know, the only English text book on radio servicing. Unlike many American books on the same subject, it is decidedly more technical in its treatment of circuit measurements. So much so, as a matter of fact, that it is more precisely classified as an engineering treatise.

"Radio Receiver Measurements" gives an outline for the benefit of the radio service engineer, methods of measuring receiver performance, and also provides provisional standards as a basis for judging performance.

Details of up-to-date methods of receiver testing are given, with full descriptions of commercial signal generators and their use, set-ups for the measurement of receiver sensitivity, selectivity and fidelity, and interpretations of receiver performance.

There are 53 illustrations, concise summaries of methods following the respective chapters, four appendices, and a general index.

Recommended only for the advanced technician.

"Radio Receiver Measurements," by Roy M. Barnard, 116 pages, published by Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1, England. Price 4/6 net—by post 4/9.

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SHORT-WAVE ANTENNA DATA

The Cornish Wire Co., 30 Church Street, New York City, manufacturers of radio antenna products and radio wire, announce the publication of a treatise on All-Wave Antenna Kits and Accessories.

A feature of this work is a map of the world, showing the important short-wave stations, with their call letters and kilocycle designations. The reverse side explains the importance of the aerial in modern long-distance and short-wave radio reception, pointing out that the Service Man is the man to do the job of adjusting a customer's radio antenna to local conditions.

The company continues by cataloging its kits and antenna parts, including an ordinary kit (No. 10) ... also a kit for the circuit recently patented by Amy, Aceves and King.

The chart is listed at 25c. for consumer distribution, but is free for inspection and distribution by dealers, wholesalers and Service Men, who are invited to communicate with the Cornish Wire Company at once for a supply.

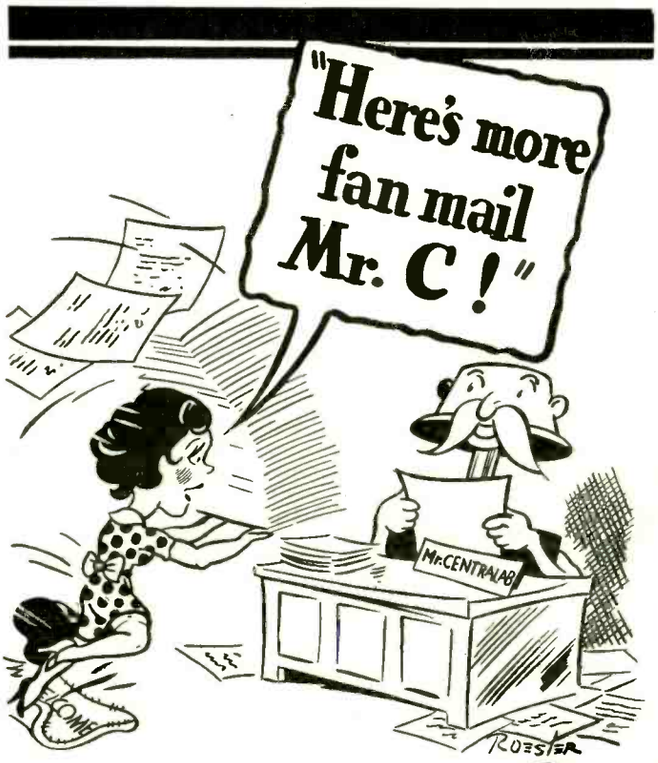
A definite educational and merchandising job has been attempted, and the manufacturer feels that the trade will benefit directly by capitalizing what it has just done.

•

OIL BURNERS

Some of the boys have gone in for the servicing of electric refrigerators as a sideline. May we suggest that if you are taking up this work that you also give thought to oil burners which have nice ignition systems to play around with.

The electrical system of an oil burner requires attention now and then. Moreover, some of them cause considerable interference with the reception of short-wave and broadcast programs. In such cases there is the chance of making a nice profit on the installation of a noise-suppression device.



"Since using your control I feel like a new radio" . . . "never performed better in my life," writes another.

And so it goes . . . thousands of old, worn out, tired radios are being rejuvenated by alert servicemen with CENTRALAB replacement units.

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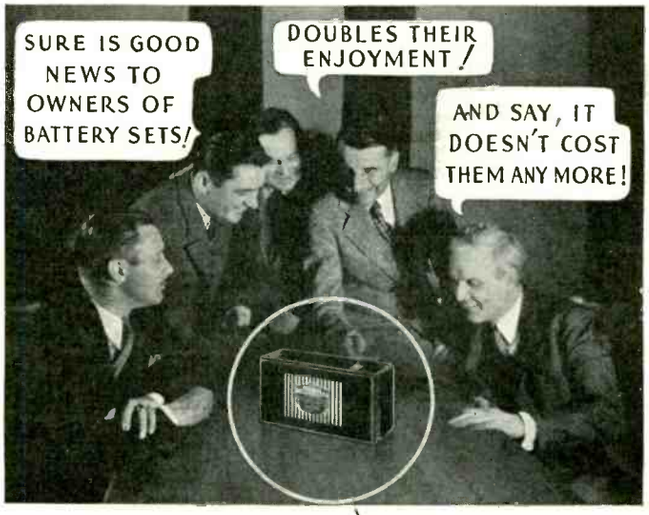

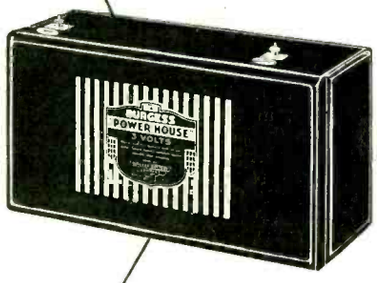

SERVICE MEN KNOW that many owners of battery-operated sets still have the old-fashioned belief that batteries give fewer hours of service when used more than 3 or 4 hours a day. That belief has been exploded by BURGESS engineers. Repeated tests in our laboratories and in actual use have proved that you can use BURGESS Batteries 7 or 8 hours a day—and get maximum service!*

When battery-operated sets need new batteries, tell your customers about the BURGESS "8 hour day". They will be glad to know they can double their enjoyment at no increase in their battery cost per hour!

Owners of 2-volt sets can buy 400 hours of dependable "A" power in the BURGESS Power House for only $3.20. The Power House is 100% DRY, requires no attention and is not affected by weather. Like the world-famous BURGESS "B" and "C" Batteries, it costs no more per hour when operated 7 or 8 hours a day. BURGESS BATTERY COMPANY, Freeport, Illinois.

*For economical operation of 7 to 8 hours a day, sets should be powered by batteries of proper capacity. Set owners should ask their Service Men to recommend type and size of batteries best suited for their use.

BURGESS

BATTERIES AND FLASHLIGHTS

ASSOCIATION NEWS . . .

I. R. S. M. NEW YORK CONVENTION

Nearly 1,500 radio Service Men attended the Second Annual Convention and Trade Show held under the auspices of the Institute of Radio Service Men at the Hotel Pennsylvania in New York City last month, the most auspicious gathering of radio Service Men in the history of the industry.

The convention opened with a "bang" when, on the opening night, more than a thousand Service Men checked past the Registration Desk into the Convention and Exhibition Halls, filling the spaces to capacity. Never before had there been such an august assembly of Service Men anywhere, and the strange part of the whole thing was that the meeting was strictly one of business—no refreshments were served.

The first thing that caught the eye of the Service Men entering the portals was the vast array of exhibitions that filled the Salle Moderne and extended on into the Roof Garden. Thirty-six booths representing forty-seven exhibitors and around each of them clustered a group of men interested in learning all there was to know about the products being displayed.

Technical Sessions

The technical sessions, presided over by Paul J. McGee, President of the Institute, were held in the Roof Garden. The speakers, in the order in which they appeared on the program, were: E. T. Cunningham, President, RCA-Victor Company; Dr. Alfred N. Goldsmith, Consulting Engineer; T. F. Joyce, Sales Promotion Manager, RCA-Victor Company; W. F. Diehl, RCA-Victor Engineering Laboratory; George Lewis, Vice President, Arcturus Radio Tube Corporation; Glenn Browning, Consulting Engineer for Tobe Deutschmann Corporation; John F. Rider, Publisher; Paul G. Andres, P. R. Mallory & Co.; Kendall Clough, Clough-Brengle Company; Julius Aceves, Technical Appliance Corporation; Arthur Lynch, Fred Horman (with Aceves and Clough) in symposium on antennas; Allen B. Forsberg, Trade Relations Counsellor; and, Walter R. Jones, Engineer, Hygrade Sylvania Corporation.

Forthcoming Conventions

Arrangements have been made for the Third Annual Convention and Trade Show to be held at the Hotel Sherman in Chicago, March 22-24, 1935, and for the Third Annual Convention and Trade Show to be held at the Hotel Pennsylvania next October. Like every Convention and Exhibition conducted by the Institute this one marked another milestone in the development of the radio service profession and industry.

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N. A. R. T. TO REGISTER SERVICE MEN

The Northwest Association of Radio Technicians is instigating and sponsoring a movement locally to register all Service Men and assign them a number, such number to be placed on each chassis serviced, either by sticker or otherwise, in order that irresponsibles may be checked up on in case of violations of the ordinance, which is expected to specify adherence to the Underwriters' rules, the utilization of parts equal to, or better than the original, fair prices, etc. This will probably set up a board of radio control consisting of representatives from the industry, broadcast station owners and the general public.

A non-technical examination is provided for, a yearly fee not to exceed five dollars and a penalty of fifty dollars for serious infractions, with loss of registration for varying lengths of time for milder offenses.

We feel that this step will result in greater stabilization of chaotic conditions, a greater respect in the public mind for our profession; and we find the city officials very kindly disposed toward such action, though we expect to do the policing ourselves and the small fee will mean no great addition to the city finances.

At our last regular meeting enjoyed a thorough demonstration of a cathode-ray oscilloscope by Mr. Art Holmboe, one of our members.

At the last annual election Ralph Terrill was elected president; E. L. Fremery, vice president; Earl Grulke and Claude Austin reelected secretary and treasurer respectively.

Ralph Terrill, *President.*

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WASHINGTON I. R. S. M.

The October Meeting of the Washington Section of the I.R.S.M. was a much appreciated one, technically, and socially a success. The speakers: Mr. Chase, of the National Electrical Supply Company; Mr. S. K. MacDonald, Vice President of the I.R.S.M.; Mr. Gilpin, General Electric Sound and P-A Engineer; Mr. Feldstein, General Electric Radio Engineer. Latest G. E. Sound, Public-Address and Radio-Equipment was demonstrated and explained.

The Executive Committee of the Washington Section, due to the need of Service Men in this city, has started an employment agency.

Plenty to eat, and a good time was had by all of the 86 attending.

Gerard G. Larkin,
Sec'y & Treas.

•

ST. JOSEPH (IND.) R. S. A.

The Radio Servicemen's Association of St. Joseph County, with headquarters at Davidson Sales Co., South Bend, Ind., and having a membership of sixty active Service Men of South Bend, Mishawaka and vicinity, were addressed by Mr. Mohaupt of Radio Training Association of Chicago upon the subject of "The Oscillator in Servicing," at their regular meeting, Oct. 25.

The Association, with the cooperation of the local jobbers and dealers, is putting on a DX contest to promote more service calls and sales; and is gaining considerable enthusiasm from the boys and their customers.

Meetings are held weekly; two meetings a month are given to systematized instruction while the other two are more of a business nature.

As our pledge we have the following:

1. *Make and keep fair and reasonable promises.*
2. *Highest quality materials.*
3. *Efficiency and courtesy—always.*
4. *To charge only fair and reasonable prices.*

Our organization is doing everything in its power to raise the standard of the radio service business, that it may in time be a more business-like and profitable occupation.

H. H. Parsons, *Vice-Pres.*

•

P. R. S. M. A. NEWS

The well-known Walter R. Jones, engineering consultant for Hygrade Sylvania was guest speaker at the Philadelphia Radio Service Men's meeting October 2nd. Mr. Jones gave a very interesting lecture on tube design as well as an insight into the difficulties encountered in adapting tubes to various circuits and vice versa. In fact, his talk was so interesting that the men almost made him miss his train by keeping him answering questions at the end of his lecture.

Fun Night, celebrating the Association's anniversary, which was held at the Hotel Stephen Girard turned out to be a huge success; in fact so much so that the boys who did not attend are still kicking themselves.

The Association's booth at the Philadelphia Electric and Radio Show was received with a great deal of interest and favorable comment both by the public and those interested in the radio business. Reports from the membership indicate that financial returns in the form of additional service jobs and sales, for which the Show was found directly responsible, started coming in immediately after the Show opened. 35,000 copies (actual—not newspaper figures) of the directory of members was distributed to people visiting the booth. The entire cost of the Show was paid out of the Association's treasury with no cost whatsoever to the members.

It might be well to add here that the Association received the kind assistance of several manufacturers and they take this opportunity to thank them.

H. R. DeLong, *Secretary.*

•

N.H.R.S.A.

We have just received word of the formation of the New Haven Radio Servicemen's Association, New Haven, Conn. Our best wishes to you, fellows.

All communications should be addressed to Mr. J. E. Guetens, Secretary, 6 Hall Street, New Haven, Conn.

•

ALL-WAVE ANTENNAS

Service has carried any number of articles on all-wave antenna systems, so that by this time the readers should be well acquainted with the merits of each type. However, as effective as these systems are, we receive quite a number of letters stating that the antennas do not work out the way they are supposed to.

We can draw only one conclusion—there has not been sufficient data published on the installation of these systems and the means of getting them to work properly. Consequently we are going to run an article on this subject next month; an article which will permit one to determine the type of system to use under any given set of conditions, the manner in which noise sources may be located, etc. We think you'll like it.

THE FORUM...

HELP WANTED

Editor, SERVICE:

Have been using SERVICE magazine in our shop for a long time and find it interesting and useful.

However, it is not complete. For a long time I have been looking for a real good radio man, good personality, fine appearance, well educated, able to meet fine people, and repair radios without lost motion.

I know from experience that it is not easy to locate a good man, but because of the quality of your publication, I believe quality men are available through it.

Do you think a service of this kind would be of value to your magazine and the men whom it serves?

H. C. WEBBER,
Radio Engineering Service,
8 West Willow Grove Ave.,
Chestnut Hill, Phila., Pa.

(*We trust that the publication of this letter will bring to you applications from men of the type you require. It should. We will be pleased to run similar inquiries relative to positions available.* — THE EDITOR.)

•

I-F INTERFERENCE

Editor, SERVICE:

All-wave receivers with intermediates peaked on or near the frequencies used by commercial stations have revived the old bugaboo of code interference in many cities, especially in the region of the Great Lakes. I have checked the thing from the commercial station end and submit the following definite information. It is from authentic sources; you can further verify if you wish by referring to licensing authorities or to the RCA.

The standby channel (corresponding to 500 kc on the ocean and its coast) is 410 kc for the Great Lakes. All commercial shore, ship and coast guard stations are equipped for it. This channel is used entirely for calling and for distress.

The working channels on the Great Lakes are 425 kc and 454 kc. It is this latter channel that causes most of our troubles. Ship and shore stations of the five lakes call each other on 410 kc. Their traffic then shifts immediately to either 410 or 425. The shore station selects which of the two shall be used for that particular message, selecting the one not being used at the moment by other stations near enough to interfere.

Weather reports are sent by the various shore stations on a regular schedule. Some of them are on 425 kc, some on 454 kc. They are so scheduled that Cleveland, for instance, may be sending weather on 454 kc at the same time Chicago or Buffalo is sending it on 425 kc. Summing up, code transmission along the Great Lakes is to be picked up occasionally during the winter and very frequently during the navigation season on 410, 425 and 454 kc. The code on 454 kc often interferes with broadcast receivers peaked between 450 and 460, at distances up to at least 20 miles from transmitters.

At least one large manufacturer is shipping into the Cleveland district his standard all-wave receivers, but specially peaked for this territory. You might find it worth while to see how many manufacturers peak around 454 kc and how many have special intermediates for special territories (and what the frequencies are in this case and *whether the sets are so marked*).

Great Lakes stations are also licensed to use various frequencies between 143 and 167 kc (Canadian 187 kc) but these are practically in disuse today. This was for shore station intercommunication, and has been supplanted by frequencies above 3,000 kc. They are still licensed for 143 kc, etc., but do not use it, and it probably will disappear as stations are relicensed.

The channels at 410, 425 and 454 kc are set by international agreement and are not likely to be changed in the near future. It seems to be up to the manufacturers of broadcast receivers to avoid those channels or to build sets in which there will be no r-f coupling between the i-f transformers and the antenna or other circuits.

Further, the manufacturers who align sets to special i-f peaks for certain territories should label the sets. Also, they might well supply your readers with information on these sets, whose proper operation depends on their being peaked at a frequency different from that shown in standard service manuals.

RALPH WORDEN,
Lakewood, Ohio.

(*Many thanks for the very complete and precise data. It should prove of great assistance. We hope to obtain from the manufacturers lists of special i-f peaks.*— THE EDITOR.)

•

STANDARDIZED SERVICING

Editor, SERVICE:

Standardized servicing? Well, you will have to show me. I have in the past ten years tried to devise some systematic routine, but only to find that every job provides an entirely different problem. It seems to me that one would be foolish to apply a systematic check. I find that I am guided solely by a few questions asked the owner of a set. As a rule, what they tell me directs my point of attack.

As for the ever-changing tubes, radio chassis, etc., that is fine. The more changes that are made the more demand there will be for competent Service Men. As for test equipment I use in the field (on service calls), I employ a first-class tube checker, oscillator and a combination ac-dc volt-ohmmeter. I find these three instruments sufficient.

W. E. SMITH,
Oak Forest, Ill.

•

ORGANIZATION

Editor, SERVICE:

I wish to express my appreciation of the many interesting and helpful articles which you have published. Those about organizing have been especially interesting to me, for I believe organization will be the salvation of the servicing profession.

I mean by that, effective, *local,* organization, perhaps eventually to be loosely tied together in some sort of federation. It is my opinion that a strong national organization is an impossibility, and a national code entirely impractical.

There is another thing to which I have given much thought, and that is the business education of the Service Man. Undoubtedly most Service Men are poor business men. A great many of them do not know whether they are making money or not. They have not the slightest idea of how to figure the cost of doing business. If they collect $10 for a job, they figure they have made $10, less perhaps the cost of the parts used, and forget all about automobile expense and all the other incidentals.

A little education in simple bookkeeping and cost accounting would go a long way toward eliminating price cutting, by showing the Service Man what it actually costs him to do business.

I hope you will find this idea at least worthy of consideration.

W. HAMILTON GEMMILL,
Baltimore, Md.

(*A national organization, whether closely or loosely tied together, would be of great advantage to all Service Men. The Service Man needs the protection and the recognition such an organization will provide him.*

No doubt some business knowledge is a good thing—even for the independent Service Man who conducts a small establishment. Equally as important is the manner of conducting a radio-servicing business. Both subjects will be given treatment in forthcoming issues of SERVICE. *The first article of a series covering these and similar subjects, appears in this issue.*—THE EDITOR.)

•

TUBE-PRONG NUMBERING

Editor, SERVICE:

The writer has noticed a controversy in your issues regarding tube-prong numbering.

Admittedly both the new and the old systems are inadequate and neither one had a logical excuse for being in existence. However, let's quit "beefing" about the new system which has been adopted by RMA, forget the old system, and I believe if everybody feels the same, we can put the new system over and make it standard for all the Service Men.

The writer was one of the first to protest the proposed change, not only protested once, but kept protesting until the new system was adopted by the RMA standard committee.

When this system was adopted, the time for kicking was past, so we immediately started to learn all over, the numbering system. This was accomplished in very short order, and I suggest that every Service Man learn this, and he will find nothing complicated about same.

F. E. WENGER
Bluffton, Ohio

(*Undoubtedly the best way for all of us —but where is the voice of the Service Man that he has so little representation in matters referring to standards which affect him. A loud voice is needed.*—THE EDITOR)

Guilty..
we confess!

For years we have been so busy designing and selling transformers that we've forgotten to tell you an important fact. We do more than *just make transformers.* . . . WE MAKE EVERY CONCEIVABLE TYPE FOR EVERY PURPOSE . . . and that is something for you to consider.

YOU KNEW . . . our line includes:

Inputs Outputs Audio
Microphone Filament Line Chokes
and Dreadnaught Transmitting Transformers

YOU KNEW . . . that 5 Kenyon replacement transformers will service over 95% of present day receivers. . . .

BUT NOW YOU KNOW . . . we can supply you *quickly* with *any type of transformer or choke* . . . at real low prices . . . let's get together . . . get our

SERVICE DATA FREE

Ask for KENYON distributor for service data. He can show you our handy replacement units. Or write us giving us his name on your business letterhead.

NRA WE DO OUR PART

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SERVICE MEN

Select the Jobbers Stock

Progressive jobbers are supplying this demand. SERVICE MEN KNOW Ward Leonard resistors are dependable. The price is so low there is no profit in taking chances with overrated resistors. Ward Leonard resistors are wire wound with silver soldered joints at the terminals. The resistance does not change. They assure quiet operation.

Write for new literature for service men.

WARD LEONARD RESISTORS

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MOUNT VERNON, NEW YORK

Name .....
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City ..... *State* .....
Jobber ..... S

2 *profit producers*
FOR DEALERS AND SERVICE MEN
WESTON BUILT

THE NEW WESTON MODEL 698 SELECTIVE SET SERVICER
$34.50 NET *complete*
IN THE U. S. A. *Including socket selector set, leads, carrying case, etc.*

THE NEW WESTON MODEL 682 TUBE CHECKER
$29.25 NET IN THE U. S. A. *With either counter or portable case.*

A Weston Selective Set Servicer, complete for $34.50! A Weston combination portable and counter type Tube Checker for $29.25! That's news . . . good news, for dealers and service men. No wonder these two profit-producing instruments are sweeping into favor.

Model 698 Set Servicer employs the improved Weston Method of Selective Analysis . . . making this a lifetime Servicer. Model 666 Type 1A Socket Selector Set is included at this low price, together with leads, instructions, carrying case, etc.

Model 682 Tube Checker is a combination servicer and merchandiser. Attractively finished and with a scale with a "good tube" area it makes a convincing merchandiser when mounted in the counter type case. A leatherette case is available for field work. Has a low obsolescence factor. Meets every requirement.

Every dealer and service man should get the facts about these two instruments. See them at your jobber's or send for descriptive bulletins. Weston Electrical Instrument Corporation, 604 Frelinghuysen Avenue, Newark, New Jersey.

WESTON *Radio Instruments*

WESTON ELECTRICAL INSTRUMENT CORPORATION, 604 Frelinghuysen Ave., Newark, N. J.
Send Bulletin on Weston Radio Instruments.

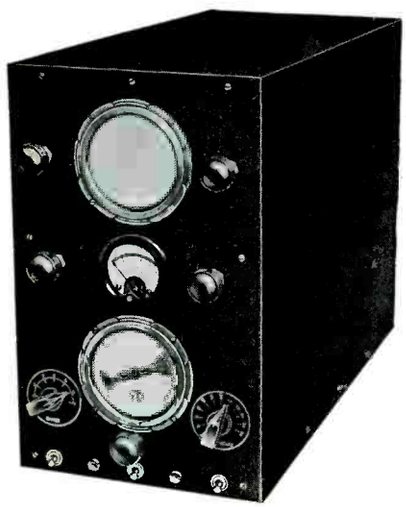
Name .....
Address .....
City and State .....

THE MANUFACTURERS . . .

NEW CATHODE-RAY OSCILLOSCOPE

Wireless Egert Engineering, Inc., 179 Varick St., New York, N. Y., has placed on the market a completely self-contained combination Visual Resonance Indicator, using a Cathode-Ray Tube, and All-Wave Signal Generator.

This device provides direct reading resonance indications for all types of intermediate, broadcast and short-wave frequency alignment tests, and may also be used for visual indications of selectivity curves, adjacent channel selectivity, avc action, r-f signal distortion, presence of regeneration or oscillation in circuits, hum measurements, vibrator-transformer operation, a-f harmonic distortion, noisy circuits, and so on.



The Model 500 illustrated uses a type H72 cathode-ray tube for visual indications, a 6F7 as frequency modulated oscillator and buffer amplifier, a 75 as diode rectifier and a-f amplifier, a type 6A7 as all-wave oscillator and mixer tube. A type 84 tube serves as the rectifier supplying voltage for the modulated oscillator, audio amplifier and all-wave oscillator. A type 143D tube is used as a rectifier for the cathode-ray tube voltages.

Focusing adjustments are provided on the front panel. Due to the circuit employed, the attenuation is said to be equally accurate on all frequencies.

The all-wave oscillator which is a part of the Model 500 unit, covers a range of 100 kc to 22,000 kc. The oscillator dial on the front panel can obtain accuracies to an absolute value of 1/10 of 1 per cent of the frequencies desired.

•

ALADDIN RESONATOR

The Aladdin Resonator, manufactured by Aladdin Radio Industries, Inc., 4049 West Diversey Avenue, Chicago, Illinois, consists of a flexible rubber rod, with a small Poly-iron core at one end and a brass insert at the other end.

The resonator is used to determine whether an inductance is below or above the required value for resonance. Insert one end of the Aladdin Resonator in the field of the inductance. If the inductance is above the resonant value, the insertion of the end having the brass insert will decrease the inductance to the resonant value, while if the inductance is low, the insertion of the end having the Poly-iron core will increase the inductance to the resonant value. The flexible rubber rod facilitates insertion of either plug in difficult places.

The Aladdin Resonator is of great assistance to inspectors, experimenters and Service Men. It will instantly tell whether any tuning inductance is correct, or high, or low, and immediate replacement or modification of incorrect units will speed up repair or final acceptance of the receiver. The Aladdin Resonator can be used at frequencies as high as 25 megacycles, because the losses in the Poly-iron cores even at these high frequencies are extremely low.

•

JEFFERSON P-A KITS

The Jefferson Electric Company, Bellwood, Ill., have announced a unique amplifier kit service based on a special, universal chassis which may be employed for the construction of three different types of push-pull amplifiers. The same universal chassis may also be used as the basis for other types of power amplifiers.

The Jefferson Amplifier Chassis is constructed of .049" gauge material, is bright galvanized finished on the inside for easy soldering, and is black crackle enamel finished on the outside. The four corners of the chassis base are reinforced with angle iron and spot welded to insure greater strength and rigidity.

The chassis is 3⅜" high, 11" wide and 17" long. There are holes for sockets and slots for mounting sockets are included. These holes are die cut to insure accuracy and uniformity and will accommodate all standard sized wafer sockets.

Templates, wiring, diagrams, etc., are provided for the special power amplifiers worked out and engineered by Jefferson. One amplifier is a push-pull type using 2A3 tubes in the output; another a Class B push-push using type 59's in the output. The third type employs 2B6 tubes in the output.

Complete details of the three types of amplifiers may be obtained direct from the Jefferson Electric Company.

•

NEW LYNCH STATION LOCATERS

Two new beat-frequency oscillators, to permit tuning of short-wave radio stations with the older types of receivers, has been introduced by Arthur H. Lynch Inc., 227 Fulton St., New York, N. Y. The new oscillators are audio-frequency units and they are completely independent of the intermediate frequency used in the receiver, eliminating the possibility of reaction in the intermediate-frequency circuit, it is stated.

One type is made to operate with a single tube, the tube securing its power from the receiver by means of a cable and wafer adapter which fits directly to the prongs of one of the tubes in the receiver itself. The oscillator of the tube type produces a 500-cycle musical tone. This tone is almost inaudible until the carrier wave from the desired station is tuned in and then it becomes loud. A switch removes the 500-cycle tone, leaving the station tuned at the correct position.

The second type is made without tubes, but functions in exactly the same manner as the tube type. However, the beat note produced in the latter unit is very much lower in frequency and lacks the musical tone of the tube type.

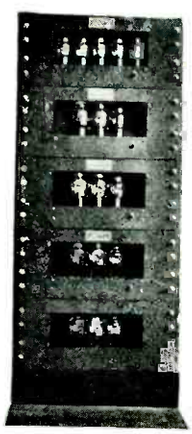
Both oscillators are provided with a toggle switch having an "on" and "off" position. These switches are provided with 18-inch leads so that the oscillator may be placed at any convenient place in the cabinet and the toggle switch mounted directly on the front panel.

•

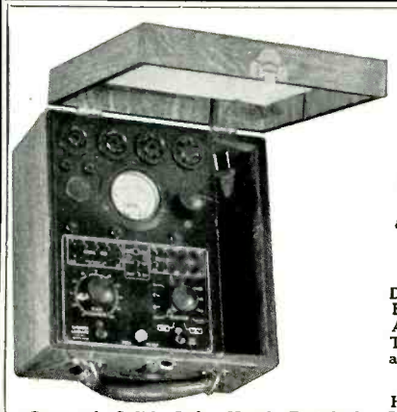
NEW HIGH-FIDELITY AMPLIFIERS

Sound Systems, Inc., Cleveland, Ohio, announces a new line of high-fidelity general-purpose amplifiers which are supplied with panels for rack mounting or without panels for other purposes.

The new Series S Amplifiers are constructed in a heavy sheet-steel, one-piece case, with tubes mounted in a single row and completely protected. All audio- and power-transformer chokes and retards are sealed in heavy individual steel cases. These cases are mounted within the main amplifier case. Input and output terminals are conveniently located inside of the base of the amplifier with a removable cover mounted in the back of the amplifier, giving easy access to these terminals; and knockouts are provided in the end of the amplifier to accommodate input and output lines. All metal parts are rustproof and have a black crystalline finish.



The Series S voltage amplifier is provided with a master gain control. Input impedances of all Series S amplifiers are as follows: 500 and 200 ohms center tapped; 300, 235 and 50 ohms are also available. Output impedances; 500-ohm tapped at 250, 168, 125, 100 and 84 ohms, permitting the use of from one to six 500-ohm lines. There is also a separate 15-ohm monitor line. The PA-100 and all combinations of the PA-100 and PA-101 give the desired output ratings, such as, 4½, 10, 15, 39, 45, 60, 75 and 90 watts. The PA-100 is rated as a 4½-watt voltage amplifier and is also recommended as a driver or pre-amplifier by connecting its output to from one to six PA-101 output stages to obtain power outputs up to 90 watts. The hum level of the PA-100 is said to be approximately 60 db below signal level.



Case of Solid Oak, Hand Finished. Dimensions Approx. 10" by 9" by 5".

Serviceman's Portable Tube Checker and VOLT-OHMMETER Model 427

●

Direct Reading — Checks Every Type of Tube—Also Has Neon Shorts Test and Cathode Leakage Test.

●

Has Meter Ranges for DC Volts — Milliamperes and Ohms. See Specifications.

Specifications on Test Meter Ranges

Ohms Range—Dial Calibrated Direct . . . No chart required. Reads 0-20,000 ohms /0-200,000 ohms. Readings as low as 10 ohms easily made. Compensator provided to correct for battery voltage errors.

D.C. Volts Ranges . . . Scales of 0-10, 0-100, 0-300 volts D.C. (200 ohms per volt).

D.C. Milliamperes . . . Scales of 0-10, 0-100, 0-300 D.C. M.A.

Selection of Ranges . . . All scales selected by main switch—very simple and rapid to use.

Net Price $28.40

The Jackson Electrical Instrument Co.

DAYTON, OHIO

THE JACKSON ELECTRICAL INSTRUMENT CO.
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Please send latest circular describing testing equipment.

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KEEP UP-TO-DATE *with* DAYRAD.... *Write for our complete* CATALOG

For years DayraD has been anticipating the radio service man's needs . . . keeping an eye on the future so that every new radio development finds DayraD ready with testing equipment to fit. That's why thousands say, "I keep up-to-date with DayraD and it pays."

POPULAR PRICES . . . and QUALITY you can "BANK ON"

You're never "equipment poor" when you buy DayraD. The prices are as reasonable as we can make them for testing equipment that does the job right. It's a satisfaction to work with equipment that gives you a "break" in price plus performance you can trust.

Get next to DAYRAD.

THE RADIO PRODUCTS CO.
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including latest models in:

TUBE TESTERS (4 models)
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ETC.

A FEW GOOD TERRITORIES STILL OPEN

REPRESENT US — THERE IS GOOD MONEY IN IT! !

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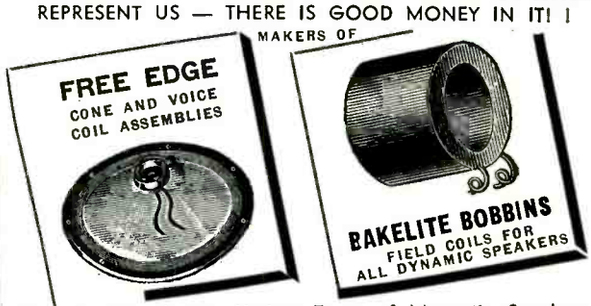

We also Manufacture Various Types of Magnetic Speakers

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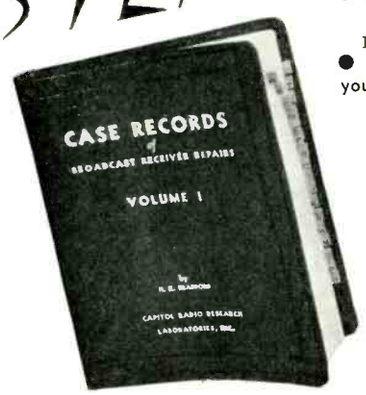
Supplemented for 1 year free.

STEP AHEAD

of the rank and file—with "CASE RECORDS" OF BROADCAST RECEIVER REPAIRS

● Add 10,000 hours to your service experience!



● ELIMINATE GUESS WORK IN YOUR SERVICING!

● DON'T PUZZLE YOUR PROFITS AWAY!

Your work has already been done and recorded for you in CASE RECORDS. This 9x12" flexible leatherette binder contains 1,500 alphabetically and numerically arranged CASE RECORDS of successfully completed service jobs. Each Record tells—symptom—parts responsible—electrical values—location, and best replacement or repair. This Manual introduces the fastest technique known to the service profession. $4.75 postpaid with supplements.

108 receiver makes listed. 3,000 models.

Capitol Radio Research Laboratories, Inc.

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Originators of Case Record Servicing Technique

Please send me complete information on "CASE RECORDS OF BROADCAST RECEIVER REPAIRS" and your introductory DATA SHEET offer. I understand that this does not obligate me in any way.

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Consider the advantages afforded by the long-established RCA Institutes

The beginner or the experienced man who seeks instruction in any branch of radio will find courses designed for him . . . either at the resident schools in New York and Chicago or in the RCA Institutes Extension Courses for Home Study.

Following Units Especially Recommended to Readers of "Service":

Elementary Radio Mathematics—Advanced Radio Mathematics—Advanced Radio Servicing—Sound Amplification

Resident schools are fully equipped, conveniently located, low weekly tuition rates. Home Study Courses are on the "no obligation" plan. Free post-graduate practical training period at a resident school.

Catalog on Request

RCA INSTITUTES, Inc.
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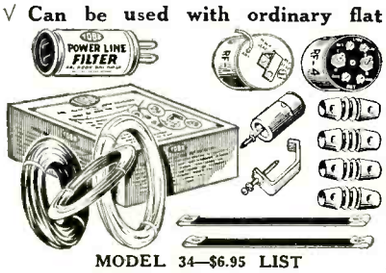
1154 Merchandise Mart, Chicago

UNIVERSAL ALL-WAVE ANTENNA SYSTEMS

Thousands of TOBE antenna kits are now in use. HERE'S WHY!

√ **Can be used with ordinary flat tops or doublet antennas.**



MODEL 34—$6.95 LIST

√ Receiver coupling transformer has two wave band toggle switches.

√ Tremendous noise reduction.

√ Contains everything required for a complete antenna system.

Sold by leading parts jobbers everywhere at regular trade discounts.

TOBE DEUTSCHMANN CORP., Canton, Mass.

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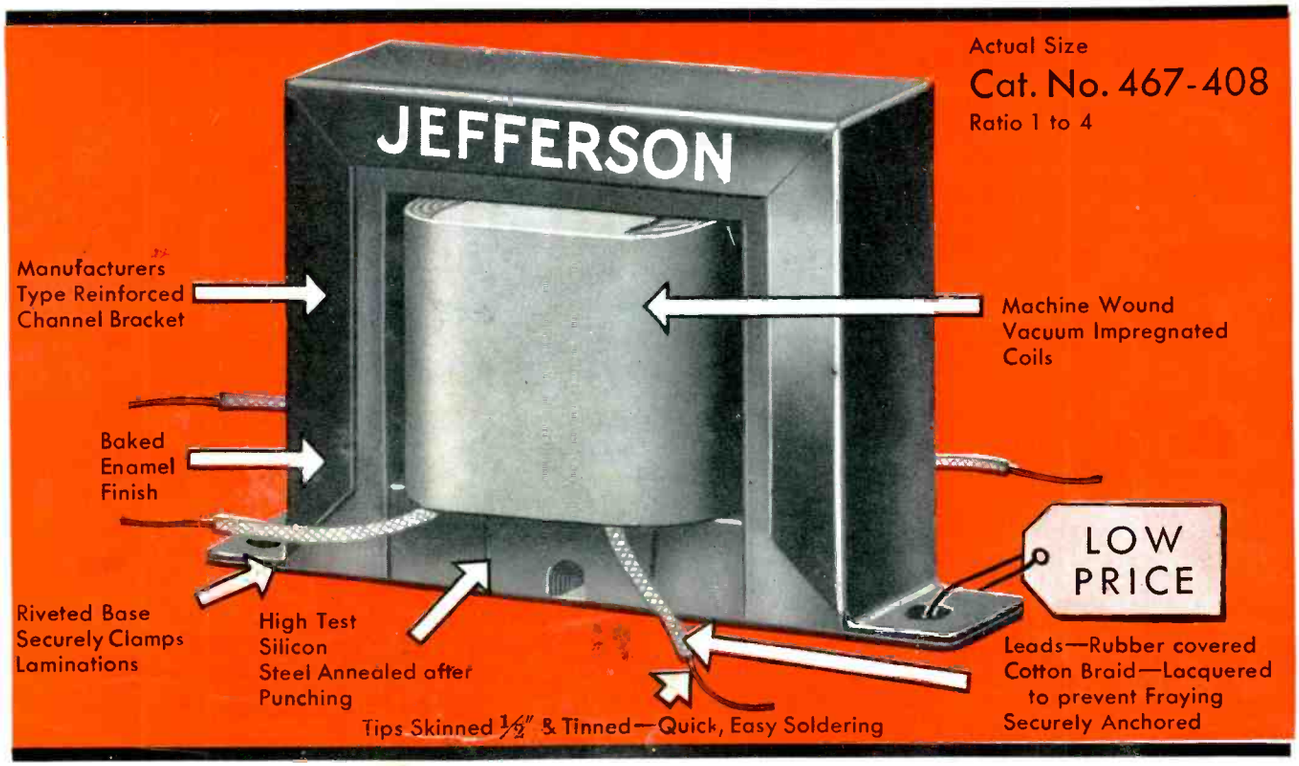


Profitable Service Jobs . . . Customer Satisfaction

Profit and customer satisfaction are two essentials assured through the use of quality replacements. Wise and experienced service men recognize that quality insures *distinctly improved* performance that pleases the customer.

There is no greater tribute to Jefferson quality and fair price than the marked preference indicated by service men throughout the country.

The unit illustrated above is one of a very complete line of power—audio—input—output—filament—line—mike transformers, chokes and radio fuses, which incorporate the very latest engineering principles, fine materials and careful workmanship.

The high test silicon steel used in Jefferson transformers is annealed *after* punching. The coils are machine wound, to insure accuracy and uniformity. All except power transformers are vacuum impregnated to remove all trace of moisture and prevent reabsorption. Power transformers are impregnated in special varnish and baked 24 hours—a hard durable finish impervious to all climatic conditions.

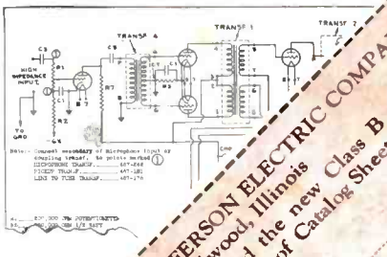
JEFFERSON ELECTRIC COMPANY
Bellwood (Suburb of Chicago), Illinois

Manufacturer Types for Every Purpose

Cat. No.	Description	Dimensions—In.	List
467-401	Audio—Small and Compact, Ratio 1 to 2	1⅝ x 3 x 1⅝	$1.05
467-402	Input—Small and Compact, Ratio 1 to 2.	1⅝ x 3 x 1⅝	1.10
467-409	Output—2 Watt, 7000 C. T. to 4-6 ohms Pentodes or P. P. triodes	1⅞ x 3 x 1⅝	1.00
467-403	Audio—Medium Type, Ratio 1 to 3	2 x 3¼ x 1⅞	1.30
467-404	Input—Medium Type, Ratio 1 to 3	2 x 3¼ x 1⅞	1.40
467-410	Output—3½ Watt, 7000 C. T. to 6-8 ohms Pentodes or P. P. triodes	2 x 3¼ x 1⅞	1.15
467-405	Audio—Large Type, Ratio 1 to 4	2 x 3¼ x 2⅛	1.55
467-406	Input—Large Type, Ratio 1 to 4	2 x 3¼ x 2⅛	1.65
467-411	Output—6 Watt, 14,000/C. T. to 10-15 ohms P. P. pentodes	2 x 3¼ x 2⅛	1.30
467-407	Audio—Concertone Size and Quality, Ratio 1 to 2	3 x 4 x 2⅛	1.95
467-408	Input—Concertone Size and Quality, Ratio 1 to 4	3 x 4 x 2⅛	2.05
467-412	Output—10 Watt, 6000/C. T. to 10-15 ohms, Class B—2A3-250	2½ x 4 x 2⅛	1.65

New Circuit FREE ➡

This new 38-watt Parallel Push-Pull "45" Class A prime amplifier circuit will be sent—free—on request. Your name will also be added to our list to receive new circuits and data as they are issued in the future.



JEFFERSON ELECTRIC COMPANY
Bellwood, Illinois
Please forward the new Class B Amplifier diagram and ☐ copy of Catalog Sheet No. 343R.

Name _____ Address _____ City _____ State _____

JEFFERSON
Radio Transformers

(B-150)

THREE MILLION?
TWELVE MILLION?

your guess is as good as any . . .

How big is the radio tube racket? To what extent are honest radio dealers and service men — you and you and you — being swindled out of legitimate radio tube sales by unconscionable operators who polish up worn-out tubes and palm them off on the public as new?

A few issues back, Radio Weekly estimated the illicit traffic in tubes at three million a year. Now comes the Radio Journal with an estimate of a million a month—twelve million a year. Twelve million tube sales lost to a bunch of cheats whose only contribution to the radio industry is the grave suspicion they cast on an honorable profession!

The exact size of the used tube racket can never be known, but informed sources such as the above agree that it is big—alarmingly so. When the Sealed Carton Crusade provides you with a means of stamping out this menace to honest profits forever, can you afford not to give it your support?

RECENTLY INTRODUCED THE RCA Radiotron "sealed carton" backed by hundreds of thousands of dollars in advertising, aimed to eliminate one of the worst conditions in the industry, that phase of "perpetual motion" of re-selling old tubes as new. It seems high, but estimates are made that 1,000,000 tubes a month are sold the second time as new by the brigands, and if stopped, what a help it would be to the tube makers and jobbers. Unreliability of radio service men is worse than with automobile repair men, because people are duped so easily, and this campaign of the RCA Radiotron Co. is dual-edged, to stop substitution of used tubes for new ones, and to educate the public to look for a sealed carton with their Radiotrons.

The Sealed Carton Crusade is on the side of every honest dealer and service man . . .

There is only one method of dealing with a Racketeer, and that is the method of the strong man fighting with his two fists. A polite, refined attack is as ineffectual as it is incomprehensible to the intelligence of the man you are fighting. Thus the vigor of the Radiotron campaign.

No honest dealer or service man need fear for his repufation, however, for the utmost care is exercised in framing our warnings to the public. We say: "There are two ways of protecting yourself against the swindling tactics of the tube Racketeer: First, buy only from dealers or service men you know to be honest—and they are by far in the majority; Second, insist on RCA Radio Tubes in Sealed Cartons."

Your own livelihood is at stake—protect it by joining the ranks of these modern Crusaders!

RCA RADIOTRON CO., Inc.

A Radio Corporation of America Subsidiary

HARRISON - - - - NEW JERSEY