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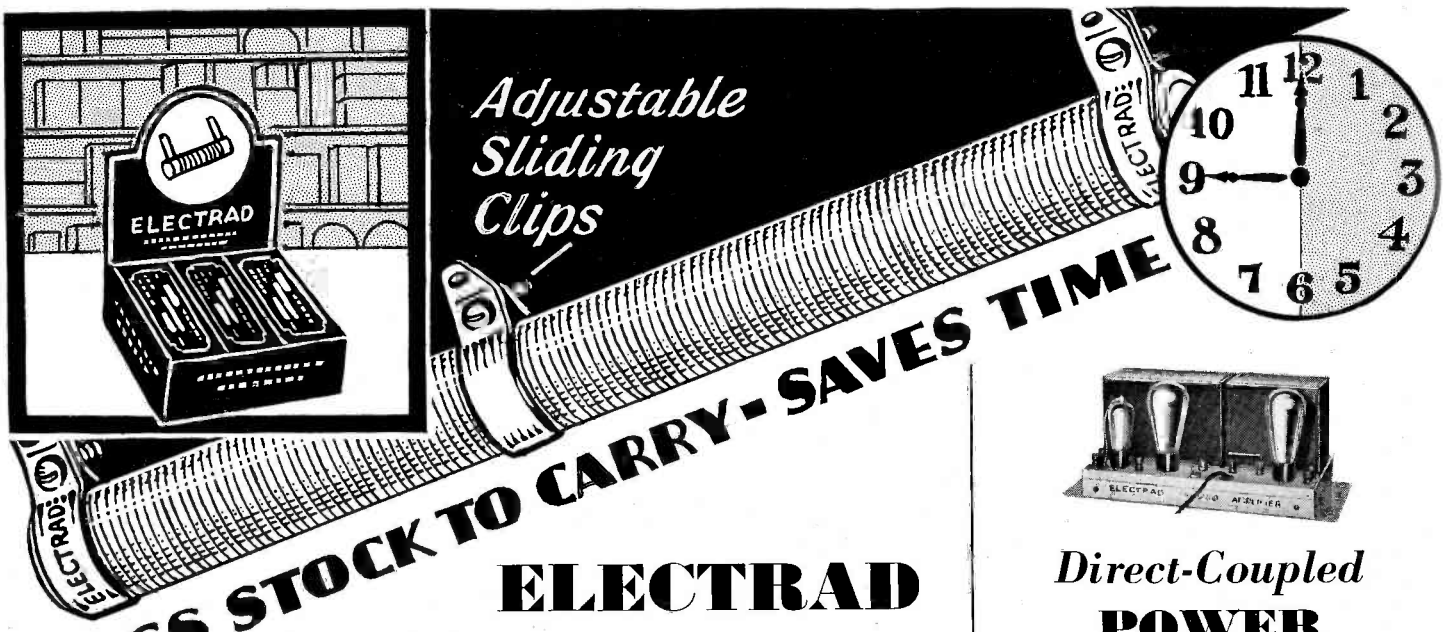

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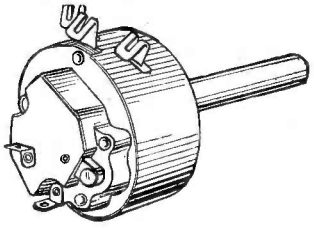

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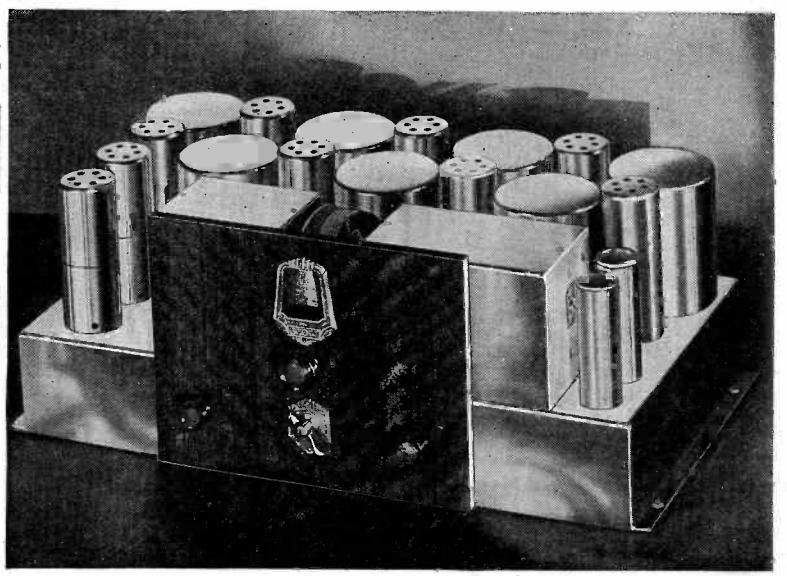

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

MAY, 1932
Vol. 1, No. 4

EDITOR
John F. Rider

MANAGING EDITOR
M. L. Muhleman

Editorial Contents

Advertising Director

ROBERT N. MANN
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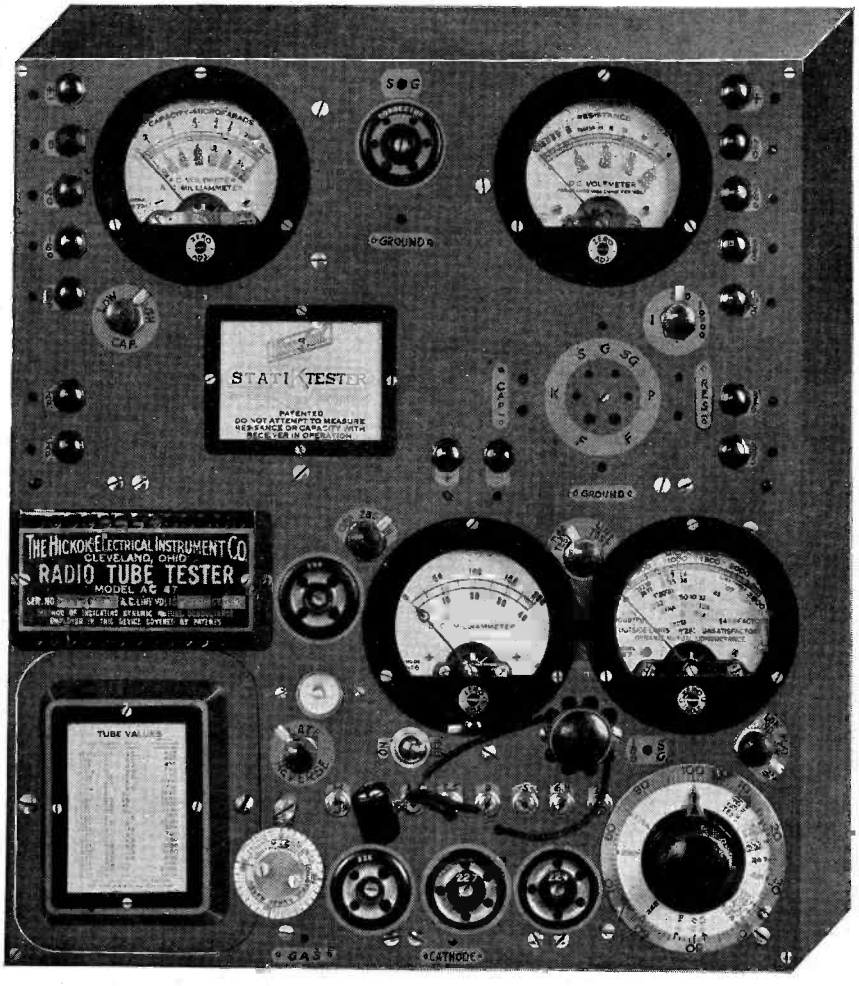

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THE ANTENNA...

THE present talk of resistance measurement as the basis for service procedure has its foundation in material presented in the past, in radio receiver manufacturer's service manuals in the form of continuity test data, and in books. Resistance measurement methods of service analysis will no doubt accomplish a much sought after effect, namely to make the Service Technician "resistance conscious." Altogether too much service in the past has been based upon voltage measurements with set testers and analyzers, with the result that the service analysis operation became mechanical. So much attention has been paid to voltage and current associated with the tubes, that mental analysis was minimized and the operator expected to discover all faults by means of voltage indications or current indications. As a result, all thought of resistance was neglected and confusion resulted when the defect was of the nature which did not influence the operating voltage.

By making the service industry resistance conscious, everyone from the customer to the manufacturer derives some benefit. This type of work means operation upon a definite basis with minimum tolerances, guesswork and variations. It means that all receivers and amplifiers are brought down to the same servicing level, irrespective of special circuits, thus eliminating the condition that a Service Man is incapable of analyzing a receiver or amplifier because its circuit structure is such that a routine voltage test is impossible. There are known several instances where receiver and amplifier manufacturers who employed the Loftin-White a-f. amplifier encountered grief because this part of the receiver was not serviceable with routine voltage tests, such as have been the standard service practice in the past.

The customer will receive more accurate service and faster service. The Service Man will work faster and more profitably to himself and his dealer. The manufacturer, too, will benefit because accurate service will be rendered upon his products irrespective of how complex the circuits. In many instances in the past, dissatisfaction concerning the manufacturer has been voiced because of the failure of several Service Men to satisfactorily repair the receiver.

There is much to be said about resistance measurement as the basis for service analysis. It has certain limitations, but the advantages so outnumber the limitations that the latter are of very little consequence. This is particularly true when we realize that the resistance measurement method of service analysis does not completely do away with voltage and current testing methods. Voltage and current methods are applicable when resistance measurement is not. Of course there is no time when the resistance of a circuit or unit cannot be checked, but we are concerned with such measurements without removing the chassis from the cabinet. A comparison between resistance measurement and voltage measurement must be made upon the same basis, that is, working right through the sockets in the receiver without completely removing the chassis from the cabinet. Upon this basis, the measurement of resistance is by far more practical and logical: practical because it leads immediately to the trouble and furnishes definite and specific information. Logical, because it represents the ultimate test in every receiver after the voltage test indicates the presence of a fault.

In the past resistance measurements supplemented voltage measurements. In the future, voltage measurements will supplement resistance measurements. Service work will be simplified, yet in its increased simplicity it will improve the technical ability of the Service Man and thus raise his rating in the radio industry and in the eyes of Mr. John Public. A special article, covering the subject in detail, will appear in the June issue.

• • •

WHAT is a rightful service charge? A very simple question, but it requires a great deal of thought to arrive at the answer. Let us review some of the problems. First we have several degrees of proficiency upon the part of the Service Technician. Should all of these men charge the same fee? Upon an hourly basis, assuming that all the men can effect the required remedy, the customer gains by having the proficient man make the repair in the shortest possible time. On the other hand, the man who is not so proficient must take longer and thus it is apt to cost the customer more than he is willing to pay. Again, the beginner in the field who is confronted with the same problem as the man with many years experience cannot charge a low fee because it will not give him a living income, which he is entitled to.

Second, there must be some division between the cost for an examination when the receiver is brought into the shop and when the Service Technician travels to the home. What is the solution when the calls are within the town and when traveling involves a trip of 20 or 30 miles in suburban communities?

Third, what basis of operation is satisfactory with respect to the replacement parts? Should they be sold at cost or a profit made, and how much profit? In this connection it is necessary to remember that the mail order houses and chain stores list many replacement parts in their catalogs; these parts are quoted below the regular list and the catalogs reach the man at home. Then again it is necessary to remember that hundreds of thousands of receivers available at "dumped" prices are purchased each year, but the cost of the replacement parts for these receivers is based at the original sales price of the receiver. Thus a small unit needed for a receiver may represent 10 percent of the total cost of the receiver.

Fourth, charges now range from $1.00 to $2.00 per hour with the same range for the minimum fee. Recognizing that the customer should pay the traveling time, $2.00 as the minimum fee sounds quite reasonable. However, as to the service cost, should it be on an hourly basis or upon a flat rate? An hourly basis after the examination creates suspicion in the mind of the customer. A flat rate at least tells him what it will cost.

We have our ideas. We want your thoughts. Suppose that you jot them down and let us have them.

We are working upon plans to acquaint the general public with the fact that service charges have become flat rate—but this program to eliminate cut rates cannot be completed until the charges have been set.

John F. Rider.

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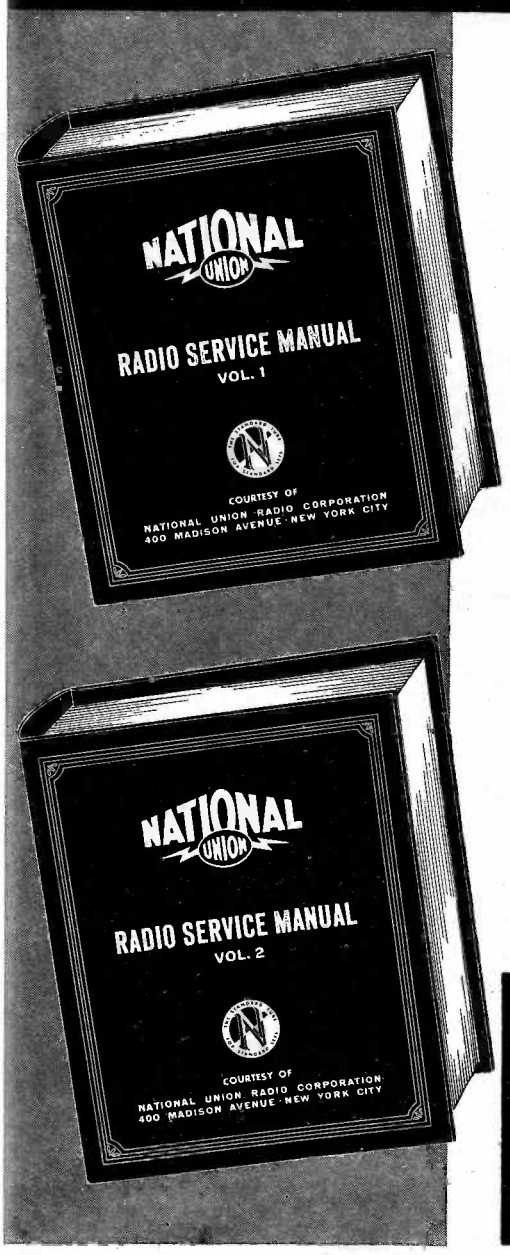

. . National Union Radio Corp., maker of the famous National Union Radio Tubes, is offering this free equipment for a short time only. So you must act quickly.

The two service manuals shown at the left were written by John F. Rider, well-known lecturer and scientist. They should be part of every up-to-date radio man's equipment.

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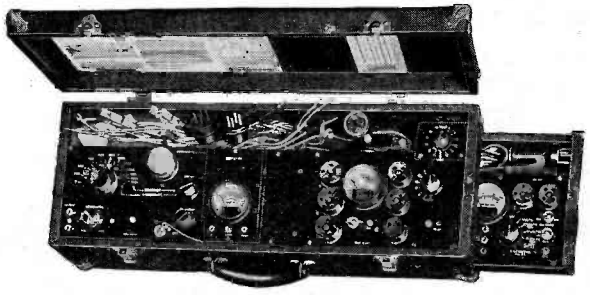

No. 550 Oscillator

No. 407 Tube Tester

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No. 577 Servicing Instrument

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Here is a service combination right up-to-the-minute in every respect. With this combination you are prepared to analyze any receiver or amplifier . . . working in the most modern manner, with the greatest accuracy and utmost speed.

There is nothing in the line of service analysis operation which you cannot carry out with the Readrite No. 577 unit. One part of this complete testing system is the oscillator which will supply a modulated or unmodulated carrier for broadcast-receiver frequency alignment. The operating range is from 550 to 1,500 kc. This range and the intermediate-frequency range of from 120 to 185 kc. are direct-reading. Extremely sharp second and third harmonics cover the range from 260 to 475 kc., thus enabling you to check all i-f. stages in all modern superheterodynes.

The A.C. tube tester contained in the No. 577 enables you to make a real and accurate test upon the tubes used in the receiver. No longer are you dependent upon the receiver voltages . . . no longer are you stopped when the receiver is inoperative. With this unit you can check the tubes irrespective of the trouble in the receiver . . . test all kinds of tubes under real laboratory conditions. With the greatest ease you can tell if tubes are good or bad, and really "match" tubes. Class B amplification in the modern sets just being introduced requires accurate matching of output tubes. The 577 will do it.

With the set tester part of the 577 it is easy to check the voltages in receivers, measure the resistance of various units, and check the capacities of fixed condensers. Because of the A.C. tube tester in the 577, you can check the receiver without any voltages applied to the tubes. You simply measure the resistance of the various units. The set tester contains a d-c. voltmeter which will read as high as 600 volts; a-c. voltages as high as 700 volts, and current as high as 150 ma. And all meters are available for external use.

The 577 opens the way to improved and complete testing. It will increase your business. It is furnished in a leatherette covered case, and is 22¾" by 6½" by 8½" high. Shipping weight is 22 pounds complete.

No. 576 Servicing Instrument

The Readrite No. 576 is the same as the No. 577 except that the tube tester does not contain the means for checking short circuits between tube elements. The net price to Service Men is $51.00. In both the 576 and 577 Units the set tester is contained in a self-locking drawer, shown open in the illustration above. Both instruments come complete with batteries and tubes for the oscillator unit.

Net Price of No. 577 to Service Men $54.00, Less 2% for Cash, F. O. B. Factory. If these goods are not obtainable from your regular jobbers we will ship direct upon receipt of advice.

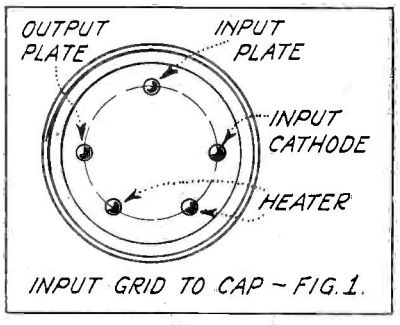
READRITE METER WORKS

25 College Avenue, Bluffton, Ohio

The Triple-Twin Tube

BY G. M. REED

THE last five or six years have witnessed the introduction of several kinds of "multi-tubes" housed in a single container. Some were domestic and some were foreign. The latest tube, a domestic product, is the Triple-Twin. Although but recently announced, this tube will soon enter into the problems of servicing in as much as it is reported to be used in several of the new receivers to be displayed at the Chicago show. As such it might be well to dwell upon the passage of a signal through this tube, so as to study its operation and its relation to servicing. There are certain definite differences between this tube and conventional products and it is necessary that these be recognized when working with the tube.



INPUT GRID TO CAP – FIG. 1.

When testing a set with a Triple-Twin tube, keep in mind that both plates are connected to the tube prongs, as shown. The input grid connects to the cap on the tube

The tube housing contains two sets of elements, each set representing one tube or section. The input section is the equivalent of an indirectly-heated cathode type of three-element tube, consisting of a heater, cathode, control grid and plate. The second section is the equivalent of an ordinary filament type of three-element tube, consisting of a filament, control grid and plate. The heater of the input tube is joined in parallel with the filament of the output tube, both being excited by means of an a-c. transformer. This paralleling of heater and filament is made within the tube housing. The cathode of the first section and the control grid of the second section or tube are also joined within the housing. The tube utilizes a regular five-prong socket, whereby connection is made to the two plates within the tube, the two heaters and the cathode. (See Fig. 1.) Connection to the input tube or first section control grid is made by means of a cap which occupies the same position as the control grid in the screen-grid tube.

Operation of Tube and Circuit

The amplifier circuit utilizing the Triple-Twin tube (The reason behind the selection of this name to designate this tube is unknown.—Ed.) is shown in Fig. 2. At first glance the operation of the tube appears a bit mystifying, but upon second examination it is not really complicated. Consider the application of an audio-frequency signal across the terminals G-K. Now, in contrast to usual practice, the signal is not applied between grid and ground, as is the case in the conventional cathode type of single tube stage. Instead the input circuit is the grid and cathode of the first section, the signal passing through the blocking condenser C1. A simplified circuit of the equivalent of the first section or input tube functioning as an amplifier is shown in Fig. 3. We assume that the audio signal is secured from the transformer T. If we overlook the presence of the parallel circuit Lc-Rc, the remainder is identical to a conventional stage wherein Rg is the grid filter resistance—however, bearing in mind that Rg in this case is not a grid filter resistance, but a path whereby the control-grid bias is applied to the tube grid. Of course, the fact that it is present cannot help but produce a function identical to that of the usual grid filter resistance.

Related Input Circuits

Referring once more to the grid bias for this tube, the bias is developed across two units, namely the parallel combination Lc-Rc in series with R2. The total voltage developed is then applied to the control grid through Rg and whatever type of coupling unit is used across the input circuit, in this case the secondary of transformer T.

It is evident that the plate circuit of the input tube does not contain a load in the form of a transformer winding. Actually, the purpose of this plate is to complete the plate system and thus attract the electronic stream. With respect to this method of utilizing the plate of the tube, it is native strictly to the Triple-Twin.

Now during the process of amplification in this tube, the audio-frequency component flows through the parallel combination of Lc-Rc; consequently, an a-c. voltage is developed across this impedance and this combination becomes the input grid impedance of the second section, and it is from here that the second grid secures its excitation voltage. The complete circuit slightly re-arranged is shown in Fig. 4. Here

Here is a typical circuit for the Triple-Twin tube when used as an amplifier or detector-amplifier. When used in the latter arrangement a grid condenser (C-3) and r-f. choke (L-3) are included in the circuit. Note that the second input grid is tied to the cathode

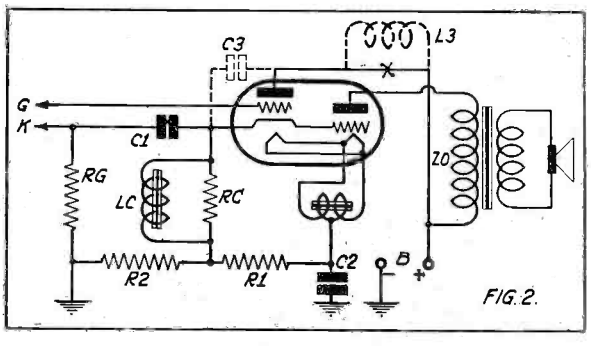


FIG. 2.

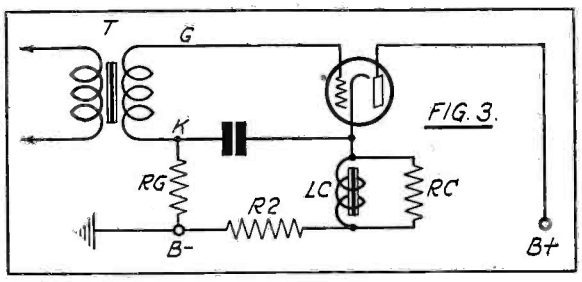


FIG. 3.

This is a simplified version of the first section or input of the Triple-Twin tube. It will better serve to clarify the action of this part of the tube as an amplifier. The function of the resistor RG is to supply bias to the grid

the relation between the respective elements is clarified. The lead from the second section grid is electrically the same as in Fig. 2, but by showing it in this fashion makes comprehension of the second circuit very much easier. The grid bias for the second tube is developed across the resistance R1 and is applied to the second section tube control grid through the input grid impedance Lc-Rc. We have omitted the heater circuit for the input tube because it has no connection with the balance of the system. In the output section, the plate circuit is conventional in that it contains the primary of the output transformer.

Service Problems

Before considering further technical details concerning the operation of the tube, let us consider some of the service problems. Measurement of the control-grid bias of the input tube is like that for any other tube which has a grid filter resistance, so that the voltage indicated upon a voltmeter connected between cathode and grid would not be the true voltage because of the presence of Rg. The effect of Lc-Rc upon this bias is negligible, because of the low d-c. resistance of Lc. It is for this reason that the bias applied to the second tube grid would have very little effect upon the input tube bias measurement, despite the fact that the input tube cathode and the output tube grid are joined. When checking the output tube grid bias voltage, the reading must be between the grid and the filament. A measurement between grid and ground would include the input tube bias developed across R2 as well as the bias developed across R1.

The method of securing the signal voltage for the output tube input circuit is entirely different from any other tube or system. In a way it is direct coupling, consequently the frequency response of the system cannot help but be of a high order. One limitation upon the low frequencies is the minimum impedance of Lc, and upon the high frequencies the effective capacity across the grid-filament circuit of the output tube.

Power Output Available

The output power available from this tube is far in excess of that which can be secured from a conventional '45 or '47 type tube in the output stage. The primary reason is that by virtue of the design of the tube and circuit, it is possible to operate the output tube upon both the negative and positive half of the grid voltage, plate current characteristic. Such operation is impossible with the normal run of standard tubes without bad distortion. When used as an amplifier, a single Triple-Twin tube operated at a plate voltage of 180 volts, and a load impedance of 4,000 ohms is capable of furnishing an output of about 2.25 watts. When operated with 250 volts upon the plates and the same load impedance, the output is about 4.5 watts. Two such tubes in push-pull, as shown in Fig. 5, operated at 250 volts upon the plates and a load impedance of 8,000 ohms will furnish about 14 watts output.

It is significant to note, and of interest with respect to output transformers, that the optimum load impedance for maximum output and minimum distortion is equal to the tube impedance and *not* to twice the tube impedance, which is the case for the regular triodes, and about 1/4 or 1/5 of the tube impedance for pentodes. The input load impedance for the input tube is 12,500 ohms, the value of Rc in Figs. 2, 3, and 4. In these illustrations Rg is 0.1 megohm, Lc is a low resistance choke of about 15 henries at about 5 milliamperes, R1 is 70 ohms and R2 is 270 ohms. C1 is 2.0 mfds. and C2 is 25 mfds. The same values obtain in push-pull systems (Fig. 5) with the exceptions that R1 and R2 are halved in value. When used in push-pull, the transformer must have a split secondary, so that the resistance Rg may be inserted and the cathodes raised above ground potential.

The Triple-Twin Type 295 tube is suitable for detector-amplifier service and will be introduced in this form in some of the new receivers. It is also suitable as a straight am-

CHARACTERISTICS OF TRIPLE-TWIN TUBE

Amplifier	*Input Section*		*Output Section*	
Plate Voltage	180	250	180	250
Grid Voltage	—10	—14	—2.5	—3.0
Plate Current	3.0	4.0	32.0	52.0
Plate Impedance	12,500	12,000	3550	3000
Amplification Factor	14.4	14.4	13.0	13.0
Mutual Conductance	1150	1200	3650	4350
Load Impedance	12,500	12,500	4600	4000
Power Output	———	———	2.25	4.5
Grid Signal (for full power) Volts R. M. S.	4.0	5.0	——	——

Detector-Amplifier	*Input Section*		*Output Section*
Plate Voltage	180	250	Other values
Grid Voltage	—12	—16	remain as
Plate Current	1.0	2.0	specified
Grid Signal—Volts, Carrier (for full power) 100% Modulation		8.0	above

The complete circuit of the tube slightly re-arranged to clarify the relation between the respective elements. The arrows indicate the first and second input circuits

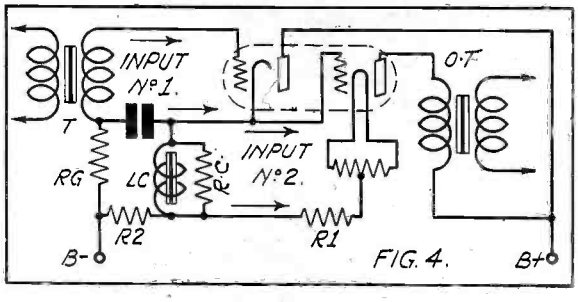
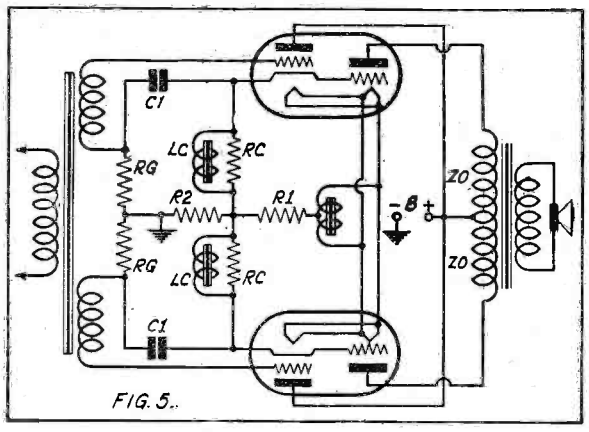


FIG. 4.



The circuit of two Triple-Twins in push-pull. This arrangement, with 250 volts on the plates and a load impedance of 8,000 ohms, will furnish about 14 watts output

plifier for phonograph or public-address work. In this case it is advisable to use a 227 in the input stage, irrespective of whether a single 295 is used, or two in push-pull.

The characteristics of the 295 Triple-Twin used as a detector-amplifier and as a straight amplifier, are given in the accompanying table.

A New Department

IN the July issue of SERVICE we will inaugurate a new department, to be called, "On The Job." It will appear each month thereafter, and we trust that its contents will be of everyday value to you in your servicing business.

The primary purpose of this department will be to assist you in increasing the volume and the character of your business. In order to carry out this purpose to its full effectiveness we acknowledge the necessity of calling upon you as a reader to contribute your own ideas so that others may also benefit by them. You in turn will no doubt benefit considerably by the contributions of other readers. But, apart from this, we feel that worthy contributions should merit more than a possible return to the author of valuable ideas submitted by others. Consequently, we are going to offer each month, starting with the July issue, three prizes for the best contributions received. Aside from the prizes themselves, all other contributions accepted for publication will be paid for at the rate of one dollar each.

Contributions to this new department are not to be limited to any specific type. You may have an idea relative to the installation of a Public-Address System which you have tried, and found that its simplicity proved a saving in time and money. Or it may be some little advertising scheme that has been of great assistance to you in gaining new clients, or, again, some simple servicing stunt which improves the operation of a standard receiver. No matter what the idea, if it has helped your business directly or indirectly, it is eligible. The only restriction we impose is brevity.

Now, as to the prizes. The first prize each month will be a complete set of seven volumes of the Radio Service Library, or its equivalent in cash, which is seven dollars. The second prize each month will be Volume No. 2 of Rider's Radio Service Manual, or its equivalent in cash, which is five dollars. The third prize each month will be a selection of any three of the seven books composing the Radio Service Library, or three dollars in cash.

The Editors of SERVICE will be the final judges in the selection of the winning contributions. In the event of a tie, both winners will receive the total amount of the respective prize.

Entries for the July contest must be in the hands of the Editors not later than June 20th. However, any entry received later than this date will automatically become an entry for the contest of the following month.

Address all entries to: Contest Editor, SERVICE, 1440 Broadway, New York, N. Y.

The Man on the Cover

LEROY J. BELL

General Service Manager, Fada

HE deliberated in his youth . . . it took him quite a while to determine just what sort of an education he wanted. But, when he finally decided upon an electrical career he carried this determination to a successful conclusion.

After completing his High School education, Mr. Bell entered Columbia University where he learned about sparks from Professors, and eventually emerged from said institute of learning with his head full of Electrical Engineering.

But, presumably this was not enough, because forthwith he continued his studies at the Western Electric Company College and later, as occasion demanded, branched out in special evening courses.

Having completed his education to his own satisfaction, Mr. Bell joined the Western Electric Company where he spent two years as a draftsman, mechanic, laboratory assistant, and later as a field supervisor on general equipment. Following this practical experience he went with the Bell Telephone Laboratories where he carried on work in connection with special Signal Corps equipment.

Mr. Bell started with Fada in 1924 as a tester, and has since worked in every department—bar none—doing any and every kind of work. He has spent considerable time on the road as an instructor, this during an educational campaign conducted for Fada's Dealer-Service Organizations.

Although Mr. Bell is considered an excellent pistol and rifle shot, he rarely goes hunting . . . that is, he rarely goes hunting with a gun. When he hits the trail it is a camera that goes with him, and he has "shot" more wild animals with the glass eye than you could shake a fist at—if you ever wanted to. Mr. Bell says that he has taken some thrillers and, fortunately—unlike a fish story—he has the pictures to back up his statements.

When Mr. Bell isn't shooting wild animals with a camera he is swimming or riding horseback. Or possibly cleaning guns.

Mr. Bell is ready to agree with anybody that servicing is one grand headache, but adds that it is not more so than you actually make it. He believes that the big job is to keep a level head, and when it comes to that he has a big start on most of us, what with his shooting of wild animals with nothing between him and champing teeth but a little box full of film.

General Data . . .

The Type 46 Tube

This new tube will appear in some of the sets to be exhibited for the first time at the RMA Trade Show, in Chicago. The General Electric "Convention Model" superheterodyne will be one of them.

The Type 46 tube was designed primarily for use in a Class B amplifier circuit, although its construction and characteristics are such that it can also be used in a Class A amplifier circuit as a driver.

Class A and B Service

It will be noted from the accompanying diagram that the tube has two grids. When the grid nearest the plate is tied to the plate the tube has a low amplification factor and functions the same as the usual type of amplifier tube, with the usual negative grid bias. The tube is so used in the "Driver Stage" shown.

When the two grids of the tube are tied together the amplification factor is so high that there is hardly any plate current flow, with the grids at zero bias. Since the tube in this connection is operated without any bias at all (which allows the elimination of the usual bias resistors) the plate current is practically zero until a signal is impressed on the dual-grid input connection, and even then there is no appreciable flow of plate current during the negative halves of the cycles. But, when the signal voltage goes positive the dual grids automatically assume this positive voltage, and during these times there is a heavy flow of plate current. Obviously, the amount of plate current is governed solely by the variations of the positive cycles of the signal voltage. This means that, for one thing, if the receiver using this type of tube in a Class B connection is set for low volume, less current will be consumed than if the volume control were set at maximum. As an example, the actual difference in power consumption in the General Electric "Convention Model" receiver, between low and high volume setting is 84 watts and 105 watts respectively.

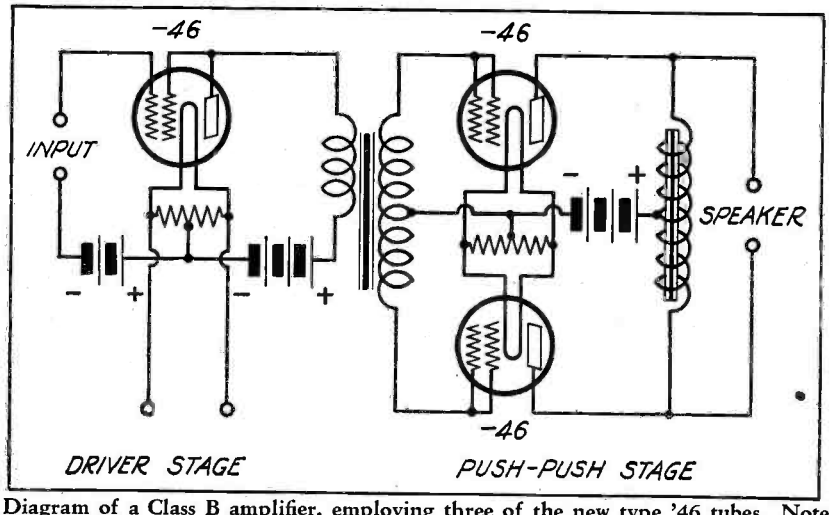


Diagram of a Class B amplifier, employing three of the new type '46 tubes. Note that there is no bias placed on the tubes in the "push-push" stage

Assume for the moment that just two type 46 tubes are used in an amplifier; the first tube in a Class A connection and functioning as a driver for the second tube in a Class B connection, with no grid bias. In such a case, since the dual-grid of the second tube would be driven positive with each positive cycle of the signal voltage, the output would include second and other even harmonics. Such an arrangement of course would be totally unsuitable because of the harmonic distortion. However, if instead two type 46 tubes are employed in the Class B stage, in a push-pull connection, then the harmonics will be cancelled out, just as they are in any push-pull amplifier. This is the arrangement used, and the complete connection is shown in the accompanying diagram.

Advantages of Class B Amplifiers

There are three advantages gained by the use of the type 46 tubes in the amplifier circuit shown. The first is increased power output with small tubes (from 10 to 16 watts . . . enough to break the china in the kitchen). The second is economy of operation, because "no signal, no plate current," and "low volume, small plate current." The third is the absence of the usual grid bias resistor, which means that the full voltage of the power supply is available for the plates of the Class B 46 tubes, and the absence of the usual degeneration effects created by such resistors, which reduces amplification considerably.

Special Equipment Necessary

It should be added here that the increased power advantage lies mainly in the fact that the Class B 46 tubes will provide the extra kick at peak modulations which spells the difference between fair and brilliant reproduction. The amount of output power produced at such times is so much greater than ordinarily encountered that a specially designed dynamic speaker which can "take it" must be used.

Since the current drain is excessive during positive signal voltages it is also necessary to use a special rectifier tube and filter system. Thus the reason for the new type 82 full-wave, mercury vapor rectifier. Details of this tube and its associated circuits will be found on page 61 of the April issue of Service.

The type 46 tube has a 2.5-volt filament which draws 1.75 amperes. When the tube is used as a Class A amplifier the maximum plate voltage used is 250, with a negative grid bias of 33 volts. When used as a Class B amplifier the maximum plate voltage is 400. At this voltage the minimum plate current is 6 ma. and the maximum 200 ma. The complete conditions and characteristics for both Class A and Class B service are given in the accompanying table.

OPERATING CONDITIONS AND CHARACTERISTICS

Class A Amplifier

Filament Voltage	2.5 ac.
Filament Current	1.75 amps.
Plate Voltage	250 max.
Grid Voltage	—33
Amplification Factor	5.6
Plate Resistance	2380 ohms
Mutual Conductance	2350 micromhos
Plate Current	22 ma.
Load Resistance	6400 ohms*
Max. Undistorted Output	1.25 watts

*Approximately twice this value is recommended for load of driver for Class B stage.

Class B Amplifier

Plate Voltage	300	400 max.
Grid Voltage	0	0
Plate Current	4 ma.	6 ma.
Peak Plate Current	150	200 ma.
Load Res. per Tube	1300	1450 ohms
Max. Signal Voltage	40	41
Continuous Output (2 tubes)	16	20 watts
Plate Dissipation (per tube)	10	10 watts

Oscillator Computations

Just a note about coil and condenser combinations in oscillator systems. It is a very simple matter to select certain constants for a coil and a condenser so as to cover a certain frequency band. However, these constants apply only when the coil and condenser are utilized as a tuned circuit independent of everything else. A series of investigations carried out upon several oscillators intended for use in the service field and prepared with the idea of description at a future date, illustrated the need for definite stipulations relative to the tuning range and the inductance and capacity.

A resonant circuit containing an indicating instrument whereby the state of resonance is indicated when used alone and isolated from other equipment will run true to the calculations, but not so when that same coil-condenser combination is inserted into an oscillating tube circuit.

Capacity of Circuits

In every instance, the tuned circuit does not cover the range calculated because the minimum capacity is many times the original assumed in the computations. Before citing any examples, the statement is made that coil and condenser constants for circuits utilized in tube systems must be accompanied by the exact circuit used. The reference to the circuit is made because the type of circuit influences the tuning range.

For the benefit of those who are interested in the construction of oscillator systems, let it be said that the capacity between the tube grid and filament or cathode is *not* static capacity of a few micromicrofarads, but includes the reflected capacity due to the structure of the plate circuit. This is a very important consideration. The minimum capacity of a .00035 mfd. tuning condenser may be around 25 to 30 micromicrofarads. The capacity of the leads connecting the coil and condenser and the condenser and the tube elements may be from 10 to as high as 30 micromicrofarads. The static grid-cathode capacity of the average tube with the cathode cold may be around 3.5 micromicrofarads (for the '27). The sum total of these capacities shows more than a 100 percent increase over the condenser minimum. When coil-condenser combinations are placed into operation we find that the highest frequency, representing the minimum capacity, is much lower than indicated by the static values quoted. In fact, it deviates to a very great extent, so much so in certain cases that the apparent minimum capacity tuning the coil may be from six to ten times the minimum previously considered and in certain circuits the sum total of all the capacities across the circuit may be 100 percent greater than the capacity as determined by the manufacturer's rating of his products.

Practical Examples

The greatest discrepancy occurs at the high-frequency end of the frequency band, because here the added capacity represents a much greater percentage of the total capacity. The following are a few examples of such discrepancies. An inductance of 2300 microhenrys (2.3 millihenrys) when tuned by the minimum capacity of a .00035 mfd. condenser (minimum figured as 40 mmfds.) was calculated as being tunable to a frequency of 521 kc. When placed into use in the oscillating system, it was found to resonate 329 kc. with the tuning condenser set to minimum which, with an inductance of 2300 microhenrys, is the equivalent of a tuning condenser of approximately .0001 mfd., an increase of more than 100 percent over the computed value. As is obvious, the various capacities present in the system, exclusive of the tuning condenser itself, added about 60 micromicrofarads.

Another interesting item is that related to the plate-coupling capacity, in the capacity-coupled Hartley system shown in Fig. A. Varying this capacity changes the resonant frequency of the system. When changed from a .001 mfd. condenser to .5 mfd., the resonant frequency for a definite setting of the tuning condenser changed from 420 kc. to approximately 390 kc. Thus, if you are interested in changing capacities in a condenser which is calibrated, bear in mind that the calibration settings will also change.

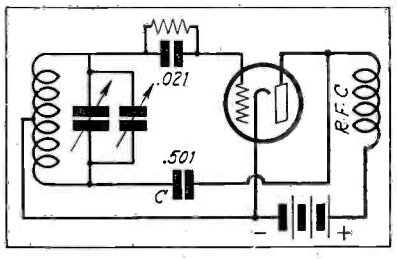


Fig. A. Circuit of a capacity-coupled Hartly oscillator

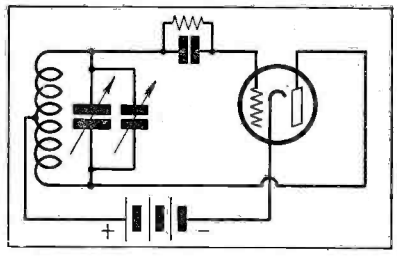


Fig. B. Circuit of the conventional Hartly oscillator

Fig. B illustrates the conventional Hartley oscillator system and is shown for the purpose of stating that the character of the circuit also governs the frequency limits of the tuning system. Thus, with identical settings of the tuning condensers, but changing from circuit A to B showed a very appreciable difference in the frequency limits covered.

Capacity Allowances

When operating over the broadcast band, it might be well to allow between 80 and 100 micromicrofarads as the minimum capacity. The only exception to this rule is the use of the tuned circuit as a link, as is done in a few broadcast receiver oscillator systems. When working upon the intermediate frequency band, allow at least 100 micromicrofarads as the minimum capacity in the circuit. Another exception to these statements is the use of the screen-grid tube as the oscillator, and also in dynatron oscillator systems.

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Color Coding

(*Continued from April issue*)

Grigsby-Grunow (Majestic) have been using the RMA coding for about 1 year. Started in the Model 60 Receiver.

Howard Radio Co. First used in the Model H Superheterodyne produced in March, 1931.

International Radio Corp. RMA code used for 2 years.

My Own Radio, Inc. RMA code used since June, 1931.

National Company does not use the RMA color coding. They do not have a special code of their own.

Parsons Laboratories started using the code about 18 months ago. The first receiver was Model 1.

Philco started the code about June, 1931. The first model to use RMA coding was the 90.

Pierce-Airo started using the code about 16 months ago. The first model was the 624.

RCA-Victor. RMA code used since March, 1931. Started with R-7 receiver known as the Superette.

Remler Co. Code used for about 1 year in all receivers with serial number above 15,000.

Simplex Radio. Use the code. Started about 18 months ago with Models J and K.

Sparks-Withington. RMA code used for all carbon and braided wire resistors. Started about June, 1931, with Models 5, 9, 10, etc. A few resistors still used do not bear color coding.

Stewart-Warner. Started using the code with their Model 102-A. Vitreous and wire wound units not coded.

Stromberg-Carlson use the code. Started about a year ago. First models were 19-A, 20-A, 22 and 29.

Transformer Corp. of America. (Clarion) Started using the code in January, 1931. The first receiver was the Model 70. One or two wire-wound, low-resistance units in each model are not coded.

Trav-Ler Radio and Television Corp. Use the code. Started about October 3, 1931.

United American Bosch. (Bosch) Started using RMA color coding about one year ago. The changes and additions were gradual.

U. S. Radio and Television Corp. RMA code in use for about 18 months. Initial chassis, Model 48.

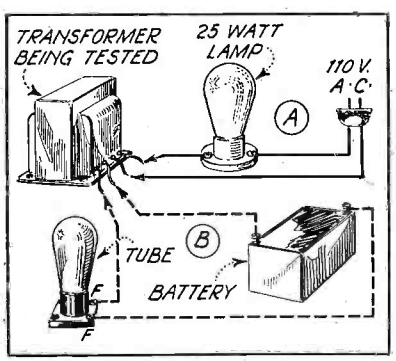
Wells-Gardner. Use the code. Started with Model 80. General circuit coding is as follows: Grid-White, Plate-Red; 180B-Blue; 250B-Yellow; Filament and ground-Black.

Westinghouse Electric and Mfg. Co. See RCA-Victor.

Zenith Radio Corp. RMA code in use since January, 1930. Started with Midget A.

Locating Transformer Windings

One of the complicated service routines is to locate the various windings upon a power transformer which is not marked to show the primary and the various secondaries, or the voltages available from these windings. The following is a fairly simple method of checking such units. The first step is to locate the rectifier winding. Arrange a series circuit of a 4- to 6-volt battery and a 5-volt tube such as the 201A. It may be a good idea to select a deactivated tube or one which is unfit for actual radio use, but with the filament intact. Connect this series circuit across the two terminals of the various windings; of course, across one winding at a time. The tube will glow when the test circuit is connected across either the primary winding or the filament windings. If the test circuit is connected across the rectifier winding, either across the entire winding or across either half, the tube will not glow. Assuming that



Showing simple methods of locating the respective windings of a power transformer

the continuity of the circuits is intact, the winding being tested is the high voltage plate winding. This winding is marked with a tab.

Now we must locate the primary winding. The impedance of this winding is much higher than that of the filament windings and this condition is taken advantage of for the test. Now arrange a test circuit consisting of a 25-watt, 100-volt lamp and a lead which connects to the 110 volt a-c. line. The a-c. line is used as the voltage source and the lamp is used as the indicator. When the circuit is connected across the filament windings, the lamp will glow, perhaps with normal brilliancy. However, when the test circuit is connected across the primary winding, the impedance presented by the primary will reduce the current in the circuit and thus reduce the brilliancy of the lamp. The lamp will glow dull. Thus the primary winding is located and should be properly tabbed.

It is now necessary to determine the voltage output of the various windings. Connect the primary winding to a 110-volt, a-c. source. Connect any tube which requires 7.5 volts upon the filament, such as the '10, '50 or '81, across the respective filament windings. The tube filament will glow with normal brilliancy when connected across a 7.5 volt winding; will glow dull when connected across a 5-volt winding and will not glow at all when connected across a 2.5- or a 1.5-volt winding. The 7.5- and the 5-volt windings are located in this fashion. If desired, the 5-volt winding may be checked by using a 5-volt tube as stated. These windings are tabbed. The same process is carried out to locate 1.5-volt and 2.5-volt windings, using a 2.5-volt type of tube.

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Additional Dynamics

On page 32 of the March issue of SERVICE details were given for connecting up an additional dynamic speaker to the output of a push-pull amplifier. The simple system of using two blocking condensers was shown in the sketch. Notice is hereby given that this arrangement works well providing the output tubes are not pentodes. In such cases where the set uses two pentodes in push-pull the system should not be used for this arrangement reduces volume considerably.

•

Shorted Voice Coils

The lower the resistance of a voice coil or secondary of an output transformer, the more difficult is it to locate a short circuit across this winding. As a general rule voice coil resistances vary from approximately .8 ohm to about 15 or 20 ohms. There are, of course, several voice coils with resistances as high as 200 ohms. Naturally, a short circuit across such a high value of resistance will be located without very much trouble. However, in the case of low-resistance units, a fairly accurate resistance measurement is required. An open voice coil, with one end connected to the output transformer, will still be productive of a signal. Of course the signal will be very weak, but it will be present nevertheless.

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Changes in A-K Receivers

Several changes have been made upon recent Atwater-Kent receivers. The original 82-D, 110 volt d-c. receiver bore serial numbers below 5,760,301. The second production of this same model differs in the following respects: a plate filter choke is connected between the 1st detector plate choke and the plate voltage supply lead. A bypass condenser associated with the additional choke and connected to ground has also been added. An additional filament resistor has been added. The junction of the i-f. plate trimmer and 2nd detector grid trimmer condensers is connected to ground. In the original model the i-f. plate trimmer shunted the second detector i-f. transformer primary and the rotors of these two trimmers where common to one lead of the 2nd detector i-f. transformer primary. Another fixed condenser has been added between the high side of the ground coupling condenser and the receiver chassis.

Battery Model Changes

The original production of 82-Q (battery model) was marked with serial numbers below 2,550,940. The second production bears serial numbers above this figure. One of the changes is the addition of an r-f. grid filter and its associated condenser in the input tube grid circuit. An r-f. choke and its associated bypass condenser (connected to ground) is to be found in the 1st detector plate circuit, between the low end of the plate choke and the voltage supply lead. The r-f. choke and bypass condenser originally used in the i-f. plate circuit has been removed. The "on-off" switch in the later series has six contacts instead of four. The white (-15 volts bias) lead is also interrupted at the switch.

Changes in Super

Quite a few changes have been made in the 85-Q. The second type or series bears serial numbers above 163,767. The number of tubes used is the same in both series, but the later series has the functions altered. The early series had one tube as 1st detector, two tubes as intermediate amplifiers and the conventional 2nd detector, audio-frequency amplifier (two tubes) and oscillator. In the later series, the first tube is the r-f., the second is the 1st detector and there is only one tube used as an intermediate amplifier. In the later type 85-Q, the first i-f. transformer is replaced by a choke-condenser method of coupling. The transformer system is retained between the i-f. amplifier and 2nd detector. In the original model the 1st i-f. and 2nd i-f. were transformer coupled, and the 2nd i-f. and 2nd detector were choke-condenser coupled. In the later series (above serial 163,767) the i-f. and 2nd detector are transformer coupled and the 1st detector and i-f. are choke-condenser coupled. The double spot tuning circuit (image frequency suppression system) in the later model is connected between the r-f. and 1st detector, as a part of the complete transformer system. The changes are so numerous that the later model is practically a different receiver.

Model 96 was produced with three ranges of serial numbers. The first type was below serial 7,289,385. The second type bore serial numbers between 7,289,385 and 7,291,674. The third type was numbered above 7,291,674. The same type tubes are used in all three productions, but the voltage distribution differs. All heater voltages are the same, namely 2.4 volts. A tabulation of the operating potentials is given in the accompanying table:

Tube Voltage Data

	Model 96 Type 1			Model 96 Type 2			Model 96 Type 3		
	Plate	*Screen*	*Con. Grd.*	*Plate*	*Screen*	*Con. Grd.*	*Plate*	*Screen*	*Con. Grd.*
T.R.F.	100	45	3	150	40	3	205	70	3
1st Det.	110	40	5	135	35	4	150	70	4
I-F. Amp.	100	45	3	150	40	3	205	70	3
2nd Det.	95	55	7	95	45	7	90	30	5
1st A-F.	200	210	3	200	210	4	195	205	4
Osc.	80	0	*	70	0	*	80	0	*
Avc.	40	0	17	35	0	15	30	0	3

* Variable. May be zero or as high as 10 volts.

Test Data on G-2-S Tube

The Grigsby-Grunow Company (Majestic to you) have placed certain definite factory test limits on their new G-2-S Duodiode Detector Tube which the Service Man should follow as well in his own tests.

As you probably know, the G-2-S is a special linear detector having two plates, instead of a plate and grid. These two small plates are concentric with the cathode and have a spacing of about one millimeter between them. The two plate leads are brought out separately to the standard plate and grid prongs of the standard five-prong base.

The tube is used in a push-pull connection, and since there is no d-c. voltage impressed on either of the plates, but only the signal voltage, the tube cannot be tested in the same manner as standard tubes. (By the way, since there is no d-c. voltage on the plates, the tube has a much longer life.)

Another point of interest is this: Using this tube as a detector allows the construction of a more efficient automatic volume control circuit, due to the fact that a very low impedance may be used in both the input and output circuits of the tube, thus eliminating the danger of any possible leakage which would effect the automatic volume control. Also, due to the fact that this tube uses a push-pull circuit, it is much simpler to filter the r-f. currents.

FACTORY TEST LIMITS

But, getting back to the tests . . . after the tube has been tested for short-circuited elements, it should be tested for the following characteristics: Filament current, plate current, gas current and emission. These tests should be made with the following standard voltages:

Filament=2.5 volts
Plate 1=20 volts
Plate 2=0 volts
Emission=50 volts*

(*With plates 1 and 2 connected)

With the test voltages as given, the limits of acceptance shall be:

Plate 1=8 to 14 ma., with plate 2 tied to cathode
Plate 2=8 to 14 ma., with plate 1 tied to cathode
Emission=55 ma. minimum
Filament=1.5 to 2 amps.
Gas current=1 microamp. max.

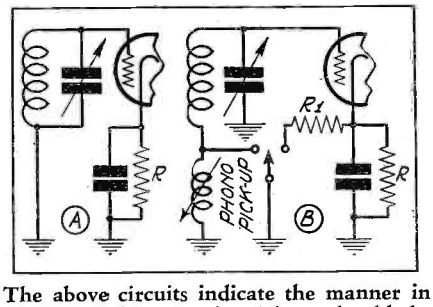
With a negative voltage of 13.5 on plate 1 and a positive voltage of 30 on plate 2, and a filament voltage of 2.5, the gas current should be less than one microampere.

Adding Tone Control

There are two types of tone controls commonly used in receivers. (See February issue of SERVICE for additional data.—Ed.). These are the switch-controlled series of fixed condensers and the series combination of a variable resistance and a fixed capacity. The latter circuit is more easily applied to a finished receiver. Its usual position is across the input or output circuits of the output tubes. In the case of pentodes, the majority of manufactured receivers employ tone control across the plate-to-ground, in single tube output systems, and from one plate to ground in push-pull systems, or across the two plates in push-pull systems. 100,000 ohms maximum and .04 mfd. makes a good combination between the two plates of a pair of '45s in a push-pull output stage. A resistor of from 100,000 ohms to 200,000 ohms maximum and a condenser of .04 mfd. to .05 mfd. makes a good combination between the plate of a single pentode tube and ground.

Adding a Pickup

A phonograph pickup can be added to a receiver as shown herewith. Fig. A illustrates a conventional biased type of detector circuit. Fig. B shows how the pickup is added. The "low" end of the grid coil is disconnected from ground or the grounded side of the tuning condensers. The pickup is connected in series with this lead and ground. A connecting lead from the junction between the pickup and the "low" end of the grid winding terminates at one terminal of the pickup control switch. The switch lever connects to ground. Another switch terminal connects to the amplifier biasing resistance R1, which joins the cathode end of the regular detector biasing resistance. As a general statement, R1 can be around 5,000 ohms. With respect to operation, when the switch is set to the right hand contact, the pickup is ready for use. When set to the left hand contact, the pickup is shorted and the grid coil is grounded for proper tuning by means of the condenser. A high-impedance pickup should be used.



The above circuits indicate the manner in which a phonograph pickup should be connected into the grid circuit of a detector tube

Majestic Image Suppression

Image frequency suppression in the Majestic (Grigsby-Grunow) receivers Models 200, 210 and 220 chasses is accomplished by employing a tapped input coil in the first detector grid system. This circuit is made resonant to the desired frequency by means of the regular tuning condenser and because of the position of the tap upon the winding (This tap is connected to the control-grid of the first detector tube.—Ed.), the circuit is made anti-resonant to the image frequency. The image frequency in these receivers is 350 kc. higher than the frequency to which the circuit is tuned.

AND MODEL NAMES . . .

Majestic designates the models according to names. The 200 chassis is used in the Sheffield, Fairfax and Explorer models. The 210 chassis is used in the Whitehall, Stratford and Croydon models. The 220 chassis is used in the Collingwood and Abbeywood models. (*Quite English, what say!*)

Chassis No. 10 short-wave converter is used in the Model 11 Converter and in the Viking and Explorer model receivers. Chassis 55 is used in the Ardmore, Berkshire and Viking models.

Aligning Majestic 200, 210 and 220

Supply a 175 kc. signal (modulated) to the grid of the first detector tube and adjust all i-f. tuning condensers to give maximum sensitivity. Then supply a modulated 1,500 kc. signal to the input of the receiver. Set the receiver dial at 1,500 kc. and adjust all r-f. alignment condensers for maximum output. Then set the tuning dial at 550 kc. and adjust the oscillator tracking condenser for maximum sensitivity with 550 kc. feeding into the input of the receiver. For each adjustment of the oscillator tracking condenser there will be a different dial setting for maximum sensitivity. The combination of the tracking condenser adjustment and dial setting which gives maximum sensitivity, disregarding calibration, is the correct adjustment. If this adjustment falls within 5 kc. of the 550 kc. calibration point, readjust trimmers at 1,550 kc. and check dial calibration at 1,000 kc. Each receiver must be aligned for maximum sensitivity.

Colonial 36 Bleeder

Reduced volume and intermittent fading in the Colonial 36 and 36-P is in all probability due to an open in the 100,000-ohm bleeder resistance connected between ground and r-f. screen grid voltage supply lead, and located adjacent to the tone control switch. The 100,000-ohm resistor is a part of a resistance unit having a total resistance of 165,000 ohms with a tap at 65,000 ohms, working away from the junction between this resistor and a 5,000-ohm choke. It is not necessary to replace the entire resistance. To replace the 100,000-ohm section, disconnect the ground lead from the grounded end of the defective resistance. Then connect a new 100,000-ohm resistance, rated at about 5 watts, between ground and the r-f. screen grid voltage supply lead.

Testing French H-1

The Jesse French Junior H-1 employs the Loftin-White system in the audio amplifier. Routine set analyzer voltage measurement methods cannot be applied. To check the a-f. amplifier measure the resistance between the following points: Between the output tube control-grid and 2nd r-f. tube plate, the resistance should be approximately 525,000 ohms. Between detector cathode and ground, 100,000 ohms. Between the detector control-grid and ground, slightly more than 450 ohms. Between detector screen-grid and ground, about 1,425 ohms. During all of these measurements, the receiver must be disconnected from the power circuit and the tubes must be removed from the sockets.

Checking I-F. Oscillator Calibration

The *Philco Service Department* says that any oscillator which is not crystal-controlled —particularly those which are battery-operated and portable—should be checked from time to time for correct frequency calibration. This is good advice and should be followed. The calibration of such oscillators can be appreciably affected by rough handling and by the condition of the tubes and batteries. If an oscillator is in daily use, it should be checked two or three times a week.

One of the most accurate and convenient methods of making this check is through the use of the signals from local broadcasting stations known to be reliable. Most of the better class stations have crystal-controlled frequency regulation which assures broadcasting of the assigned frequency. I-F. oscillators can be checked with the aid of broadcast signals in the following manner:

175 KC. Check

Tune your set *accurately* to a reliable broadcast station on any of the following frequencies: 700, 1050, or 1400 kc. When a station is heard at any one of these three points, disconnect the aerial and substitute a connection from the aerial post on the set to the output of the oscillator. Place the oscillator in operation at 175 kc. If the oscillator is calibrated correctly, its signal should be heard on the receiver without changing the tuning in any way. If it is necessary to re-tune the set before the oscillator signal can be heard at maximum volume for the particular setting of the attenuator and the radio set volume control, the oscillator is off calibration. Its compensating condenser should be re-adjusted until the signal is heard at exactly 700, 1050, and 1400 kc., these frequencies being the fourth, sixth and eighth harmonics of 175 kc. (In the Philco Oscillator Model 095, the compensating condenser is the one nearer the 175 kc. switch position.)

260 KC. Check

Proceed in the same manner as for the 175 kc. check described above, but tune the broadcast set to a signal at 780, 1040, or 1300 kc. Again substitute the aerial connection and place the oscillator in operation at 260 kc. Check in the same way as for 175 kc., making any necessary adjustments of the 260 kc. compensating condenser so as to make the oscillator signal heard at 780, 1040 or 1300 kc., these being the third, fourth and fifth harmonics respectively of 260 kc. (In the Philco 095 Oscillator, the 260 kc. compensating condenser is nearer the 260 kc. switch position.)

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Suggestion for Radiolas 50 and 55

The suggestion is made to remove the series combination of the 18,000 ohm resistor and .005 mfd. fixed condenser connected between the plates of the two push-pull pentodes in the Radiolas 50 and 55. This slight operation improves the tone quality.

Installation of Multicoupler Antenna System

The satisfactory operation of the Multicoupler Antenna System, as designed by Amy, Aceves & King, Inc., is dependent to a great extent on proper installation. The following notes on the installation of the Multicoupler System in buildings already completed should be followed closely:

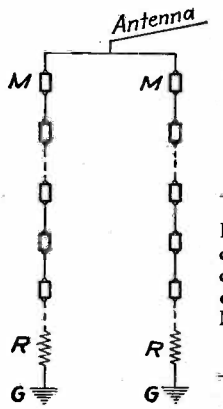

Fig. 1. Manner of connecting Multicouplers when two downleads are used. Maximum, thirty Multicouplers

Each antenna should consist of a single wire 50 to 75 feet in length, employing standard No. 14 aerial wire supported at least 20 feet above the roof of the building and clear of such obstacles as chimneys, metal smoke stacks and guy wires. The support to which the lower part of the antenna wire or downlead is fastened should be at least 8 feet in height so that the aerial wire and insulator are well out of reach. Also, an approved lightning arrestor should be installed for each aerial and mounted at the head of the downlead.

Where roof space is limited, satisfactory results can be obtained by using an aerial made up of two or more sections connected at one end and spread out fanwise at the other.

If the aerial or aerials conform to the above specifications, as many as 30 radio sets may be operated from each antenna, using one Multicoupler for each set. But the manner in which the Multicouplers are connected into the downlead of any one aerial should conform to one of the following: (1) By connecting all Multicouplers in series in one downlead; (2) Two downleads with 15 Multicouplers in series with each lead, as shown in Fig. 1; (3) Three downleads having three to six Multicouplers in series in each lead (It is not well to use more than three downleads with each antenna.); (4) One or two horizontal risers connected to a single antenna for two- or three-story buildings, as shown in Fig. 2.

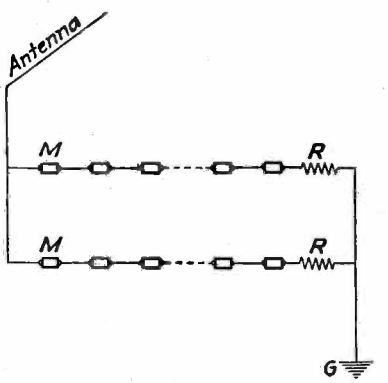

Fig. 2. Typical layout when two horizontal branch risers are used. Maximum, eighteen Multicouplers

Terminal Installation

The downlead wire should also be standard No. 14, and supported at the top and bottom by strain insulators, as shown in Fig. 3. This downlead should be held off from the side of the building by stand-off insulators, with a stand-off of at least 3 inches.

The lead-in-wire from the Multicoupler is brought through the window by means of a well-impregnated wire through a 3/16-inch hole in the windowsill. The connecting wire from this point to the radio set proper should not be more than 75 feet long.

It will be noticed in the diagrams and in the sketch that a terminal resistance is required for each downlead, even if there is but one. The terminal resistance must be connected between the end of the downlead and a good ground, such as a water-pipe. The terminal resistance unit consists of a weatherproof, non-inductive resistance of 1,000 ohms, rated at 30 watts.

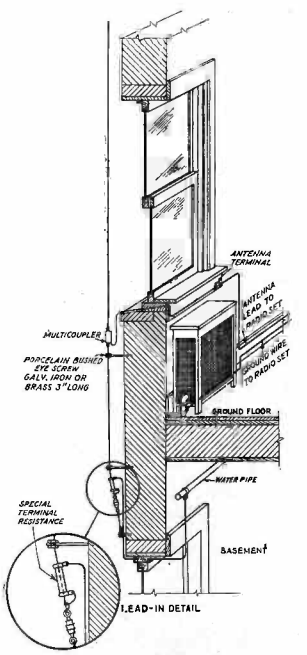

Fig. 3. Showing the manner in which the individual installations should be made. Note the special terminal resistor, in circle

Method of Test

After the installation is completed, a continuity test should be made, and preferably using an ohmmeter. The resistance of a single downlead to ground should measure approximately 1,000 ohms; two downleads in parallel, each with a terminal resistance, 500 ohms; and for three downleads, 333 ohms.

Radiolas 60, 62, 64 and 66

Mechanical hum in the Radiolas 60, 62, 64 and 66 can be corrected in the following manner: Remove the transformer from the socket power unit and heat in a slow oven. (*But do not serve.*) In the case of the 60, 62 and 66 the open end of the transformer should be kept up and the compound heated sufficiently to allow it to adhere to the laminations of the transformer. In the case of the 64, the terminal end should be held up during the heating process. After heating, the transformer should be allowed to cool for at least 24 hours and then returned to the socket power unit.

RESISTANCE OF I-F. WINDINGS

Resistance of i-f. windings in the Radiola 60, 62, 64 and 66 is 20 ohms for the i-f. transformer primaries and 100 ohms for the i-f. transformer secondaries. In the case of the 60, 62 and 64, the circuit arrangement is such that it will only be possible to get a reading of 50 ohms on the secondary, as the end connection goes to the neutralizing condenser and the reading must be made at the center tap connections. In the case of the 66, the aforementioned condition applies only to i-f. transformers No. 1 and No. 2. I-F. transformer No. 3 has no center tap upon its secondary and the full 100 ohms can be measured.

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Atwater-Kent 80 and 83

Atwater-Kent 80 and 83 diagrams require special mention. In some diagrams the chassis connection to the oscillator cathode and grid leak is shown. This should be omitted. The oscillator grid leak should be connected to the cathode.

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Kolster K-80, K-82

Kolster K80 and 82 receivers as originally manufactured employed a 15,000-ohm volume control. To improve volume control action, this unit has been replaced with a 15,000-ohm potentiometer. In addition to replacing the volume control unit just mentioned, a 1200-ohm fixed resistor is installed in the cathode circuit of the AVC tube, connected between the end of the volume control unit and the 20,000-ohm resistor.

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Motorboating

Motorboating, or fluttering as many people call it, is frequently due to the first detector and oscillator tubes, which vary greatly from standard values. In receivers which use electrolytic condensers, defective condensers (high leakage and low capacity) will also cause this type of trouble. Imperfect r-f. or 1st detector screen-grid bypass condensers are also apt to cause this type of trouble.

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AVC in U. S. Radio No. 7

Imperfect AVC tube operation in U. S. Radio No. 7 series receivers is related to incorrect adjustment of the "Localizer" unit. To adjust this part of the receiver proceed as follows: Turn the localizer knob counterclockwise as far as it will go. Then turn the knob one-quarter turn clockwise. Next tune in a fairly strong signal and reduce the volume by means of the volume control knob on the front of the panel. This will cause plate current cutoff in the r-f. and i-f. tubes. Then turn the knob slowly in a counterclockwise direction until the signal is again heard. With a slight additional turn in the same direction the signal builds up sharply to full strength and this is the correct position of the localizer setting. This adjustment should not be changed unless the receiver is re-installed or the tubes are changed.

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Grebe A.C.-6 Volume Control

The volume control in the Grebe Synchrophase A.C.-6 receiver is 2,800 ohms. It is connected across the primary of the last r-f. transformer. This information is given for replacement guidance and to correct the figures contained in some of the volume control table lists published by several organizations.

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Handy Test Methods

Isolation of trouble in a receiver is greatly expedited by determining whether or not a signal voltage is present in the detector system. At least it gives one an idea of the approximate condition of the r-f. system, that is, in t-r-f. receivers. Check the voltage across the cathode bias resistance and note the change in voltage as the test signal is tuned in. There will be a change in voltage if you use a high-resistance voltmeter or an output meter. Another satisfactory method is to employ a plate circuit break-in adapter connected to a 0-5 d-c. milliammeter. Do not use the regular set tester plug and cable. Place the break-in adapter right into the detector tube socket and connect the meter to the leads from the adapter. If a plate circuit adapter is not available use a cathode circuit adapter. For work of this type connect a .0005 mfd. condenser across the two plate-circuit contacts upon the adapter, right at the adapter. This will remove the meter from the path of the rectified r-f. currents in the plate circuit. The condenser bypasses the meter.

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Condenser Opens and Shorts

Bypass condensers of the dual and triple type contained in a single housing—for that matter even single bypass condensers—are frequently reported as giving much trouble. The use of a test shunting condenser is satisfactory when the regular condensers are open circuited within the cans, but in very many cases intermittent shorts develop between the internal connections and the grounded cases. To check for such shorts try one of the following methods: Measure the voltage in that circuit or the resistance in that circuit. Observe the condition. Then disconnect the condenser can from the chassis. Remeasure the voltage or resistance. In some instances, the tension applied to the can when located in a certain position and when attached to the chassis causes the can to bend slightly and cause the short. If this is the case, arrange a washer between the mounting screw and the chassis in order to relieve the strain.

It is possible that when the chassis is in a certain position, the internal connections drop and make contact. To check for this condition, detach the condenser can from the chassis and shake it gently or vary its position. Arrange the test circuit, voltage or resistance, so that you can note the effect of changing the position of the condenser.

In some instances, intermittent operation and often clicks are due to insufficient separation between the condenser lead and the condenser container. A few thousandths of an inch separation may not be sufficient to withstand the voltage present in the circuit and momentary arcing occurs, particularly during and after the passage of strong signals. Striking the condenser a sharp blow may increase the separation. If not, replacement is necessary.

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Grebe SK-4

Intermittent fading after continued adjustment of the volume control and then relief from fading after the control has been advanced to a certain point is due to abnormal grid-to-cathode leakage in the '27 detector tube. Change tubes if the detector grid circuit has a 1.0 megohm resistor. You may try reducing the value of the resistor (by replacement) to 0.5 megohm. If the resistor is of 3.0 megohms (silver ends), replace it with a 0.5- or 1.0-megohm resistor. (The 1.0-megohm resistor to be found in some of these receivers has brown ends.—ED.)

This receiver is available in two productions. If the operation of the local-distance control does not increase the sensitivity of the receiver, be sure that the contact of the switch is perfect and that the switch is operating in normal fashion. When closed, for distance operation, it short circuits a 150-ohm resistor. There are some minor variations between the two productions. The early production has a 20,000-ohm grid filter resistor in the 2nd r-f. stage. This is absent in the later production. The detector grid-filter resistance in the early production is of 3.0 megohms; in the later production of 1.0 megohm. The aforementioned two variations constitute the changes in the event that the old model is troubled by modulation hum. If the trouble is present in the later models, try a capacity filter across the power transformer primary. Also try disconnecting the ground end of the antenna coil from the chassis. Connect this lead to the ground terminal. In other words, the chassis of the receiver should not go to ground. With the exception named, everything else remains connected to the chassis as before, but the antenna circuit is isolated. (See February issue of SERVICE. Abstract by Teachman.—ED.)

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Announcement

The June issue of SERVICE will carry a complete listing of the new radio receivers to be exhibited at the Chicago Show. This listing will include all the salient features of the sets which will be of special value to Service Men.

Public Address . . .

Acoustics

Where an installation is of sufficient magnitude acoustical treatment (if indoors) is usually a part of the installation. However, there are numerous cases of small installations where there exists a need for the installation—but where finances are limited, which means that acoustical treatment is out of the question. One simply gets by with what conditions are existent at the point of installation. The following data applies to such conditions.

Where a room has walls, ceiling and floor of hard, polished surfaces with very little absorbing mediums within it, it is always better to operate at the lowest possible volume level. Contrary to general opinion, although not necessarily engineering opinion, several loud speakers located in different parts of the room, and operated at the lowest practical levels will be found superior to a single or multi-speaker system located at one radiating center and operated at a level high enough to reach all corners of the room. The usual disadvantage of segregating speakers and locating them around the room is that sound waves from two different speakers located at different points may cross at one point and if the phase relation is adverse to that desired, may cause a dead spot. Such a condition may sound strange in the face of the presence of several loud speakers within an enclosed room, but it is true nevertheless. (See "Phasing of Voice Coils" in April, 1932, issue of SERVICE.—ED.)

VARIABLE ABSORPTION

Of course, if the sound is supposed to issue from a certain point, as for example behind a screen, then it is imperative that the speakers be located at this point, either directly behind, above and behind or below and behind the screen. One thing must be noted in connection with installations where absorption is a variable and represented by the people who enter the room.

The power output applied to the load must be varied in accordance with the number of people in the room. This variation cannot be made in accordance with the sound heard through the monitor speaker located in some other room. While it is true that the output of the monitor will show excessive or insufficient power, it still cannot be used as a gauge because of the acoustical variations in an empty room or auditorium, a partially filled room, medium filled room or entirely filled room. In very many instances, the output from the monitor based upon a medium filled room sounds normal, yet the sound as heard in the auditorium or room, when only sparsely occupied, may be so bad as to be annoying. Reflection and reverberation are bad in such instances.

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Load Requirements

Load requirements of a public-address or multi-speaker system depend upon the area or the number of units (loud speakers or headphones) which must be served. In multi-headphone systems, power requirements for each pair of headphones range from about 15 milliwatts to about 50 milliwatts. Of course, the exact amount of power applied is a variable, depending upon the intensity desired by the listener. However, when considering power output requirements of a system to be utilized in conjunction with a number of headphones, do not figure on less than 40 milliwatts per pair of phones. It is of course true that this amount of power will not be utilized in each case, but by allowing sufficient tolerance, better reproduction will be available, with less tendency towards overloading. Based upon about 40 to 50 milliwatts per headset, a power amplifier affording about 5 watts output will service between 100 to 125 headphones, assuming small losses in the transmission system. Practice however shows that this high figure is not reached very satisfactorily because of the inherent losses in any system which includes this number of headphones. A safe figure would be about 50 percent of the quoted value. (We invite comment in this connection; particularly data pertaining to actual number of headphones in the system and the power output of the amplifier employed.—ED.)

Engineering opinion (Samson Electric Co., the birthplace of Pam amplifiers) concludes that when working outdoors, five watts of power is required to serve one-sixth of the area of a circle 100 feet in diameter, which is the equivalent of a radius of 50 feet, each speaker covering an arc of 60 degrees. Proper location of the speakers is assumed. Six such speakers, each operating with 5 watts input, all six centrally located and each covering the arc named, would effectively cover the space named. With centrally-located speakers (added information from Pam) the power requirement increases as the square of the radius to be covered. Doubling the radius required four times as much power. (Actually 30 watts of power distributed among six speakers will be heard for somewhat more than 50 feet in a straight line from the source, but these figures no doubt are conservative calculations, based upon complete comprehension of what is being spoken. As far as musical reproduction is concerned, the distance is definitely greater because the subject of intelligibility of speech does not enter.—ED.)

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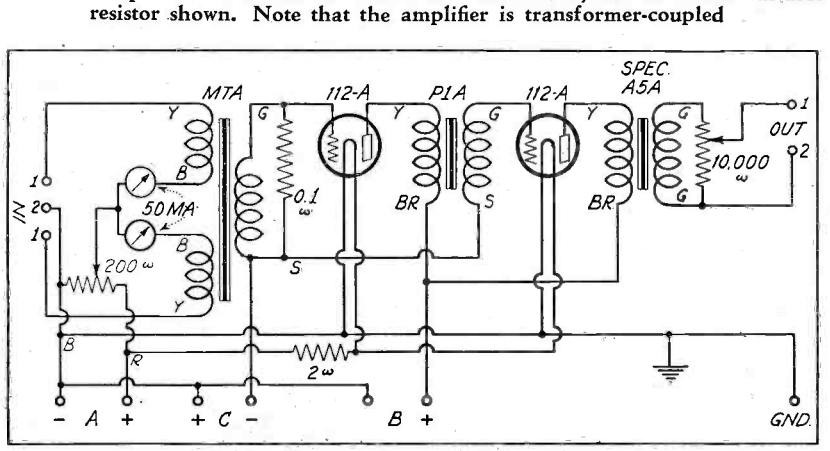
Schematic diagram of the Samson MIK-1D battery-operated speech amplifier designed specifically for use with a double-button microphone. The two milliammeters shown in the input circuit are used for giving the readings on each of the buttons in the microphone. The button current is controlled by the 200-ohm variable resistor shown. Note that the amplifier is transformer-coupled



Pam Amplifier Data

Information about Pam amplifiers has, as a rule, been mighty scarce. Herewith are several wiring diagrams of two microphone amplifiers and the complete a-c. operated combination microphone and power amplifier, the Pam 80. In the last named unit the power for the double-button microphone is secured from the power pack. Provision is made for utilizing the input amplifier tube ('24) as the microphone amplifier or as a voltage amplifier for energy received from an independent pre-amplifier. Control of the upper audio register to prevent the passage of undesired high frequencies is secured by means of a 1.0 meg. resistance shunted by a .0001 mfd. condenser, connected across the input circuit of the '45 tube in the second stage. The microphone current is a part of the plate current of the output tubes. Proper bypassing is secured by means of a 2,000 mfd. electrolytic condenser. The power pack filter system employs two sets of 8 mfd. electrolytic condensers in series. (Note the polarity of these condensers.—ED.)

A battery-operated amplifier, this time primarily for the microphone, is the MIK-1D. The filament battery furnishes the microphone current. A 50-milliampere meter is located in each microphone circuit. In contrast to the usual run of resistance-coupled systems, this amplifier makes use of transformers. The volume control is a 10,000-ohm unit connected across the output transformer secondary.

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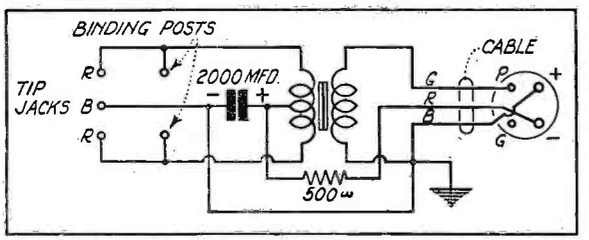
Microphone Data

Microphones employed in connection with speech amplifier apparatus are of four types: the hand microphone, the broadcast type of double-button microphone, the condenser microphone, and the moving coil microphone. Of these three the hand type is least sensitive and should be located close to the mouth of the speaker. These mikes are useful where



Circuit of the MIK-80 microphone input transformer, and cable plug which permits this unit to be connected into the input of the Pam 80, shown below. Note the 2000-mfd. filter condenser for the microphone button current

rough treatment is to be expected and where the noise level is very high. The fact that it must be held close to the mouth makes its use advantageous in places where the location of the person speaking is out in the open and surrounded by noise-making machinery. As far as speech reproduction is concerned, the fidelity characteristics of the unit are passable, but it is unsatisfactory for music.

With respect to double-button microphones, they are more sensitive and less rugged. In connection with such types of pickup units, let it be known that all sensitive microphones employing carbon granules need not necessarily be of the two-button variety. There are several microphones which employ constructional methods different from the button type, yet are sensitive and satisfactory for similar use. When used in the open, these microphones are sensitive to atmospheric variations.

A higher order of sensitivity is available with the condenser microphone, and better fidelity is also secured. However, these units are anything but rugged and cannot be subjected to physical jars or shocks. Each unit is calibrated and such work is a laboratory operation.

DYNAMIC MICROPHONE

The latest type of microphone is of the moving-coil type. In basis of operation it is similar to the dynamic speaker. Essentially it consists of an acoustic diaphragm to which is attached a coil of wire that projects into a magnetic field. To comprehend this structure, consider the cone of the average dynamic speaker to be a flat diaphragm. When the diaphragm is set into motion by the sound waves, it causes the coil to move within the magnetic field. This causes the generation of a voltage of the frequency corresponding to the vibration, to be generated within the coil by means of magnetic induction. In a way the operation of this type of microphone is the reverse of the dynamic speaker.

The flux required in the gap is produced by means of a permanent magnet, as in the case of the recently introduced permanent-magnet dynamic speakers. This type of microphone shows very excellent frequency characteristics and is far more rugged in construction than the condenser type of microphone.

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Lapel Microphones

Instead of a carnation, the future lecturer may wear a microphone on his lapel, that is, if the lapel microphone recently announced by Western Electric comes into use. While it may be said that the primary reason for the development of this unit is to obviate the necessity of multi-mike installations when a number of persons remotely located are expected to deliver speeches, or to avoid the usual decrease in sound output when a lecturer turns away from the microphone to explain an illustration or slide, it is possible that quite a few similar uses will be developed in connection with small public-address systems.

The microphone may be used with an ordinary public-address system and is about 1.5 inches in diameter. It has a metal clip whereby it may be attached to the lapel of the person who will deliver the address or may be attached to the breast pocket of the wearer's coat.

The "mike" employs a diaphragm made of thin aluminum and is conical in shape. Granular carbon is packed in the housing. The usual type of double-button construction is not employed. The metal diaphragm is insulated from the granular carbon by a coating of phenol varnish. A protective grid is placed in front of the diaphragm to protect the latter against injury. Electrical connection to the carbon is made through two stationary, circular electrodes insulated from each other by a ceramic barrier.

OPERATION REQUIREMENTS

The plug which terminates the two-foot cord is equipped with a small condenser which prevents the carbon granules in the microphone from "packing" if, for any reason, the plug is withdrawn from the jack while the microphone is in the circuit.

The W. E. lapel microphone requires 12 volts d-c. for its operation. This excitation voltage may be secured from a storage battery (two 6-volt batteries connected in series) or some other d-c. source which may be a part of the public-address system employed.

It is said that the frequency characteristic of this pickup unit is substantially flat over the voice-frequency range and while authentic data is not available, it is believed that the unit is intended for speech and not musical frequency pickup.

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RCA. CE-29 Phonograph

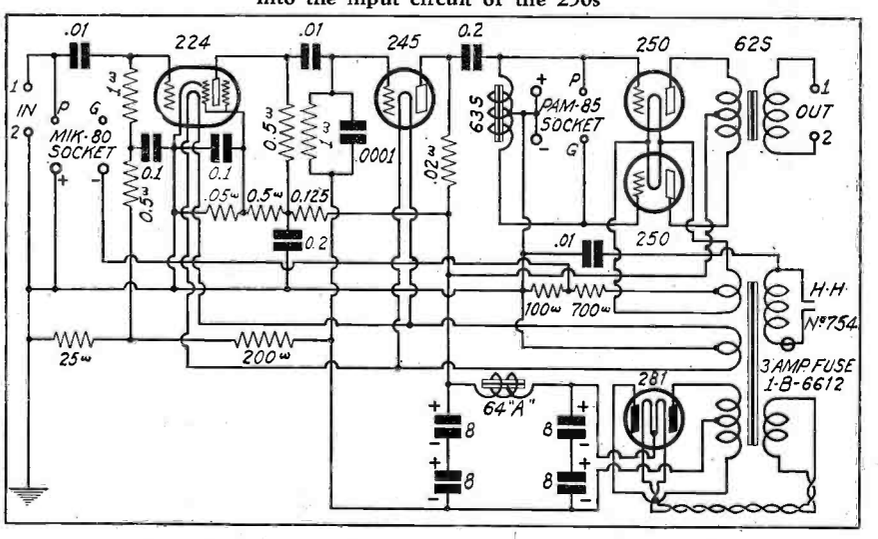
CE-29 is the designation of the RCA. coin-operated power amplifier. This unit consists of a standard automatic record changing mechanism that holds ten 10-inch records, a two-stage audio amplifier with '47 type tubes in a two-tube push-pull output system, a coin box with the necessary switches for controlling operation, an eight-inch dynamic speaker and a continuously variable tone control. The magnetic pickup feeds a single type '30 tube, which in turn is transformer coupled (parallel feed) to the push-pull output stage.

The wattage consumption of the complete unit is 130 watts. It is designed for a-c. operation 105-125 volts and 25, 50 and 60 cycles. The speaker field dissipates 10 watts and the d-c. resistance of the field is 1330 ohms. The output of the speaker is 4 watts. The turntable speed may be 78 or 33-1/3 rpm. The voltage table is given below. Line voltage 120.

Tube	*Control Grid to Filament*	*Screen Grid to Filament*	*Plate to Filament*	*Plate Crnt.*	*Filament Volts*
RCA 247***	17.0	270	250	30.	2.6
RCA 230	2.0**	——	80	2.0	2.0*

* The filament voltage may vary due to variations in filament resistance. The current however should be very close to 60 milliamperes. Measuring the current will give a much more accurate indication of correct operation and measuring voltage.
** This actual voltage is 4.5. Different resistance meters will give varying voltages.
*** The figures quoted in connection with one output tube apply to both tubes, that is, like values are to be found in both tube circuits.

Circuit diagram of the Pam 80 Public-Address Amplifier using two 250s in push-pull. Note the socket in the input for the MIK-80 microphone input. Posts 1 and 2 are used for phonograph or radio. Also note that a separate amplifier can be plugged into the input circuit of the 250s



Auto-Radio . . .

Atwater-Kent Auto Supers

Atwater-Kent Models 91, 91-B and 91-C automobile receivers are of the super-heterodyne type with an intermediate frequency of 260 kc. This is of importance because it is the general opinion, due to continued practice, that all A-K superhet. receivers employ 130 kc. i-f. systems. Up to the present time and with the exception of the stipulated three receivers, such has been true.

Difference in Models

The same chassis is used in all three of the models heretofore mentioned. It is a nine-tube job with automatic volume control and dynamic speaker. The accompanying circuit diagram (Fig. 1) indicates that there is a stage of r-f., first detector, an i-f. stage, second detector, oscillator, automatic volume control tube, intermediate a-f. stage, and two 38s in push-pull in the output. Details of the control unit and speaker cable wiring are shown in Fig. 2.

The regular Model 91 chassis is mounted in a single, large container which also holds the "B" and "C" batteries. This model is designed for under-floor mounting and is 15 inches long, 10 inches deep and 9¼ inches high.

The Model 91-B has a small container for the chassis and "C" batteries, and is designed for dash mounting. It measures 10¼ inches by 10⅛ inches by 6¾ inches deep.

The Model 91-C has a small container for the chassis and "C" batteries and may be mounted under the floor, or through a hole cut in the floor boards. It is 10 inches long, 7¾ inches deep and 9¼ inches high.

Two sizes of "B" battery containers are available for use with the Model 91-B or 91-C. One measures 24½ inches long, 8½ inches deep and 3½ inches high. The square type container is 9¾ inches long, 8½ inches deep and 8⅜ inches high.

Servicing

In taking voltage readings on the tubes, use the 250-volt scale of a 1,000-ohm-per-volt d-c. voltmeter. The "B" battery voltage during the test should be 130 volts. All plate, screen and grid measurements are made from cathode.

Before taking the measurements, turn the volume control to maximum. The voltages on the various tubes should then approximate those given in the following table:

TUBE VOLTAGE TABLE

Tube	*Fil.*	*Plate*	*Screen*	*Grid*
R-F.	6	130	80	2.5
1st. Det.	6	125	75	5.0
I-F.	6	130	85	2.5
2nd. Det.	6	60		9.0
1st. A-F.	6	130		3.0
2nd. A-F.	6	127	130	12.
Control	6	5		2.5
Osc.	6	100		Small

Philco Interference Data

The appearance of the Model 7 Philco Transitone, with its increased sensitivity, has caused much worry on the part of some Service Men who have gotten it into their heads that special precautions and equipment are necessary to eliminate the motor interference. Such is not the case. If the installation of the set is made in the standard manner there should be no cause for interference, even though the sensitivity of this model receiver is greater than former models. However, the following installation notes should be followed closely:

It is still necessary to use one resistor on each spark plug, and one resistor on each high-tension coil lead at the distributor.

An interference condenser is necessary on the generator and usually on the battery lead at the ignition coil.

Peening the rotor is effective in practically every installation. Be sure this is properly done.

The "A" lead must be connected to the storage battery.

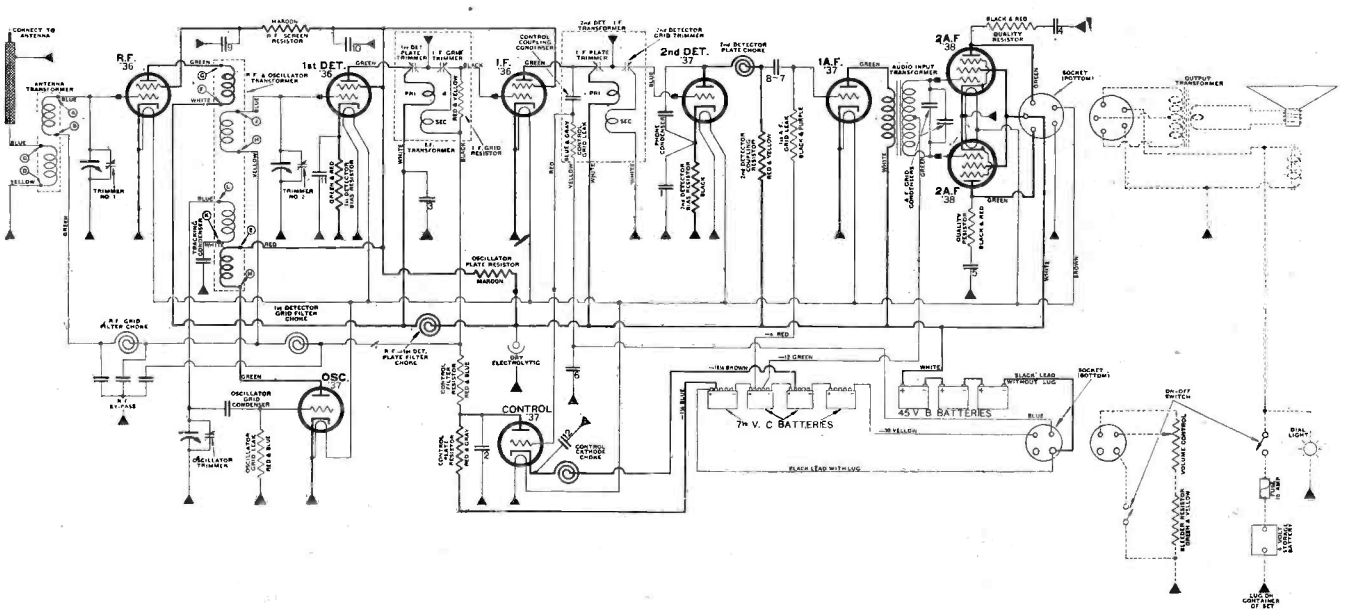
The shielding on the cables must be securely grounded. Sometimes it will be necessary to ground the cables at more than one point.

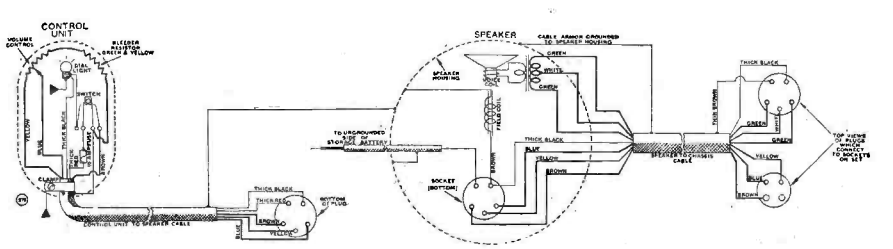
The antenna lead from the receiver must be shielded. The shielding must extend from the receiver housing to the cornerpost and should be soldered to the housing. This is so important that Philco is now furnishing a shielded lead with each receiver.

Extra interference condensers may be required at times. The ammeter, fuse blocks, cut-outs, dome light leads, are placed where an extra condenser may sometimes help.

Separate high- and low-tension wires. Never run them close together, or parallel to each other.

Dressing other wiring in the car and the





Above is the schematic diagram of the A-K Auto Superheterodyne chassis, which is used in Model 91, 91-B and 91-C units. The wiring of the control unit and speaker is shown at the left. The same wiring arrangement is also used in Model 81. (Courtesy, Atwater Kent Mfg. Co.)

set and speaker cables is often very effective in eliminating interference.

Choke and spark rods, oil lines and other metal tubing, often bring the interference through from the engine compartment. It may be necessary to ground these with flexible copper braid.

Quite frequently it may be necessary to bond the dash to the engine block.

Sometimes, when the ignition coil is located on the instrument panel, it may be necessary to shield the high-tension lead as far as the engine compartment.

Once in a while, you may encounter a particularly stubborn case of interference which can be traced to a defective coil, distributor condenser, or defective spark plug. In such cases, the defect must be corrected.

There is no new stunt for eliminating interference. The procedure is the same, the interference noise reacts to the same remedies that were used six months ago.

•

Majestic Model 110

The Majestic Model 110 is a seven-tube, radio-frequency job, as shown in the accompanying diagram. The specific Grigsby-Grunow tube type numbers are given.

Although the receiver is battery-operated, no external "C" battery is used, as all biasing of grids is accomplished automatically through the proper resistances in the respective grid circuits.

The "A" voltage supply is taken from the regular six-volt storage battery in the car. In cases where a twelve-volt battery is used in the car, the "A" supply leads should be connected to three cells of the battery only, to give the necessary six volts.

Sensitivity

Whenever low sensitivity is encountered, the first step taken to remedy the condition should be the checking of the r-f. type G-36 tubes. Tubes having a low mutual conductance in any of the radio-frequency positions will seriously affect the sensitivity of the receiver. This should be ascertained before an attempt is made at realignment.

Alignment of Gang Condenser

The position of the alignment condensers is of utmost importance, as the sensitivity of the receiver is affected by their setting. Should the receiver need realignment (but be sure it does), the following procedure should be followed: Tune in a station at approximately 1,300 kc. and align the receiver in the usual manner. In case one alignment condenser will not indicate a peak sensitivity, slightly advance or retard the tuning control and proceed to readjust the alignment condenser as before.

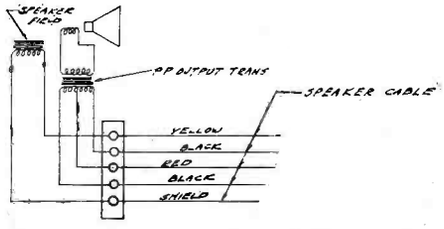


Fig. 2. In some of the models a five-lug speaker terminal board is used. The correct connections, as well as the color coding, is shown in the above diagram

Speaker Terminal Board

In some cases the speaker terminal board has five instead of four lugs. The proper connections for the five-lug board are shown in Fig. 2. It will be noted that they are quite different from the four-lug board connections.

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American Bosch Model 100

The American Bosch Model 100 Auto Radio is a superheterodyne employing a stage of tuned r-f., first detector, one stage of i-f, and a second detector feeding directly into a pair of '38s in push-pull. A type '37 tube is used as the oscillator. This receiver is also provided with automatic volume control, this function being taken care of by the type '38 second detector which has a peculiar connection. The plate voltage is applied to the screen and consequently the screen current is read instead of the plate current of the usual arrangement.

The speaker used is a dynamic, and it receives its field current from the storage battery in the car.

The receiver is protected by a 10-ampere fuse in the storage battery lead, and a 1/16-ampere fuse in the "B" lead.

When the receiver is first placed into operation there is one adjustment that must be made to insure maximum power and sensitivity. This is accomplished by simply turning the hexagonal nut, marked "Ant. Adjustment" (this nut is adjusted through a hole in the side of the receiver casing) until a point is found at which the volume reaches a maximum.

The servicing details of this receiver will appear in the June issue of SERVICE.

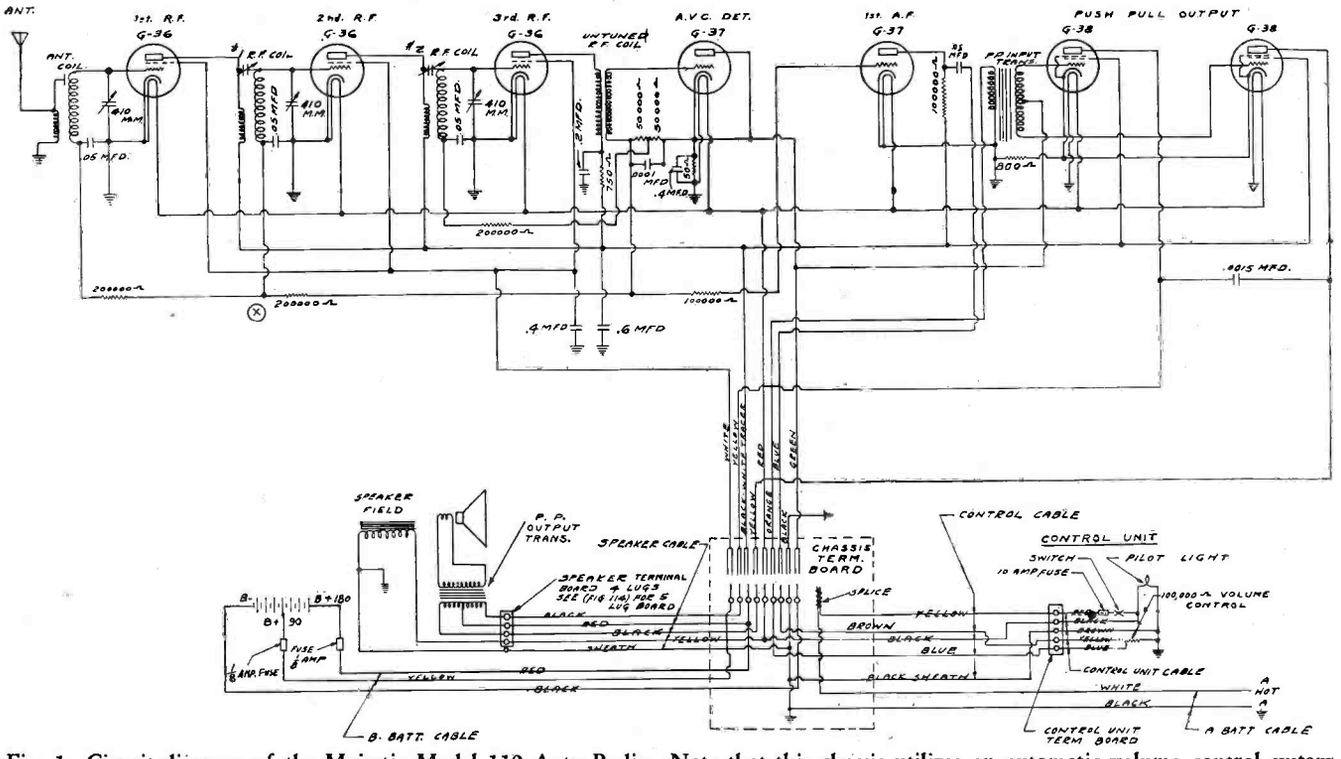

Fig. 1. Circuit diagram of the Majestic Model 110 Auto Radio. Note that this chassis utilizes an automatic volume control system in combination with a diode detector, the G-37 tube serving both functions. (Courtesy, Grigsby-Grunow Co.)

Short Waves . .

Majestic Model 10

The Majestic (Grigsby-Grunow) Model 10 short-wave converter has an intermediate frequency of 1000 kc. The oscillator required to align this unit must have a frequency range from 16,000 kc. to 3,000 kc. It must be of the type which is modulated and wherein the system can be altered to generate an unmodulated r-f. carrier. The alignment frequencies for adjusting the converter are 16,000 kc. (modulation off); 9,000 kc., 8,400 kc., 7,400 kc., 4,900 kc., 3,800 kc., 3,400 kc., all with modulation on. Also a 1,500 kc. signal which can be secured from any standard generator utilized for the adjustment of broadcast receivers. The wavelength range of the short-wave converter is from 15 to 200 meters. The individual bands are 15 to 37.5 meters; 37.5 to 85 meters and 85 to 200 meters. The numbers upon the dial of the converter give the frequency adjustments in megacycles. Thus 1.5 upon the dial designates 1,500 kc. or 1.5 megacycles, etc.

Circuit and Tubes

This converter employs three tubes and has two tuned circuits, as indicated in the accompanying diagram. The modulator is a type G-24-S (eq. 224), the oscillator a type G-35-S (eq. 235) and the full-wave rectifier a type G-80 (eq. 280). The oscillator and modulator tubes are self-biasing by their plate-current drop across a common 1,000-ohm resistor in the cathode circuit.

Color Code

The following table giving the color code of the cables from the power transformer will be of assistance in checking the respective circuits to their "conclusions."

Start of Primary	Yellow
Finish of Primary	Red
Start of 5-volt filament	Yellow
Finish of 5-volt filament	Yellow
Start of 2.5 volt heater	Black
Finish of 2.5 volt heater	Black
Start of anode	Blue
Center tap of anode	Black
Finish of anode	Blue

Tube Readings

The current and voltage readings on the three tubes should be as follows: On the G-24-S modulator, a-c. filament voltage, 2.5; plate voltage, 250; filament to ground, zero; cathode to ground (d-c) 8; d-c. plate current, 0.1 ma.; d-c. screen voltage, 135 and d-c. screen current, .02 ma. The G-35-S oscillator should give the same filament and cathode readings, and, d-c. plate voltage, 170; d-c. plate current, 7.5 ma.; d-c. screen voltage, 75 and d-c. screen current, 1.0 ma. The G-80 should have a filament reading of 5 volts a-c. and a d-c. filament-to-ground reading of 275 volts. The total d-c. plate current should not exceed 20 ma. All of these readings are based on a line voltage of 115. All readings should be taken with the Band Selector Switch in the medium position, that is, set to the 37.5 to 85-meter band.

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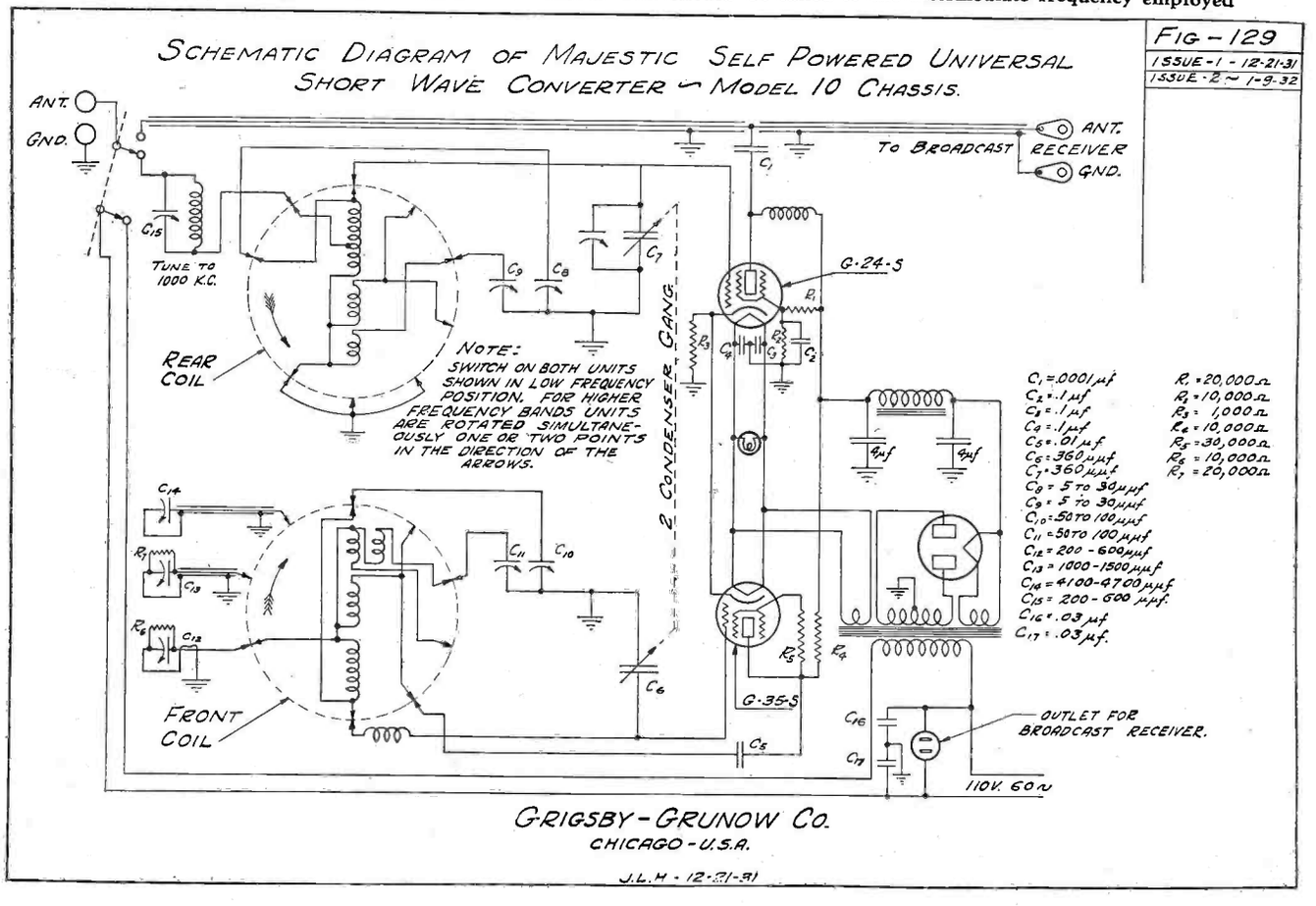
Jackson-Bell Model 33

The Jackson-Bell Model 33 Short-Wave Converter is a three-tube job, using a 227 as the oscillator, a 224 as the mixer, and a 280 rectifier in the power unit. The converter operates on a frequency of 840 kc., so the broadcast receiver with which the converter is used should be tuned to 840 kc. or thereabouts.

A three-position channel selector switch is used. When the knob of this selector is turned to the extreme right, the converter is turned off and the antenna and ground automatically re-connected to the broadcast receiver.

As the channel switch is turned to the left, the right-hand scale of the tuning dial will be illuminated, showing the numbers from 200 to 300. This covers the wave-band from 78 to 185 meters. Turning the knob again to the left the illumination will shift to the center scale, showing the numbers 100 to 200. This scale covers the waves from 40 to 85 meters. The next shift to the left illuminates the scale reading from 0 to 100, which corresponds to the wave-bands of 19 to 40 meters.

Note the trap circuit in series with the antenna lead. This should be tuned to the intermediate frequency employed



Checking Operation

Be sure the broadcast receiver is set at 840 kc. Check the converter tubes. A slightly flat 227 in the oscillator socket may refuse to oscillate on the short waves.

Check continuity from short-wave 224 control-grid to ground, and the 227 oscillator grid to ground on each of the three waveband settings. Check the 224 plate and screen voltages. No plate voltage indicates an open plate choke. If the screen voltage is the same as the plate voltage it indicates that the 227 oscillator tube is not oscillating or drawing plate current.

To check the 227 oscillator tube, set dial at approximately the 35 meter reading on the scale. Then, while reading the screen voltage on the 224, touch the grid winding of the oscillator with your finger. The screen voltage should rise approximately 20 volts.

Check coupling condenser from plate of 224 to antenna lead to broadcast set. Check all connections on channel switch by continuity test.

Alignment

Place the converter in operation and with the scale on dial at the first position (200 to 300) set an external oscillator at 1,710 kc. Now adjust the oscillator trimmer on the oscillator variable condenser to correspond to this setting on the dial. (The oscillator trimmer is the second section from the front of set.) Next, adjust the front trimmer to resonance at maximum output.

Atwater Kent Model 93 Converter

The Atwater Kent Model 93 short-wave converter employs four tubes, as follows: a 227 as the oscillator, a 224 as the first detector or mixer, a 227 as the i-f. amplifier, and a 280 full-wave rectifier for power supply. Since the i-f. amplifier in the converter is tuned to 1,000 kc. or 300 meters, the broadcast receiver with which the converter is used must be adjusted to the same frequency.

The set has a three-position, dual switch for changing wavebands, the three different bands covering the range from 15 to 200 meters. The details can be followed from the accompanying circuit diagram.

Servicing

In servicing this converter, do not change the original position of the wiring as it will disturb the dial calibration. Incidentally, this is a precaution which should be taken in servicing any calibrated short-wave converter or adapter.

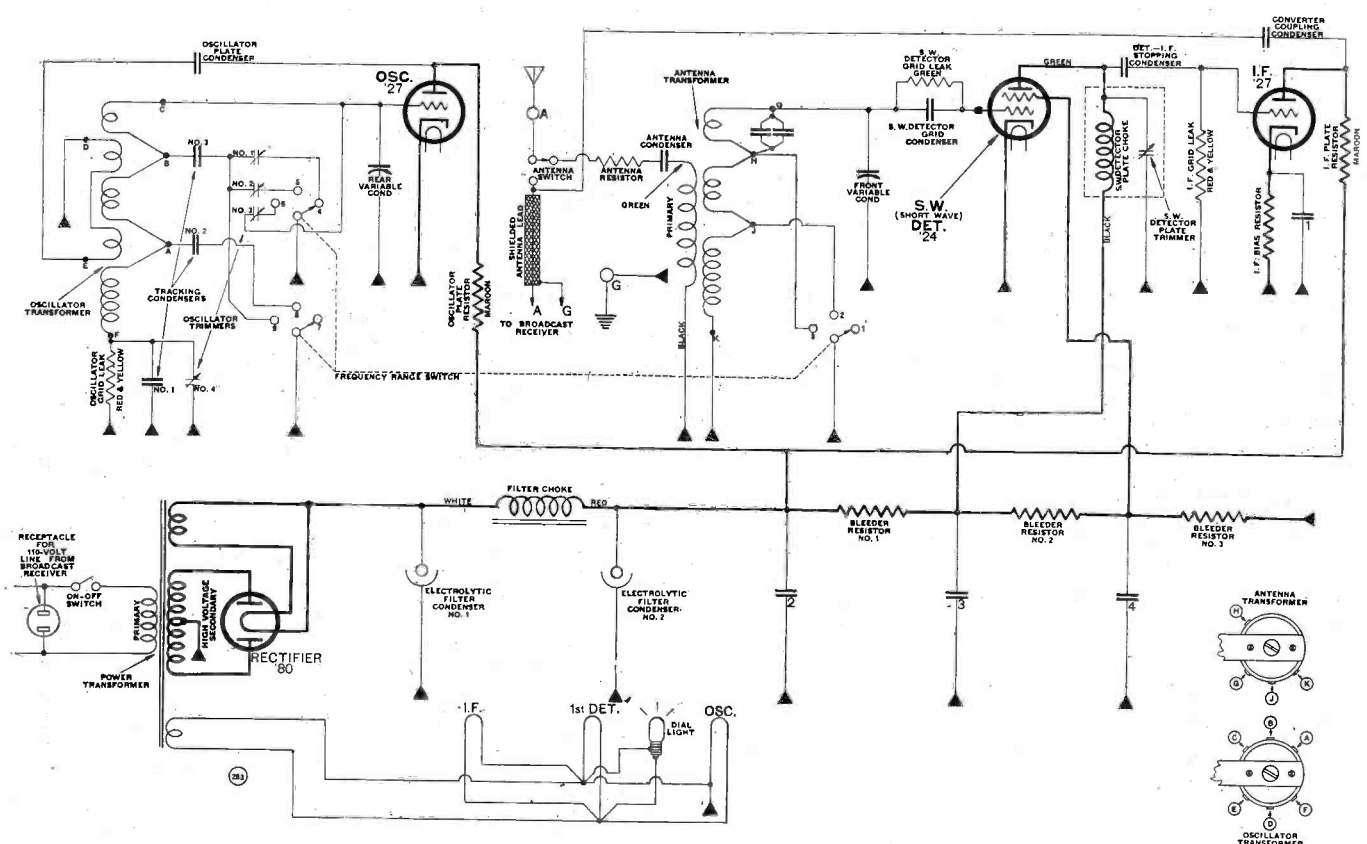
In some Model 93 converters there is a choke connected across the antenna condenser. This choke (Part 26510) is not shown in the diagram. Also, the two fixed condensers across contacts G and H of the antenna transformer are listed as "compensating condensers" in the A-K parts list. This is incorrect. Again, in some of the early-type sets, a paper-and-foil condenser is used instead of electrolytic condenser No. 1 shown in the diagram.

The voltage readings should be taken with the frequency range switch turned to the low frequency scale. Readings are based on a line voltage of 110.

All filament voltages, with the exception of the 280, should be 2.4. The first detector tube should give voltage readings as follows: Plate, 90; screen, 20; grid, 1.0. The i-f. tube should read: Plate, 115; grid, 3. The oscillator tube should give a plate reading of 110 volts. The measured oscillator grid voltage will vary, dependent upon several factors. In some cases, no reading will be secured for grid bias. In other cases the reading will be only slight, or it may be as high as 10 volts.

S-W. Aerials

If you have some real short-wave hounds among your clients, why not suggest the installation of a special aerial for short-wave reception? Fading can be reduced to some degree by the use of a vertical wire—the higher the better. At any rate, the average broadcast receiver aerial is not exactly up to specifications for short-wave work and represents a sizable load on the input of any short-wave receiver. Aerials of this type are often the cause of numerous dead-spots in the various wavebands. This capacity load is usually reduced artificially at the input by the use of a series antenna condenser. Such an arrangement is okay, but a shorter aerial in the first place will likewise reduce somewhat the background noise level. And that's something!



The schematic diagram of the Atwater Kent Model 93 Short-Wave Converter, with its attendant power unit. An intermediate frequency of 1,000 kc. is employed. Note that tapped coils are used in connection with a series of condensers to effect a change of waveband. The lettering on the terminals of the antenna and oscillator transformers, as shown in the right hand corner, correspond to the lettering in the circuit diagram above. (Courtesy, Atwater Kent Mfg. Co.)

Home Talkies . . .

Servicing Notes on RCA, PG-38

(Continued from the April issue)

Alignment of Picture Optical System

Several adjusting screws are attached to the projection lamp reflector so that an adjustment can be easily made. Turn on the power to the projection lamp. Then remove the projection lens by unscrewing from the holder. It is now possible to determine the focus of the projection lamp images. This is done by placing a small card directly in front of the lens so that an image of the filaments of the projection lamp is projected on the card. (See Fig. 1.) The filament image should be such that the reflected image is between the actual filament images. Furthermore the light must be evenly distributed throughout the entire opening. If these conditions do not exist then the various reflector adjusting screws and the projection lamp socket must be adjusted until both the even distribution of light and correct placement of the reflected filament images is obtained.

Alignment of Sound Optical System

Several pieces of equipment are required. One of these is an output meter, of either the commercial type utilizing a rectifier type of meter, or a thermo-galvanometer, or low range a-c. meter. The output meter is connected across the output transformer primary or secondary and if desired can replace the speaker voice coil. If both an aural and visual indication are desired, the output meter can be connected across the speaker voice coil without distributing the connections of that winding to the output transformer secondary.

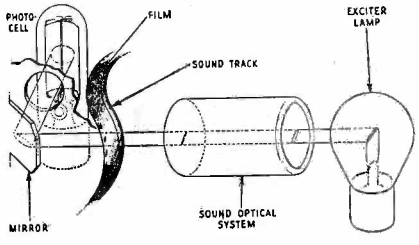


Fig. 2. View of the sound system. Note the slits through which the light must pass

Another essential part is a length of 4,000-cycle test film. Also a set of two metal studs (See Fig. 3. RCA part number 22,978) are needed to properly adjust the exciter lamp socket. The length of test film is known as RCA part number 22,983. An offset screw driver (RCA part number 22,107) is also required because the placement of the exciter lamp socket and optical system mounting screws are such that they are inaccessible with an ordinary screw driver. A capstan head screw is used in later models and a suitable wrench included with the equipment for making adjustments.

With the output meter connected, remove the exciter lamp socket and insert the lamp so that the snugness of the fit may be checked. If a snug fit is not possible, a new socket must be used—for if the lamp is not in proper alignment there will not be sufficient light intensity to satisfactorily operate the photoelectric cell. Fig. 2 will serve to make this point clear.

After replacing the socket insert the steel studs heretofore mentioned in the optical system holder and exciter lamp socket, as shown in Fig. 3. In order to accomplish this the optical system must be temporarily removed. Now, with the studs in place, adjust the socket by moving up and down and turning until the surfaces A and B (Fig. 3) are evenly touching. The final check should be made with the sound optical system and the socket clamps tight.

Continue by cleaning the optical system lenses and replacing the optical system. Insert the exciter lamp into its socket and check its filament to make sure that it is parallel to the optical system face. Then remove the sound take-off drum and clean the reflector mirror—and see to it that all the light from the optical system falls on the mirror and that none of it is thrown on the casting instead of going through the hole. If these points are satisfactory, replace the drum.

With these points cleared up, connect the output meter and turn on the amplifier switch. Thread the constant-frequency test film with the emulsion side of the film on the outside of the loop into the machine and start the projector. Now, focus the optical system until sound is heard or a reading obtained on the output meter. The volume control should now be adjusted so that the reading on the output meter is approximately in the center of the scale.

As a final adjustment, focus the optical system by moving it forward or back until a maximum deflection is obtained in the output meter. Then carefully tighten the clamp so that the focus does not change. When tightening this screw be sure that you do not scratch or burr the pressure roller (See Fig. 4) as a "wow" or "flutter" will result.

Wows and Flutter

A "wow" is caused by a slow variation in speed of the film passing the sound optical system. It is very much like the sound from a phonograph with the motor running at an uneven speed.

A "flutter" is a fast wow, that is, the variation is rapid. Flutters are caused by any of the following:

1. A "wow" on the film. (Some 16 mm. films have wows recorded on the sound track. Obviously, nothing can be done in such a case.)
2. Lack of oil on felt pads of sound take-off drum. This drum may be easily disassembled and the pads well lubricated.
3. Damaged or worn take-up sprocket.
4. Oil or dirt on the idler roller, impedance roller, sound take-off drum, or pressure roller will cause a wow or flutter.
5. Any binding of the rollers mentioned in (4) must be remedied either by cleaning, lubricating or replacing the unit.
6. Improper threading. Unless the proper loop is present in the film after leaving the picture gate a flutter will result.
7. Worn sprocket holes in the film may cause a wow.

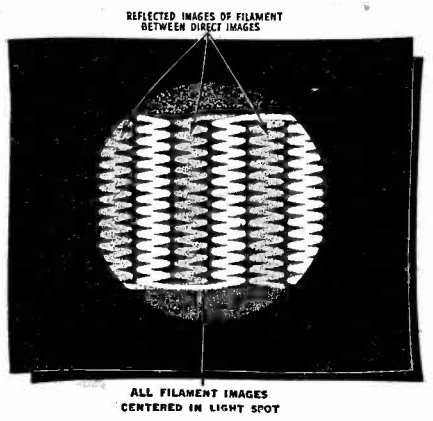
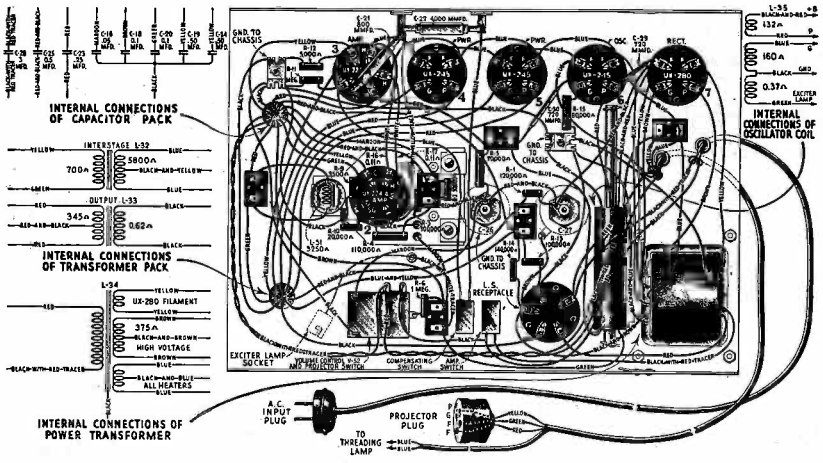


Fig. 1. This shows the correct projector lamp filament images

Adjustment for Location of Sound Track

An adjusting screw and lock nut are provided for adjusting the pressure roller (See



Wiring diagram of the amplifier unit of the RCA, PG-38 Home-Talkie Outfit

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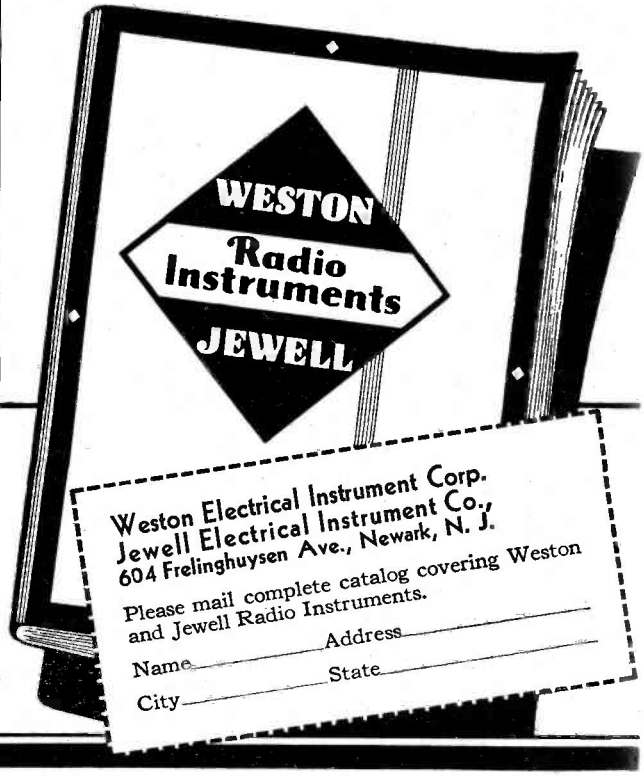

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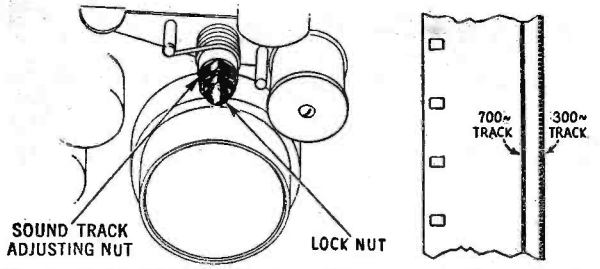


Fig. 4. (left) This sketch shows the pressure roller adjusting screws referred to in the text. Care should be taken in tightening the lock nut. Fig. 5. (right) A section of Buzz Track Film, which carries sound tracks of 300 and 700 cycles

To the extreme right is shown the assembly wiring diagram of the sound optical system unit. The wiring under the chassis is shown on the opposite page

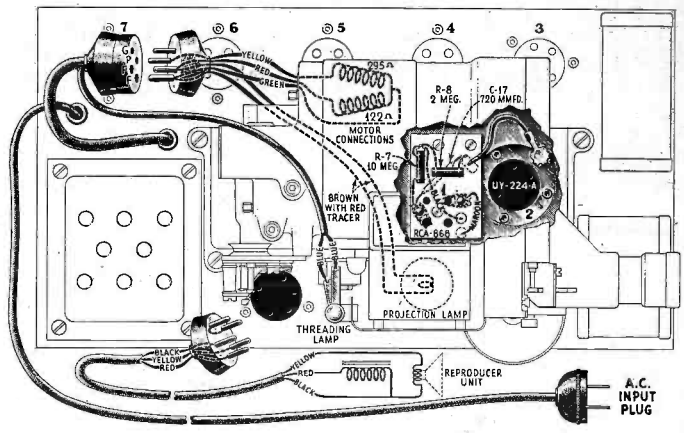


Fig. 4) so that the film sound track is centered on the light slit. For this adjustment the following equipment is necessary: Open end wrench (Stock No. 22,979), Spintite socket wrench, "Buzz" track film loop (Stock No. 22,980).

After the equipment has been procured, proceed with the adjusting as follows: Place the instrument in operation with the "Buzz" track film threaded into the machine. (See Fig. 5.) If the pressure roller, as per Fig. 4, is adjusted correctly no sound will be heard. However, if it is off center either a high- or low-pitch note will be heard, the former being 700 cycles and the latter 300 cycles.

If the 700 cycle note is heard, then the pressure roller must be moved out; if the 300 cycle note is heard, the pressure roller must be moved in. The best way to go about this adjustment is to move the roller back and forth so that both notes can be heard alternately, and then lock the assembly half-way

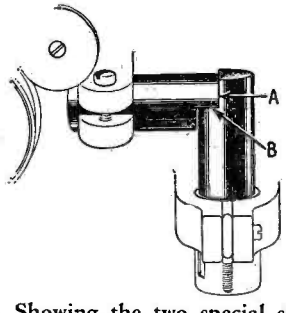


Fig. 3. Showing the two special studs in place for the exciter lamp socket adjustment

between—where no sound is heard—making sure that the correct position is held when locking.

ADJUSTMENT OF FILM GATE

The film gate adjusting screws are shown in Fig. 6. The opening for the film should be .007 inch. A poor adjustment of the gate is evidenced by excessive film jump, blurring or excessive wear on the sprockets. If the opening is too tight the film will be scratched and the result will be increased background noise.

In order to adjust the film gate opening, split a small piece of film about 4 inches long, so that it may be placed under the

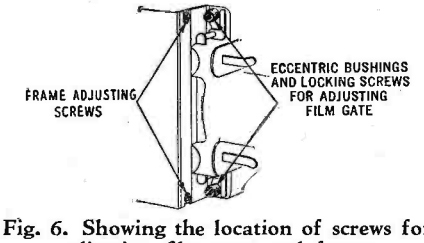


Fig. 6. Showing the location of screws for adjusting film gate and frame

gate shoe. The film gate locking screws should then be loosened (Fig. 6) and the eccentric roller turned until the strip of film slips easily back and forth under the shoe. Since a piece of 16 mm. film is .006 inch thick, an opening of .007 inch is such that it prevents both excessive play or binding.

When the locking screw is tightened be careful not to disturb the position of the eccentric roller.

CORRECT FRAMING

The film gate may be adjusted if proper framing of the picture is not obtained. In this case, loosen the two frame-adjusting screws, as shown in Fig. 6, and shift the gate up and then down until both frame lines of the picture show up on the screen. The proper adjustment is then about half way between these two extremes.

Projection Lamps

The projection lamp used in the Stewart-Warner home movie projector is rated at 500 watts and is manufactured by the General Electric Co. This rating means that the lamp draws approximately 5 amperes when operated at about 110 volts. The normal life of this lamp is about 25 hours. This rating is the equivalent of about 75 reels carrying 400 feet of film each, or about 300 reels of 100 feet each. The usual run of 16 mm. film is projected at a rate of about 20 feet per minute.

Projection lamps are of a special type and lamps of other type, but having equal wattage rating, are not interchangeable. Because of the high light efficiency of projection lamps, they are very susceptible to line voltage variations. It is said that a 110-volt lamp will not operate satisfactorily for more than one hour if the voltage applied is 115 volts. On the other hand a lamp rated at 115 volts will not afford more than half the rated light if operated at 110 volts.

It is interesting to note that normal service in the case of lamps is related to the operating voltage. While it is true that normal service is 25 hours, when operated at 110 volts, it may be only one hour at 115 volts, but during this hour, the lamp is emitting more light than may be obtained at 110 volts. However, it is burning itself out at a much higher rate.

RCA 35 MM Talkies

The RCA Victor Photophone Reproducing Equipment Type PG-29 is a 35 mm. "non-theatrical" unit, and is portable. PG-29s are being used a great deal for special lecturing purposes and you may run into one of them any day.

The equipment consists of three separate units, namely, the projector, the audio amplifier and the dynamic speaker. Carrying cases are provided for each unit, making them adapted for transportation.

The amplifier unit employs a 224 which is impedance-coupled to a 227. This tube in turn is transformer-coupled to a pair of 245s in push-pull. The rectifier is a 280.

Cables and plugs are provided so that when desired two projector units may be used alternately, by the throw of a fader switch, so that the showing of the film is uninterrupted.

The power consumption of the entire equipment is 1500 watts. The undistorted output of the amplifier is 3 watts. The exciter lamp in the projector unit is a 10-volt Mazda and is energized directly from a 60-cycle, step-down transformer.

Detailed service notes on the PG-29 will appear in an early issue.

OPERATING VOLTAGES

Tube	Control Grid to Cathode or Filament	Screen Grid to Cathode or Filament	Plate to Cathode or Filament	Plate Current	Fil. Volts
1 AF	0.1	28.	150	0.5	2.3
2 AF	1.5	—	110	2.0	2.5
Output	35.0	—	240	30.0	2.5
Output	35.0	—	240	30.0	2.5
Oscillator	75	—	240	25.	2.5

And Now the Crosley "Super Buddy Boy"

1931

In which the "Midget" set develops a giant's reach and voice

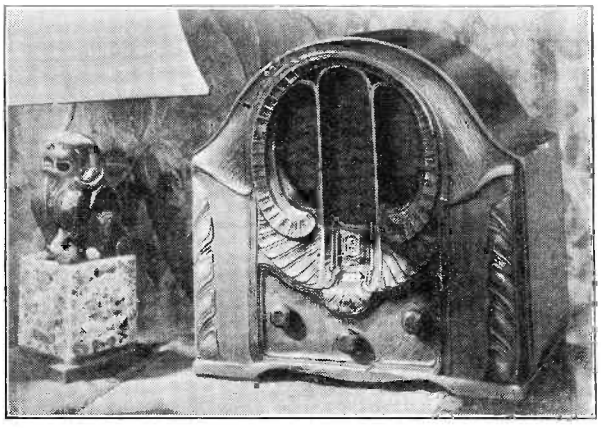


Fig. A
"Super Buddy Boy" is little, but oh my—!

WE tried out this superheterodyne in New York City, and were struck by the remarkable amount of power that such a small set can develop. It is literally impossible to turn the power on full; as the volume is entirely too great for locals.

Even on the distant stations, such as Boston, Pittsburgh and Chicago, the volume was often uncomfortable when the set was turned on full power.

It was found possible, in the heart of New York City, to tune in stations within a radius of a thousand miles without interference from the locals; which we think remarkable.

This receiver worked exceedingly well without an aerial; it was necessary only to connect the ground lead to the aerial binding post, and this worked exceedingly well even on distant stations.

SCORE another bulls-eye for the Crosley Radio Corp., whose engineers have the happy faculty of turning out good sets incorporating the latest technical advances, for a little lower sum than the next fellow. This hallmark is observed in the new Crosley mantelpiece receiver, the "Super Buddy Boy" illustrated in Figs. A, B and C.

Before considering the many electrical and mechanical refinements embodied in the design, the outstanding features are to be noted. The tubes required for this set are two type '35 tubes, three '24s, one '47, and an '80. These few words tell the whole story to the technician; that of ultra-modernism in radio set design. Referring now to the schematic circuit, Fig. 1, we find that V1, one of the new type '35 tubes (first known as the variable-mu, and now variously termed "exponential," "logarithmic," "multi-mu," and "super-control"), functions as a radio- or signal-frequency amplifier. The characteristics of this tube greatly minimize "cross-talk," the two-stations-at-one-time bugaboo of the type '24 screen-grid tube; the latter, however, in this circuit

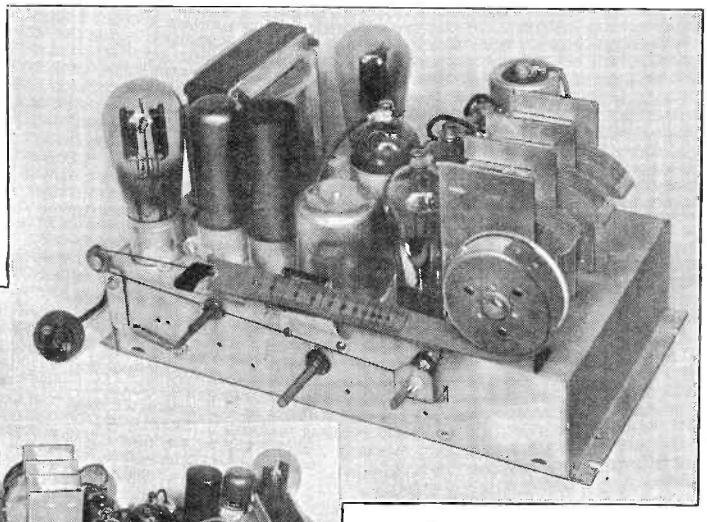


Fig. B
The upper view shows the compact chassis, with the tuning gang at the right; its ingenious flexible tuning scale in the center, and, at the left, the power unit.

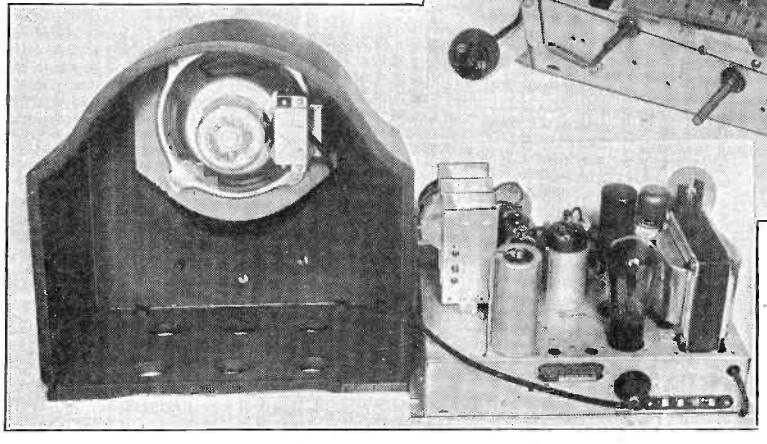


Fig. C (left)
A rear view of the chassis beside its one-piece "repwood" cabinet, the back of which may be used as an antenna for local reception; thus making the whole system self-contained, without aerial or even ground.

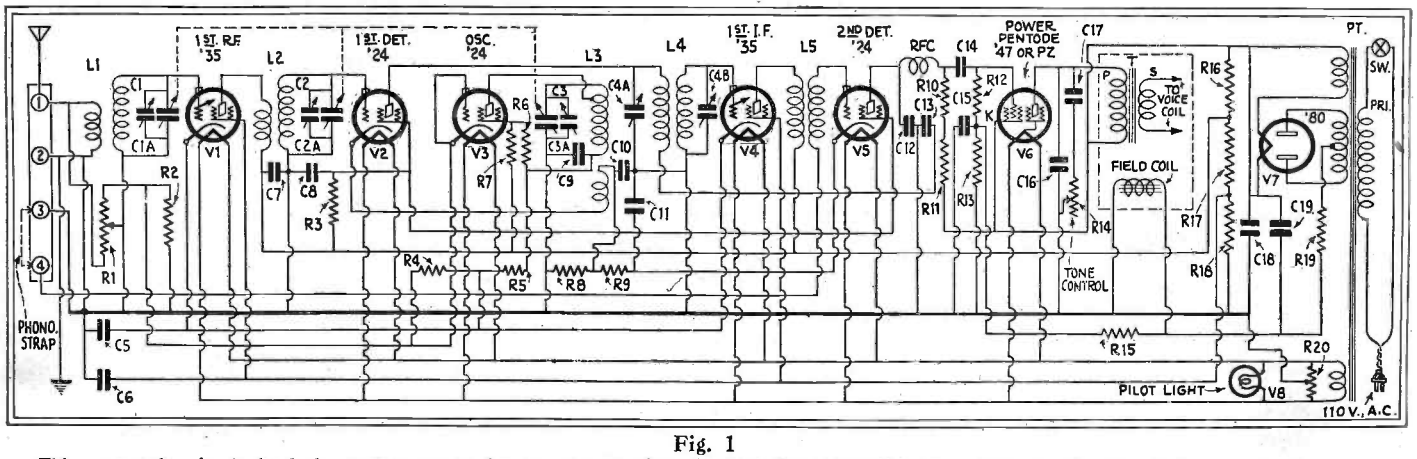


Fig. 1
This seven-tube circuit (and the pentode counts for two stages) gives the immediate impression of a large console set. It incorporates the latest tubes—variable-mu amplifiers, and a pentode output giving a margin of volume on all signals.

THE FORUM . . .

"Service is the Keynote for Repeat Business"

Editor, SERVICE:

Our Assistant Advertising Manager, Mr. M. W. Thompson, has just referred a copy of your latest magazine SERVICE to me for my attention.

It is quite interesting to know that at last we have a magazine devoted entirely to service whereby information regarding circuits and developments can be conveyed to the every-day Service Man in a manner that he will be able to digest very thoroughly, giving him a knowledge of what to expect in line with the regular duty on service.

We must admit the service problems of today are becoming more complicated, due to the fact that the trend in the radio business is governed by the sales qualifications of the radio receivers. By this I mean that in order to place your set at the head of the list in sales, you must have an outstanding feature and when one speaks about an outstanding feature it means something different in the circuit whether it is twin speakers, new tubes or a specially designed circuit. With this in mind you can readily see where a magazine of this type can become a guiding hand to the radio Service Men throughout the country.

It has been the motto in our Service Division that "SERVICE IS THE KEYNOTE FOR REPEAT BUSINESS," which I believe is true in every respect because without the proper service your receivers are at a loss to function properly, thereby not giving satisfaction to their owner, which naturally causes the consumer to look elsewhere for a receiver which can be relied upon from that particular angle.

I would appreciate very much receiving a copy of this magazine and if this Company can be of any help to you in regards to information, please do not hesitate to call on us as we can see where a magazine of this type will benefit all concerned.

M. T. NORDENGREN,
General Service Manager, Radio Division,
GRIGSBY-GRUNOW COMPANY.

•

Thank You

Editor, SERVICE:

I have just seen a copy of your new magazine SERVICE and wish to congratulate you upon the way you are giving the Service Man assistance in his many problems.

I feel that a magazine such as you are publishing is one much needed today and I am sure you will be very successful with it.

RAY F. SPARROW,
Vice-President,
YAXLEY MANUFACTURING CO.

•

Engineering Data Needed

Editor, SERVICE:

We have received with much pleasure every copy of SERVICE to date, but have delayed writing until it had developed into a definite form. We receive regularly many other radio publications but SERVICE is the only one that is read from cover to cover with relish.

Most of all, we appreciate clear, concise articles explaining the theory of operation, construction, etc., of new circuits, tubes and equipment. This is the type of information most difficult for the Service Technician to obtain. We are often called upon to service new machines embodying the latest developments upon which we have had no engineering data whatever. This certainly calls for plenty of common sense and ingenuity.

You have done splendidly along this line already and we do not mean to criticize, but merely to show what type of material we derive the greatest benefit from. We only regret that we must wait a month for our next copy.

Here is hoping SERVICE never fails us.

A. L. LEE,
RADIO SERVICE SHOP,
Rensselaer, Ind.

(*We thank you for your frank expressions. —The Editors.*)

•

Courage and Determination

Editor, SERVICE:

This may sound like a big joke to you, but I am graduating this June from the Philadelphia School for the Blind and have been offered a job as a Service Man in a Radio Store, in Reading.

Do you think I can arrange the various testing instruments so that I can use them? I would like to know of any books on testing that might be of help to me.

I would like to get in touch with a lot of other radio fellows to whom I might write. I am interested in short waves and hope to become an amateur as well as a good Service Man.

CHARLES W. GENTHNER,
437 *Fern Ave., Reading, Penna.*

(*Mr. Genthner rates a good send-off. We have a hunch he will make a fine Service Man despite his grave handicap. Some of you fellows could help him a great deal, if you will. How about it?—The Editors.*)

•

Why "Short Waves"?

Editor, SERVICE:

In most respects I think SERVICE is a fine magazine, because it really helps me. But I don't see why you have a section on Short Waves. Most of our work is on broadcast receivers and I think other Service Men will agree with me that more good, practical dope like that in your General Data section would be appreciated more than the Short Wave stuff.

I think you would be doing another good "service" by cutting out the Short Wave pages and giving us more of the other stuff.

CARL ALVIN,
Little Falls, N. Y.

(*We appreciate your attitude, but feel that the data published in the Short Wave Department is of help and interest to others if not to you. It is possible that the short-wave adapter and converter fad has not hit your location with much force as yet. At any rate, there are an ever-increasing number of adapters and converters being put into service—as well as many new combination long- and short-wave receivers—and it is our belief that servicing material on this equipment is needed. Furthermore, we believe that the need for short-wave servicing material will grow very rapidly as the short-wave fad continues to spread. Thus, the department in question will become more valuable as time passes. We are equally sure that in time you will also welcome the material provided, even though it appears to be of no value to you at present.—The Editors.*)

•

Wants SERVICE a Weekly

Editor, SERVICE:

We are not going to find fault with "our" (if you'll pardon us) magazine by referring to it as of the female type, or such, for it has come to being the nearest answer to a Service Man's Prayer as possible.

There is only one suggestion we can think of, and that is to issue SERVICE as a weekly instead of a monthly . . . then the Service Man's Prayer would be complete.

I think this would find the favor of most real Service Men, and there isn't a doubt that you could find enough radio service data to keep you busy. I have never met a Service Man who wasn't looking for data of some kind . . . it has to be in the blood, and the more data we have in our systems the more our good customers will appreciate our asking for an extra five spot.

I hope all Service Men take a good long look at your editorial on cut-rate servicing. Any Service Man who charges less than a dollar and a half per call is flirting with the poorhouse, unless he is out for his health instead of his living.

Our good public doesn't seem to realize that service apparatus costs its weight in diamonds, and that the data required in the average service shop would fill the average public library!

Well, we have been pretty outspoken in our ideas, but if you ever think of changing SERVICE to a weekly just drop us a bill for the difference and see how quick we get it back to you! The money, we mean.

HERB CORBETT,
A. R. CORBETT & SON,
Amboy, Minn.

(*We are pleased that you refer to* SERVICE *as "our" magazine. It is a part of our aim to make it sort of a "community" proposition. And we are pleased that you have been outspoken. We wish all our readers would be good enough to give us their unbiased opinions. As to making* SERVICE *a weekly, we doubt if that is possible. However, we are going to improve the monthly and we hope that this will make up for the long intervals.—The Editors.*)

CLAROSTAT

CLAROSTAT Replacement Volume Controls are "Custom-made" to exactly suit the receivers for which they are offered. Not a makeshift job lot idea.

The resistance, taper, shape and shaft are made according to the proper specifications.

There is no delay in installing them. There are no comebacks when you use CLAROSTAT products.

See the new CLAROSTAT CONTROL HANDBOOK AND CATALOG for 32 pages of dope for servicemen. Send for your FREE copy.

MEMBER RMA

CLAROSTAT MFG. CO.
285-287 N. 6TH ST. BKLYN. N.Y.

Essential to MODERN RADIO!

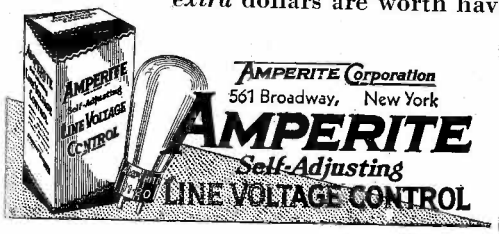
and a MONEY-MAKER *for the* SERVICE MAN

AMPERITE is the only self-regulating line voltage control that successfully compensates for line voltage variations, up and down. Greatly improves reception and adds life to tubes and filter equipment.

AMPERITE can be installed in any radio in five minutes. It is so easy to sell that service men are averaging from $60 to $110 *extra profit* each month.

S. Commadore, service man at 200 E. 104th St., New York, averages 60 AMPERITE sales a month. H. McFarland, 306 Stuyvesant Ave., Brooklyn, sells 48.

Get in on this live-wire money-maker. Those *extra* dollars are worth having.

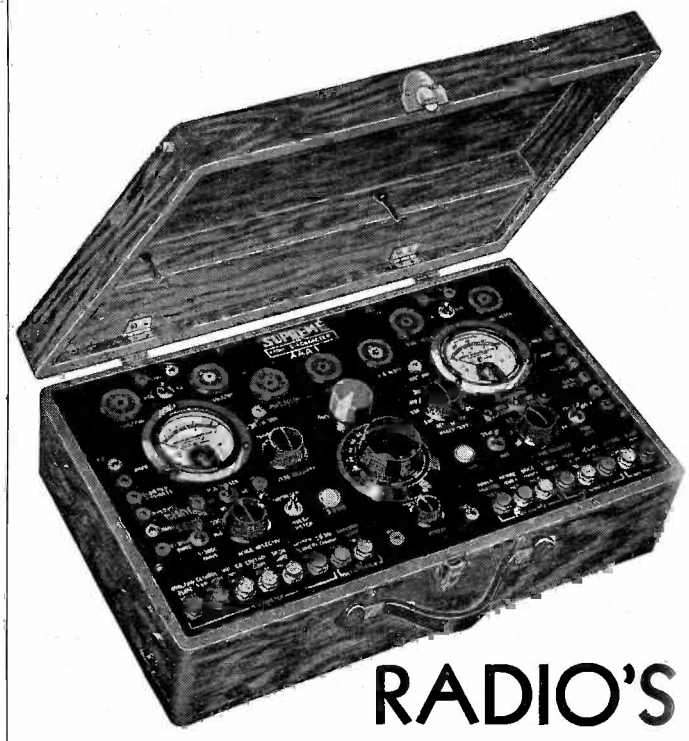


AMPERITE Corporation
561 Broadway, New York

AMPERITE
Self-Adjusting
LINE VOLTAGE CONTROL

Send $1.62 to Dept. S-5 for dealers' sample and sales helps.

LET'S GO!



RADIO'S BUSIEST SUMMER

JUNE . . . the exciting nominating conventions of both political parties, and then . . . "the battle of the century" . . . marking the peak for all time in number of radio listeners per hour. No radio owner wants to miss any part of this gripping drama . . . the oratorical onslaughts . . . and the tense final hours. Time is ripe now . . . to canvass, phone or write, lists of radio owners for a check-up and replacement service. And with this instrument so marvelously complete, accurate and speedy, you can make more service calls at less manpower cost and greater production profit. Designed to anticipate every possible "new" type or development in radio receivers. Say "Let's Go to Radio's Busiest Summer" by equipping with radio's most amazing service instrument—

SUPREME DIAGNOMETER AAA-1—$147.50

5 ultra modern testing instruments in one for the price of **1**

With only a coupon between you and increased profits, you can't afford to buy any testing instrument until you have sent the coupon below for full information on AAA-1 and the SUPREME Instruments as follows:

Model 90 Supreme Set Analyzer.	$78.50
Model 60 Supreme Oscillator.	$30.00
Model 70 Supreme Oscillator.	$49.75
Model 40 Supreme Tube Tester.	$30.00

All prices Dealers' Net Price, F. O. B. Greenwood, Miss. Good Jobbers everywhere ready to demonstrate.

SUPREME INSTRUMENTS CORPORATION
437 Supreme Bldg., Greenwood, Miss.
Please send me full particulars on

.....
(Here specify those interested in)

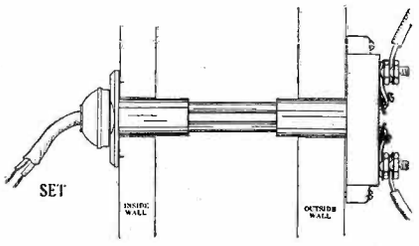
Name.....
Address.....
City..... State.....
Jobber's Name.....
City..... State.....

THE MANUFACTURERS . . .

The Woodruff "Super-Thru"

Woodruff & Company, of Meridian, Miss., have introduced a new Aerial-Ground entrance fitting called the "Super-Thru." The accompanying illustration indicates the manner in which it is installed.

The Super-Thru has a number of good features, such as . . . the approval of the Underwriters' Laboratories; made of bakelite; fits through a single 13/16" opening and requires no wall box; fits any thickness of wall; has a polarized connector plug so that there can be no mistake in the aerial and ground connections.



That section of the Super-Thru which is mounted on the outside wall is both the connecting link for the aerial and ground, and a resistance-type lightning arrester.

The connecting wires used in the Super-Thru are very heavy and strong. This is necessary, as the tension of these wires holds the inside and outside units firmly in place. Special tension screws are provided so that the wires may be drawn taut after the connections have been made.

A sample of the Super-Thru has been received. It is very well made.

•

The Hickok StatiKtester

The Hickok Electrical Instrument Co., of Cleveland, Ohio, has introduced a new and very complete servicing kit, called the StatiKtester. The reason for this particular name is that it is possible to make practically every form of test with the receiver "dead." Obviously, this manner of testing has numerous advantages as it is not necessary to rely on variable voltages.

Present-day receivers contain resistors having values from a fraction of an ohm to several megohms. The measurements of high resistances require a high voltage to operate the ohmmeter. This is obtained in the StatiKtester by using the d-c. supply of the tube tester which is built in as a part of the unit.

The StatiKtester also has a double range capacity meter which obtains its voltage from the a-c. source of the tube tester. The capacity-measuring system also permits the measurement of the capacity of electrolytic condensers, and their leakage.

Inductances, such as transformer primaries, secondaries and choke coils can be measured in all values from 0.5 to 50 henries.

With the StatiKtester, the voltages delivered to the tube socket terminals are read directly at the sockets, which eliminates the usual voltage drop in cables.

In servicing a receiver with the StatiKtester, all the measurements enumerated above, except voltage readings, are made with the receiver dead, and in practically all instances are made from the tube socket of the receiver. Thus, it becomes an easy matter to locate an incorrect resistance, capacity or inductance value without removing the chassis from the cabinet, or disassembling any part of the chassis.

The point-to-point resistance measurement idea incorporated in the StatiKtester is worthy of particular note for the reason that voltage measurements will not always indicate the trouble in a receiver. The system of measuring the resistance of coils, resistors, etc., is practically foolproof.

Since the StatiKtester contains its own source of power and applies standard values of voltage to the tubes, a check is made which is instantly comparable to the standard I.R.E. values of radio tubes.

All values of d-c. voltage from zero to 1,000 volts are readable on a quadruple-range voltmeter having a resistance of 1,666 ohms per volt. The a-c. voltages are readable on a quadruple-range voltmeter from zero to 800 volts. Both a-c. and d-c. millampere readings are obtained on double-range milliammeters from zero to 200 milliamperes. The triple-range ohmmeter gives readings from 0.25 ohm to 20 megohms, and the double-range capacity meter readings from .05 mfd. to 15 mfd.

One of the unique features of the StatiKtester is that it is a self-contained testing unit, without adapters or auxiliary apparatus. This is made possible of course because the tester is also its own source of "measuring power."

•

Lynch Color Code Chart

The Lynch Manufacturing Company is distributing free to Service Men a handy little card, which will fit the pocket, listing the complete R.M.A. Standard Resistor Color Code, so that the value of a resistor so marked can be determined at a glance. The card also carries a descriptive illustration of a resistor which clearly shows how the color coding is placed.

If you want one of these charts just drop a post card with your name and address on it, to Readers Service Department, SERVICE, 1440 Broadway, New York City.

•

Philco Resistor Kit

For the convenience of the service man, Philco is now making available a Philco resistor kit, containing twenty-five standard Philco resistors most commonly used in Philco sets. The resistors are mounted on a card which is attractively colored in yellow and blue, and is so arranged that it can be hung on the wall above the service bench. The resistor chart as shown in Philco Service Bulletin 65A is reproduced at the bottom of the card, giving complete information on all available Philco resistors.

The card contains fifteen .5 watt resistors of various resistance values and ten 1 watt resistors. Duplications are made in the case of resistors which are most commonly used. The card, Philco part 6560, sells at a list price of $7.50, subject to regular parts discounts.

•

Clarion's Resale Idea

The Transformer Corporation of America has announced that they are offering for resale the Clarion 10-tube chassis with dynamic speaker and special metal panel for installation in expensive cabinets housing obsolete radio sets.

There are numerous set owners who refuse to purchase a complete new receiver for the reason that the cabinet containing their old set is handsome and costly. The idea is to sell these people on a modern radio chassis that can be easily and effectively installed in place of the old chassis. It is being done, much to the benefit of the set owner and the man who does the job.

•

The NA-ALD "Fade Out"

The Alden Manufacturing Company is marketing a handy little "hush up" gadget, appropriately called the Fade Out, which can be attached to any radio set for the purpose of muzzling announcers who are either too long-winded or suffer from over-zealousness. Of course, the same gadget will also mute programs when desired.

The Fade Out, as shown in the accompanying illustration, consists of a Makalot molded push button with a large size top, with a travel of one-half inch. As the button starts on its downward travel it throws resistance into the circuit, which is gradually reduced to a complete short. The push button is attached to a flexible rayon tinsel cord. The end of the cord has two brass hooks which are slipped over the antenna

and ground binding posts in the radio set.

In sets without an antenna, the push button is operated through a special adapter which goes under one of the tubes in the set.

Of course, the leads on the Fade Out present a certain capacity in the antenna-ground circuit, but this capacity is not sufficient to upset the operation of the set.

The Fade Out can be supplied with a weighted tapestry strap so that it can be placed over the arm of a chair, or with a table clamp. In some cases the Fade Out is placed on the floor and operated by foot . . . fine for bridge players.

Index of Monthly Literature

AUTO-RADIO

Raytheon LA 6-volt Output Pentode
QST, pp 20, May, 1932

Service Men and Auto-Radios
Arthur Lynch, Journal, I.R.S.M., April, 1932

Suppression of Ignition Interference
F. W. Schor, Journal, I.R.S.M., April, 1932

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C. A. Johnson, Radio News, pp 1016, June, 1932

Harmonic Analyzer
B. Brunn, Radio World, pp 11, April 30, 1932

New Tubes for Class B Audio
George Grammer, QST, pp 14, May, 1932

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Radio Call Book, pp 35, June, 1932

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Automatic Volume Control, Installation and Servicing, Part 1
L. W. Hatry, Modern Radio, pp 15, May, 1932

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Joseph Calcaterra, Radio News, pp 1019, June, 1932

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Pilot "Dragon" All-Wave Super
M. B. Sleeper, Short-Wave Craft, pp 36, May, 1932

Servicing a Portable Super
J. E. Anderson, Radio World, pp 3, May 14, 1932

Silver-Marshall, S-M. 727 Super
McMurdo Silver, Radio News, pp 1023, June, 1932

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How to Install and Service Automatic Volume Control, Part 1
L. W. Hatry, Modern Radio, pp 15, May, 1932

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C. A. Johnson, Radio News, pp 1016, June, 1932

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Radio Call Book, pp 35, June, 1932

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Hy Levy, Radio-Craft, pp 727, June, 1932

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Attenuators, Filters, Matching Transformers, Part 2
Hy Levy, Radio-Craft, pp 727, June, 1932

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C. A. Johnson, Radio News, pp 1016, June, 1932

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S. Gordon Taylor, Radio News, pp 1000, June, 1932

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M. H. Brown, Radio News, pp 1007, June, 1932

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B. Brunn, Radio World, pp 11, April 30, 1932

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(*See "Amplifiers, A-F."*)
(*See "Tubes, A-F."*)

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S. Gordon Taylor, Radio News, pp 1000, June, 1932

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Edgar Messing, Short-Wave Craft, pp 39, May, 1932

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M. B. Sleeper, Short-Wave Craft, pp 36, May, 1932

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R. K. Wheeler, Radio News, pp 1040, June, 1932

Re-ranging Meters
J. C. Bank, Radio-Craft, pp 728, June, 1932

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B. Brunn, Radio World, pp 11, April 30, 1932

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Beryl B. Bryant, Radio-Craft, pp 740, June, 1932

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George Grammer, QST, pp 14, May, 1932

What Tube Shall I Use? Part 3
Joseph Calcaterra, Radio News, pp 1019, June, 1932

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Type '82 Full-Wave, Mercury Vapor
George Grammer, QST, pp 14, May, 1932

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M. H. Brown, Radio News, pp 1007, June, 1932

What Tube Shall I Use? Part 3
Joseph Calcaterra, Radio News, pp 1019, June, 1932

All articles listed on this page are cross-indexed for your convenience. Titles given are not necessarily the titles of the original articles, but in each case serve to determine the substance of the article. Listings marked with an asterisk (*) are abstracted in this issue. The material in each issue of SERVICE is alphabetically indexed on the Contents Page.

I R C Service . . .

Get Busy On Motor Radio!

This is the season to interest motorists in radio sets for their cars—and there is good money to be made on such installations—and servicing.

When repairing house sets, just ask the owners if they've ever ridden in a car equipped with radio. Tell them of the pleasure of it—how it takes the strain off of driving long distances—how it cuts down "back seat driving," even in traffic, and how it cuts down speeding. It actually does all this, according to enthusiastic users. With the baseball news or a song from some good quartet floating out from under the dash, the motorist finds himself idling along instead of constantly "stepping on it." Furthermore, there's no annoyance to people on the sidewalks or verandas as he passes. The sound does not reach them.

The International Resistance Company foresaw the possibilities of this new use for radio. I.R.C. Motor Radio Suppressors — shock-proof and unaffected by heat—are now specified by many set manufacturers. And to assist you in installation or replacement work, they are put up in handy kit form, with an instruction folder telling just how to go about it, with a complete wiring diagram of the electrical system of an automobile.

Practically everyone you know has a car, some of them of expensive makes. Go after this business this summer—it is virgin field.

Besides the Suppressor Kit, we are showing two other new handy kits on this page, devised for your convenience.

The summer season is also a good time to build test equipment for your use in the fall and winter. I.R.C. service helps are yours for the asking —and give clear instructions how to do this. For instance, there is the Ohmmeter Calibration Scale, which automatically changes a milliammeter to a direct-reading ohmmeter—in other words, gives you two meters in place of one. A postal card will bring it to you without cost. In writing, ask for "Form 2065."

Then there are the I.R.C. formulas for converting all sorts of meters. These money-saving charts have been a marvelous thing for Servicemen. They show how to build, with the use of I.R.C. Precision Wire Wound Resistors, valuable test equipment at astonishingly small cost. One man who used them saved over $200 last year in equipment he would have had to buy otherwise! When you write for these free Conversion Charts, ask for "Form 2069."

I.R.C. engineers stand ready to help you in any replacement problem that comes up in your daily work. Feel free to write them at any time.

Below is the Motor Radio Suppressor Kit referred to in the adjoining column. The electrical system of an automobile is Greek to the average person, and even a radio man has his troubles in starting from scratch unless he has a clear picture of the scheme of wiring. The folder that goes with this kit makes it simple as A B C. It gives complete information with diagrams on the installation and use of suppressor units and filter condensers for the suppression of radio noises.

The kit itself contains a suppressor resistor for each spark plug and a suppressor for connection in the main distributor lead. Different kits, of course, for 4-cylinder, 6-cylinder and 8-cylinder cars.

The same extraordinary ruggedness and accuracy which have made I.R.C. Metallized Resistors the recognized standard for radio purposes under all climatic conditions, stands them in good stead for travel conditions in motor cars.

I. R. C. Resistor Replacement Guide and I. R. C. Color Code Chart.

Don't forget that an order for a kit of 20 resistors entitles you to these two valuable articles without extra charge. Your check or money order for $4.65 ($6 in Canada) will quickly bring you the Kit, the Guide and the Chart—all three.

Handy kits for every resistor replacement problem! The up to date Service technician has come to rely on them. Instead of fussing around with individual resistors carried loose in his pocket, he carries one of these neat little packages, from which he can pick just the value or combination of values he wants.

The first Certified Kit put out by the International Resistance Company—a 20 unit, 1-Watt Kit—made such a hit that two more have now been added. One is the MR 4 two-Watt package shown immediately above. It contains 20 Metallized Resistors ranging from 500 ohms to ½ megohm. Literally thousands of values can be obtained from these 20 units. A complete instruction folder goes with the kit showing how you can secure them. This kit is listed at $8, but it is sold to you for $4.65 ($6 in Canada).

You know what you run into sometimes on the proper biasing of radio tubes—and the time such problems consume. Well, with the new handy Grid Bias Kit here illustrated complete data is supplied on biasing tubes, together with wiring diagrams which simplifies the whole procedure. This kit contains 10 assorted resistors of MF4-MR 4 and Power Wire Wound (5-Watt) types, required to bias the following types: '24, '26, '27, '71A, '10, '45, '50 and '47. The list is $3.70 and the price to you is $2.15 ($2.90 in Canada).

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Resistors for Replacements

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There's Something On the Radio Horizon

IT IS NOT A MIRAGE!

The farsighted man needs no telescope to see it. The foresighted man is getting ready for it now. It is television by means of the newly-perfected cathode ray receiver, producing brilliant black and white motion pictures by radio so that they can be seen in a lighted room on a screen a foot or more in width; pictures providing sufficient detail to satisfy the most critical lover of entertainment in the home. Here is something new and compellingly attractive for the radio man to sell or service.

ALTHOUGH the exact date of its announcement cannot yet be told, it will be soon, probably by fall. Then there will be a scramble to find out about it. But if you want, you can now at your leisure find out how and why it works. Whether you plan to sell or service it, the first essential is to know its underlying principles of operation. "Know your product."

THIS necessary knowledge of cathode ray television receivers can be acquired by any man who already understands the simple principles of a radio receiver which is used to reproduce broadcast speech and music. And in acquiring knowledge of television, he gains a clearer conception of the underlying principles of radio.

PERHAPS the easiest and quickest way for getting this knowledge is to study the clearly written text which is the basis of the lectures on television which are being given for the University of California Extension Division by Arthur H. Halloran. These lessons require no previous knowledge of mathematics. They have been prepared primarily for radio service men. They are concerned with the receiver rather than with the transmitter problems which require mathematical interpretation.

THE lessons are ten in number, as listed on the facing page. One is mailed each week during a ten weeks' period. Each is accompanied by questions which emphasize the salient facts in the text. The student can mail his answers to these questions, if he desires, so that they can be corrected and graded, a certificate as to his passing being sent to him at the end of the course. The price for this service is one dollar per lesson.

ANY radio dealer, service man, jobber, or salesman can profit from the information in this course. By studying it slowly now, instead of hurriedly when television does "break," he can be ready for immediate, intelligent action. The first men to qualify should be the first to profit.

This is a NEW non-mathematical course for men who understand only the elementary principles of radio.

Synopsis of the Course

Lesson 1: The Physical Problems of Television. The Optic Nerve. Peculiarity of the Eye. Disk Scanning. Cathode Ray Scanning. Amplification and Transmission.

Lesson 2: The Electron Theory of Matter. Nature of Substance. Liberation of Electrons. The Periodic Table. Periodic Classifications of the Elements. Thermionic Action. Photoelectric Action. Secondary Emission.

Lesson 3: Radiation. Conduction in Vacuum. Gaseous Conduction. Conduction in Solids. Electrostatic Effects. Electromagnetic Effects.

Lesson 4: Applied Electrical Theory. Electromagnetics. Capacitance. Electromagnetism. Inductance. Transformer Design.

Lesson 5: Physical Optics. Interference of Light. Law of Reflection. Dispersion of Light by Prism. Color Wavelengths. Diffraction. Refraction. Formation of Images. Mirrors and Lenses. Properties of Lenses. The Eye as an Optical Instrument.

Lesson 6: Photoelectric Cells and Neon Tubes. Photoconductive Effect. Photo-voltaic Effect.

Lesson 7: Mechanical Scanning. Light Sources and Modulators. The Kerr Cell. Scanning Methods. Disk Scanning. Baird, Jenkins, Sanabria, Gramophone Ltd., Ives and other Systems. Rotating Mirror Scanning. Vibrating Mirror Scanning. Nicholson System. Zworykin System.

Lesson 8: Synchronization of Mechanical Scanning. The A. T. & T. System. Baird System. Jenkins System.

Lesson 9: The Cathode Ray Tube. Fluorescent Screens. The Electron Gun. Focusing the Beam. Deflecting the Beam. Varying the Intensity of the Beam.

Lesson 10: Rosing's Cathode Ray Receiver. Electrical Scanning Methods at the Receiver. The Dauvillier Tube. Zworykin's Kinescope. Farnsworth's Oscillight . . . and, finally, the system of electrical scanning which will be used in commercial television receiving sets for the home.

Enrollment

Arthur H. Halloran, Television Consultant,
430 Pacific Building, San Francisco, Calif.

ENCLOSED is $ for your non-mathematical course of instruction on Cathode Ray Television Receivers in 10 lessons. Send the first lesson immediately.

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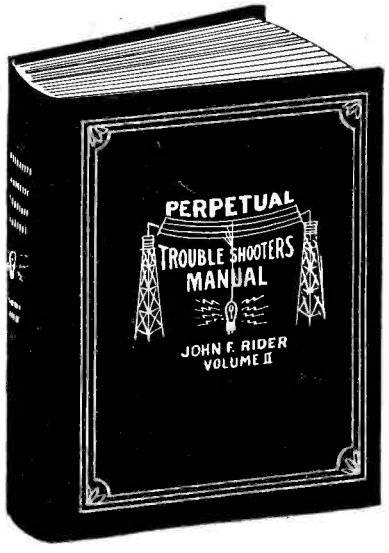
THE Student is asked to remit $5.00 with the enrollment coupon. This pays for the first 5 lessons. Then another $5.00 is payable; this being the final payment. Or, if you prefer, you can remit the entire amount of $10.00 with your enrollment. Because of the short time that may elapse before the cathode ray tube is commercialized it is advisable that you be prompt in sending the coupon.

ANNOUNCING . . .

Volume No. 2
of the Perpetual Trouble Shooter's Manual

. . . By JOHN F. RIDER



Volume No. 2 of the Perpetual Trouble Shooter's Manual picks up where Volume No. 1 left off. It contains all 1932 receivers announced and manufactured up to date.

More than 700 pages of the finest type of radio service material that it was humanly possible to secure. Guaranteed to contain no diagrams to be found in Volume No. 1.

In this Manual John F. Rider fulfills every demand made by the servicing industry for service data. For the first time in the history of radio service publications, every radio receiver shown in the manual contains full electrical values of resistances and condensers.

Radio Service Men have continually asked for electrical values. . . . You will find them in Volume 2 and we guarantee that every diagram shows these values. Radio Service Men have continually asked for electrical values of Atwater Kent receivers. You will find them in Volume No, 2 of the Perpetual Trouble Shooter's Manual.

Point-To-Point Resistance Data

Rider's Volume No. 2 of the Perpetual Trouble Shooter's Manual now offers to the radio service man circuit breakdown of commercial receivers. Not only do the diagrams in the manual show the resistance and capacity values, but special pages are included which show the point-to-point resistance, between any two points in the receiver. NO OTHER MANUAL CONTAINS THIS TYPE OF INFORMATION.

This point-to-point resistance data has no equal in information which enables rapid and accurate servicing. With this data at hand, you can use your ohmmeter or other resistance measuring unit and check the circuit by simply contacting different points upon the receiver or amplifier tube socket.

The point-to-point resistance data contained in the manual represents the finest and latest advancement in the art of radio receiver servicing. When you have this information you can check a receiver and locate the defective part without pulling the chassis from the cabinet. . . . Resistance measurement in this fashion removes all circuit limitations. . . . You need not worry about line voltages—voltage tolerances. . . . It makes possible measurement of resistance between any two points in the receiver and there are no "ifs"—"ands"—or "buts." . . . The circuit is either correct or incorrect.

This is a partial listing of this information as applied to one receiver in Volume No. 2 of the Perpetual Trouble Shooter's Manual. If you will examine this data and try to apply it to any receiver by working between the various points suggested, you will realize how easy it is to analyze a receiver without removing it from the cabinet. Of course, the values given in this table apply only to this receiver.

From '47 Space Grid to 2nd Detector Plate	29,454 ohms
" " " " " IF Plate	50 ohms
" " " " " 1st Detector Plate	50 ohms
" " " " " RF Plate	26 ohms
" " " " " IF Screen Grid	6,000 ohms
" " " " " 1st Detector Screen Grid	6,000 ohms
" " " " " RF Screen Grid	6,000 ohms
" " " " " Ground	13,000 ohms
" " Control Grid to Ground	59,250 ohms
" IF Screen Grid to Ground	7,000 ohms
" " Control Grid to AVC Tube Plate	50 ohms
" " Cathode to RF Cathode	0 ohms
" " " " RF Control Grid	200 ohms
" 1st Detector Control Grid to Ground	26 ohms
" '80 Filament to RF Plate	26 ohms

Wiring Diagrams—Chassis Layout—Etc. . . .

The contents of Volume No. 2 has been prepared with the idea of aiding the service man. John F. Rider sent out several thousand questionaires to service men at large and to owners of Volume 1. The answers to these questionaires indicated the type of information required. Everything you need in the form of data you will find in Volume No. 2. Wiring diagrams—chassis layouts—socket layouts—alignment data—peak frequencies—location of trimmers—color coding—electrical continuity of units sealed in cans—special notes—circuit peculiarities—voltage data—and much more. Special attention has been paid to auto-radio receivers—installation notes—special data—automatic record changers—superheterodyne converters—everything to help the Service Man.

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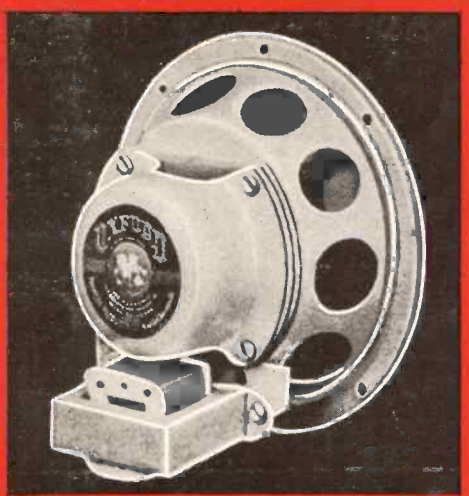

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