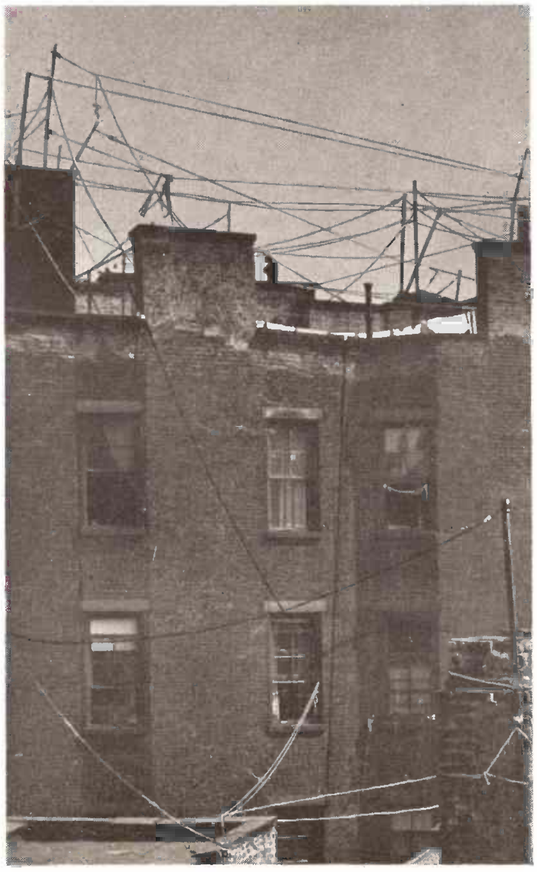
SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



Poor aerials for Radio Progress Week
(Fix those in your neighborhood)

PER COPY
20 CENTS

SEPTEMBER
1933

SERVICE

A Monthly Digest of Radio and Allied Maintenance

SEPTEMBER, 1933
Vol. 2, No. 9

EDITOR
John F. Rider

MANAGING EDITOR
M. L. Muhleman

Editorial Contents

Advertising Director

FRANK TIBBITTS
1440 Broadway, N. Y. City
Telephone: CHickering 4-4542

Published monthly by

John F. Rider Publications, Inc.
1440 BROADWAY
NEW YORK, N. Y.

Officers

JOHN F. RIDER, President and Treasurer
M. L. MUHLEMAN, Vice-President
J. SCHNEIDER, Secretary

Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price $2.00 per year in the United States of America; 20 cents per copy. $3.00 per year in Canada and foreign countries; 35 cents per copy.

THE ANTENNA...

NEW YORK I.R.S.M. CONVENTION

FORWARD march! Let's go! We're on the way to the I.R.S.M. Rebuild Prosperity Convention, to be held at the Hotel Pennsylvania, New York City, on October 2nd to 4th, 1933.

This will be the second convention since the inception of the *Institute of Radio Service Men,* and a mighty good record at that. Judging by the success of the first wholesale gathering in Chicago during January of this year, the New York assembly should be a success. You should be there!

There will be about fifty-five booths and from what we hear, most of this space has already been taken. We feel mighty enthusiastic about these conventions. The presence of almost a thousand men at the first Chicago convention is concrete evidence of faith and interest on the part of the service industry.

One of the big bugbears of Service Men's associations is the mental attitude of the members. Altogether too many Service Men's associations have folded up in the past. For one reason or another the organizations failed. Today the possibility of failure is very remote. There is no reason for failure. The service group have realized that they must band together to derive their just desires. The NRA makes membership in an association a definite requisite. Only by voicing demands as a group can anything be achieved.

Many local associations have been formed during the past three months—many more than in any like period heretofore. Now is the time to achieve national co-ordination. Conventions such as the one in Chicago and the forthcoming one in New York should occur more frequently in different parts of the country. Naturally, all will not be great money-makers; that is for the associations or chapters. However, if nothing more than an even break is attained; that is, financially speaking, the convention is a success, because the publicity and prestige thus attained is worth thousands of dollars to the industry at large.

It is our suggestion that Service Men conventions have a display by the associations showing how service procedure is carried out by its members. Servicing short cuts, special ideas and the actual application of testing equipment of various types, would prove definitely advantageous to the visiting men. Every effort to make these conventions more than just circular distribution points would be highly valuable. We recognize the value of informal talks upon sundry radio subjects. However, we still feel that even greater educational efforts can be made and should be made.

Actual demonstration periods should be allotted to test-instrument manufacturers, and these demonstrations should be featured. Lest this suggestion be misconstrued, let us state that these tests are not intended to be competitive. The sole purpose would be to provide an opportunity for the visiting Service Men to see the equipment they intend buying or the equipment they own, in action in the hands of the most experienced men available. Service Men would thus have the opportunity of noting the utility of these devices in ways which they did not comprehend or realize, and the instrument manufacturers would have the opportunity of securing first hand ideas and suggestions.

• • •

SHOULD a Service Man remain a Service Man? This is quite an interesting question. Somehow or other we are tempted to believe that being a radio Service Man, particularly since "radio service" is quite broadly defined, is a thing to be proud of. Furthermore, we feel that many men in this country of ours who have realized what it is to be a real good Service Man, have built up fairly representative establishments—and profitable at that—without appearing in some other guise, and without wasting time dreaming of the day when they might become engineers in the broadcast field. At any rate, we dislike these men who under-rate servicing in one breath and over-rate engineering in the next breath. Such men will never be either good Service Men or good engineers.

We cannot help but give some thought to the large number of electrical contractors and electricians operating stores in this country. They have held these positions for years and have had stores for years. They have raised families, have purchased their own homes, have automobiles, yet they remain electricians and electrical contractors. Would you say that these men have been failures, or that they have lacked ambition to better themselves, just because they refused to change the name of their vocation or refused to become electrical engineers?

Mind you, we are not speaking about correspondence schools or suggesting that Service Men should refuse to better their conditions. As a matter of fact, we still suggest, just as we have in the past, a continued education. But we also say that money can be made in radio service and sales, and the art of rendering good radio service and the establishment of a radio service and sales organization can be a life-long and profitable enterprise.

One of the dangers of the service profession is the ambition of some Service Men to call themselves engineers. Granted that some so-called engineers who have nothing to do with radio servicing actually know less than many Service Men. But that is not the point at all. The point is to have sufficient respect in radio service work to call it by its right name.

Another thing—most men are better off in business for themselves than they would be working for someone else. Why give up a personal business with all the earmarks of permanency for something less secure? Why lose the pride of owning your own business because the word "engineering" sounds sweeter when quite often it is not so sweet?

The word "engineer" may sound good to the public, but so would plain "radio Service Man" if it were given its proper due by everyone in the field.

Maybe we are all wrong. But it's our way of thinking. What do you think? Isn't radio servicing fine enough as a life-long profession? We think most of you fellows will agree that it is. What say? *John F. Rider.*

AGAIN OBSOLESCENCE TAKES IT ON THE CHIN!

Announcing

A *New* Weston TUBE CHECKER

No longer is there any need for worrying about tube checker obsolescence. Again Weston has supplied the solution; providing a design with 18 sockets, 11 of which are wired to test all of the present tubes, some 90 in number. The remaining 7 sockets are spares, and can be quickly wired in to test some fifty-odd additional tubes, when and if these tubes appear on the market.

Weston Model 674 Tube Checker is an "English Reading" tester—and is outstanding in its simplicity of operation. All reference to or knowledge of tube characteristics is avoided. The operator simply follows the few concise steps indicated on the tube limit chart and correct indication is obtained in minimum time.

Moreover, by means of the cathode leakage button the testing of all cathode type tubes for leakage between cathode and heater is readily accomplished—and in the same socket used for regular tests on the tube. Independent checking of the second plate in all double plate tubes also is accomplished simply by throwing a toggle switch.

And there are many more outstanding features—a few of them listed on the right. They will explain why Weston Model 674 is the outstanding value in tube checkers today. The coupon will bring descriptive circular RA. Weston Electrical Instrument Corporation, 604 Frelinghuysen Avenue, Newark, New Jersey.

OUTSTANDING FEATURES:

1. *Attractive appearance—harmoniously finished in three tones of brown.*
2. *"English Reading". Excellent readability.*
3. *Simplicity of operation—no calculations necessary.*
4. *Lowest obsolescence factor.*
5. *Tests second plates, all tubes —diodes, duplex and rectifier.*
6. *Tests cathode leakage by simply pushing a button.*
7. *Individual standard replaceable sockets.*
8. *Line voltage adjustment.*
9. *No adapters required.*

NRA MEMBER U.S. WE DO OUR PART

WESTON *Radio Instruments*

Also, the new Weston Model 673 Tube Checker. Combines attractive appearance, good testing ability, and low price. . . . Send coupon for descriptive bulletin.

Weston Electrical Instrument Corporation
604 Frelinghuysen Avenue, Newark, N. J.

Please send circular RA containing full information on Model 674 Tube Checker and other radio instruments.

Name..

Address..

....

THE EFFECT OF WORN-OUT TUBES ON RECEIVER PERFORMANCE

By E. C. HUGHES, JR.*

A RADIO tube, like everything else, wears out in use. After the end of its useful life has been reached, the supply of electrons which can be emitted from the cathode is so reduced that the tube is no longer able to function properly. The performance capabilities of a radio set decline rapidly with the decline in tube performance.

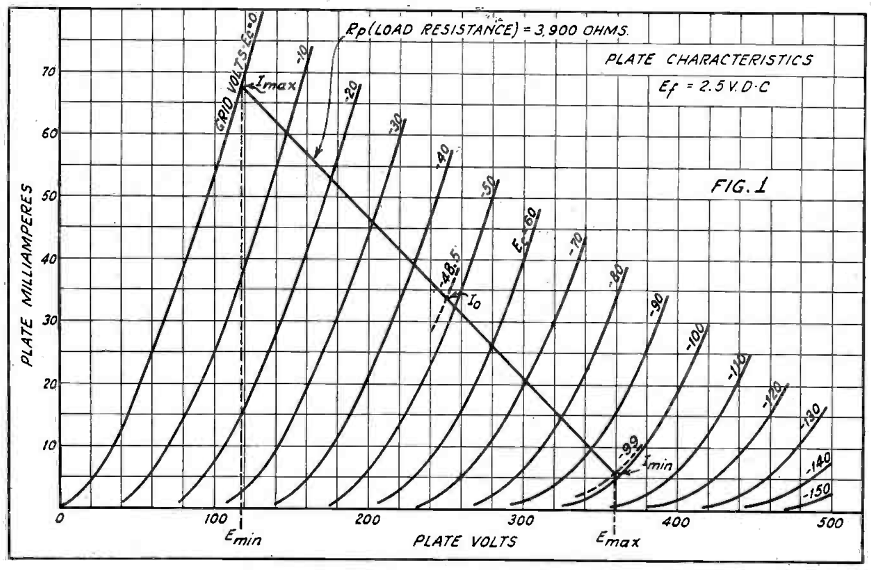
Every good Service Man knows this. And every Service Man knows that the sale of renewal tubes is good business from two standpoints, since it allows him an additional profit and it gives the customer greater radio enjoyment. Greater radio enjoyment for the customer means added good will.

Demonstrating Tube Performance

There are two methods available for demonstrating to the customer in his home the condition of the tubes in his receiver. The first method requires the use of a tube tester to give a visual indication of whether or not the tubes are satisfactory for further use. The second method employs an actual comparison of the radio's operation with good new tubes and that with the customer's old tubes. Intelligent use of either method is productive of added sales for the Service Man.

But, just what effect do worn-out tubes have upon radio performance? Seldom does the Service Man find conditions so ideal that he can readily demonstrate to the customer the improved performance to be had with new tubes. Consequently, it is of interest to the Service Man to know exactly what worn-out tubes do to a set.

* Research & Development Laboratory, RCA Radiotron Co., Inc., and E. T. Cunningham, Inc.



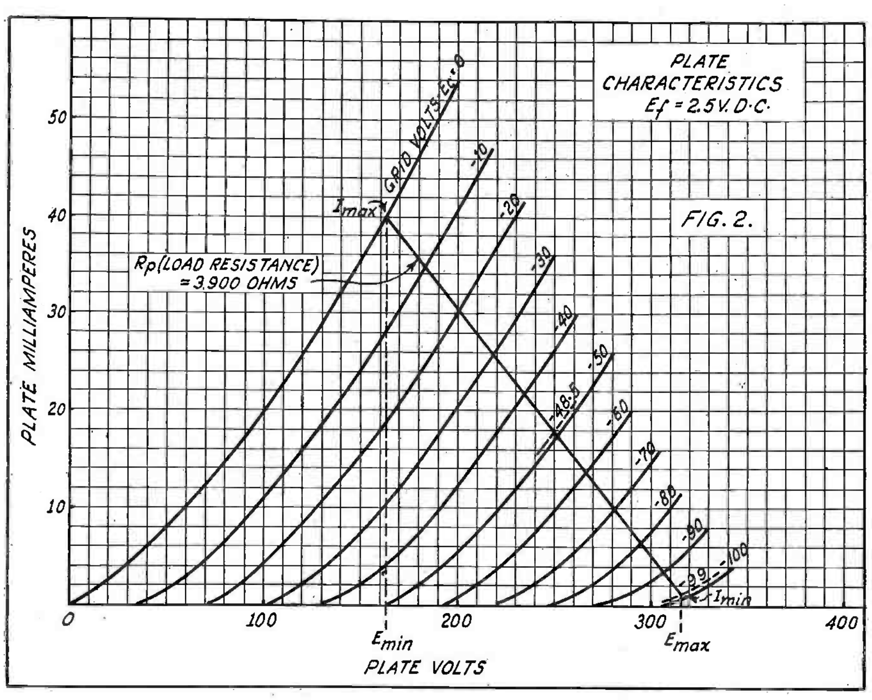
A typical family of plate characteristic curves for a triode power tube in good condition

Mutual Conductance—A Yardstick

Probably the best single yardstick for measuring a tube's performance and adherence to standards is its mutual conductance. Mutual conductance falls rapidly after the end of the useful life of a tube has been reached. The fall in mutual conductance has certain very definite limiting effects upon receiver performance.

Now, what is this mutual conductance? Mutual conductance, or grid-plate transconductance, is a factor which combines in one term the amplification factor and the plate resistance of a tube, and is the ratio of the first to the second. Thus, if the amplification factor of a given tube is 10 and its plate resistance 10,000 ohms, the mutual conductance (referred to as "gm" or "sm") is 10 divided by 10,000 equals 0.001 mho. A mho is the unit of conductance, the reciprocal of resistance, and was named by spelling ohm backwards. For convenience, a millionth of a mho, or a micromho, is used to express mutual conductance. So, in the example, 0.001 mho times a million, equals 1,000 micromhos.

Mutual conductance is strictly defined as the quotient of a small change in plate current caused by a small change in grid voltage.



The family of plate characteristic curves for the same tube after it has come to the end of its useful life. Note the drop in plate current

Voltage Amplification

The voltage amplification obtainable with a tube equals

$$\frac{\mu Z_p}{r_p + Z_p} = \frac{S_m r_p Z_p}{r_p + Z_p}$$

where Sm = The mutual conductance of the tube *in mhos.*

r_p = The plate resistance of the tubes in ohms.

Z_p = The plate load impedance in ohms.

μ = The amplification factor of the tube.

Consequently, any reduction in the mutual conductance of the tube, lowers just that much the voltage amplification of the stage in which the tube is working.

Take the case of a radio-frequency amplifier stage. Suppose that the mutual conductance of an old tube is half that which is standard for that particular tube type. Neglecting other variables which effect the results slightly, the voltage amplification of that stage is about half of what it should be. This means that for a given signal required at the output tube for full output, just twice as strong a radio-frequency signal must be fed to the old tube to give full output.

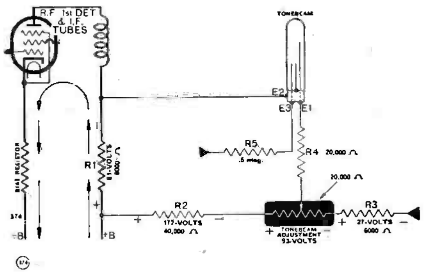
(Continued on page 328)

General Data . . .

A.K. Tonebeam

The Atwater Kent tonebeam is a neon light-column that indicates visually when the set is tuned correctly to resonance with the incoming signal.

A typical circuit arrangement for the tonebeam is shown herewith. This particular circuit is used in the Model 812.



The circuit of the Tonebeam as used in the A.K. Model 812

The tonebeam requires an initial bias to make the short center electrode (E-2) positive with respect to the long electrode (E-1). The bias is adjustable to take care of different tonebeam tubes, the adjustment being provided by a potentiometer in series with resistors R-2 and R-3 which limit the range of adjustment. In the circuit shown, the bias voltage across E-1 and E-2 can be adjusted from 91 to 184 volts.

Method of Operation

When a signal is tuned in, the automatic volume control increases the negative bias on the control grids of the r-f, first detector and i-f tubes, thus decreasing their plate current. This decrease in plate current causes a decrease in voltage across R-1 and a corresponding increase in the voltage difference between electrodes E-1 and E-2. The increase in voltage across E-1 and E-2 causes the neon glow to extend up the long electrode. When the initial bias voltage is adjusted to the correct operating point, an increase of about 20 volts across E-1 and E-2 will cause the neon glow to extend up to the top of the long electrode E-1.

The electrode E-3 and resistor R-5 are used to insure stable operation of the tonebeam. Resistor R-4 is used to make the tonebeam action more uniform on weak and strong signals.

Majestic Model 440 Chassis

The 440 chassis is used in receiver models 44, 49 and 194, with Speaker G-26-F. This chassis is for a-c only and uses a 6Z5 rectifier, a 6A7-S, 6F7-S and a 41 power tube.

There are some very interesting points in connection with this chassis. Thus, the 6A7-S tube, which is in reality two tubes in one, functions as first detector or mixer, and oscillator. The 6F7-S, which is also a double tube, functions as i-f amplifier and second detector. The detector portion of this tube then feeds directly into the type 41 power tube which has an output of approximately 2.5 watts. Thus, three receiver tubes do the work of five tubes—or six, if you were to include an intermediate a-f amplifier.

Note should be taken of the fact that the 6Z5 full-wave rectifier has a double heater, and in this case the two sections are connected in parallel so that the voltage required is 6.3 rather than 12.6 if they were connected in series.

The volume control is in the antenna and cathode circuit of the 6A7-S. Thus, it both controls the receiver input and at the same time alters the bias on the mixer tube.

The two switches marked "A" are for wave changing. When both are closed (they are in tandem) a portion of the antenna secondary coil and a portion of the oscillator coil are shorted out. In this position the receiver covers a frequency range of 1470 to 3500 kc. This wave-change switch is located at the rear of the chassis and not on the front panel.

Alignment Data

The set should be aligned at 1500 kc. The variable gang condenser nearest the front of the chassis is the r-f section. The rear condenser is the oscillator section. The two i-f transformers should be peaked at 456 kc. The first i-f transformer is on top of the chassis. The second i-f transformer is under the chassis, just to the rear of the gang condenser.

Voltage values are given on the diagram. Condenser and resistor values are given in tables to the right of the diagram. For point-to-point resistance tests, the following extra values are given: Antenna Coil: Primary, 0.795; secondary, 5.22, tap to ground, 3.77. Oscillator Coil: Primary, 1.73, secondary, 2.93, tap to ground, 1.81 ohms. First I-F Transformer: Primary, 26.5, secondary, 27 ohms. Second I-F Transformer: Primary, 55.5, secondary, 55.5 ohms. The filter choke is 980 ohms, primary of output transformer 550 ohms, speaker field 980 ohms, voice coil 1.8 ohms and high voltage secondary of power transformer 405 ohms.

Power Tube Grid Resistor Values

RCA Radiotron and E. T. Cunningham recently completed life tests on types 38, 41, 42, 89 and 2A5 power tubes which indicated that these tubes will give satisfactory operation with a resistance of one megohm in series with the grid, and with 250 volts on the plate, provided the heater voltage does not rise more than 10 per cent above the rated value under any conditions of operation.

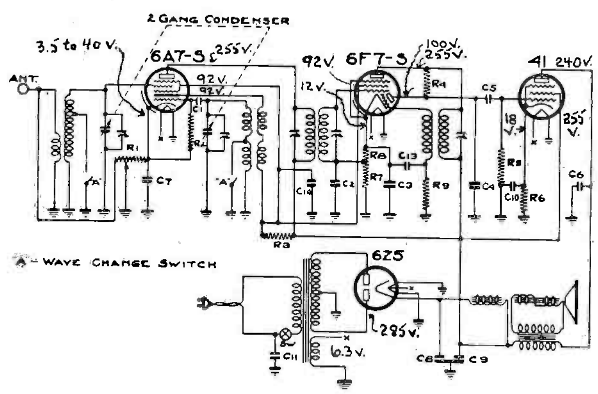
This increase in the maximum permissible value of resistance in series with the grid of any one of the tubes mentioned above makes possible the obtaining of higher amplification from the preceding tube, together with lower distortion and higher voltage output. This is especially true when the preceding tube is a pentode, a high-mu triode, or a diode, since each of these requires a load of 100,000 ohms or greater.

Majestic Chassis Wiring Color Code

Majestic have worked up a uniform color code from the wiring in their late model receivers. It is stated that for some time to come there will be cases where substitution will be made for the purpose of using up inventory. There may also be cases which arise, where it will be impossible to obtain specific wire when needed, in which case a substitution will be made. In general, however, the code shown in the accompanying table will be adhered to.

MAJESTIC WIRING COLOR CODE

Blue—Yellow Tracer	High V. from Rect. (filter input)
Red	B Plus
Orange	Cathodes
White	Screen
Blue	Filament
Black	Filament and Grounds
Green	Grid Returns
Brown	Cathode Returns
Black—Red Tracer	Grid
White—Red Tracer	Grid (Cond.)
Orange—Black Tracer	Suppressor Grid
Black—Yellow Tracer	Special Plate
Blue—Red Tracer	Special Screens
Yellow	All Plates
White R.C.	AVC Circuits
Yellow R.C.	Special AVC Circuits
Black and Red Twisted	Pilot Lamp



CONDENSER VALUES

No.	Mfds.	No.	Mfds.
C1	.00025	C8	6.0
C2	.01	C9	4.0
C3	.5	C10	10.0
C4	.001	C11	.03
C5	.03	C12	
C6	.007	C13	.03
C7	.1	C14	.25

RESISTANCE VALUES

No.	Ohms.	No.	Ohms
R1	7,500 V.C.	R6	500
R2	150,000	R7	1500
R3	20,000	R8	300
R4	700,000	R9	1,000,000
R5	500,000	R10	

Diagram and values for the Majestic Model 440 Chassis. Note the double-heater rectifier

RCA Victor R-22 Universal

This a-c, d-c super has a continuous tuning range from 540 to 1712 kc and an additional range from 2400 to 2500 kc. Wave changing is accomplished by the tandem switch S-3, S-4 which controls two small condensers which may be thrown in series with the r-f and mixer gang condensers.

Since the 25Z5 rectifier is used in a voltage-doubling circuit when the receiver is operated from an a-c line, a switch (S-2) is used to change the connections for d-c operation. The low voltage values given on the diagram are, of course, for d-c operation and the high values for a-c operation. The diagram also includes all resistance and capacity values for point-to-point testing.

ALIGNMENT

The i-f line-up condensers should be adjusted first, at 175 kc. These condensers are on the i-f transformer. Next adjust the broadcast band r-f circuit at 1710 kc. (with range switch in broadcast position). The receiver dial should be set at 8 and the trimming condensers on top of the gang condenser adjusted for maximum output.

The next adjustment should be made at 1400 kc, with the tuning dial set at 18. Adjust the r-f and mixer line-up condensers. This adjustment is made so that the r-f and mixer will be aligned over the broadcast band but the receiver will still tune to 1710 kc due to the oscillator line-up condenser not being readjusted.

Now set the wave switch in the short-wave position (clockwise). Set test oscillator at 2440 kc. Two points on the dial will be noted where the signal will be heard, one of which may be louder than the other. Set the dial at either point. (*Note—the 2440-kc signal will still be heard at two points since these r-f stages act as fixed tuned circuits.*) Adjust the two high-frequency trimmers, located on the lower side of the gang condenser, for maximum output.

When taking voltage readings with the receiver operating from a 25-cycle a-c line, divide the highest values on diagram by 1.3, which will give the average readings for 25-cycle operation. The voltage across the speaker field, with line voltage of 115, should be 185 volts for 60 cycles a-c, 140 volts for 25-cycle a-c, and 105 volts for d-c operation.

A.K. Dual-Speaker Tests

In order to get correct tone quality from the A.K. dual-speaker sets, Models 612 and 812, it is essential that the two speakers be so connected that the diaphragms of both work in unison or synchronism. If the terminals of one speaker are reversed, the tone of the set will be flat.

To test for proper connections, remove the speakers from the cabinet (leaving them plugged in) so the movement of the diaphragms may be observed. Turn on set, but turn volume down. Connect the terminals of a $1\frac{1}{2}$-volt dry cell across the voice-coil terminals of either one of the speakers. If the diaphragms move in or out together at the instant of contact, the speaker connections are O.K. If one moves out and the other moves in, they are bucking, and the remedy is to reverse the red leads of the five-prong speaker at the voice-coil terminal strip.

Philco Models 16 and 17

In the first runs of both the Models 16 and 17 receivers (16-121 and 17-121) a type 80 tube is used in the power unit. In the second runs of both types (16-122 and 17-122) a type 5Z3 rectifier is used in lieu of the type 80 tube.

Microphonic Howl

The most common reason for microphonic howl, states Philco, is failure to loosen the radio chassis hold-down bolts so as to allow the chassis to float on its soft rubber supports. A microphonic tube, particularly in the detector-oscillator or second detector socket, is also a common source of microphonic trouble. In certain models, particularly the short-wave sets, it is important that the tuning condenser be floating on its soft rubber support pads on the chassis; in many cases microphonic howl can be corrected by loosening the tuning condenser mounting screws. Care should always be taken in all models that no part of the chassis is touching the cabinet; it often happens that a volume control or station selector shaft will be touching the side of the cabinet opening and produce a microphonic howl.

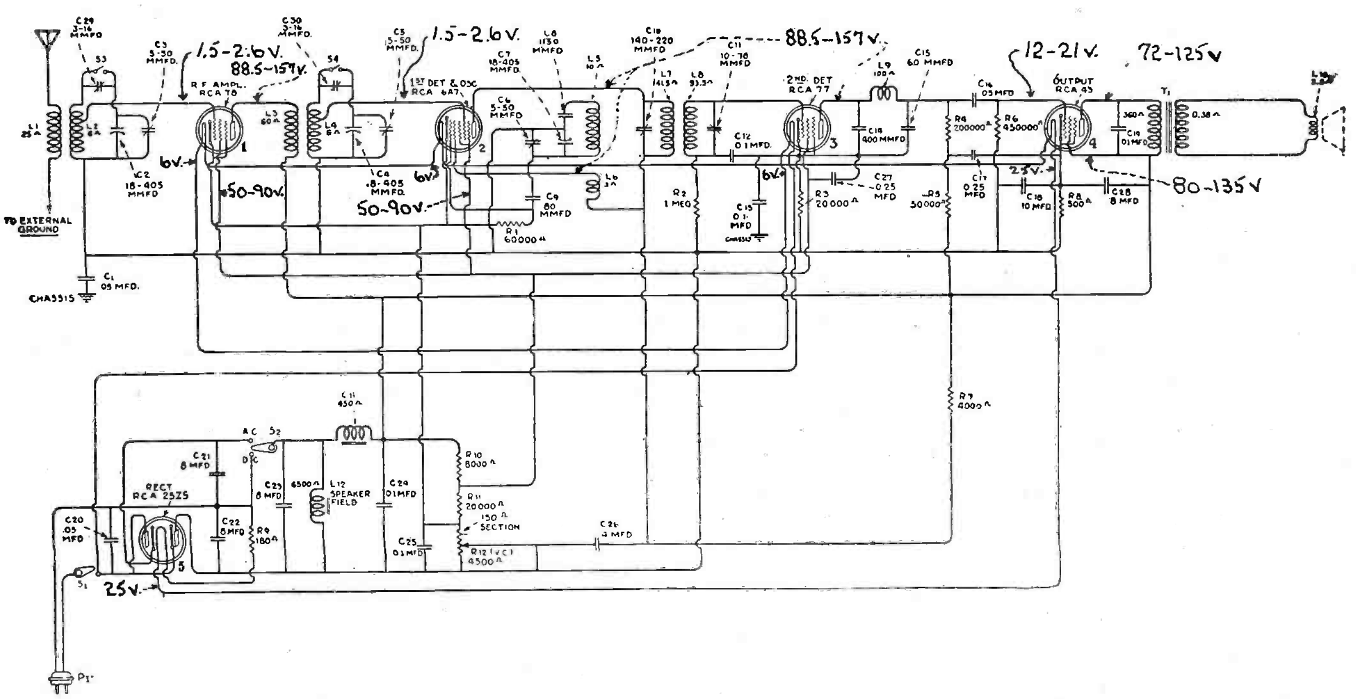
In the Philco Model 43, a hardened rubber gasket on the movable station indicator bracket will produce microphonic howl. In some remote cases it has been found that a vibrating plate in one of the i-f or high-frequency compensating condensers will produce microphonic howl.

Matching P-P 2A3's*

The plate resistance of a 2A3 is only 765 ohms but the mutual conductance is 5500 micromhos. Therefore, a small variation in plate resistance will affect relatively large changes in mutual conductance.

It is evident from the above that if two of these tubes are not matched in a push-pull amplifier distortion will result. Service Men should sell two new ones when and if one goes bad, because it would be rare to find an old tube that would match up with a new one.

Radio, pp 13, Sept., 1933.



Schematic of the RCA Victor R-22 Universal, which uses a voltage-doubling rectifier. Voice-coil d-c. resistance is 3.8 ohms

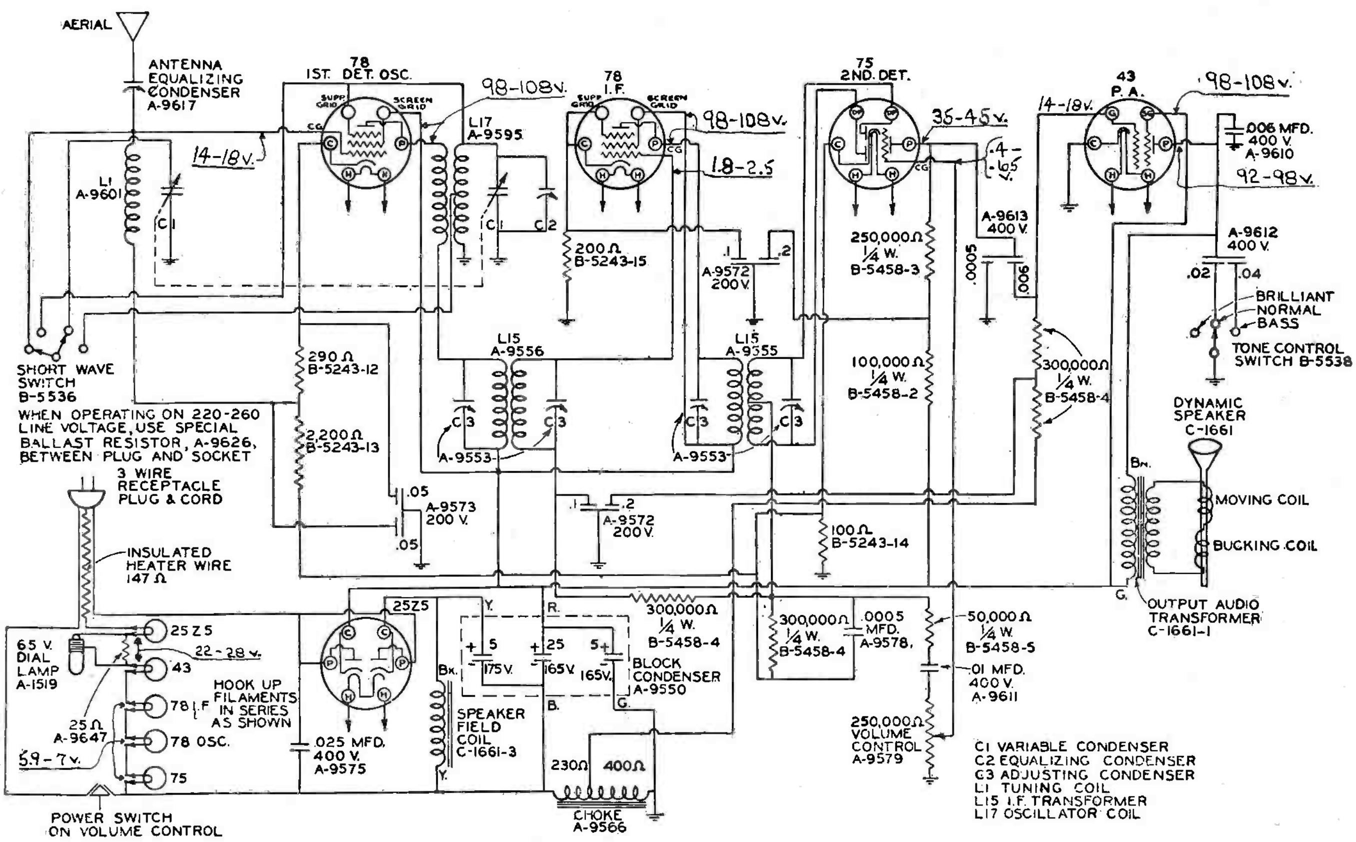


Diagram of Sparton Models 61 and 62, with all values and socket connections shown

Sparton Models 61 and 62

This is a super of the universal type, covering the broadcast and upper short-wave band. The i-f peak frequency is 456 kc.

One cathode of the 25Z5 rectifier feeds the dynamic speaker field coil and the other cathode supplies the tube voltages.

The circuit is more or less self explanatory. Note that the type 75 second detector and first audio tube uses a full-wave connection to the i-f transformer, the secondary of this transformer being center-tapped. The volume control is in the grid circuit of the a-f section of the type 75 tube. This section is resistance coupled to the type 43 power tube.

The tone control consists of an adjustable condenser in the plate circuit of the power tube.

AVC is provided by the double-diode portion of the type 75 tube. Both the mixer section of the first type 78 tube, and the type 78 i-f tube are controlled by this circuit.

Short-Wave Switch

Note the short-wave switch. When in the position shown, the variable condenser C-1 is shunted across the antenna coil L-1 for broadcast reception. When the switch is thrown to the right hand position condenser C-1 is thrown out of circuit and the coil L-1 functions as an impedance, or aperiodic circuit. At the same time the short-wave switch shorts out a portion of the oscillator coil.

The accompanying diagram gives all resistance, capacity and voltage values, as well as socket connections. In reference to the voltage values, the lowest value given in each case is the approximate reading to expect when the set is being operated from a d-c line, and the highest value when the set is on an a-c line. The reading across the speaker field coil should be about 100 volts for d-c operation and 120 volts for a-c operation.

•

Stromberg-Carlson Nos. 52 and 54

The Stromberg-Carlson chassis used in the Nos. 52 and 54 receivers is similar in many respects to the chassis employed in receivers Nos. 48, 49, 50 and 51. However, the same type tubes are not used throughout. Three type 35 tubes are used as r-f amplifier, mixer and first i-f amplifier, instead of the type 58's formerly employed. A type 27 tube is used as oscillator whereas the earlier chassis employed a type 56 tube.

In the Nos. 48, 49, 50 and 51 receivers, a type 55 tube is used as second detector or demodulator. In the Nos. 52 and 54 receivers this tube is used as the first stage audio amplifier. The diode plates are not used. A type 2B7 tube is used as an i-f amplifier and demodulator; the new chassis, therefore, has two stages of i-f whereas the earlier chassis had but one i-f stage.

•

Midget Receiver Developments*

The metal cabinets are usually insulated from the chassis by simple fibre bushings. Since the chassis is often connected directly to one side of the line there were numerous possibilities for receiving shocks. Most manufacturers have insulated the low side of the line from the chassis.

The use of higher voltage heaters of the 25Z5 and the 43 has meant that the series dropping resistor has had less power dissipated in it and is therefore smaller in size. The "heat cord" has been introduced—a line cord containing a resistor in the form of a third wire built into the cord. This takes the heat out of the set and puts it in the line cord where it is spread out over several feet and hence more readily dissipated. The 25-volt heater tubes, however, dissipate about 7.5 watts apiece and are quite hot so that the cabinet has to be protected from them.

Double spot tuning, due to overload, has been pretty well taken care of by the introduction of overload devices and AVC. For example—when the detector grid goes positive under the impulse of a large impressed signal draws grid current, which, passing through a dropping resistor, biases back the grids of both the first detector and i-f tube.

Radio Engineering, pp 6. Aug., 1933.

•

Emerson Chassis and Model Numbers

The Emerson Radio and Phonograph Corp. Model T-6 chassis is employed in the Model 35 receiver. The Model G-4 chassis (a T.R.F. job) is used in the Model 20-A and 25-A receivers. The Model H-5 chassis is used in the Model 250, 30 and 300 receivers.

•

Philco Models 35 and 36

The Philco receivers Models 35 and 36 are battery operated superheterodynes. The circuits of these two models are identical.

THE STORY OF RECEIVER DESIGN

Part VII

WE have already discussed in previous issues each of the component parts of the radio receiver. We shall now proceed to discuss the receiver as a whole, using a representative set of modern design for our purpose.

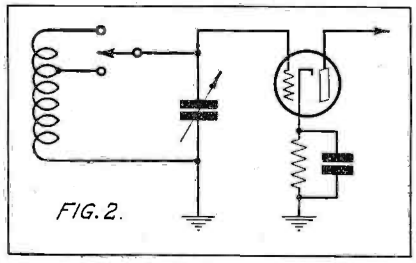
Fig. 1 shows the schematic diagram of a receiver having most of the new ideas incorporated in its structure. This is the Philco Model 17. It will be seen that it employs one stage of radio-frequency amplification, combined oscillator and mixer, one stage of intermediate-frequency amplification, second detector, and three stages of audio-frequency amplification.

Short-Wave Switching

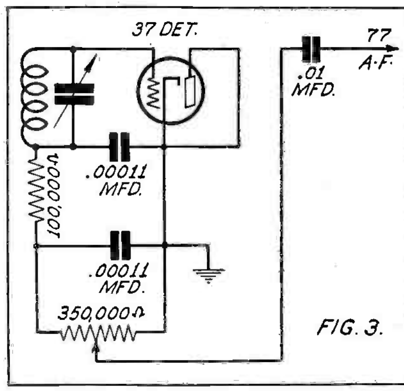
This receiver is arranged for operation over two bands of frequencies but this need not affect our discussion except to point out in passing that part of the tuning coil is shorted out by the gang switch when tuning to the short-wave band. The coil might have been tapped, of course, and grid and condenser switched to the proper tap, as shown in Fig. 2, thus leaving the unused portion of the tuning coil open. At first it would appear that leaving part of the coil open would be better than shorting some of the turns, since experience has taught us that even one shorted turn is bad business. There is a good reason for shorting the turns, however, as will presently appear. If an appreciable part of the coil is left open, the capacity (both distributed and due to circuit wiring, shields, etc.) across this portion of the coil is likely to resonate it in or near the desired short-wave band. If this occurred it would greatly reduce sensitivity and selectivity over part of the short-wave band and in addition one coil would resonate at one frequency and the other at a different frequency in all probability, and this would throw the circuits so badly out of line that it is doubtful if any signal would be received at certain frequencies.

Tracking

Spoiling the oscillator tracking is of course much more serious than spoiling the tracking of the other tuned circuits. If the resonant frequency of the unused portion of the oscillator happened to fall in the desired short-wave band, it is probable that oscillations would stop entirely. Now, if one unused turn of a coil is shorted it is very serious, since a large current will flow in the shorted turn and this will seriously alter the effective resistance and inductance of the remainder of the coil. If two unused turns are shorted the effect is less serious because while the voltage induced in the two unused turns is almost twice as great as before, the inductance of these two turns is four times as great as for one turn (inductance is nearly proportional to the square of the number of turns), and the current flowing in the two shorted turns is only half what it was in one turn. When there are a large number of unused turns, the effect of shorting them, as is done in the circuit of Fig. 1, is usually negligible.



A form of wave changing, with tapped coil, which has disadvantages because of the possibilities of circuit detuning



The diode detector circuit of the receiver shown in Fig. 1. This is independent of the AVC circuits

Antenna Circuit

Referring again to Fig. 1, we notice that the antenna circuit consists of a high inductance winding loosely coupled to the tuned circuit and that this winding is shunted with a 10,000-ohm resistor. The high-inductance primary winding probably resonates at about 650 meters, which is well above the broadcast band, and this will tend to provide uniform voltage step-up to the tuned circuit over the entire band. The function of the shunting resistor is to broaden the received band somewhat at the long-wave end. This resistor has practically no effect at the short-wave end.

The radio-frequency amplifier tube is a variable-mu pentode, which will reduce cross-modulation considerably due to very strong signals.

The oscillator-mixer tube employs the 6A7 pentagrid converter in the conventional circuit used with this tube and described in some detail on page 131 of the April issue of Service. The principal advantage of using this tube over the usual circuit em-

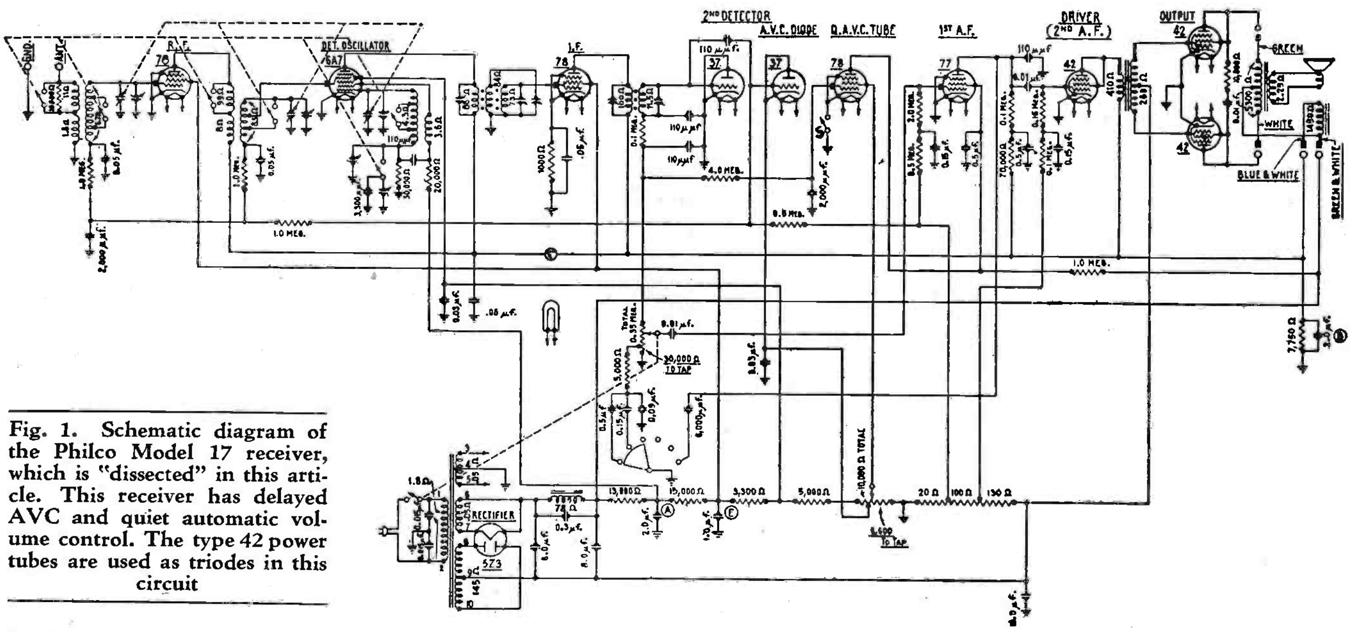
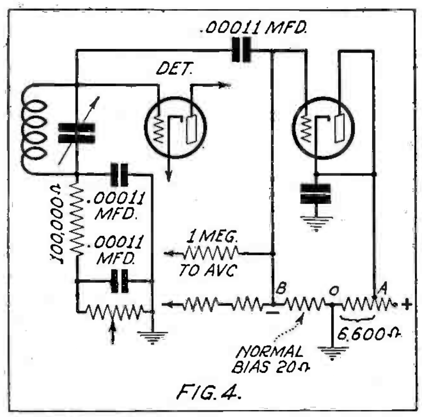


Fig. 1. Schematic diagram of the Philco Model 17 receiver, which is "dissected" in this article. This receiver has delayed AVC and quiet automatic volume control. The type 42 power tubes are used as triodes in this circuit



The AVC arrangement in the circuit of Fig. 1. This AVC circuit controls the r-f. and mixer-oscillator tubes only

ploying a separate oscillator and modulator lies in the higher conversion efficiency obtained with the 6A7 together with some simplification of wiring. Since the plate resistance of this tube (i. e., the mixer portion) is about 300,000 ohms and the effective resistance of the first intermediate-frequency coil in its plate circuit is about 50,000 ohms, optimum conditions exist for good selectivity in this circuit. This matter is fully discussed on page 134 of the April issue.

Tuned Circuits

While there is only one stage of intermediate-frequency amplification, inspection will show that there are five tuned circuits. This insures adequate intermediate selectivity. Sometimes an additional tuned circuit coupled to the last intermediate-frequency transformer is used to feed the QAVC tube. This is not done in the receiver of Fig. 1. The purpose of employing an extra tuned circuit solely for the QAVC tube is to insure that the receiver is properly tuned (i. e., intermediate-frequency carrier properly centered) before this tube releases the bias and permits an audio signal to pass to the speaker. Such a tuned circuit adds nothing to the selectivity of the set, but it makes it *appear* to tune sharper since the set is operative over only a relatively narrow band in the vicinity of the desired carrier.

A selective QAVC circuit is open to one objection and that is that if the oscillator drifts slightly or if the selective circuits used for QAVC should become misaligned, then no signal can break through unless it is very strong—and if it does, it can only be heard when the set is *mistuned*. This, of course, is likely to result in a distorted signal and possibly in interference with another station. If a selective QAVC circuit is carefully maintained, or is built to hold its adjustment, it does make a nearly foolproof receiver from the standpoint of mistuning.

Diode Detector Circuit

Fig. 3 shows the diode detector circuit of Fig. 1 drawn in separately with all extraneous connections omitted. It will be noticed that the diode detector is completely divorced from AVC which function is performed by a separate tube. The reason for this is that delayed AVC is used and distortion would result at certain signal strengths if both functions were performed by one diode. Of course, a 6B7 duplex diode pentode might have been used to replace the two type 37 tubes and the type 77 first a-f stage. This would save tubes by replacing the three with a somewhat more expensive tube which would perform the same functions. This is more a question of the size of the chassis. Where space is at a premium, as in an auto receiver, such a consolidation would prove effective. A good example is the Majestic Model 66 auto-radio receiver, which also has delayed AVC and employs a type 6C7 tube, which is similar to the 6B7.

The AVC Circuit

Fig. 4 shows the AVC circuit from Fig. 1 with all extraneous connections omitted. Reference to Fig. 1 will indicate that the cathodes of the r-f amplifier and oscillator-mixer, which are the only tubes to which AVC is applied, are at ground potential.

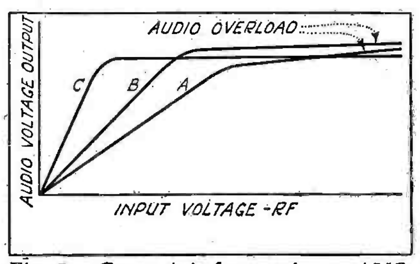


Fig. 5. Curve A is for maximum AVC control voltage, B for partial voltage, and C for delayed AVC

The control grids of these two tubes have a normal negative bias represented by the voltage drop in resistor O-B (Fig. 4), which is part of the power-supply voltage divider in Fig. 1. When a signal is received no current flows in the AVC tube circuit until a voltage in excess of that across A-B (Fig. 4) is developed in this circuit; then AVC bias is applied to the controlled tubes. This is called delayed AVC and simply means that the output of the receiver is proportional to the input until a certain voltage (called delayed bias) is developed in the AVC tube, after which the output is essentially constant for increasing inputs. This is illustrated in Fig. 5 in which curves (A) and (B) indicate results obtained with ordinary AVC and (C) with delayed AVC. There is one important advantage of delayed AVC and that is a better signal to receiver noise ratio for weak signals. It will be observed from Fig. 5 that for small inputs the signal output with delayed AVC is considerably greater than with ordinary AVC. Set noise is of course independent of the AVC circuit and will therefore be the same for all three of the curves of Fig. 5.

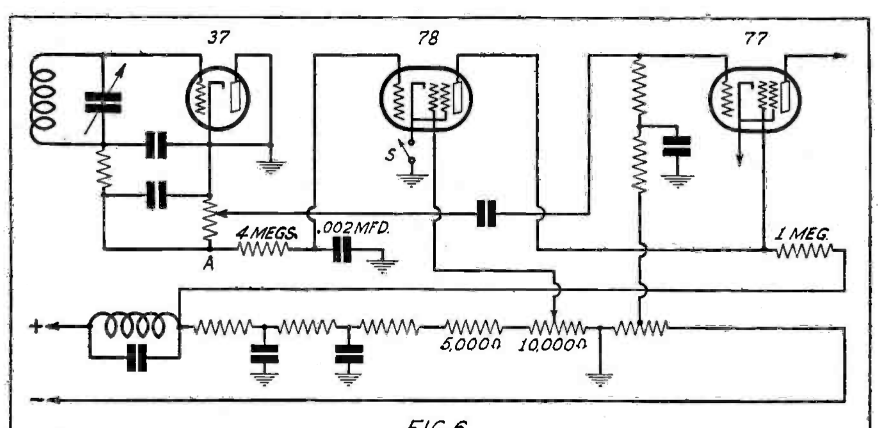
QAVC Circuit

Fig. 6 is a simplified schematic of the QAVC circuit of Fig. 1. Most squelch or QAVC tubes operate on the grid of the first audio tube; this one, however, operates on the screen of the type 77 tube which is the first a-f amplifier. The grid of the type 78 QAVC tube is connected to the negative end of the detector load resistance. It could not be connected to the AVC circuit because of the delay bias which would prevent action until the AVC started to function.

When no signal is coming in the plate current of the type 78 tube is such that a sufficient voltage drop occurs in the 1-meg-ohm resistance to reduce the screen potential of the type 77 tube to so low a value that this tube is essentially at cut-off. When a signal is received "A" becomes more negative which in turn reduces the plate current of the type 78 tube so that the screen potential of the type 77 tube is increased. As the signal intensity increases the 78 is forced nearer cut-off (this is a variable-mu tube, of course) until a small, fairly uniform plate current is drawn. The 77 then has a normal screen potential and functions normally until the incoming signal stops, due to tuning the receiver to another station, at which the grid potential on the 78 goes to zero and the 77 is immediately blocked.

The A-F Amplifier

The audio amplifier of this receiver consists essentially of three stages, the first stage having a small gain and being controlled by the squelch or QAVC tube. This tube



The simplified circuit of the quiet automatic volume control system in the receiver shown in Fig. 1. The switch S takes the QAVC tube out of circuit

feeds a type 42 pentode which in turn feeds two type 42 pentodes connected in push-pull. It should be noted that each of these three type 42 tubes are not actually used as pentodes, but rather are utilized as triodes, with the screen grid tied directly to the plate in each case. The effect of this on the first tube is first to cut down the gain or amplification factor and second to reduce the total harmonic output. Much the same holds true for the two output tubes. The combined result is less harmonic distortion and increased power handling capabilities. Or, to put it the other way around, the high gain of the type 42's employed as pentodes is not required and they are therefore employed as triodes so that the percentage of harmonic distortion will be less at high powers. It is a known fact that triode power tubes have a lesser percentage of harmonics in their outputs than do pentodes. Thus, the two 42's in push-pull are capable of delivering around 10 watts of undistorted output signal. By undistorted we mean with less than 7 per cent harmonics. The percentage in this case is probably much lower.

THE POWER SUPPLY

The power supply is a conventional full-wave rectifier circuit. The choke coil is tuned to 120 cycles. Notice the segregation of circuits and filtering by resistance-capacity networks. These are both cheap and effective since they also serve to prevent motor-boating which could be very serious in a circuit of this sort which was not carefully designed.

The only unusual service problems likely to develop in a receiver of this sort are those having to do with the QAVC tube and these can be easily localized by means of the switch S, shown in both Fig. 1 and Fig. 6, which takes the QAVC tube out of circuit. Thus an increase in the value of the 1-meg-ohm resistor common to the plate of the type 78 tube and the screen of the type 77 tube would result in a circuit which would operate only at large inputs, if at all. Low emission in the 78 would have the same effect. Open circuiting the 4-megohm resistance in the grid circuit of the 78 tube might cause motorboating since the 78 would periodically block and remain so until discharged.

G. S. GRANGER.

(*The End*)

Philco 81 Police-Band Adjustment

The adjustment of the two additional compensating condensers in the police-frequency band on the Model 81 is made at 1700 kc and 2400 kc. These condensers are located on the underside of the chassis, and are indicated as (8) and (9) in the diagrams.

The condenser (8) is adjusted by setting the dial at approximately 1700 kc and adjusting for maximum volume on a police broadcast station at this frequency. The condenser (9) is adjusted in the same manner at 2400 kc.

American Bosch Models 250, 251

The circuit for Models 250 and 251 is shown below. This is a recent job, being a superheterodyne employing the 50 series r-f. pentodes. The function of each tube is indicated in the diagram.

Note that a pair of '45 tubes in push-pull

BOSCH 250 VOLTAGE DATA

Tube	*Fil.*	*Plate*	*Screen*	*Cathode*	*Grid*
R-F.	2.4	200	100	4.5	0
1st Det.	2.4	200	100	8.5	0
Osc.	2.4	85	. .	0	7.8
1st. I-F.	2.4	200	100	4.5	0
2nd I-F.	2.4	200	100	4.5	0
2nd Det.	2.4	0	. .	47.	0
1st A-F.	2.4	175	. .	47.	0
Outputs	2.4	350	. .	. .	55
Rect.	4.8				

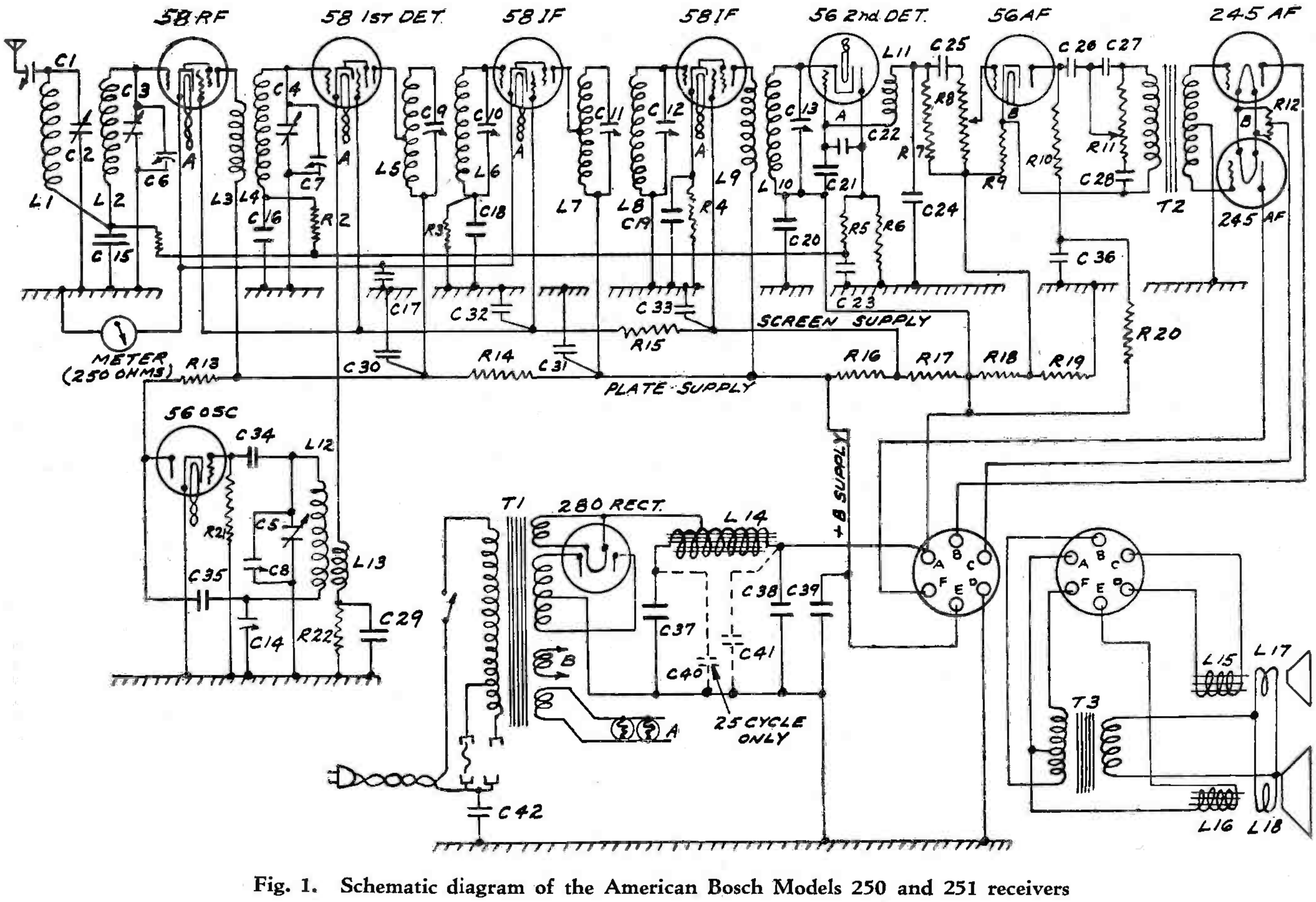


Fig. 1. Schematic diagram of the American Bosch Models 250 and 251 receivers

BOSCH MODEL 250 CIRCUIT VALUES

R1—100,000 ohms	C1—Trimmer	C23—.05 mfd.	L2—R-F. Coil
R2—100,000 ohms	C2—Tuning	C24—100 mmfd.	L3—R-F. Coil
R3—100,000 ohms	C3—Tuning	C25—.05 mfd.	L4—R-F. Coil
R4—500 ohms	C4—Tuning	C26—.5 mfd.	L5—I-F. Coil
R5—500,000 ohms	C5—Tuning	C27—.05 mfd.	L6—I-F. Coil
R6—100,000 ohms	C6—Alignment	C28—.05 mfd.	L7—I-F. Coil
R7—100,000 ohms	C7—Alignment	C29—.05 mfd.	L8—I-F. Coil
R8—500,000 ohms	C8—Alignment	C30—.05 mfd	L9—I-F. Coil
R9—1,500 ohms	C9—I-F.	C31—.05 mfd.	L10—I-F. Coil
R10—25,000 ohms	C10—I-F.	C32—.05 mfd.	L11—Choke
R11—100,000 ohms	C11—I-F.	C33—.05 mfd.	L12—Osc.
R12—Center Tap	C12—I-F.	C34—100 mmfd.	L13—Osc.
R13—30,000 ohms	C13—2d Det.	C35—.05 mfd.	L14—Choke
R14—1,000 ohms	C14—Alignment	C36—4.0 } mfd.	L15—Field
R15—1,000 ohms	C15—.05 mfd.	C37—8.0 } mfd.	L16—Field
R16—3,700 } ohms	C16—.05 mfd.	C38—8.0 } mfd.	L17—Voice
R17—2,270 } ohms	C17—.05 mfd.	C39—4.0 } mfd.	L18—Voice
R18—230 } ohms	C18—.05 mfd.	C40—8.0 } mfd.	
R19—1,280 } ohms	C19—.05 mfd.	C41—8.0 } mfd.	
R20—10,000 ohms	C20—.05 mfd.	C42—.01 mfd.	T1—Power
R21—100,000 ohms	C21—100 mmfd.		T2—Input
R22—5,000 ohms	C22—.05 mfd.	L1—R-F. Coil	T3—Output

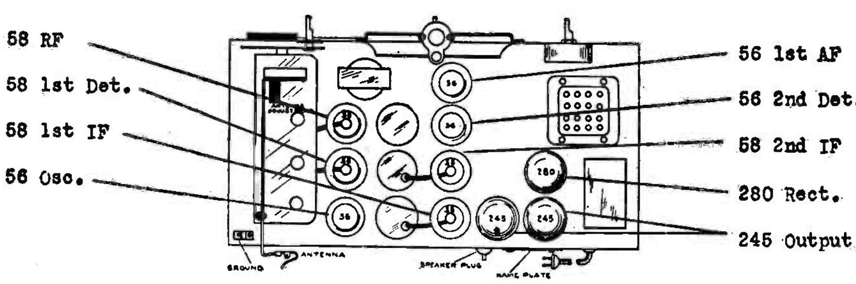


Fig. 2. Chassis layout of the Bosch Models 250 and 251 receivers

are employed in the output, rather than 47's. These tubes and the first a-f. tube receive filament and heater current from winding B on the power transformer. The rest of the tubes obtain their heater current from winding A.

The volume control (R-8) is in the grid circuit of the first a-f. tube, the tone control in the plate circuit.

The circuit values are given below the diagram. The location of each tube on the chassis is shown in Fig. 2.

The voltage values given in the accompanying table are readings on a high-resistance voltmeter to ground, with the exception of the filament voltages. Cathode voltages are given for those tubes having the grid at ground.

Time Constant of AVC Networks

Considerable is heard these days about the time constant of AVC circuits, tuned circuits, etc., although it appears there is some confusion about just what it all means.

First, let us define the time constant of resistance-capacity networks which is the thing with which we are concerned in AVC. Consider the circuit of Fig. 1, in which C is a charged condenser and R the leak resistance. When switch A is opened the condenser will be charged to a voltage E. When switch B is closed the condenser will discharge through R, at first very fast and then more slowly as the voltage drops. The quantity R x C is called the time constant and is the time taken for the current through R to fall from its maximum value to 37 per cent of its maximum or initial value at the instant the switch B is closed. Or it may be defined as the time required for the condenser to lose 63 per cent of its charge. It is measured in seconds. As an example, let C = 0.1 mfd and R = 1,000,000 ohms. Then $RC = \frac{0.1}{1{,}000{,}000} \times 1{,}000{,}000 = 0.1$ second.

Now the usual AVC circuit reduces the amplification of the receiver instantaneously when a large signal is applied and if the signal is removed the receiver will recover its amplification slowly as the condenser discharges. The time taken for the set to recover approximately full gain, or the con-

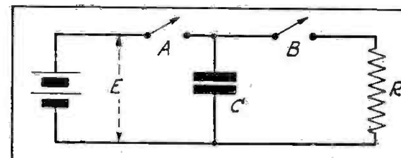


FIG. 1.

denser to lose most (63 per cent) of its charge is called the time constant of the circuit and is determined by the resistance-capacity filter in the AVC circuit.

The time constant of an inductive circuit such as that of Fig. 2 is much the same sort of thing. It is equal to $\frac{L}{R}$ and is the time required after the switch is closed for the

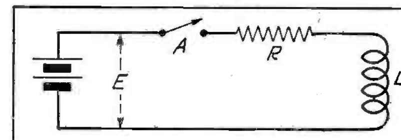


FIG. 2.

current to reach 63 per cent of its final value. Thus, if L = 1 henry, and R = 1 ohm, then $\frac{L}{R} = 1$ second; had R been 10 ohms the time constant would have been 0.1 second. Since an inductance has electrical inertia it will tend to resist a sudden rise of current and this gives rise to the slow rise and decay of currents in inductive circuits.

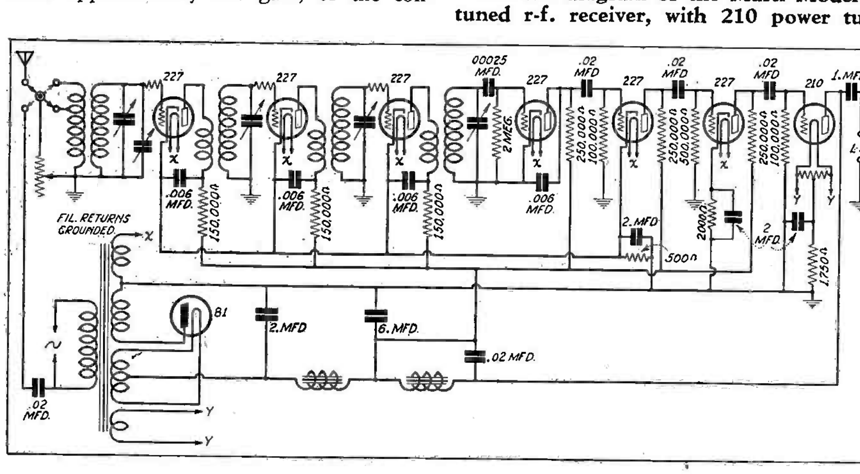
Marti Model T

The schematic diagram of the Marti Model T is shown on this page. This, of course, is an early model receiver, but the diagram has not been easily obtainable.

It is seen to consist of three stages of tuned r-f, detector of the grid leak and condenser type, two stages of resistance coupled a-f and a single type 210 tube in the power stage. The power unit employs a type 81 half-wave rectifier and a double filter with the second section tuned to resonance in the vicinity of 60 cycles.

The volume control is seen to be in the antenna circuit. In the same circuit is a switch which permits changing from a regular antenna installation to the use of the light line as an antenna.

Schematic diagram of the Marti Model T tuned r-f. receiver, with 210 power tube



Lyric Model B-80 Battery Super

This battery-operated superheterodyne employs a stage of r-f, first detector, separate oscillator, one stage of i-f peaked at 175 kc, second detector and a stage of a-f feeding two Class A triodes in push-pull. As indicated in the diagram shown on this page, the speaker is of the permanent magnet dynamic type.

Together with the diagram are given the tube socket connections as well as the chassis layout. The schematic diagram itself carries all capacity, resistance and voltage values.

Note that a dual volume control is employed. One section is in the antenna-r-f cathode circuit and the second section in the grid circuit of the first detector. This arrangement provides good regulation. The tone control is in the grid circuit of the first a-f tube.

Note that two r-f chokes are connected in the A + lead. They connect to filaments 1 and 2 respectively, as marked.

All voltage readings listed should be taken with all controls turned on full and no signal. Use a 1000 ohms per volt meter.

Oscillation in Philco 71 and 91

On some models of the 71 and 91 series, difficulty is occasionally experienced with inoperation of the set from 800 to 1500 kc, because the detector-oscillator tube fails to oscillate. The remedy for this trouble is usually puzzling, since it is rather an uncommon type of complaint.

The condition can usually be corrected by changing the type 36 tube in the detector-oscillator socket. The tube change alters the overall characteristics of the oscillator circuit in such a way that oscillation is again established, and the set then operates properly.

In some instances the tube change is not sufficient, and it is then necessary to change the cathode resistor from 15,000 ohms to 10,000 ohms.

Locations which are subject to prolonged damp weather usually experience this difficulty more than locations having a dry atmosphere. In extreme cases it may be necessary to change the oscillator coil, making absolutely sure that the coil is entirely covered with paraffine to seal out all moisture.

"Star Raider" Models R-20, R-25, R-30 and RP-40

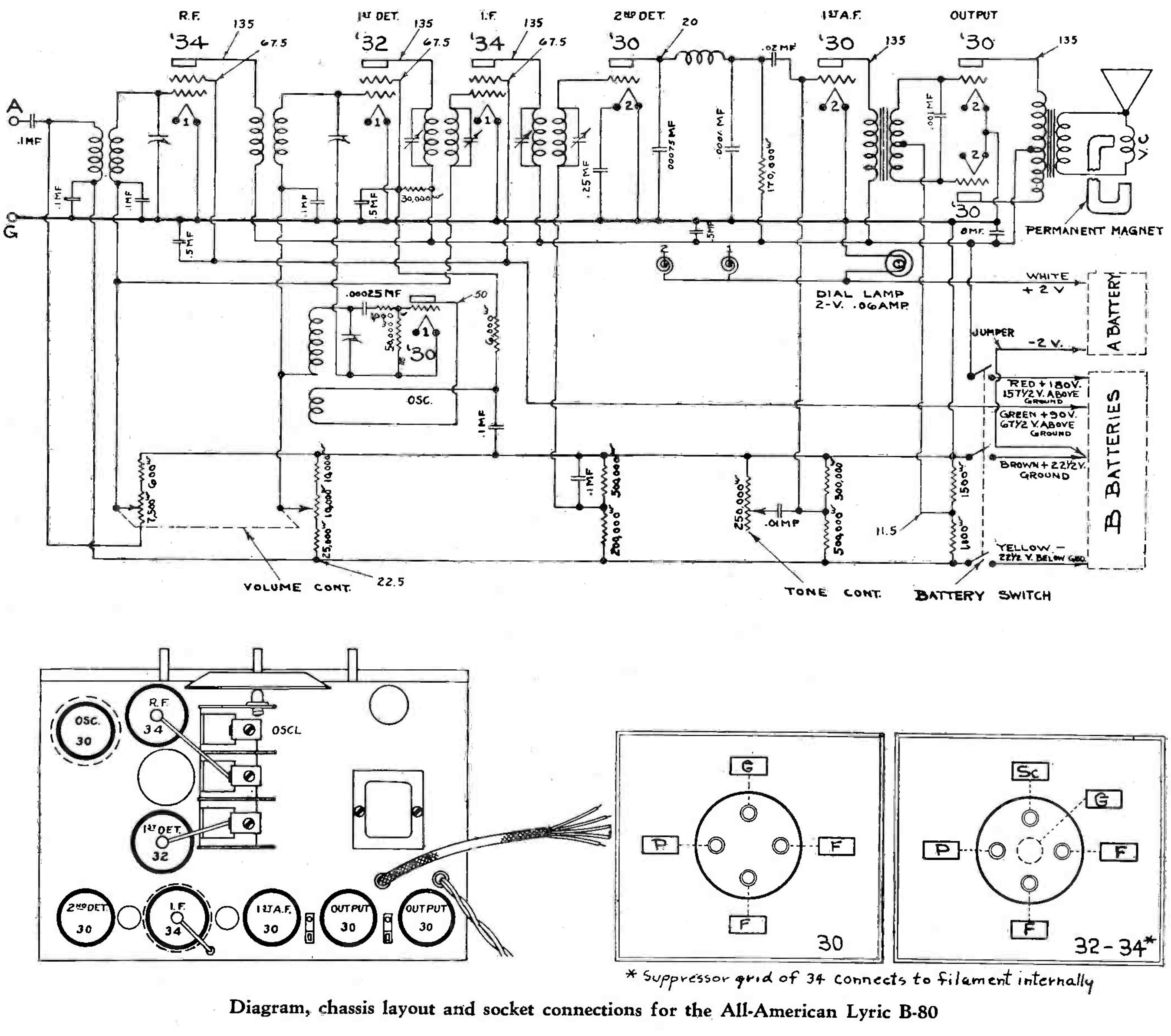
In the Continental "Star Raider" receiver models given above the section of the voltage divider connected between the "high" side of the filter and the various plate circuits is a 4100-ohm unit. Most diagrams shown list this unit as 41,000 ohms.

Another correction is that the values of the r-f coupling condensers are .00028 mfd instead of .0001 mfd. Furthermore, the fixed condenser shunting the fixed resistor in the r-f tube plate circuit is .0001 mfd instead of .00028 mfd as shown on some diagrams.

The two field windings have d-c resistances of 850 ohms and 4250 ohms respectively. If these windings are checked on the schematic diagrams, the former field is marked L-20 and the latter is marked L-21.

A 0.5-megohm resistor is in shunt with each half of the input transformer feeding the output tubes. These resistors are not usually shown. The detector plate bypass condenser has a value of .002 mfd.

H. A. S.

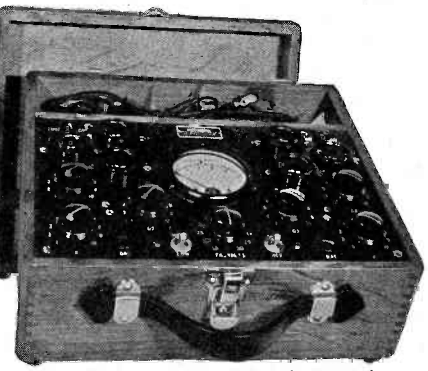


* Suppressor grid of 34 connects to filament internally

Diagram, chassis layout and socket connections for the All-American Lyric B-80

FREE REFERENCE POINT SYSTEM IN TUBE TESTERS

By H. BERNREUTER*



Panel view of the Model 45 Tube Tester

ALL professional radio Service Men are familiar with the point-to-point method of making circuit connections utilized in modern radio set analyzers to minimize the possibility of obsolescence. In this discussion the adaptation of this method to modern tube testing is outlined and a fundamental circuit described as incorporated in the new Supreme Model 45 Tube Tester. With new tubes being put on the market so rapidly, one can easily recognize the advantage of possessing a tube tester which can test these tubes without adapters or rewiring the instrument.

Free Reference Point System

The fundamental principle involved in the Free Reference Point System of tube testing used in this tester is the connection of each element of the tube to the contact arm of an individual rotary selector switch so that each element of the tube can be placed in its proper connection in the circuit.

An individual socket is provided for the four, five, six and both sizes of seven-prong tubes. The socket holes are numbered in accordance with R. M. A. standards. All four sockets have their corresponding numbered contacts wired together and these contacts are brought out to rotating arms of the circuit selecting switches as illustrated in Fig. 1. There is a rotary selector switch for each of these socket terminals bearing a corresponding number.

The eleven contacts on each of these rotary switches are connected to various parts of the tube checker circuit, and to a selection of alternating potentials as shown in Fig. 2. The figure shows tube element number one connected to selector switch number one. If this element happened to be the control grid, selector switch number one would be rotated to the "—C" position, thus connecting the control grid to the bias-changing switch "S_1". Likewise, if element number one happened to be the plate, selector switch number one would be rotated to any one of the different voltages shown, depending on the plate voltage rating for that particular tube, and so on. The selector switches for the remaining variable element terminals, numbers two, five, six, seven, and the top cap are also connected to the same various parts of the tube checker circuit, and the same selection of alternating potentials shown in Fig. 2. Contact numbers three and four are always the heater or filament terminals of the tube, and are brought directly to the filament voltage secondary of the transformer through a voltage selector switch as illustrated in Fig. 3.

Use of Selector Switches

In order to further illustrate the use of the selector switches in this tube tester let us take, for example, an arrangement of elements as in the type 57 tube. Element No. 1 is the screen grid whose rated potential is around 90 volts. Selector switch No. 1 is, therefore, set at the 90-volt position. Element No. 2 is the plate whose rated voltage is around 250 volts. Selector switch No. 2 is, therefore, set at the 250-volt position. Elements 3 and 4 are the heater. Their rated potential is 2.5 volts so that the filament-heater selector switch "3-4" is set at 2.5 volts. Element No. 5 is the cathode, and selector switch No. 5 is accordingly set to "—B" position which is the plate current return point in the tube tester circuit as indicated in Fig. 2. Element No. 6 is the suppressor grid which is ordinarily tied to the cathode. Selector switch No. 6 is, therefore, also set to the "—B" position. There is no element No. 7 since type 57 is a six-prong tube. Selector switch No. 7 is, therefore, left in the "O" position. Element "TC" or tube cap is the control grid and selector switch "TC" is accordingly set in the "—C" position. This places it at the proper point in the tube tester circuit for shifting its "bias," also shown in Fig. 2.

It can thus be seen that a means is provided for adapting this tube tester to any arrangement of elements within the tube that the tube manufacturer cares to make. Some of the later types of tubes incorporate the function of two or more tubes in a single glass envelope. By means of the selector switches individual tests of each combination of elements can be made which is a distinct advantage over testing the multi-function tube as a whole.

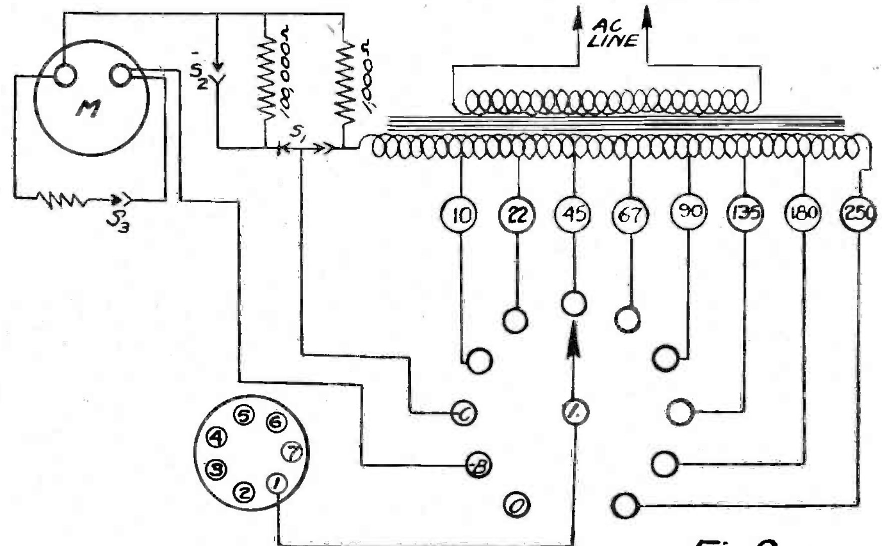
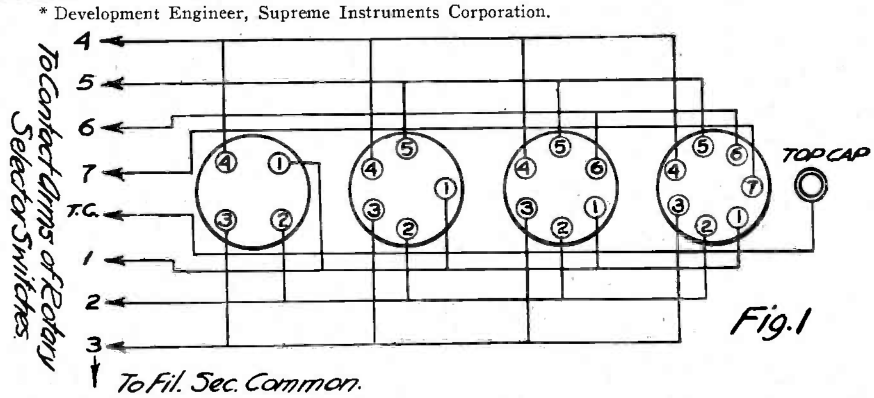


Fig. 2

Circuit of the power transformer and the selector switch for low and high voltages. Switches S-1 and S-2 are for grid and gas tests, while S-3 shifts the meter range

* Development Engineer, Supreme Instruments Corporation.



The wiring of the sockets, which are numbered in accordance with R.M.A. standards. The resultant terminals connect to a rotary selector switch

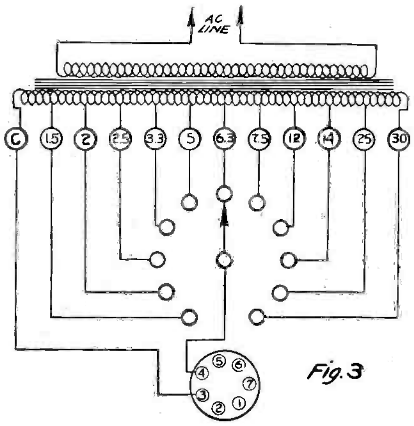
Cathode-Heater Shorts

This free reference point tube tester also provides a means of determining a cathode-heater short, which test is becoming more and more important as many elements are being crowded into a single tube. The rotary switch, whose contact arm is connected to the cathode element of the tube, is moved to the "O" position. If the plate milliammeter drops to zero when this rotary switch is thrown to the "O" position, the cathode and heater are naturally free from each other. If the plate milliammeter drops only part way to zero, this is an indication of a partial short between the cathode and the heater. If the plate milliammeter remains in its original position, the cathode and heater are directly shorted together.

Again referring to Fig. 2, it may be noted that the amplifying ability of the tube under test is determined by changing the bias on the control grid by an amount automatically determined by the plate current load of the tube under test. This plate current passes through the 1000-ohm resistor causing a potential drop across it which is applied with negative polarity to the control grid with switch "S_1" in the position indicated. By pressing switch "S_1" the control grid is connected to the other side of the 1000-ohm resistor which is at zero potential, thus changing the bias on the grid.

Gas Test

The 100,000-ohm resistor is placed in the control grid circuit to provide a gas test on the tube. The grid current flowing due to the presence of gas causes a drop across the high



Transformer and selector switch to provide the various values of heater and filament voltage

resistor, thus affecting to some extent the bias on the grid which in turn affects the plate current flowing as indicated on the milliammeter. When switch "S_2" is closed the high resistor is shorted out and the bias due to the gas current is thus removed from the control grid which in turn causes a change in the plate current. The difference in the plate current reading with switch "S_2" open and closed is, therefore, an indication of the amount of the gas present within the tube.

The milliammeter employed in the plate circuit is a double-range meter. The low range of ten milliamperes for full-scale deflection is used to test detectors and amplifiers, and the high range of one hundred milliamperes for full-scale deflation is used for testing large power amplifiers and rectifiers. The range of the meter is shifted by means of Switch S_2 shown in Fig. 2.

To facilitate setting the selector switches, each tube is charted with the various positions for each switch. The normal plate emission and plate current change are also included on the chart as well as the discard values.

Voice-Coil Impedances

The General Transformer Corporation calculate the approximate voice-coil impedance of a dynamic speaker as being about 1.3 times its d-c resistance. Thus, a voice coil in a diagram marked 5 ohms d-c would mean that the impedance would be approximately 6.5 ohms.

Dewald Model 55 Super

The Dewald Model 55 is a superheterodyne of the universal type, operating from either a-c. or d-c. It employs a type 78 pentode connected to function as a composite oscillator and modulator. This feeds a type 44 tube in a stage of i-f. which in turn feeds a type 77 second detector with a high bias. The type 77 tube is resistance coupled to a type 43 output pentode.

The rectifier is a type 25Z5 with half-wave connection. There is a 250-ohm choke in the negative leg of the supply system. The 3000-ohm speaker field is in the positive leg.

There is a fixed bias in the type 78 oscillator-modulator tube, but a variable bias on the type 44 i-f. tube, the latter functioning as volume control.

Resistance and capacity values are given in the diagram.

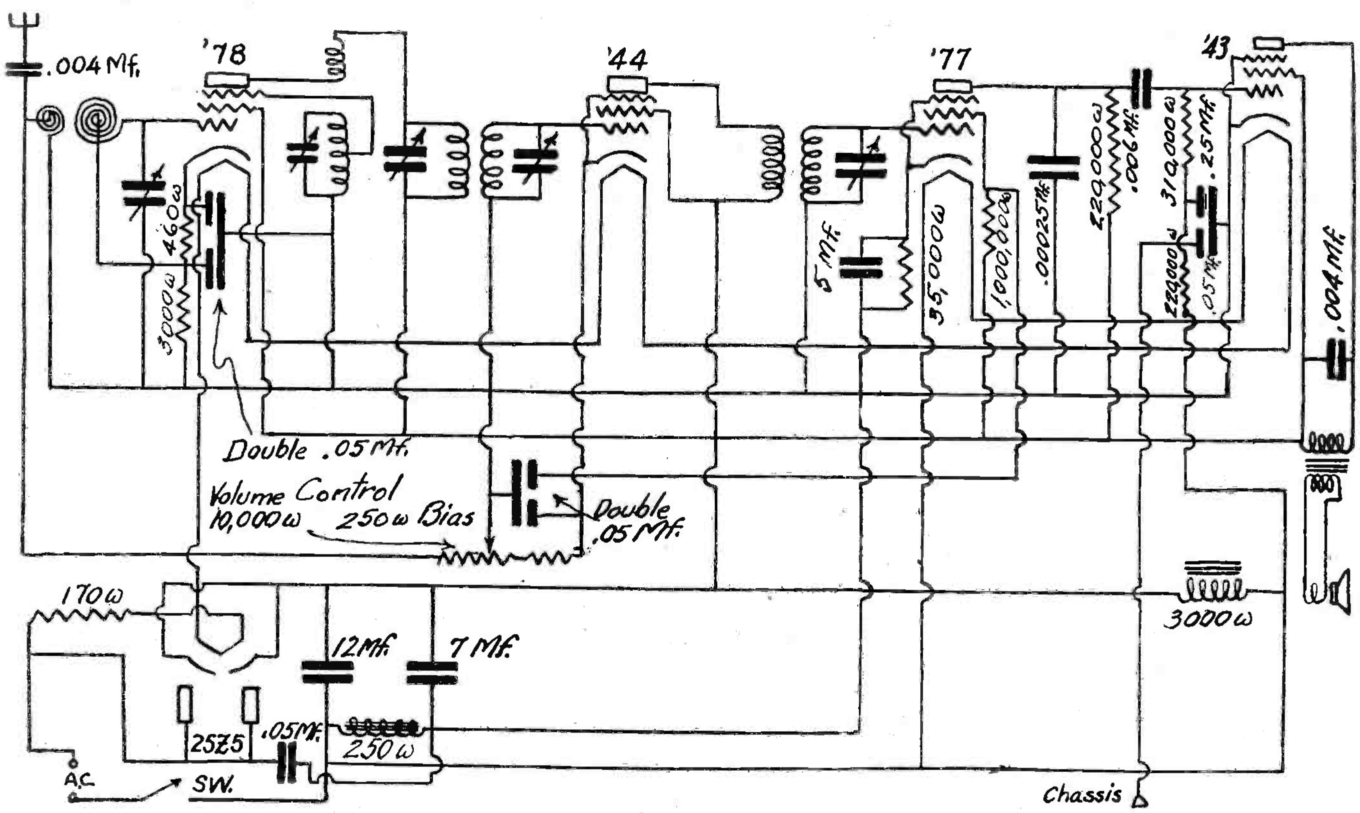


Diagram of the Dewald Model 55 Universal superheterodyne

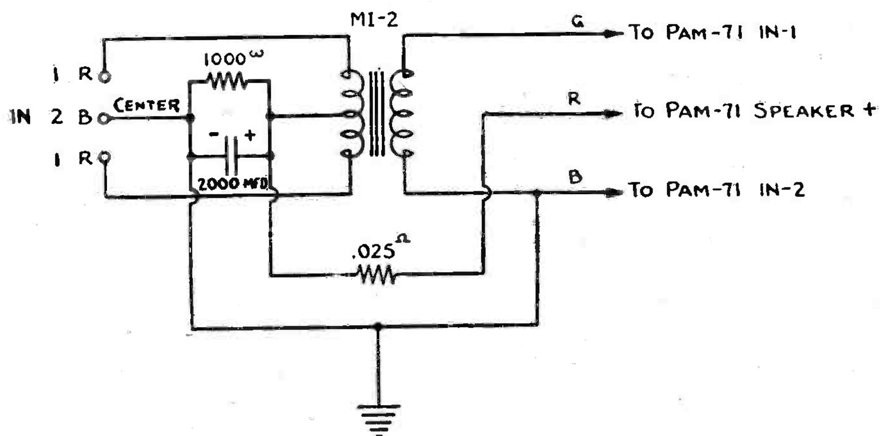
Public Address . . .

Samson Mike-71 and Pam-70, 71, 72

The Samson Mike-71 microphone unit is shown in Fig. 1. This is designed for use in connection with the Pam amplifiers Models 70, 71 and 72, the circuit for which is shown in Fig. 2. It will be seen from this diagram that the only difference between the three models is the different values for condenser C.

Note should be taken of the fact that the two types 45 tubes are in a resistance-coupled push-pull circuit, the passage of audio voltage through a series resistor and condenser providing a voltage on the grid of the lower 45 tube equal in value to that impressed on the grid of the upper tube, but opposite in phase.

All resistance and condenser values are given on the diagram. A voltage test on such a circuit is not necessary except to determine if circuits are open or shorted.



How Good Is Faithful Reproduction?

There has been a great deal of discussion during the past ten years as to how much distortion is permissible in public-address systems of high fidelity—or, in other words, when has a public-address system high fidelity?

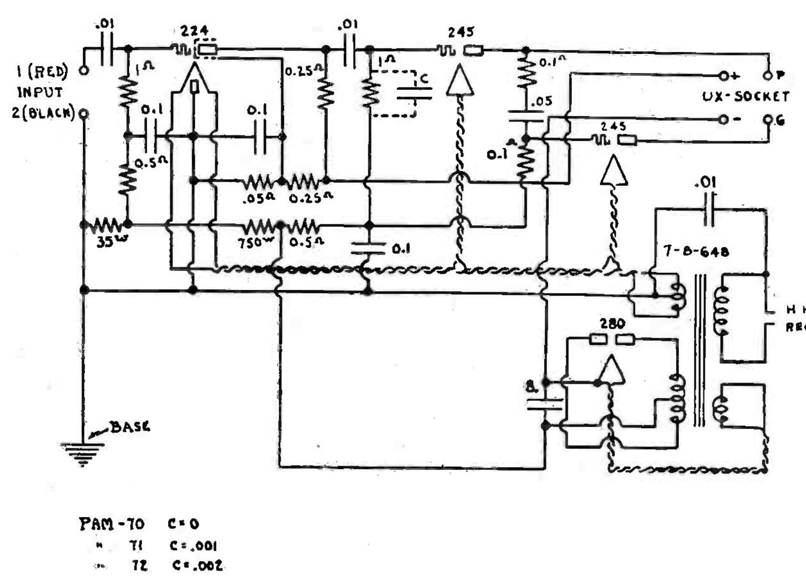
While high fidelity amplifiers have been available for some time, it is only recently that microphones and loudspeakers have been built with sufficient fidelity that a true picture of the effect of distortion on the human ear could be determined.

It has been known for some time that the human ear has very definite limits and the effect of harmonics of pure tones on the ear has also been well known. How the ear was affected by speech and music distortion of given amounts has remained unknown until recently, when certain measurements were made with ribbon microphones and high fidelity loudspeakers by Mr. Frank Massa. An account of his work is given in the *Proceedings* of the Institute of Radio Engineers for May, 1933.

This work shows that if the system reproduces frequencies up to 5,000 cycles that about 12 per cent of either second or third harmonic is the least that trained observers can distinguish when a distortionless system is available for switch-back comparison. If the system reproduces frequencies to 8,000 cycles, 5 per cent of either second or third harmonic can be observed under the same conditions of comparison. When the upper frequency limit is 14,000 cycles (try and find such a P-A system!), 5 per cent of second harmonic and 3 per cent of third is noticeable under conditions of switch-back. When no perfect system for quick comparison is available and the harmonic content of the signal is increased until just noticeable to trained observers—and this is the part of practical interest—the results are as follows:

Frequency Limit of System	*% Second Harmonic*	*% Third Harmonic*
5,000 cycles	17	10+
8,000 cycles	10	7
14,000 cycles	10	5

Fig. 1. (Above) Samson Mike-71 microphone unit circuit for use with—
Fig. 2. (Below) PAM amplifiers Models 70, 71 and 72 circuit



The best practical public-address systems seldom reproduce much above 8,000 cycles when measured from sound pressure into the microphone to sound pressure out of the loudspeaker, and not so many actually reproduce faithfully frequencies above 5,000 cycles.

Rating a P-A System

Now let us see how we can use this in rating the various elements of a public-address system. First, there is microphone distortion, then amplifier distortion, and finally loudspeaker distortion (there is practically no harmonic distortion in good impedance-matching transformers). Now the distortion from successive circuit elements will in general add up as the square root of the sum of the squares of the various components. For example, suppose that the microphone, amplifiers, and loudspeaker each introduce 10 per cent distortion. Then the total harmonic distortion in the system output will be

$$\sqrt{.1^2 + .1^2 + .1^2} =$$
$$\sqrt{.03} = \sqrt{3} \times \sqrt{.01} = 1.73 \times .1 =$$

.173 or 17.3 per cent distortion. Had each component of the system introduced only 5 per cent distortion, then the total would be $1.73 \times 5\% = 8.65$ per cent distortion. This latter figure is quite permissible for even the best of modern public-address systems. Thus we see that the figure of 5 per cent harmonic which is commonly taken as the overload point of high fidelity apparatus is in reality a conservative figure and a happy choice.

Good microphones and loudspeakers operated at about 80 per cent of their maximum rated output usually have something less than 5 per cent harmonic distortion, and good amplifiers operated up to full load of course have not more than 5 per cent.

Peak Values

Now the above values all refer to peak values and it is usual practice to estimate that the voltage peaks of speech are about twice as great as the average values; i.e., 6 db higher. Therefore, if an amplifier is rated at 30 db, or 6 watts, then program

(Continued on page 328)

THE SOURCE of SUPPLY

FOR

SOUND AMPLIFYING EQUIPMENT

Everything from the small Portable Public Address outfits to large Rack and Panel combinations for theaters, auditoriums and schools.

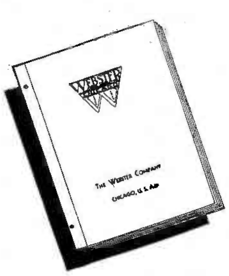
All types, sizes and prices of units for indoor and outdoor fixed or movable installations — many of them carried regularly in stock ready for immediate delivery.

Mixing Panels, Transformers, Booster Devices, Centralized Control Assemblies, Radio and Phonograph, Screen Grid Audio, Pentode Amplifiers—and special equipment built to order.

Whatever the requirements of the radio dealer, service man or engineer, he can usually fill them here; at a fair price and *immediately* without wasting time tinkering or hunting around.

Back of every unit in this wide, well balanced line is the Webster laboratory and the Webster guarantee.

Therefore when in the market for sound amplifying equipment save yourself time and "grief" by coming or writing direct to Webster.

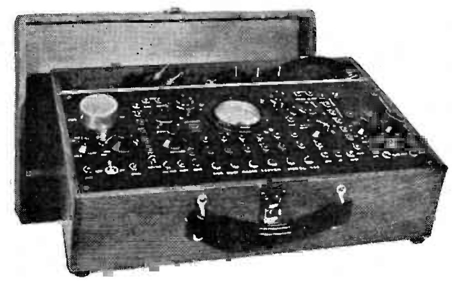


NOTE *Send for our complete catalog so you will have it handy for reference. Mailed on request.*

THE WEBSTER COMPANY

3825 West Lake Street
CHICAGO, ILLINOIS

COMPLETE LABORATORY EQUIPMENT



At a Popular Price

SUPREME Model 444

Five Unit Radio Tester

A modern analyzer, an A.C. tube tester, a shielded oscillator, an ohm-megohmmeter, and a capacitor tester—the kind of versatile instrument that has made "Supreme" the "buyword" for testing equipment—the instrument that gives the 1934 radioman complete laboratory efficiency at a popular price. And the instrument that has leaped out in front in a scant thirty days.

Includes the exclusive Supreme FREE REFERENCE POINT SYSTEM OF ANALYSES with all circuits of radio tube sockets extended through analyzer cable to four moulded sockets and to convenient terminals to which any ranges of the meter may be applied for current, potential and resistance measurements. A single meter for all measurements. All tubes including latest types without adapters.

The greatest value in radio test equipment at anywhere near its moderate price and in view of rising material costs, we recommend prompt placing of order. Leading jobbers prepared to demonstrate—Write for full mail details.

Dealers Net Cash Wholesale Price...... $89.50

Supreme Instruments Corporation
474 Supreme Bldg. Greenwood, Miss.

Auto-Radio . . .

Stromberg-Carlson No. 33 Super

This receiver is in two units: i.e., the receiver proper, and the speaker-power unit. The latter is illustrated in Fig. 2. A part of the Elkonode power unit is shown in the lower left corner of the drawing.

Operation

Referring to the schematic diagram of Fig. 1, when the On-Off switch is turned on, the battery voltage is applied to the heaters of the tubes in the receiver unit, the dial lamp, and the power relay in the speaker-power unit. The contacts of the power relay are, therefore, closed and the battery voltage is applied to the vibrator power supply. A slight hum will be heard from the vibrator. In a few seconds when the tubes have heated, the local relay will pull up, cutting off the temporary load resistor R-18. This resistor is kept in circuit until the tubes reach operating temperature to control the voltage applied to the receiver. Both of these relays must perform properly if the receiver is to function correctly.

The type 78 tube is used as an r-f amplifier and its output is coupled to the type 6A7 composite detector-oscillator. The i-f generated in the output of this type 6A7 tube is fed to the pentode portion of the type 6B7 tube which functions as an i-f amplifier. The two diodes in the 6B7 are operated on the amplified i-f signal. One diode is used for AVC and controls the type 78 and 6A7 tubes. The other diode is used for audio detector and its load resistor is coupled to the volume control potentiometer R-13 through R-12 and C-17.

The arm of the volume control feeds the audio signal to the grid of the type 37 a-f tube. From this tube the amplified signal is applied to the push-pull output stage which uses type 41 tubes.

The "B" power supply uses a self-rectifying vibrator. The rectified current is applied to the filter, composed of L-21, C-26 and C-27, and thence to the tubes.

I-F Alignment

Voltage readings are given in the accompanying table. These readings are made with the positive pole of the storage battery grounded. If the negative is grounded, the heater voltages will naturally be reversed. These voltages will vary slightly from the average given due to tolerances in resistors, variations in tubes and battery voltage differences.

In aligning the i-f, use an oscillator set at 260 kc. Connect the leads from this oscillator between the grid (top cap) of the 6A7 tube and chassis base. A 0.5-mfd condenser should be connected in series with the lead going to the grid to insulate the 260-kc oscillator source from the voltages of the 6A7 tube.

Connect the output meter across terminal "M" (shown in Fig. 2) of the fuse block and the speaker-power supply frame. This puts the meter across the moving coil of the speaker (4 ohms impedance). The signal applied should be very weak, just sufficient to show a deflection on the output meter.

Now adjust the aligners of the primary and the secondary of the first i-f transformer for the peak swing on the output meter. It will be necessary to check over these adjustments as they are somewhat interdependent. Now, adjust the aligner of the primary of the second i-f transformer in the same manner. Use an adjuster made of insulating material. These three adjusting screws will be found on the side of the chassis carrying the power transformer case. The two screws for the first i-f transformer will be found directly below the innermost type 41 tube. The upper screw is the secondary adjustment and the lower screw the primary adjustment. The adjustment screw for the primary of the second i-f transformer is on the same side

STROMBERG-CARLSON VOLTAGE DATA

Tube	*Heater**	*Grid*	*Plate*	*Screen*	*Suppressor*	*Cathode*
R-F.	—6.1	0.0	187	81	2.9	2.9
Det.	—6.1	0.0	187	81		—3.6
Osc.		—2**	187			
I-F.	—6.1	8.1	187	81		12.0
Det.			3†			
A-F.	—6.1	0.0	166			11.0
P-P's	—6.1	0.0	184	187		14.5

*Negative reading with positive pole of storage battery grounded.
†Audio diode. AVC diode reading is zero. Read on 100-volt scale of meter.
**Read on 250-volt scale of meter.

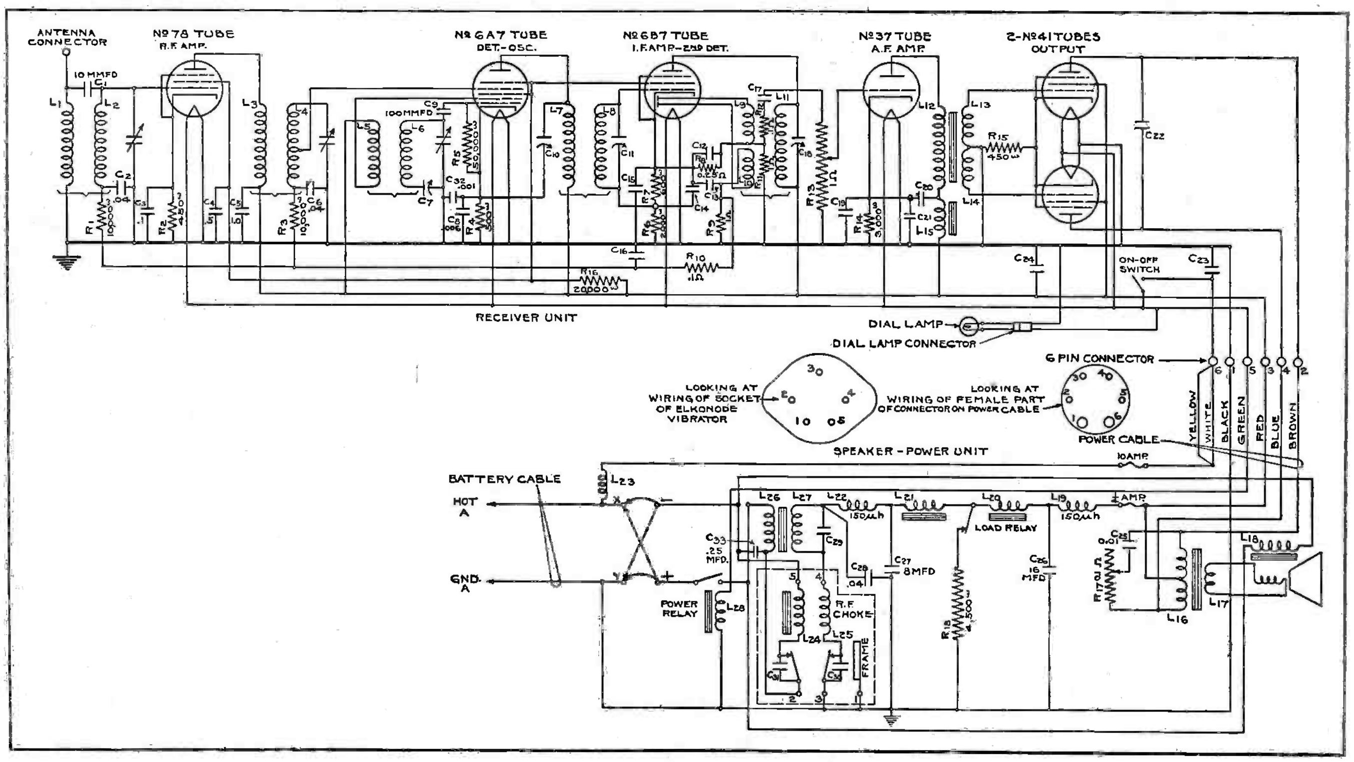


Fig. 1. Schematic diagram of the Stromberg-Carlson No. 33 Superheterodyne

How Do You Do It?

How do you solve the many servicing problems with which you have to contend . . . what special kinks have you worked out which help you in servicing receivers . . . have you developed short-cut schemes for testing, or built test devices that do the work better and faster?

No matter what the scheme or the device, there are many, many Service Men who would like to know the how's and why's—just as you would like to know about the schemes and devices employed by others.

SERVICE WANTS TO KNOW!

If you have clever ideas and clever devices, we want to know about 'em as much as do our readers. Regular space rates are paid for all material accepted for publication.

All you have to do is give us the outstanding points, and a rough pencil sketch of the device if it happens to be such—and we will do the rest.

Come on, now, and kick in. Write up those ideas now and send them in to the . . .

ON THE JOB DEPARTMENT

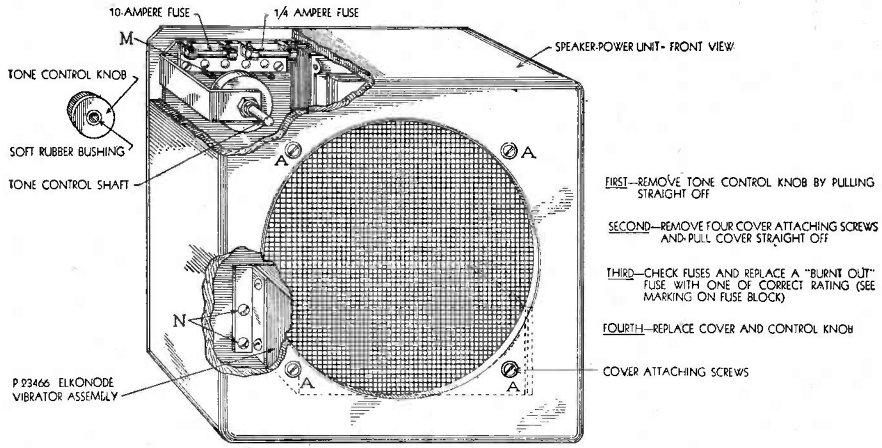


Fig. 2. Details of the speaker and power-supply unit, with directions for removing units

of the chassis directly below the power transformer case.

R-F ALIGNMENT

Now put the output of the oscillator on the antenna input terminal through a 200-mmfd condenser, the "low" side of the oscillator being connected to the chassis base.

Set the test oscillator at 1400 kc and place the set dial at 140. Make sure that the signal applied is only strong enough to give a deflection on the output meter. Now, adjust the oscillator shunt aligner for maximum meter deflection. Then adjust the r-f and antenna aligners in the same manner. The adjusting screws for all three of these aligning condensers are located on top of the condenser gang. The one nearest the front of the chassis is the antenna aligner, the next the r-f aligner and the last the oscillator shunt aligner.

Now set the oscillator at 600 kc and adjust the oscillator series aligner for maximum meter deflection. The adjustment screw is located at the front of the condenser gang. If this adjustment was very far out, it is advisable to re-set to 1400 kc and check the oscillator shunt aligner.

•

Fada Model 101 (RK) "Motoset"

The following data is supplementary to that given on page 218 of the June issue. The complete diagram is on the page mentioned.

In order to accurately adjust the various trimmer condensers it is necessary to use a shielded oscillator capable of giving a modulated carrier frequency which can be accurately attenuated at 175 kc., 600 kc. and 1,400 kc.

The set is equipped with automatic volume control which necessitates setting the manual volume control to its maximum position, to insure accuracy in alignment of compensators. To control the signal output of the set, it will be necessary to use the attenuator of the oscillator.

ADJUSTMENT OF I-F. COMPENSATORS

The three i-f. compensators are located in the top and the side of the chassis itself, as indicated in the accompanying sketch. Proceed as follows:

(1) Insert the speaker plug into the receptacle of the chassis.
(2) Connect a lead wire from the output of the oscillator to the control grid of the first detector tube. Do not disconnect the control grid connector from the tube.
(3) Connect a wire from the ground terminal of the oscillator to some part of the set chassis.
(4) Remove the type 37 oscillator tube from the receiver socket.
(5) Place the oscillator in operation and adjust the carrier frequency output to 175 kc. Regulate the attenuator control so that the output signal is low enough to insure accuracy in adjusting the i-f. compensators.
(6) With the aid of No. 4 socket wrench, adjust the compensators to resonance as indicated by the loudest signal from the loudspeaker.

ADJUSTMENT OF GANG CONDENSER COMPENSATORS

The compensators are located at the top of their respective tuning condensers and can be adjusted with the aid of a screw driver. Proceed as follows:

(1) A six-inch length of 1/4" brass rod with a standard tuning knob attached can be inserted in the condenser coupling for test purposes, thus eliminating the necessity of using the remote control.
(2) The wire from the output of the oscillator should be removed from the control grid of the first detector tube and attached to the antenna terminal on the set instead.
(3) Place the type 37 oscillator tube back in the socket.
(4) Adjust the carrier frequency output of the oscillator to 1,400 kc.
(5) With the aid of the brass shaft inserted in the condenser coupling, turn the gang condensers until the 1,400-kc. signal is tuned in.
(6) Adjust each compensator in the order given (that is, 1st, 2nd, 3rd) in the sketch, for maximum signal output as indicated by the loudest signal from the speaker. Do not disturb the setting of the gang condenser during these operations. Leave the volume control on full and regulate the signal output with the attenuator of the oscillator.

ADJUSTING OSCILLATOR SERIES CONDENSER

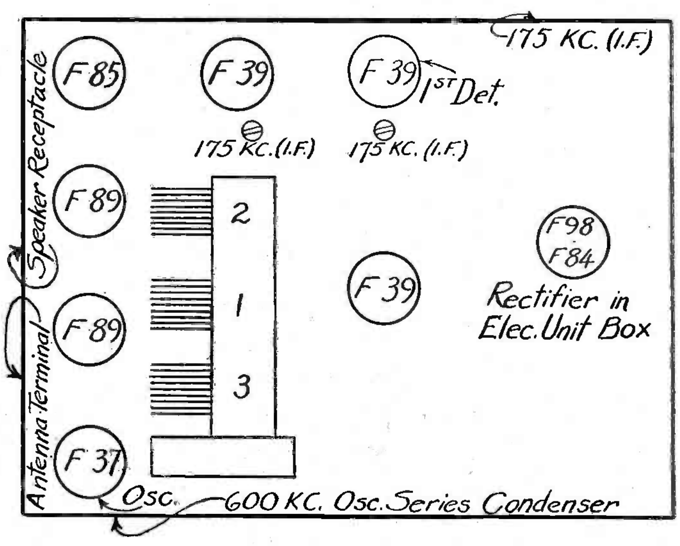
The oscillator series condenser can be adjusted through the hole in the side of the chassis as indicated in the sketch. It will be noted that it is close to the type 37 oscillator tube. Proceed as follows:

(1) Adjust the carrier frequency output of the oscillator to 600 kc.
(2) With the aid of the brass rod inserted in the condenser coupling, turn the gang condensers until the 600-kc. signal is received from the oscillator.
(3) With the aid of a No. 4 socket wrench, adjust the oscillator series condenser until the loudest possible signal is heard through the speaker. In order to adjust the oscillator series condenser to its maximum peak it will be necessary to "rock" the variable gang condenser back and forth to follow the strongest signal.
(4) After the oscillator series condenser is properly adjusted, set the oscillator in operation at 1,400 kc. and tune in the signal on the set; then readjust all variable condenser compensators as outlined previously.

USE OF OUTPUT METER

To use an output meter in the speaker circuit for the purpose of indicating the signal

(Continued on page 328)



Chassis layout of the Fada Model 101 (RK) "Motoset," showing locations of the tube sockets and adjusting condensers. The arrows indicate that the adjusting screws are on the sides of the chassis

WORN-OUT TUBES

(Continued from page 310)

Multiply this effective reduction in voltage amplification by the several stages in a receiver and the accumulative effect is seen to be quite serious. Consequently, for best results, all the tubes should be in perfect operating condition for optimum set performance.

POWER DEVELOPED

Now consider the case of a power-output tube. Fig. 1 shows a typical family of plate characteristic curves with an appropriate load line placed on them. This line represents the load impedance on the tube. The undistorted power output from a triode equals

$\frac{1}{8}$ of (I max. — I min.) $\times$ (E max. — E min.)

Suppose for a new tube the maximum plate current (I max.) is 68 ma., the minimum plate current (I min.) 6 ma., the maximum plate voltage (E max.) 360 volts and the minimum plate voltage (E min.) 120 volts. The undistorted power output then equals 2.16 watts.

As the tube wears out, less and less plate current is available. After the useful life of the tube has passed, the family of plate characteristics has changed to the conditions shown in Fig. 2. E max. is now 315 volts, and E min. is 162 volts. I max. has fallen to 40 ma. and I min. to 1 ma. The undistorted power output is now equal to 0.74 watts, or approximately 35 per cent of the original output. The loss of almost 65 per cent of the maximum undistorted output in a receiver will greatly reduce its performance capabilities. The sparkle and life-like tone of the set is lost, and the reproduction is not nearly so pleasing as that obtained with good tubes.

Another serious limitation on set performance imposed by old tubes is the distortion introduced into the output. This is somewhat difficult to demonstrate by simple mathematical means. However, the Service Man has only to listen to a receiver equipped with wornout tubes operating at full volume to realize the great increase in distortion chargeable to poor tubes.

•

FADA MODEL 101 "MOTOSET"

(Continued from page 326)

output of the set in preference to the audible method, insert a five-prong adapter in the speaker receptacle of the set. The adapter should be provided with two projecting lugs attached to its plate prongs, so that the multi-range output meter can be attached. The speaker plug is inserted in the adapter, thus affording both visible and audible testing.

•

FAITHFUL REPRODUCTION

(Continued from page 322)

levels should not exceed 24 db if 5 per cent total harmonic distortion is not to be exceeded (see the charts on page 179 of SERVICE for May, 1933, for the relation between db level and watts). However, if more distortion is permissible, the program level can be advanced as much as desired until distortion just becomes noticeable. When the usual well-designed amplifier is operated at full load the total distortion is usually between 10 per cent and 15 per cent. Of course, noticeable distortion of speech depends considerably on the voice of the speaker. Some voices are almost free of overtones and it is to be expected that they would be more susceptible to overload than voices richer in overtones.

•

Preventing Oscillation in Resistance-Coupled Amplifiers*

Resistance-coupled amplifiers can give trouble from motorboating even when decoupling resistors and condensers are used. This trouble can be eliminated by choosing a grid blocking condenser and grid leak for the following stage such that their time constant is equal to that of the plate resistor and bypass condenser. If this is not done, there is a chance that the gain at low frequencies will rise to such an extent that regeneration and oscillation can take place.

QST, pp 37, Sept., 1933.

•

Crosley Names and Models

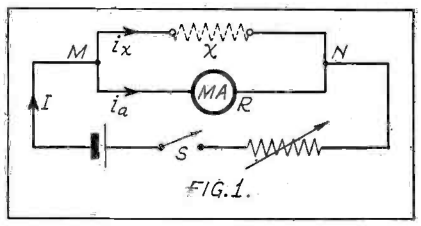
The Crosley Model 159 receiver is designed for operation on a 32-volt d-c farm lighting system. High voltage for the tubes is obtained from a type 401 Synchronode unit which uses a vibrator transformer.

The Crosley Model 164 chassis is used in the Tenace receiver. The 170 chassis is used in the Dual Ten receiver. The Dual Twelve receiver uses the 171 chassis. The 176 chassis is employed in both the Dual Travette and Dual Companion receivers. These are universal receivers.

ON THE JOB . . .

Low-Resistance Ohmmeter

It is often necessary to check up on low-resistance circuits, such as voice coils and the windings of r-f transformers. This can be easily accomplished without drawing excessive battery current by using the circuit shown in Fig. 1 in conjunction with an 0-1 ma meter.



The ohmmeter circuit. X = value of unknown resistance, i_x = current through unknown resistance i_a = current through milliammeter, R = internal resistance of milliammeter and I = full-scale deflection of milliammeter

With the test terminals open, the rheostat is adjusted to produce full-scale deflection of the meter. Since the resistance between the points M and N is small compared to the rheostat regardless of the value of X, then any value of resistance placed across the test terminals will have a negligible effect on the total current drawn from the cell. This current may be considered a constant I. That is,

$$i_x + i_a = I$$

$$Xi_x = Ri_a$$

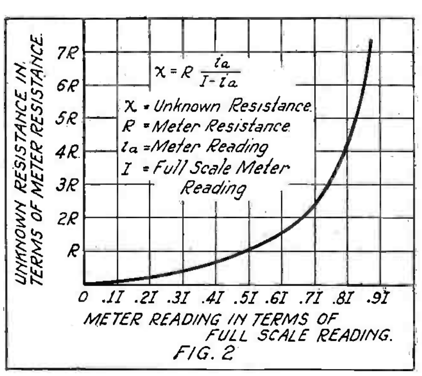
Solving this pair of simultaneous equations for X in terms of the known constants R, I, and the meter reading i_a we get:

$$X = R\frac{i_a}{I - i_a}$$

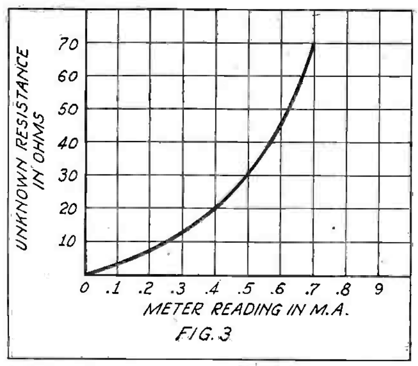
A graph of this function (Fig. 2) shows that for meter readings up to about three-quarters of full scale, the range is not too crowded, and that this allows accurate measurements to be made of resistances up to three times the meter resistance.

Taking a specific example, a Weston Model 301, 0-1 ma meter, we find that this instrument has a resistance of approximately 30 ohms. This means that accurate measurements may be made of resistances up to 90 ohms, while the important range from zero to 10 ohms is spread out almost linearly over the first quarter of the scale.

By shunting this meter so that 10 ma are required for full-scale deflection, then R would only be 3 ohms and the entire range would be cut down ten times, thus spreading out the first ohm over a quarter of the scale. Under these conditions the first division would be less than one-tenth of an ohm. This compares favorably with standard ohmmeters and draws very much less battery current.



Meter reading in terms of full-scale deflection



Approximate calibration for Weston Model 301 meter

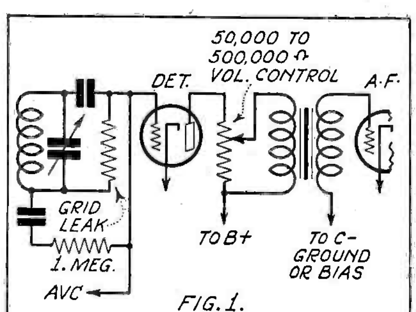
Fig. 3 shows an approximate calibration for the Weston 301 meter.

Arthur Miller.

•

Adding AVC to Sets

Fig. 1 shows an AVC arrangement I have successfully used on sets which have sufficient sensitivity and selectivity. This does not make a perfect AVC, but it is such a decided improvement over a good set that does not have AVC that it is well worth installation.

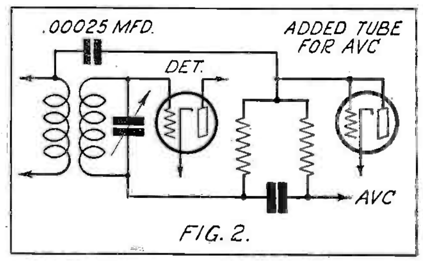


Circuit of simple AVC arrangement with grid-leak detector

The circuit is clear enough as it stands. The lead marked "AVC" connects of course to the grid circuits of the tubes to be controlled.

Another arrangement is shown in Fig. 2. In this case a separate tube is used for AVC. This system will work in either tuned radio-frequency receivers or superheterodynes, battery or a-c operated.

Naturally a fellow would have to know what he was doing to apply the above ideas to any and every set. For instance, in sets using 2-volt tubes, the circuit has to be arranged so that the tubes (those put on



Circuit with separate tube for AVC

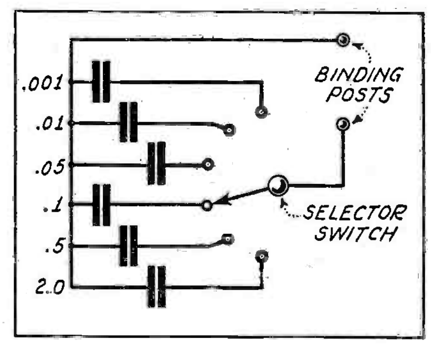
the AVC) get an initial bias from a C battery, or a drop in voltage off the B batteries.

Rudolph H. Koch.

•

Handy Capacity Device

We have on our test panel a simple device (shown in sketch) for locating open blocking or bypass condensers. There is nothing original in the idea, although very few Service Men have such an arrangement, which is handy to say the least.



Circuit of device for checking condensers in receivers

The capacities of the condensers used can be juggled to suit the builder's fancy—or more condensers added—as they are used merely to indicate opens or insufficient capacity in a circuit.

T. H. Kuykendall.

•

Curing Persistent Oscillation

Persistent oscillation in all makes of receivers which do not use pigtail connections on the rotors of the ganged variable condensers is a common occurrence. If everything else tests O.K. turn to these rotor contacts for the trouble.

They should be thoroughly cleaned, and this should be done before re-aligning the receiver. You will find that this will make a marked difference in the performance of the set.

Dirty contacts of this sort will be found in most receivers which have been in use for over six months.

W. P. Horne.

THE FORUM . . .

"Self-Reading" Diagrams

Editor, SERVICE:

Your reference to self-reading diagrams in the August issue of SERVICE sounds very encouraging. I seem to have a continual headache from reading new tube characteristics, resistor manuals, condenser manuals, etc. By all means—go to it!

HAROLD MELLE,
Toledo, Ohio.

(Glad you like the idea. A number of experimental diagrams of the self-reading type appear in this issue. They are not all alike. We have presented them in these various manners so that you fellows can pass on them. Which type do you find the easiest to read and the easiest to use?—THE EDITORS.)

Youngest Service Man

Editor, SERVICE:

Now that we've located girl "Service Men," how about America's *youngest* Service Man? I'd like to qualify for that name. I'm not speaking of "screwdriver" mechanics—I mean professional servicing.

I'm sixteen years of age and have never failed on a job yet. Just two weeks ago I repaired a "Senator" orphan receiver that other Service Men in our locality failed on. What say—are there any younger Service Men?

EDWARD J. DYMERSKI,
Pittsburgh, Pa.

(Well, you certainly have a head start on a lot of fellows—and congratulations. But, maybe you aren't the youngest after all. We'll soon find out.—THE EDITORS.)

Organization

Editor, SERVICE:

As to the organization of radio Service Men, I have seen a lot of good time go by in the effort and now I fully agree that the only way is to have our village, town, or city officials pass an ordinance calling for everyone who does radio work to be licensed and bonded under the State Utilities Commission, the same as the Electricians, Steam Engineers, Doctors, etc., in my State.

If we could only drop selfishness and acquire fellowship or cooperation, then go to work to have such a rule passed in each community, we could build a real radio servicing profession.

HARRY A. RIFE,
Grosse Pointe, Mich.

Philadelphia Organization

Editor, SERVICE:

With the object in view of organizing Philadelphia Service Men, I would appreciate your cooperation in publishing this letter in the Forum, in order that anyone in Philadelphia, or outside this area, who might be interested would be able to get in touch with me.

HARRY R. DE LONG,
107 E. Gorgas Lane,
Philadelphia, Penna.

AIR YOUR TROUBLES

THERE is hardly a set made which does not have some peculiarity, setting it apart from all other receivers. Quite often these peculiarities are of a mechanical nature—other times they are electrical. In either case they are troubles of an uncommon nature and must be sought out by the men in the field.

Of course, we are not referring to the usual run of faults common to practically all receivers, such as condenser or resistor breakdowns . . . after all, any good Service Man can find these without any great difficulty.

But set peculiarities are something else again. Quite often they defy the general forms of circuit and tube testing.

Data of this sort is of great value to any Service Man. If you have run to ground some peculiar fault and made it right, don't hoard the information. Send it along to us for publication so that others may immediately recognize the "bug" when they meet it.

SERVICE will pay the usual rates for any such material accepted for publication. Come on—air your troubles.

Self-Reading Diagrams

Editor, SERVICE:

I think the new self-reading diagrams are a *very decided improvement.* Hope they will continue.

FRED JEFFERY,
Martinsburg, Neb.

(Thanks. Glad you like them. Yes, they will continue.—THE EDITORS.)

Whoops—Sorry!

Editor, SERVICE:

About that "Switch A" in the diagram of the Weston Model 665 Selective Analyzer on page 279 of the August issue of SERVICE —don't you believe your readers would like an explanation of how this new "switch" works?

To us, it seems as if this automatic switch is made of a stack of four copper discs, one side of each having a coating of copper oxide. When potential is applied so that the copper side is positive, a bunch of electrons rush from the outside towards the copper oxide but find it tough going, so hardly any current flows.

On the other hand, when the polarity of the applied voltage is reversed the electrons about face and find themselves going through copper, which is easy going. In fact, so much so, that the acceleration attained is sufficient to crash through a layer of copper oxide and so results unilateral conduction or "Switch A" turns out to be a copper oxide, full-wave rectifier in disguise.

Perhaps that isn't just the way the game is actually played but at least it helps to refresh one's memory as to the direction in which the one-way street is laid out in these switches.

Chalk us up for another year of SERVICE, and oblige.

E. J. SAMPSON,
Brockton, Mass.

(Well, it's great fun for the kiddies, anyway. Our first assistant caption man is heartbroken that he should have made such an obvious error. Says he needs a vacation. Said that when he first looked at "A" he thought it was a letter box—which would have been nearer the truth.—THE EDITORS.)

Service Guarantees

Editor, SERVICE:

Regarding service guarantees, I believe Mr. Peran of Buffalo is right.

For the past eight years our guarantee policy has been as follows: Parts and tubes guaranteed for ninety days against defects with free replacement of parts and no charge for service.

But, it is also reasonable to assume that within fifteen days after service has been rendered that the customer should be able to make up his mind whether or not he has any complaint on the service rendered. If a call-back is made within the fifteen days we make no additional service charge, no matter what may be the cause. This occasionally uses up valuable time but is good advertising.

After the fifteen days has expired it is up to us to decide on free replacement or service, and occasionally we find it good policy to make a no-charge call. Circumstances always govern such free calls.

We render two types of service: one we call "Complete Service" and the other "Partial Service." On the first we give a ninety-day guarantee on everything. On the latter the guarantee is fifteen days on service and ninety days on parts and tubes.

There are now about five of us—four in Illinois and myself here—operating as above. It is, in my opinion, a thoroughly tested plan for the "square shooter" and one that might cause trouble for the other type of Service Man.

G. K. WARDLE,
Catskill, N. Y.

Circuits

Just to call your attention to the extra listing on the "Table of Contents" page. Under "Circuits" you will find listed the names and model numbers of all receivers whose circuits appear in this issue. This should save time.

MIDWEST 16-TUBE ALL-WAVE SUPERHETERODYNE—CORRECTIONS

(182) Mr. Victor Petsch, Newark, N. J.

(Q. 1.) What is the schematic circuit of the 16-tube all-wave superheterodyne which is being put out by the Midwest Radio Corp.? What technical information is there available concerning the components used in this set?

(A. 1.) In Fig. Q182A is illustrated the diagram of connections employed in latest-model, all-wave superheterodyne manufactured by the Midwest Radio Corp.; this is the Model 16 receiver. The values of the components are as follows:

Condensers C1, C2, C3, tuning condensers; C1A, C2A, C3A, R. F. trimmers; C4, .001-mf. padding condenser (mica); C4A, padding trimmer; C5, trimmer; C-6 to C11, I.F. trimmers; C12, C15, C16, C18, C19, C22, C23, C24, C26, C29, C30, C34, C36, C37, C38, C40 to C44, C46, C47, C53, .05-mf.; C14, C31, C35, 20 mmf. (mica); C17, 250 mmf. (mica); C20, .001-mf.; C21, 1. mf. (electrolytic); C25, 0.1-mf.; C27, 24 mf.; C28, .001-mf., padding condenser (mica); C32, C33, .002-mf. (mica); C39, 50 mmf. (mica); C45, C49, C52, 8 mf. (electrolytic); C48, C50, 4 mf. (special); C51, 4 mf. (electrolytic).

Resistor R1, manual volume control, 0.5-meg.; R2, "silent tuning" control, 1,000 ohms; R3, tone control, 50,000 ohms; R4, R9, R13, R21, R24, R36, R45, 31,000 ohms; R5, 10,000 ohms; R6, 100 ohms; R7, R11, R14, R16, R17, R26, R27, R28, R29, R31, R35, R38 to R43, 0.2-meg.; R8, R12, R20, R23, R25, R30, R37, 50,000 ohms; R10, R15, R19, 2,000 ohms; R18, 700 ohms; R22, 15,000 ohms; R32, 410 ohms; R33, 3 megs.; R34, 5,000 ohms.

The power rating of this set is 150 W. The sensitivity is better than 1. microvolt absolute and the rated power output is approximately 20 W. One of the dual reproducers is a 10 in. dynamic unit and the other is an 8 in. model. A master wave-change switch controls the R. F., detector and oscillator circuits; at the same time, a corresponding colored pilot light identifies the band.

(Q. 2.) Is it possible to make a really sensitive crystal set?

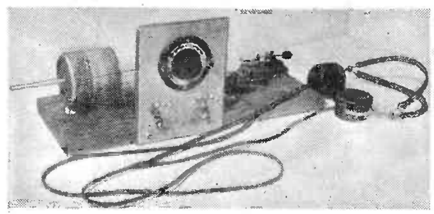


Fig. Q182B
Photograph of the sensitive crystal receiver.

(A. 2.) The sensitivity of a crystal set is mainly dependent upon the sensitivity of the particular piece of crystal used as the rectifying element. However, the high power in use today by a great number of stations renders it necessary to use some form of selector circuit which will enable the high-power "locals" to be tuned out in order to hear the more distant stations.

(Continued on page 442)

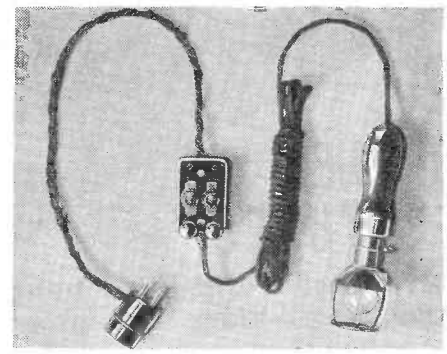


Fig. Q182C
Photograph of the device used to obtain power from receiver power units

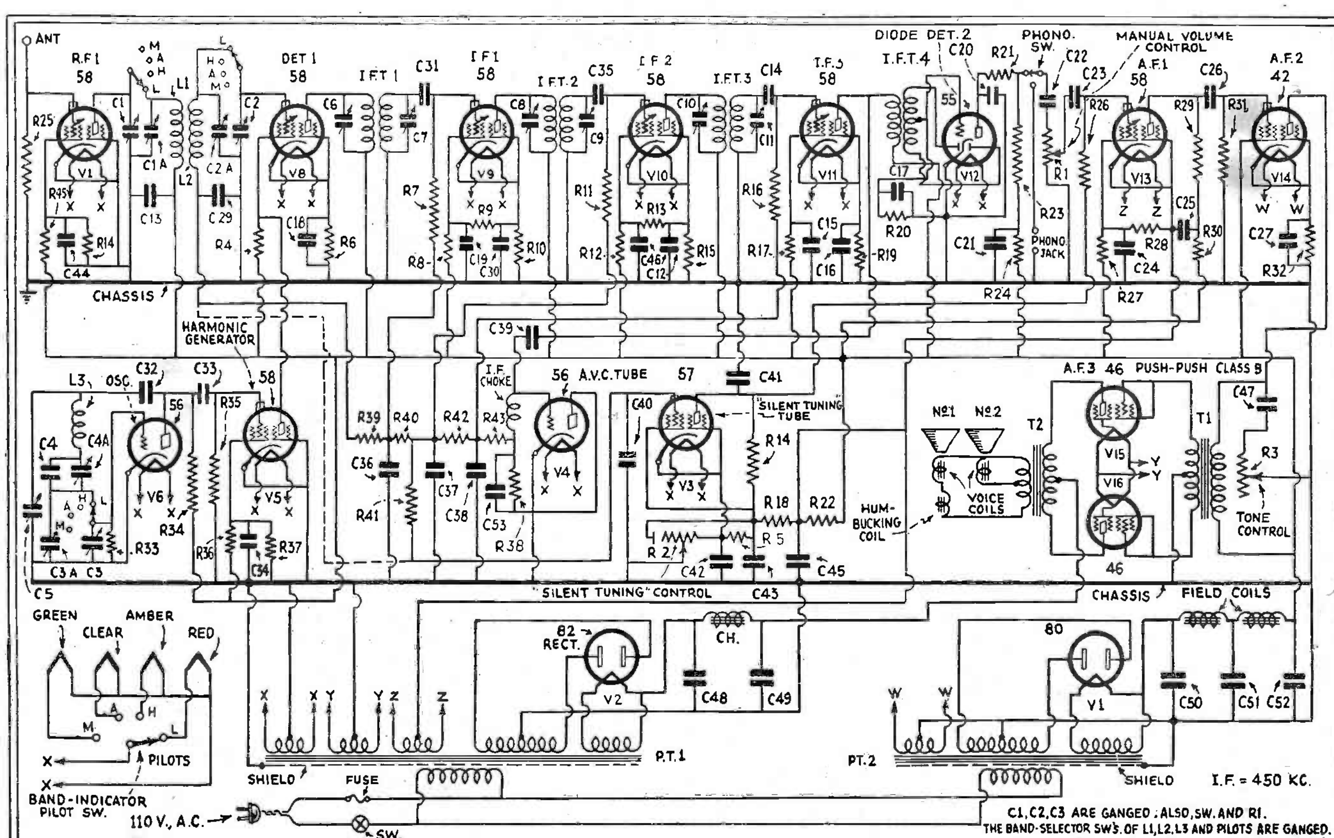


Fig. Q182A
Complete schematic circuit of the Midwest 16 tube receiver, a question concerning which was asked by Mr. Petsch.

HIGHLIGHTS . . .

"RPC"

RPC—that's Radio Progress Week; October 2 to 7. Don't forget. Send those circulars out to your list. If you failed to get circulars and mats for your advertising, get them now, before it's too late—the supply may well run out.

We have had a number of reports from Campaign Headquarters. Things seem to be buzzing along in fine shape. Everyone getting behind the idea. Everyone pushing —sales—service—special installations.

RPC ought to bring results. It depends a great deal on you and what you do to help.

•

Remote Control

There is a definite trend towards the breaking up of the once happy family of radio components. The speaker—and in some cases the power amplifier—are being torn away from the receiver proper.

Well, why not? Small receivers are very convenient—and very good if a large speaker is used separately and mounted on a fair sized baffle. Thus the present form of remote control.

Armchair tuning is very desirable, not just because people are lazy but also because it is necessary nowadays to continually jump from station to station to get away from many objectionable program "features." After all, people can't forever be jumping up from their chairs to retune. They get fed up with such athletics and more often as not end up by turning off the receiver to be free of this inconvenience.

For these reasons we believe that the Service Man can do a great deal for himself and for his customers by selling to them some form of remote or armchair tuning and volume control. Such suggestions may bring about the sale of a new receiver of the remote control type, or the sale of a special installation on an old receiver.

What ways are open for such installations? Well, first of all, it is possible to obtain quite cheaply completely-equipped remote control tuning and volume control units which may be easily attached to practically any receiver, no matter its type. This provides complete armchair control, and is nothing less than the berries.

Another arrangement—suggested in a past issue—is the use of a midget receiver as the remote control unit and the old receiver as the power amplifier and speaker unit. In this case one merely dispenses with the "receiver" portion of the old set and uses only the amplifier and speaker.

Another scheme which might appeal to some customers—a midget chassis, connected as above, but mounted in a plain-faced cabinet with no tuning dial or speaker opening. To the chassis is added a group of midget variable condensers and a system of push-button switching for the purpose of progressively adding shunt capacity to the main tuning condensers. This should be quite a simple arrangement in a midget with a double gang condenser. The gang condenser would be permanently set at the lowest wavelength broadcast station desired by the set owner. Then by the switching arrangement other condensers would be thrown into shunt with the gang condensers for the reception of stations on higher wavelength. These extra condensers would, of course, be permanently set for certain desired stations so that at the push of a "tuning button" the station wanted would break in instantly.

We would like to hear from any of you fellows who work out some of these schemes.

•

Receiver Design Story

This month ends the series of articles on The Story of Receiver Design. Wish it could have been longer.

We have had letters from a number of readers requesting the complete series bound up in booklet form. If there is a sufficient demand for the series in this form, then we can afford to do this at a moderate price. The question is, how many of you fellows would be interested? Won't you let us know by postcard?

•

"Short Wave Radio"

Robert (Bob) Hertzberg and Louis Martin, both well known in the scientific publishing field (and both good radio men) have instituted a brand new publication named "Short Wave Radio."

The magazine is essentially a "fan" medium devoted to the growing short-wave field, and will particularly exploit international short-wave reception.

You fellows who are interested in the short waves should watch for "Short Wave Radio." It'll be sold on the newsstands—first issue about October tenth—but if you don't see it, you can write to Standard Publications, Inc., 1123 Broadway, New York, N. Y.

•

Help! Police!

C. A. Snider, of Waynesboro, Pa., and the local Atwater-Kent dealer were trying to make a sale of one of the new five-tube A.K. Compacts to an old gentleman who is rather well-to-do and who has a large summer cottage on the mountain resort near that city. In explaining that one could get police calls with the set, the gentleman exclaimed rather pompously, "Oh, I wouldn't bother to use the radio to get the police; I would use my telephone for that."

•

United Transformer Corp.

Mr. I. A. Mitchell, Mr. S. I. Baraf, and L. Goldstone, formerly of the Kenyon Transformer Co., Inc., have organized the United Transformer Corp., with offices and plant at 266 Canal Street, New York, N. Y.

UTC engineers specialize in the design of audio transformers, filter and plate transformers and similar equipment.

"Post" Mortem

Mr. R. H. Koch, of Prestonsburg, Ky., has written us about a service job which is the berries.

Says Mr. Koch, "I was called out on a Westinghouse clock model job—the one with the speaker aimed at the ceiling. There was neither volume nor tone. *After taking two copies of The Saturday Evening Post off the top of the set, everything was O. K.*"

The above brought on a discussion here as to whether or not a Service Man should charge his usual rate for a call on anything so simple as removing two copies of a magazine from off the speaker. Everyone finally agreed that the full charge should be made in such cases, as Service Men, like men of many other professions, are charging for their knowledge as well as the work they do.

•

Shure Technical Bulletin

A monthly publication of interest to Service Men is issued by the Shure Brothers Co., 215 West Huron St., Chicago, Ill. The publication deals with the practical and technical phases of microphones, speech-input equipment and public-address systems.

Address subscription requests to the company on your letterhead. There is no charge. A limited number of back issues are available for those who wish complete files.

•

Fog Eye

A local boy has been playing around with sensitive thermocouples for the detection of infra-red rays. From this experimentation—which, incidentally, was an outcropping of his original researches in television—he developed a device for spotting ships and planes through fog, or in the darkness. He spots 'em by the infra-red rays given off by the hot stacks on the ships and the hot exhaust manifolds on planes. It is claimed that in this manner he can spot a ship some 12 to 15 miles distant, or over the horizon!

Thus, radio adds to the collection of devices the war barons can use.

•

Fire Signals

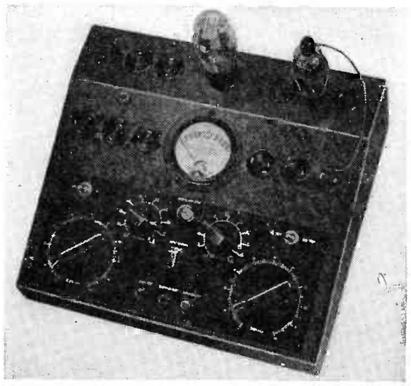
Mr. H. B. Conway, of South Nyack, N. Y., has a neat way of attracting business and at the same time keeping his name before the public eye. He has had printed the local fire alarm signals—something the average person keeps around. Below the list of signals Mr. Conway has his little song and dance, and on the reverse side of the card, he lists his service charges.

Maybe you think the only time a person would have his eyes greeted by Mr. Conway's little advertisement would be when his own alarm sounded. Tain't so. In towns and cities having volunteer fire departments, everyone is interested in whose house is afire. A list of fire signals is therefore a much consulted item.

THE MANUFACTURERS . . .

Dayrad Series 10 Tube Checker

The Radio Products Co., Dayton, Ohio, have introduced a new type tube checker with a number of interesting features. First off, all tubes having the same number of prongs are tested in the same socket. By means of one of the switches on the panel of the instrument, the tube sockets are automatically connected for the tube to be tested.



All filament voltages from 1.5 to 30 volts are available. A selector switch picks the correct voltage for the tube under test.

Push buttons on the panel provide a diode test, rectifier test and amplifier test. There is also a lamp for indicating shorts.

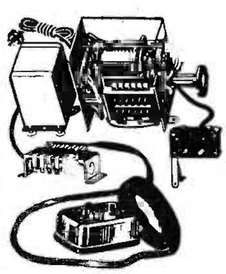
Future growth is provided for by means of an 8-hole socket, already connected.

The case of the instrument is of steel, hard enamel finished with a bakelite panel, suitably engraved. The large meter is used for testing tubes as well as for the line voltage.

•

Automatic Remote Control

Wholesale Radio Service Co., Inc., 100 Sixth Ave., New York, N. Y., have at hand Westinghouse automatic remote tuning and volume control units which should fit in splendidly with the present trend of "hide the set but hear the music," or "less set and more convenience."



This remote control unit provides the means of selecting any one of six different stations from a remote point, as well as the adjustment of volume and turning on and off the receiver. This is all done from a small case, with pilot light, to which is attached 25 feet of flat cable with which to make the necessary connections to the remote control mechanism.

The mechanism consists of a single capicator motor which operates independently of each other the gang condenser and volume control.

The mechanism is made for operation on a 110-volt, 60-cycle line only, but just so long as such voltage is available, it will work with practically any receiver.

•

Radolek Resistance Indicator

The Radolek Company, 601 West Randolph St., Chicago, have brought out a calibrated 0 to 100,000-ohm easy-reading Resistance Indicator. Contained in a polished brown bakelite box, pocket size, with an etched aluminum scale and circuit diagram.

This unit may be substituted as a trial resistor in circuits suspected to require less than 100,000 ohms resistance. Quick hand adjustment indicates the exact value of resistance in ohms being used. Has 7 inches of wire-wound resistance contacted by a smooth non-pitting, non-arcing, roller contact. Potentiometer style special 25,000-ohm calibrated variable resistance and three selected 25,000-ohm carbon resistors in series constitute the entire resistance element. The potentiometer is designed with the initial 1000

ohms distributed uniformly over half the arc of rotation. The balance of 24,000 ohms is uniformly distributed over the remaining portion of the resistor strip.

The fire-proof bakelite construction of the Resistance Indicator prevents shock or burn from exposed metal.

Accessories include a pair of 24" test cords with alligator spring clips and spring plugs to fit the pin jacks on the unit.

•

IRC "Elbow Type" Suppressor

A new "elbow type" motor radio suppressor for cable installations on cars having recessed spark plugs has been introduced by the International Resistance Co. This is known as Type MCB Improved Cable Type Suppressor.

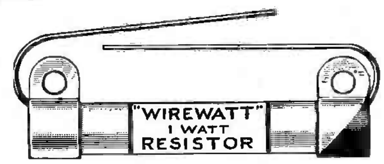
The design of this new unit eliminates the danger of poor contact with resulting loss of spark intensity. Using the "MCB" it is only necessary to pry off the old cable terminal fitting. The cable is then fastened on the recessed screw in the suppressor for positive contact in the very center of the wire while the suppressor elbow is slipped snugly over the top of the spark plug.

The MCB Suppressor is molded into solid, one-piece construction without springs, etc. Standard value is 15,000 ohms although other values can be furnished.

•

Ohmite "Wirewatt" Resistors

Ohmite announces a new resistor unit known as the "Wirewatt". It is a wire-wound unit having a one-watt rating. It is the same size as the ordinary one-watt composition unit and may be used both in original equipment and for replacement work where the resistance value is not over 25,000 ohms.



It is stated that the inductive effect of these resistors is so slight that it may be safely disregarded in all broadcast receiver circuits.

•

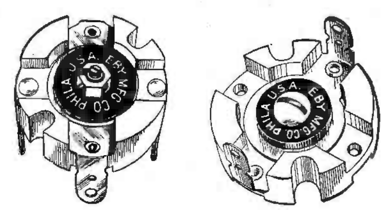
Aerovox Compact Electrolytics

The Aerovox Corporation, of Brooklyn, N. Y., recently announced a new series of Aerovox Hi-Farad electrolytic condensers especially designed to meet the requirements for compact units for use in modern midget radio receivers and other small size apparatus assemblies.

•

Eby Trimming Condensers

These new condensers are available in both single and double assembly. The double trimmer is quite novel. The single assembly can be used in the i-f. transformer and adjusted from one side for each condenser which is respectively connected to the primary and secondary of the transformer to be tuned. The single condenser is so arranged that several arrangements are possible, making practical electro-static coupling schemes that are usually not possible with condensers of this sort.



The condensers are used separately or in sets in connection with i-f. transformer assemblies and any other place where trimming condensers are ordinarily used.

The base is made of a high grade ceramic material with a power factor between 0.4 and 0.5 per cent. The plates are of spring, non-ferrous material.

The lowest ranges are 10 to 80 mmfd. and the highest ranges 700 to 1,000 mmfd.

Group Subscriptions at SUBSTANTIAL SAVINGS!

- The Regular Subscription price for SERVICE is now $2.00 per year.

You, no doubt, know many other Service Men who would like to receive SERVICE every month. Probably several other Service Men in your acquaintance are already subscribers.

Here are two plans whereby you can save money for yourself and your friends:

- *1—Subscriptions (new or renewals) can be purchased in groups of ten or more for $1.00 per year each.*
- *2—Subscriptions (new or renewals) can be purchased in groups of five to ten for $1.50 per year each.*

If your subscription is about to expire show SERVICE to five or ten of your friends. They, too, will want it. If they are already subscribers, they will want to renew or extend their subscriptions.

If you wish to *extend* your subscription at these savings, get five or ten others to subscribe at the same time.

Be sure to print clearly the name and address of all the subscribers, and send a check or money order covering the exact amount, noting in each case whether the subscription is a new one or a renewal.

All Offers are Subject to Withdrawal Without Notice

John F. Rider Publications, Inc.

1440 Broadway New York, N. Y.

Index of Monthly Literature

BROADCAST

Amplifiers, A-F.

Adding Class B to Amplifiers (Circuit)
Radio-Craft, pp 208, October, 1933

A-F. Amplifiers with 2B6 Tube (Circuits, Characteristics)
C. F. Stromeyer, Radio Engineering, pp 11, August, 1933

AVC for A-F. Amplifiers (Circuit)
H. I. Metz, Radio-Craft, pp 226, October, 1933

Matching P-P 2A3's*
Radio, pp 13, September, 1933

Preventing Oscillation in Resistance-Coupled Amplifiers*
S. J. Preston, QST, pp 37, September, 1933

Amplifiers, R-F.

Low-Pass Filters for Broadcast Sets (Design)
F. C. Everett, QST, pp 36, September, 1933

Stability Problems of T.R.F. and Supers
S. W. Place, Radio Engineering, pp 8, August, 1933

General

Electric Filter Design, Part V
C. A. Johnson, Radio News, pp 216, October, 1933

Low-Pass Filters for Broadcast Sets (Design)
F. C. Everett, QST, pp 36, September, 1933

Midget Receiver Developments*
E. Messing and M. Cohen, Radio Engineering, pp 6, August, 1933

Power Supply for D-C. Dynamics (Circuit)
G. Wallace, Radio-Craft, pp 227, October, 1933

Receivers

National FB-7 (Circuit, Tests)
Radio News, pp 211, October, 1933

Sargent 9-33 S.W. Receiver (Design Details)
E. M. Sargent, Radio, pp 12, September, 1933

PUBLIC-ADDRESS

26-Watt Dual-Channel P-A System, Part II (Construction)
L. Gancher, Radio-Craft, pp 216, October, 1933

Adding Class B to Amplifiers (Circuit)
Radio-Craft, pp 208, October, 1933

A-F. Amplifiers with 2B6 Tube (Circuits, Characteristics)
C. F. Stromeyer, Radio Engineering, pp 11, August, 1933

Data on P-A. Systems
C. E. Denton, Radio-Craft, pp 221, October, 1933

Power Amplifiers (4) (Circuit Design)
F. Lester, Radio-Craft, pp 214, October, 1933

RCA Victor PG-63 Amplifier (Service Data)
Radio-Craft, pp 224, October, 1933

SHORT WAVE

Improved Wallace S.W. Receiver (Construction)
B. J. Montyn, Radio News, pp 213, October, 1933

National FB-7 (Circuit, Tests)
Radio News, pp 211, October, 1933

Sargent 9-33 S.W. Receiver (Design Details)
E. M. Sargent, Radio, pp 12, September, 1933

TESTING SYSTEMS

Analyzer Unit (Construction)
M. Reiner, Radio-Craft, pp 220, October, 1933

Inductance-Capacity-Wavelength Chart
Radio-Craft, pp 230, October, 1933

New Resistance Aanalysis Unit (Circuit)
K. Clough, Radio News, pp 236, October, 1933

Remodeling "Radio-Craft" Analyzer (Circuit Design)
Radio-Craft, pp 218, October, 1933

TUBES

Matching P-P 2A3's*
Radio, pp 13, September, 1933

RCA Tube Chart (Reproduction)
Radio, pp 16, September, 1933

"Shoe-Button" Tube (For Short Waves)
Radio-Craft, pp 205, October, 1933

Small Tubes for 1-Meter Reception
B. J. Thompson, Electronics, pp 214, August, 1933

MISCELLANEOUS

Electric Filter Design, Part V
C. A. Johnson, Radio News, pp 216, October, 1933

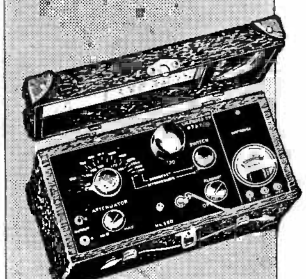
Low-Pass Filters for Broadcast Sets (Design)
F. C. Everett, QST, pp 36, September, 1933

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.

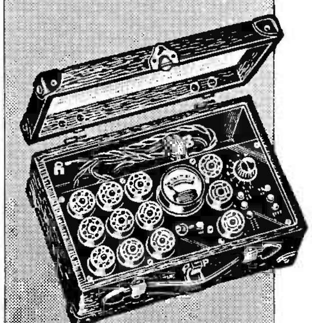
READRITE EQUIPMENT APPROVED BY PROFESSION . . .

because of Greater Flexibility ... Economy ... and Ruggedness !

No. 710 READRITE TESTER



No. 550 READRITE OSCILLATOR



No. 410 TUBE TESTER

NOW is the time to cash in on the widespread public interest that is being aroused by the sensational Radio Prosperity Campaign. And you, as a Radio Service Engineer, can cash in best by using the Readrite testers shown here. They will make money for you and save you money! You can afford to standardize on Readrite instruments. They are popularly priced. They enable you to make more calls at less cost per call . . . they make it easy for you to meet every servicing requirement . . . they withstand the hardest kind of use and abuse . . . they insure that your equipment dollar stretches much farther.

No. 710 READRITE TESTER

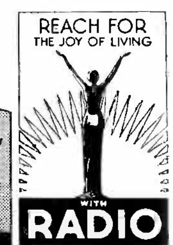
This all-purpose tester fills every need of both the expert service man and the beginner. It is designed for the testing of new and old radios. Equipped with a practical selector switch for checking all parts of tube circuits by connecting to the set sockets. Selection for testing voltage of plate, grid, cathode, suppressor grid and screen grid is quickly and accurately done. Plate current, filament volts, line and power supply volts, resistance and continuity are measured. Battery is used for continuity testing of transformers, chokes, etc. Handles most advanced circuits and newest tubes.

The No. 711 Readrite Tester is the same as the No. 710 except that it is equipped with the new Triplett D'Arsonval Volt-ohmmeter, which has 1000 ohms per volt resistance. The readings are 0-15-60-300-600---0 to 300,000 ohms. Ohmmeter reading is secured with the 4½ volt battery, which is furnished.

Here's Proof of READRITE Leadership. Write for your copy TODAY!

No. 550 READRITE OSCILLATOR

This signal generator furnishes a modulated signal of constant frequency for the alignment of all modern radios. It is used to align r. f. transformers, check oscillator stage, compare gain in tubes and determine the sensitivity of a receiver.



No. 410 TUBE TESTER

Used for checking new and old tubes in receiving sets. Simply designed, compactly constructed, this tester is ideal for both outside work and for counter use. A push button provides two-plate current readings for determining the conductance and worth of a tube. For those wanting a longer-scale instrument, the Model 416 Tester, with a Triplett D'Arsonval Flush Mounted Meter is offered. This instrument does not have illuminated dial, but in other respects is the same as the No. 410.

NRA MEMBER U.S. WE DO OUR PART

TIE IN WITH THE NEW PROSPERITY CAMPAIGN

SEND COUPON FOR QUICK FACTS !

READRITE METER WORKS,
82 College Ave.,
Bluffton, Ohio.

Gentlemen:
Send me catalog on Readrite Instrument No. ( )
as well as folder giving proofs of Readrite Leadership.

Name ....

Street Address ....

City .... **State** ....

YOUR JOBBER CAN SUPPLY YOU

See him today, or send the coupon for descriptive catalog.

READRITE METER WORKS

82 College Ave., Bluffton, Ohio

They'll Help You Too!

NRA MEMBER
U.S.
WE DO OUR PART

JOHN F. RIDER'S

PERPETUAL TROUBLE SHOOTER'S MANUALS

Volumes I, II and III

Have been found to be of tremendous aid to the entire radio service industry. You will find them as essential as your set tester, tube checker and test oscillator.

To own Rider's Manuals is to have the finest service helps—the means of employing your service test equipment to best advantage—the means of servicing receivers and amplifiers with greatest ease, speed and accuracy. These three factors mean profit for you.

Follow the recommendations of the greatest tube-manufacturing organizations—E. T. Cunningham, Inc., National Union Radio Corp., RCA—Radiotron Co.—who have used these Manuals in tube deals and honestly recommend their purchase. Acceptance of these Manuals by these companies establishes the Manuals as the finest in the world. Acceptance and recommendation by the Weston Electrical Instrument Corp., Hickok, Supreme, Readrite, and other famous service instrument manufacturers, proves that Rider's Manuals have no equal.

The best radio-receiver manufacturers endorse, use and recommend Rider's Manuals. You can do no better than to buy and use Rider's Manuals. Ask the man who has used one!

VOLUME I, $7.50 *About 1,100 pages*	VOLUME II, $6.50 *About 800 pages*	VOLUME III, $7.50 *About 1,185 pages*

Sold With a Money Back Guarantee

A NEW Rider Manual—

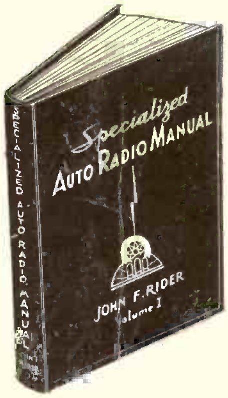
THE SPECIALIZED AUTO RADIO MANUAL

prepared exclusively for auto radio service!

Contains service information on all auto radio receivers—old—new—right up to the minute. Rider's *Specialized* Auto Radio Manual is the only one to have a symposium on auto radio installation, antenna installation, suppression, etc. Full and complete alignment details are also in this Manual.

We want you to buy this Manual by comparison. Compare it with any other auto radio manual. You will find that Rider's *Specialized* Auto Radio Manual—the Rider Manual in the Brown cover. . . .

—has about 60% more pages than any other auto radio manual
—has more old auto radio receivers than any other auto radio manual
—has more new auto radio receivers than any other auto radio manual
—has more complete information about the receivers
—has a more complete and useful index
—has about 340 pages
—Is actually bound in imitation leather
—has letter press printed pages throughout
—Is a finer, more detailed, elaborate Manual in every respect



If you are in the auto radio service business you must have Rider's *Specialized* Auto Radio Manual. You can't do without it.

340 Pages—Price, $3.50 Postpaid

Sold With a Money Back Guarantee

JOHN F. RIDER

1440 Broadway — New York, N. Y.

PRINTED BY
BLANCHARD PRESS
NEW YORK