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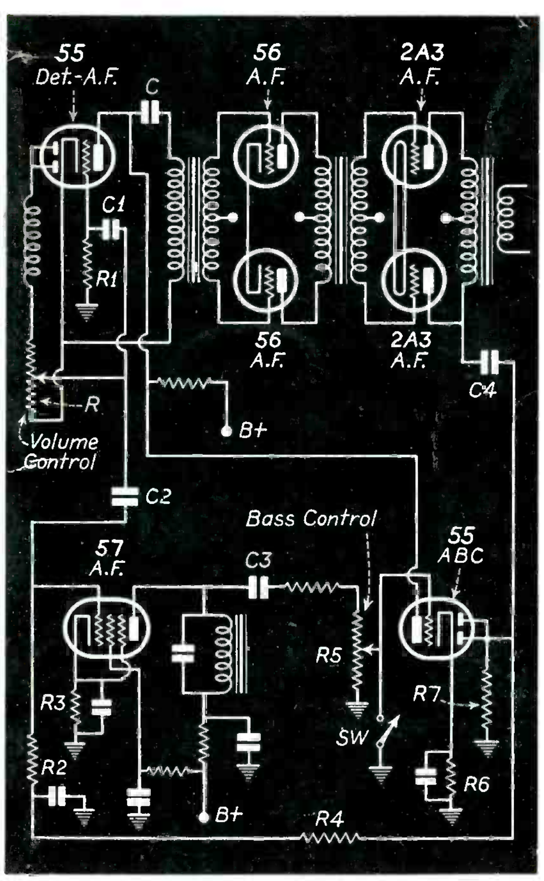

New "ABC" Circuit

(*See Page* 293)

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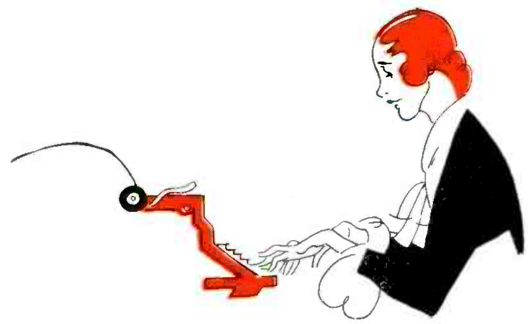
1935



a letter to mr. beers and other service men

Mr. AL BEERS,
San Francisco, Calif.

Dear Mr. Beers:

Your letter to the Editor of the Forum (June issue of Service), expressing yourself concerning "Case Histories" particularly attracted the writer.

In your letter you wrote, referring to the various parts of a radio receiver . . . "the manufacturers of each of these units maintain elaborate equipment and engineering staffs, as each unit is a study in itself. Certainly a Service Man should not be expected to understand all the technical features of all these units."

Of course you're right. What you mean, I take it, is that you want to rely on the manufacturer for the kind of replacement that will do the best job for you and that you don't want to have to fool around with it to make it do its stuff. And that's the point where STANCOR EXACT-DUPLICATE Replacement Transformers are concerned.

I don't even know whether you use these units in your work or not. Perhaps I should before writing you an open letter like this. But, I can't help but feel that you had STANCOR EXACT-DUPLICATE Replacement Transformers at least partly in mind when you wrote your letter to the Editor.

That is just what STANCOR EXACT-DUPLICATE Replacement Transformers were designed for . . . to give the service man a wide variety of transformers from which he could select exactly the right one for the job he had in hand. When we started this, there was no place he could look to for anything except tubes that were just like the originals.

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Of course there are some makes and some models and types of sets that never reached a high enough peak of production or were sold in sufficient numbers for us to duplicate and stock STANCOR EXACT-DUPLICATES. For those there are STANCOR UNIVERSAL REPLACEMENT Transformers designed so carefully that you can use them with safety. Planograph diagrams and standard color codes are included with every STANCOR Replacement Transformer.

I imagine you have one of the new STANCOR catalogs of Replacement transformers. Tell me, does any other listing of replacement transformers you have ever seen show so many different transformers for correct replacement? Have you ever seen so little duplication of part numbers? I think not.

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SERVICE

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THE ANTENNA . . .

"Automatic"—Case Histories

THE Service Man's "new year" commences with the introduction to the public of the fall and winter line of radio receivers. That occasion is practically at hand.

The "new year" is also the beginning of a crop of headaches. The efforts of the receiver design engineers are evident in each new batch of sets, and within the past two years receiver design progress has taken a decided spurt forward. The quiet arithmetic progression of developmental work has given way to a fast pace having more the character of a geometric progression. Circuits continue to become more complicated in function.

Many of the new engineering features will not appear before 1936, but there are quite a group in the offing. We are in for automatic selectivity control, automatic frequency control, automatic frequency-searching circuits, automatic bass compensation, new frequency-conversion systems and, of course, a few new tube types; such as the 6E5, described in this issue. There may be added to this partial list the possibility of some form of volume-expansion system—also automatic—and the introduction to the public of 5-meter broadcast receivers, for use in the ever-increasing number of localities providing regular program service in the 5-meter band.

Certainly there is no rest for the weary in this game, although the Service Man with a keen interest in radio developments undoubtedly welcomes new features. They add a certain zest to servicing work and offer a challenge to any man's ability as a diagnostician of receiver faults.

The word "automatic" should have particular significance for the Service Man. This word creeps into practically every new receiver development. It is the desire of the receiver design engineer to leave nothing to chance . . . or the listener. Therefore he has provided means for controlling volume level, selectivity, tone, and frequency drift, independent of the operator of the receiver, who cannot be relied upon to intelligently handle manual controls serving similar purposes. By these methods, and these methods only, can the design engineer guarantee the proper reception of broadcast programs.

Automatic control has one other significant feature—and one that may be of considerable importance to the Service Man—under certain circumstances it will rectify conditions of misalignment and mistracking in superheterodyne receivers. For example, frequency drift of the high-frequency oscillator may be compensated for automatically, and mis-tuning, purely a matter of human failing, may be reduced to a negligible degree through the use of a self-seeking circuit.

Since the "automatic" phase of receiver design is still young, there is every reason to believe that only the surface has been scratched. No doubt the automatic correction of most forms of adjustment departing from the correct one will be a feature of the radio receivers of tomorrow. If this is the case, the Service Man may never require testing devices having a degree of precision equaling that of laboratory equipment—a fear recently expressed. What will be required, however, is equipment that will tell more of the story of receiver operation. Devices such as the cathode-ray oscilloscope offer just such an opportunity. It permits a rapid and immediate check on such factors as selectivity, distortion, frequency response, avc action, oscillation, etc. These are the very factors that have become of increasing importance in modern receivers having improved tone, greater sensitivity and selectivity, and greater output. Conditions of instability, harmonic distortion, low sensitivity, etc., are much quicker to show up in a modern set than they are in older receivers not having such high degrees of definition.

It is interesting to observe that most forms of automatic control are branches of the avc circuit or, if not actual branches, function in much the same way; i.e., on r-f or a-f volume level. The Service Man is therefore provided a key to possible difficulties and can cast his cathode ray on the heart of the set—the avc network. He has here a starting point, a central functionary from which there are interconnections to other control circuits of automatic nature, each one operating in accord with the central voltage variations. Most difficulties will be reflected in this control area for the reason that there is interaction between the branch circuits and the source of control voltage.

This trend toward the automatic in receiver operation leads to the belief that future receiver design will not tend to increase the obsolescence factor of modern testing equipment. On the contrary, it looks very much as though the servicing devices being offered today will have a much longer useful life than earlier equipment had.

•

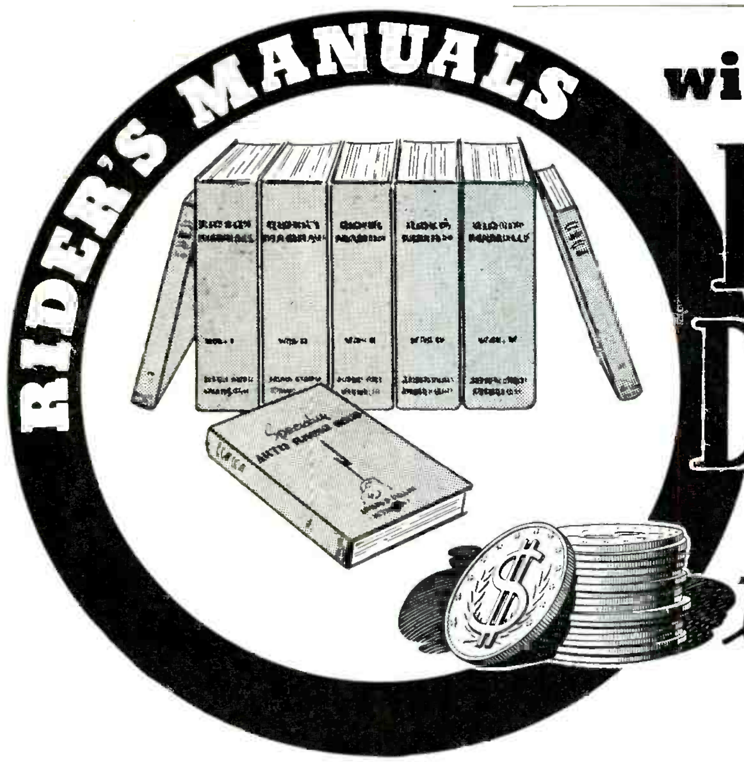
RECEIVER CASE HISTORIES

Our new department, "Receiver Case Histories," is introduced in this issue. It will be a regular monthly feature.

These special notes are arranged in alphabetical order, for quick reference or what-not. The heading in each case gives the receiver's trade name and model number. The heading is followed by a short sub-head, in italics, listing the receiver fault. Consequently it will not be necessary to read through a number of notes on the same receiver model to find the actual data required.

We have purposely stripped all notes of superfluous text, for the sake of convenience in reviewing them, and to provide added space for more notes.

It will take a few months to get this department in smooth running order. In the meantime, while we are still experimenting in attempting to arrive at the ideal method of presenting this data, won't you let us have your viewpoints? Have you any suggestions to offer? Does the department meet your requirements "as is," or is there some change that should be made? What say?



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In this day and age the Serviceman's job is a good deal like the farmer's. Like farming, making servicing pay is a matter of specialized knowledge. Increased complications in set development make it necessary, more than ever before, for the Serviceman to have at his fingertips reference data that can be easily located and instantly applied to questions about diagrams, color-coding, capacities, resistance values, operating voltages and location of different parts.

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR JULY, 1935

THE METAL TUBES

Design — Characteristics — Socket Connections — Uses — Servicing

A LOT of water has passed under the bridge since the metal tubes were first announced. In the meantime, design engineers have been at work studying the characteristics and idiosyncrasies of these "iron bottles" and adapting them to the 1936 line of receivers.

Most of the set manufacturers have announced their metal-tube chassis and in a short while many of these new receivers will be in the hands of the public. Then we shall know more about the iron bottles—how they stand up under practical usage, how they compare with their glass sisters, and so on. But already it is possible to provide a considerable amount of data on the metal tube, and this we propose to do.

Metal-Glass Equivalents

Sufficient general details have been published in radio periodicals without our having to go into them again. Undoubtedly, most of our readers have a fair idea as to the appearance and design of the metal tube, but for the sake of completeness, we show in Fig. 1 a group of the metal tubes lined up with their approximate counterparts in glass.

On the left is a type 80 and alongside of it the type 5Z4 metal tube. Next in line is a type 45 power amplifier and its equivalent, the type 6D5. This is followed by a glass tube of the 78 type and its approximate replica in metal, the type 6K7. Then we have the type 42 power pentode together with the 6F6 metal baby—and at the extreme right of the illustration is the 6H6 double diode which has no direct equivalent in glass.

Metal-Glass Comparisons

It should be understood from the very beginning that there is no metal tube having exactly the same characteristics as a glass "equivalent." The tubes are *similar* in so far as class of service is concerned, but are not directly interchangeable. Table I gives the approximate comparisons.

TABLE I

Metal	*Glass*
5Z4	80
6A8	6A7
6C5	76
6D5	45
6F5	75*
6F6	42
6H6	75*
6J7	77
6K7	78
6L7	—

* The 6F5 is similar to the triode section of the 75, and the 6H6 is similar to the diode section of the 75.

— The 6L7 is a special pentagrid mixer amplifier and has no glass equivalent.

Metal-Tube Characteristics

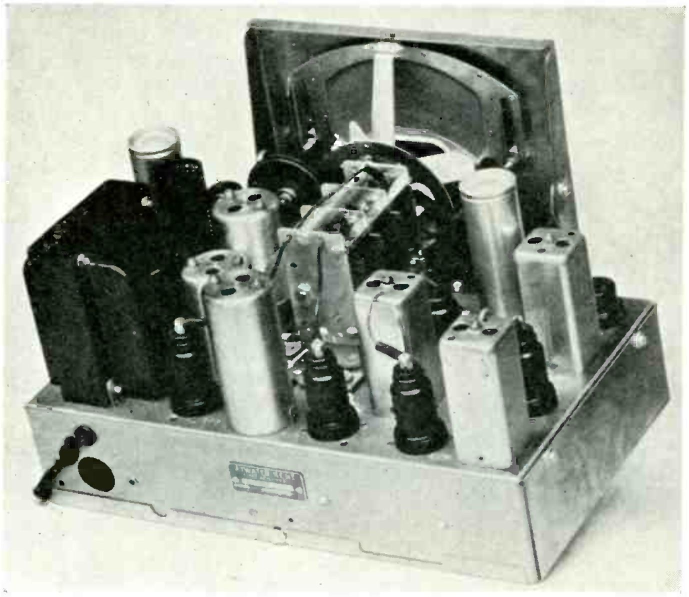
All of the metal tubes have 6-volt heaters, with the exception of the 5Z4 rectifier. Each of the tubes also has an extra pin connection to which is connected the metal shell. In practice this metal shell or shield is grounded to the chassis through the proper socket lug.

Due to an entirely new form of internal construction, the metal tubes have, on the average, lower inter-element capacities. Thus they should prove superior to the glass tubes in the short-wave bands. Some of the metal tubes also show better average characteristics. For example, the 6C5 has a plate resistance of 10,000 ohms as against 9500 for the 76; an amplification factor of 20 as against 13.8 for the 76; and a transconductance of 2000 as against 1450 for the 76.

Working voltages—plate, screen and control grid—are almost the same for the metal tubes as they are for the glass equivalents. There are a few variations, as indicated in Table II.

Pin-Numbering Arrangement

The metal tube employs an entirely new form of base and pin arrangement. A glance at Fig. 1 will show that each type of metal tube has an insulated cen-



One of the new 1935-6 Atwater Kent metal-tube chassis—9 tubes in all, including a 6H6 twin diode.

TABLE II

Tube	Plate Voltage	Screen Voltage	Grid Voltage	Cathode Current
5Z4	400			125
80	400			110
6A8	250	100	–3	14
6A7	250	100	–3	14
6C5	250		–8	8
76	250		–13.5	5
6D5	275		–40	31
45	275		–56	36
6F5	250		–2	0.9
75	250		–2	0.8
6F6	250	250	–16.5	40.5
42	250	250	–16.5	40.5
6H6	100rms			2
6J7	250	100	–3	2.5
77	250	100	–3	2.8
6K7	250	100	–3	8.7
78	250	100	–3	8.7
6L7	250	100	–3	10.8

ter pin. Each insulated pin has a "locator" in the form of a protrusion which fits a "key" in the center of the tube socket. Since the locator pin is longer than the tube base contact pins, it is only necessary to place the locator pin in the socket hole and rotate the tube until the locator lug slips down into the socket key. With this arrangement it is impossible to improperly insert a tube in its socket; therefore, all the metal tubes have contact pins of the same diameter, instead of pins of larger diameter for the heater connections as with the glass tubes.

These eight-pin or "octal" tube bases have made possible the design of a "universal" socket—a single type socket adaptable to all types of metal tubes. This arrangement has also made possible the setting up of a universal numbering system which offers advantages in simplicity.

In this new system, numbers are assigned to each of the eight possible pin positions. Numbering starts from the shell connection (the metal envelope of the tube), designated as "S," and this is always the first pin to the left of the locating lug when the base of the tube is viewed from the bottom with the lug toward the observer. Numbering is clockwise on the basis of possible pin positions. Thus the pin numbers for a 6-pin base are 1, 2, 3, 5, 7, and 8. Pins number 4 and 6 are left off the base. Only an 8-pin tube has the full complement of pins.

The pin-numbering system is shown in Fig. 2. The arrangements are shown for the 6-, 7- and 8-pin bases, indicating in each case which pin numbers are dropped.

Table III gives the pin numbers for the metal tubes announced to date. Comparing the data in this table with the sketch of Fig. 2, it will be seen that the metal shell of a tube always comes out in pin number 1, or socket contact number 1, and that the heater connections are always brought out to pins 2

TABLE III

Tube No.		Pin Positions and Numbers 1	2	3	4	5	6	7	8
5Z4	.....	S	H	..	P_2	..	P_1	..	H & K
6A8	.....	S	H	P	G_3 & G_5	G_1	G_2	H	K
6C5	.....	S	H	P	..	G_1	..	H	K
6D5	.....	S	H	P	..	G_1	..	H	K
6F5	.....	S	H	..	P	..	..	H	K
6F6	.....	S	H	P	G_2	G_1	..	H	K & G_3
6H6	.....	S	H	P_2	K_2	P_1	..	H	K_1
6J7	.....	S	H	P	G_2	G_3	..	H	K
6K7	.....	S	H	P	G_2	G_3	..	H	K
6L7	.....	S	H	P	G_2 & G_4	G_3	..	H	K & G_5

and 7, with the exception of the 5Z4 which uses pin 8 (the standard cathode pin) for both heater and cathode.

A bit of study will show that providing a universal socket with eight pin holes (any of which may be used, since all sockets are the same) permits the tube manufacturer to carry out a clean sequence of pin connections. There is always the chance that some one may place a metal tube in the wrong socket, but if this is done the tube will not be damaged . . . it will merely refuse to function properly, or not at all, depending upon the type of tube and in which socket it is "mis-placed."

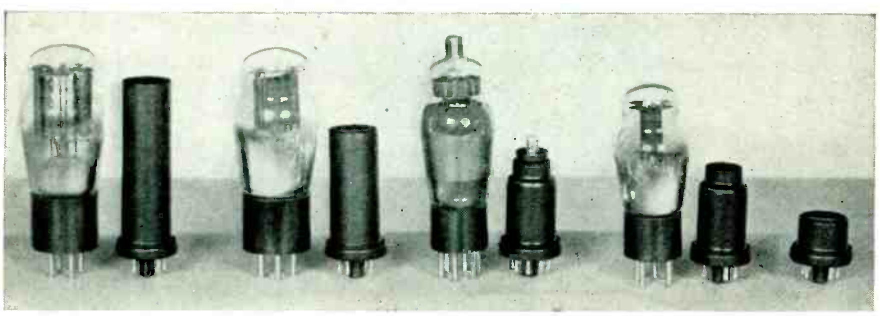


Fig. 1. Showing the contrast in sizes between the new metal tubes and the glass-enclosed tubes of corresponding ratings. The tube to the extreme right is a duo-diode.

Using the Metal Tubes

Generally speaking, the metal tubes are not interchangeable with their glass counterparts. However, chassis employing glass tubes may be converted over into "metal" jobs if some thought is given to the difference in metal and glass tube characteristics. Such a changeover will require the ripping out of the old sockets and replacing them with the new metal tube universal

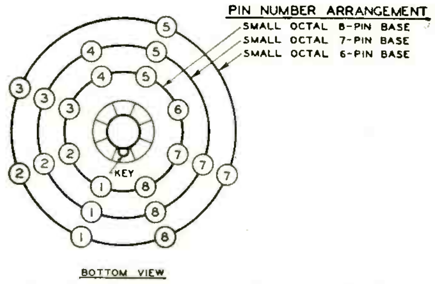


Fig. 2. Base and socket pin-numbering arrangements for the new metal tubes. See Table III on this page.

socket . . . making the necessary changes in wiring connections. This is not as simple as it sounds since the pin locations are entirely different—thus requiring the lengthening of some leads and the shortening of others. This becomes almost a major operation, and there is always the possibility of such drastic re-arrangement of leads that the receiver circuits will be thrown completely out of balance. In any event, re-alignment is an absolute necessity.

In building receivers for metal tubes, do not reduce the spacing between the tubes and the receiver components. As a matter of fact, it is a good idea to provide even more space, as the metal tubes need plenty of air space.

Servicing

In servicing metal-tube receivers, first make sure that the owner hasn't placed any tubes in the wrong sockets.

If the receiver has been in operation for any length of time, don't grab 'hold of a tube with your bare hand . . . they get plenty hot, and no fooling.

In cases of very poor or no operation of receiver, check the tubes for internal shorts. A few of the first production tubes develop this trouble after being used for a while.

In cases of low sensitivity, check tubes for emission.

RCA 6E5

A New Electron-Ray Tube for Indicator Use

Here's something out of the ordinary in the way of tubes—a miniature cathode-ray tube for use as a tuning indicator in radio receivers. You'll see some of these in the new 1936 receivers now on their way into the market.

The Design

The 6E5 is a high-vacuum, heater-cathode type of tube designed to indicate visually the effect of change in the controlling voltage. The tube, therefore, is essentially a voltage indicator and may be put to many uses other than as a visual tuning indicator.

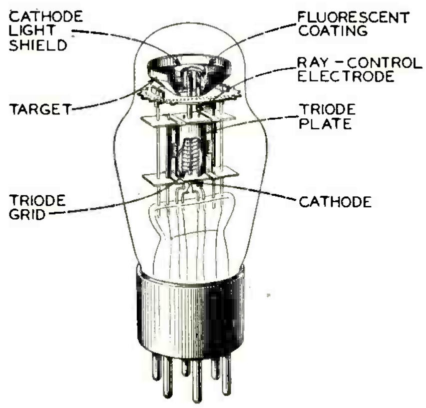


FIG. 1

Details of the 6E5 Electron-Ray Tube.

The visible effect is observed on a fluorescent target located in the dome of the bulb. For different controlling voltages, the pattern on the target varies through a shaded angle from 90° to approximately 0°. Exact tuning is indicated by the narrowest shaded angle obtainable.

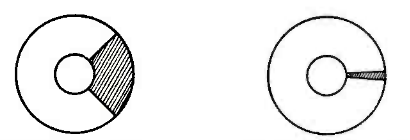
Functioning

In the basic design of an electron-ray tube, a hot cathode provides a source of electrons. These are attracted to a positively-charged target coated with a fluorescent material. Electrons impinging on the coated target cause it to glow. The extent of the fluorescent area can be controlled by means of a third electrode placed between cathode and target. The pattern developed on the fluorescent target depends on the contour of the target as well as on the position and shape of the third electrode.

Details of the physical arrangement of electrodes in the 6E5 are shown in Fig. 1. The third electrode is identified as the "ray-control electrode," and is an extension of the triode plate. The visible effect produced by different voltages on this electrode is shown for two adjustments by the shaded areas of Fig. 2. The voltage on the ray-control electrode is determined by the voltage applied to the grid of the triode connected as a d-c amplifier. A series resistor of one megohm is placed between the triode plate and the high-voltage supply to which the target is directly connected, as shown in Fig. 3.

The effect of the series resistor is to reduce the voltage applied to the triode plate, and consequently to the ray-control electrode, under conditions of decreased triode-grid bias (increased triode-plate current). For conditions of increasing triode-grid bias (decreasing triode-plate current), the triode-plate voltage increases and approaches the value of the supply voltage.

In the practical use of the 6E5 as a tuning indicator, controlling voltage applied to the triode grid is obtained from a suitable point in the avc circuit of the receiver (See Fig. 3). Thus, when connected in this manner, the triode grid has zero bias under no signal conditions; the resulting pattern is then similar to that shown at the left in Fig. 2. When a signal is tuned in, a voltage is developed in the avc circuit; this negative voltage is impressed on the triode grid which has the tendency of constricting the pattern, as shown at the right in Fig. 2. The greater the avc voltage, the greater the negative bias on the triode grid and, therefore, the greater the constriction of the pattern on the fluorescent target. The narrowest pattern is indicative of a condition of maximum resonance in the receiver.



ZERO GRID BIAS NEGATIVE GRID BIAS

FIG. 2

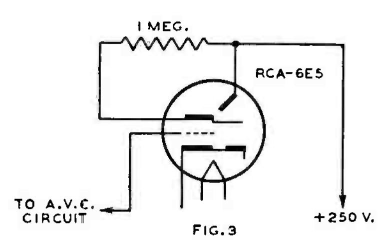


FIG. 3

Above: Maximum and minimum shadow. Below: The basic tuning-indicator circuit.

Operating Conditions

Tentative operating conditions are as follows:

Heater Voltage............ 6.3 Volts
Heater Current..............0.3 Amp
Plate Voltage (max.)...... 250 Volts
Target Voltage (Max.).... 250 Volts
Triode Grid Voltage*......—8.0 Volts

*For shadow angle of 0°.

The socket connections for the 6E5 are shown in Fig. 4. The connections as given are for bottom view of base.

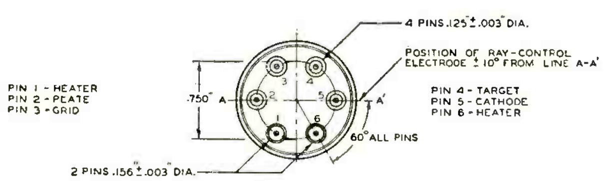


Fig. 4. Here are the socket connections for the 6E5 Electron-Ray Tube.

NEW "ABC" CIRCUIT

(See Front Cover)

THE Hazeltine Service Corporation recently developed an automatic bass compensation arrangement that has some very interesting features. This abc circuit is intended to increase the low-frequency response relative to the response at higher frequencies whenever the volume level is low, regardless of whether the level is low because of low percentage modulation or because the volume-level control is set at a low value.

It is well known that the ear is rather insensitive to sounds of very low frequencies when the sound intensity falls to low values. When the volume level on the usual receiver is reduced to a satisfactory value for home reception the music sounds thin as though there was a deficiency in low notes. The abc arrangement has been designed to overcome this defect of the ear.

The Circuit

Compensation is accomplished by having a supplementary a-f amplifier which amplifies only the low frequencies, but has a gain several times that of the original amplifier. The gain of this supplementary amplifier is controlled by a separate avc system which is actuated by the signal level at the *output* of the main amplifier. For loud signals the supplementary unit is biased beyond cut-off and the characteristic is that of the main amplifier alone. As the signal level is reduced the bias on the supplementary amplifier is likewise reduced, allowing it to introduce a greater amplification of the low frequencies than would be had with the main amplifier alone.

Referring to the circuit, it will be seen that the main amplifier consists of the 55 tube triode section fed from the volume control R through the blocking condenser C-1. The plate of the 55 triode is coupled to the input transformer through condenser C which feeds the

(Continued on page 297)

General Data . . .

Sparton Model 58 (Battery)

The Sparton Model 58 is known as the Country Home Receiver. It is designed to operate from a 2-volt storage battery or 2.5-volt air cell for "A" supply, and three 45-volt batteries in series for "B" and "C" supply.

The complete circuit, with voltage values and i-f peak, is shown on this page.

Circuit Data

The volume control (R-1) is in the antenna circuit. The antenna circuit also includes the antenna choke coil L-1, the antenna compensating condenser C-4 and the equalizing trimmer C-5. When facing the front of the chassis, C-4 will be found on top of the front gang condenser and C-5 on the left side of the same condenser.

The signals are fed to a 1A6 tube which functions as mixer and oscillator. One filament leg of this tube includes an r-f choke.

The 456-kc output of the mixer is fed through a double-tuned i-f transformer to the grid of the type 32 i-f tube. The amplified output of this tube is fed through a similar i-f transformer to the control grid of a second type 32 tube which functions as second detector and automatic volume control. The avc action is gained by having the grid return circuits of the i-f and second detector tubes common to the resistor R-3. A strong signal on the grid of the detector tube will tend to drive it positive with the result that grid current flows momentarily. This develops a voltage across resistor R-3 which connects to ground through resistor R-4. The voltage thus developed across R-3 is impressed on the grid of the i-f tube, making it more negative and thereby decreasing its gain. This, in turn, reduces the signal on the grid of the detector tube.

The output of the second detector tube is resistance-capacity coupled to the type 30 first a-f tube. This tube is in turn resistance-capacity coupled to the type 33 power pentode which feeds the magnetic speaker.

Grid or "C" bias for the tubes in this receiver is provided by the drop in voltage across the resistors R-9, R-5 and R-4, which are in series with the negative terminal of the "B" battery and ground. Bias for the 33 pentode is taken off at the negative terminal of the "B" battery; bias for the 30 a-f tube is taken off at a point between R-9 and R-5; and bias for the mixer, i-f and second detector tubes is taken off at the point between resistors R-5 and R-4.

Alignment

This receiver is adjusted in the usual manner. When facing the front of the chassis, the oscillator trimmer C-2 will be seen on top of the rear (oscillator) gang condenser.

The i-f trimmer condensers C-3 are on top of the i-f coil shields. The first i-f transformer is to the extreme right and rear of the chassis; the second i-f transformer is directly behind the gang condenser.

•

Philco 144

Effective April 15th, the center tap is removed from the filament winding on the power transformer. If hum is experienced in reception, connect a 20-ohm wire-wound resistor across the filament winding, with center tap of resistor grounded.

•

Philco 49

In connection with the servicing data on this model, the antenna transformer (2) part number should be 32-1427, and the detector transformer (10) should be 32-1379.

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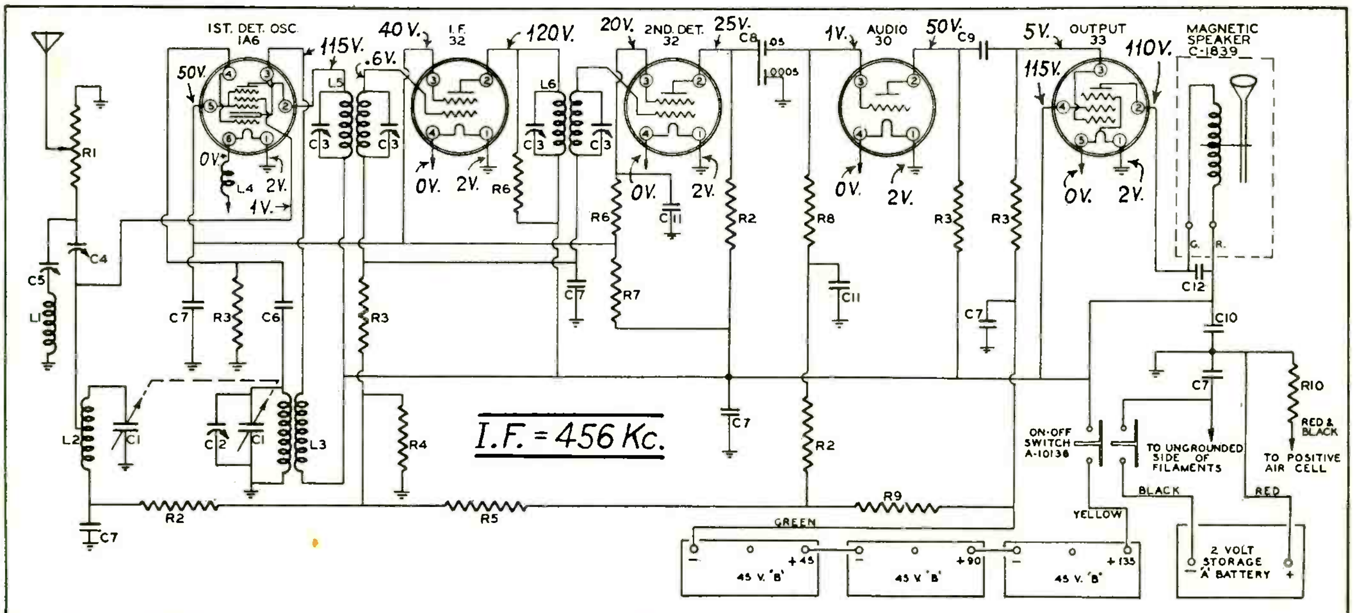
Philco Model 610

This is a three-band receiver, with following ranges: Band 1, 530 to 1720 kc; Band 2, 2300 to 2500 kc; Band 3, 5700 to 18,000 kc. The power con-



C1	VARIABLE CONDENSER	B-5650-1
C2	ADJUSTABLE CONDENSER	
C3	I. F. TRANSFORMER TRIMMERS	
C4	ANTENNA TRIMMER	A-7809-2
C5	EQUALIZING TRIMMER	A-7809-3
C6	.00025 MFD. MOLDED	A-5175
C7	.2 MFD. 200 V.	A-6869-A
C8	.05-.0005 MFD. 200 V.	A-9576
C9	.025 MFD. 200 V.	A-10206
C10	2 MFD. 150 V.	A-10318
C11	.05 MFD. 200 V.	A-9919
C12	.006 MFD. 600 V.	A-4434

R1	25,000 Ω	VOLUME CONTROL	A-10316
R2	250,000 Ω	.25 W.	B-5737-1
R3	50,000 Ω	.25 W.	B-5737-4
R4	200 Ω	WIREWOUND	B-5243-2
R5	100 Ω	WIREWOUND	B-5243-14
R6	500,000 Ω	.25 W.	B-5737-5
R7	25,000 Ω	.5 W.	B-4114-18
R8	100,000 Ω	.25 W.	B-5737-2
R9	750 Ω	WIREWOUND	B-5243-8
R10	.47 Ω	WIREWOUND	A-10000-3

L1	ANT. CHOKE COIL	A-9750
L2	NO. 1 R.F. COIL	A-11564
L3	OSCILLATOR COIL	A-10330
L4	CATHODE CHOKE	A-10401
L5	NO. 1 I.F. TRANSFORMER	A-10229-4
L6	NO. 2 I.F. TRANSFORMER	A-10356-1

Circuit of Sparton Model 58, with socket voltages and parts values.

sumption of the receiver is 54 watts and the audio output is 3 watts.

Circuit Details

The complete circuit of the Model 610 is shown in Fig. 1. An i-f wave-trap (1), which is tuned to 460 kc, is located in the antenna circuit.

The input signal is fed to a 6A7 tube which functions as first detector and oscillator. Initial bias for this tube is supplied by the voltage drop in cathode resistor (16). The i-f output signal is fed through a double-tuned i-f transformer to the grid of the 78 i-f tube. This tube receives its initial bias from cathode resistor (24). The output of the i-f tube is fed through a second double-tuned i-f transformer and the signal impressed on the paralleled diode plates of the 75 tube. The resistor (31) and the potentiometer resistor (33) form the diode load circuit. The avc voltage is tapped off from the point where these two resistors connect together, and fed back to the grids of the first detector and i-f tubes. The audio voltage appearing across the potentiometer resistor (33) is picked off by the potentiometer arm and fed through the blocking condenser (34) to the grid of the 75 triode. This triode functions as the a-f driver for the type 42 output pentode.

Bias for the grid of the 75 triode and for the grid of the 42 pentode is obtained from the voltage drop in resistor (57) in the negative leg of the power supply. These grid circuits also contain filter resistors.

Voltages

Tube operating voltages are given in the diagram. These should be read from the underside of the chassis, with the volume control at maximum, dial set at 55 and waveband switch counter-clockwise (Band 1).

Adjustments

The locations of the compensating condensers are shown in Fig. 2. For adjusting the i-f, remove antenna from receiver, disconnect the grid clip from the 6A7 and connect the output terminal of a signal generator to the grid of this tube. Connect ground of signal generator to the ground terminal of the receiver.

Set signal generator at 460 kc and set dial of receiver to low-frequency end of the standard broadcast band, with waveband switch to extreme left and volume control set near to its maximum setting. Adjust the signal-generator attenuator for approximately half-scale reading of the output meter.

The i-f compensating condensers are located at the tops of the i-f coil shields. Adjust condensers (26) and (28) (second i-f) for maximum and then condensers (20) and (22) (first i-f) for maximum.

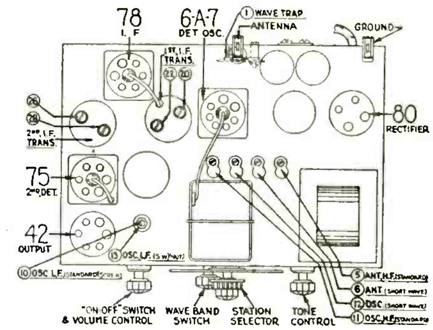


Fig. 2. Chassis of Philco 610, showing locations of capacity adjustment screws.

Adjusting Wave-Trap

Connect signal generator to antenna and ground leads of receiver. With waveband switch of receiver in extreme left position, turn the receiver dial to 550 kc.

With the signal generator in operation at 460 kc, adjust the wave-trap condenser (1) until a *minimum* reading is obtained on the output meter.

The wave-trap compensator is reached from the rear of the chassis.

Adjusting Compensators

With waveband switch in position 1 (broadcast band) set the receiver dial at 1600 kc. Set the signal generator at this frequency and adjust compen-

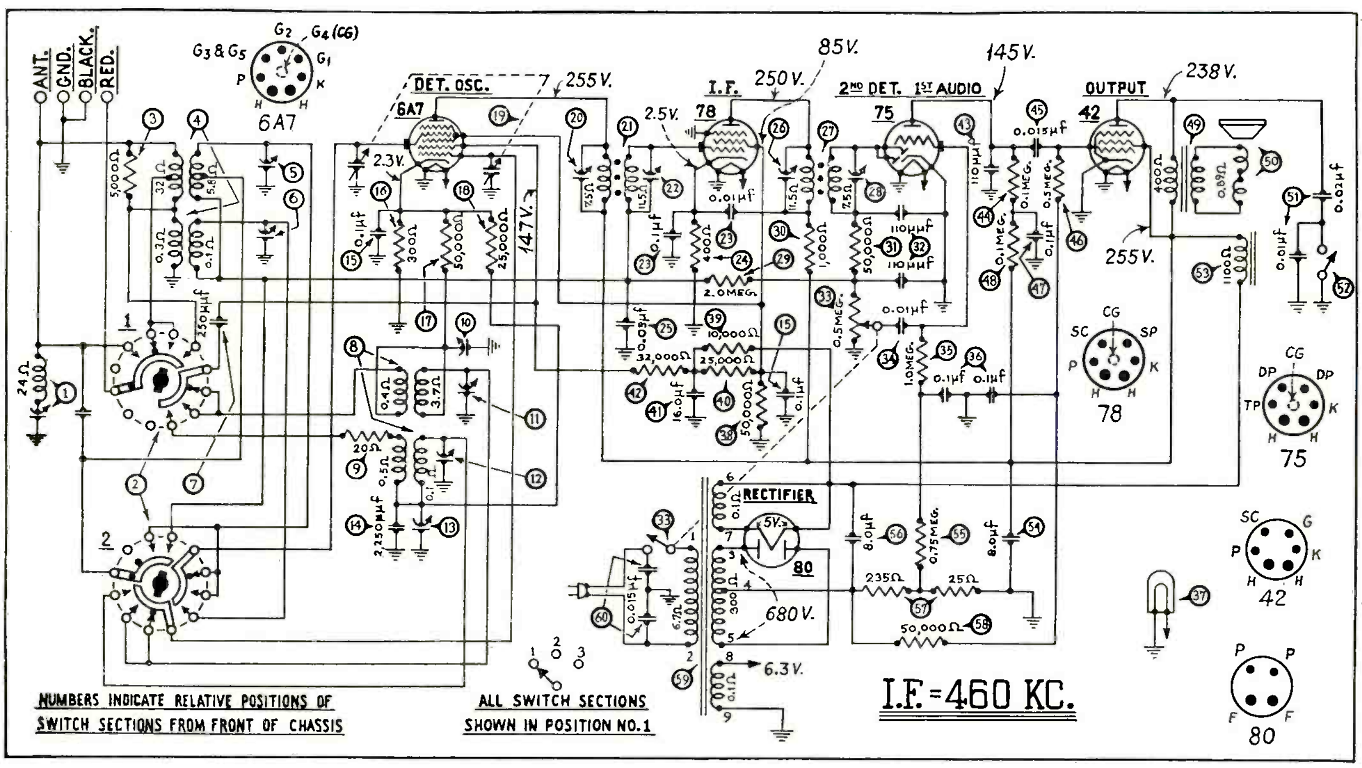


Fig. 1. Complete circuit of Philco Model 610.

sators (11) and (5) for maximum output. These are the oscillator and antenna "H. F. standard" compensators respectively.

Then tune the receiver and signal generator to 600 kc and adjust compensator (10) (screw) for maximum output. This is the oscillator L. F. standard compensator.

Next turn the waveband switch to the extreme right (short-wave band) and adjust the station selector to 18.0 megacycles. Then adjust the oscillator S. W. and antenna S. W. compensators for maximum. These are numbered (12) and (6) respectively in Fig. 2.

Then turn the receiver dial to 7.2 mc and adjust condenser (13) osc. L. F., (S. W.) (nut) to maximum signal.

•

International Model 90

The Model 90 is an interesting job in that it is designed to operate on 110 volts, 50-60 cycles (but not 25 cycles, or dc), or from a 6-volt storage battery or 32-volt farm lighting plant with the necessary power units. More of this later.

The Circuit

The complete circuit is shown on this page. The first tube, a 6D6, is used as mixer and oscillator. The converted signal is fed through a double-tuned i-f transformer to a 6C6 i-f tube. The amplified output of this tube is fed through a second double-tuned i-f transformer and thence impressed on the paralleled diodes of the 75 tube. Full avc voltage is taken from this diode circuit and impressed on the grid of the i-f tube.

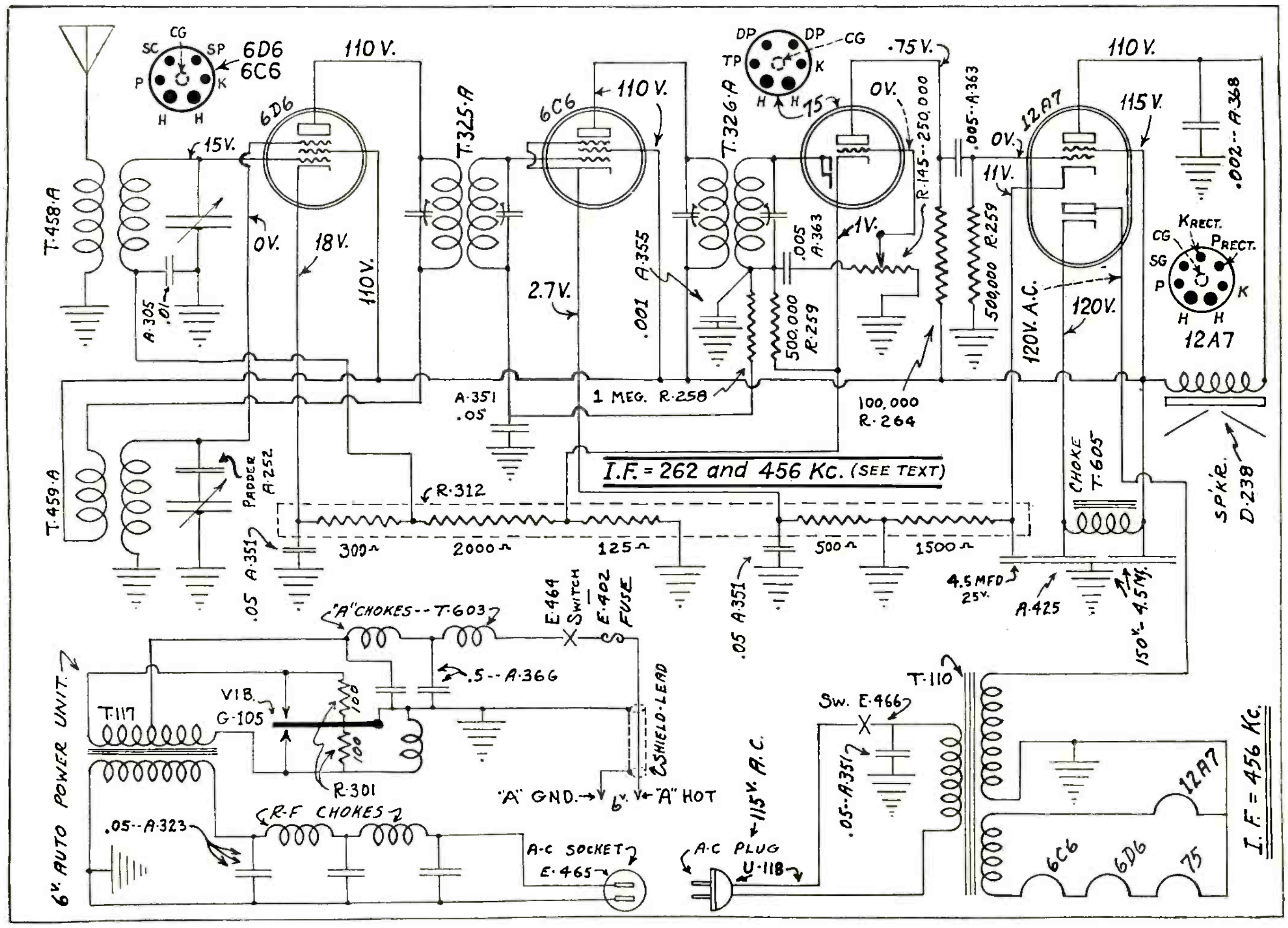
The a-f component of the signal appears across the 250,000-ohm potentiometer, is picked off by the arm and impressed on the triode grid of the 75 tube. This triode is resistance-capacity coupled to the pentode portion of the 12A7 tube. The output of this power pentode feeds a magnetic speaker.

Bias System

Note that the cathode of the 6D6 tube is grounded through the resistor bank R-312. The grid of the mixer section of the 6D6 connects to a point 300 ohms down on the tapped cathode resistor. Therefore, the bias on this grid is equal to the voltage drop in the 2000-ohm and 125-ohm sections of the resistor only. On the other hand, the oscillator grid of the 6D6 tube is returned directly to ground through the tuned oscillator coil, with the result that the bias on this grid is equal to the total voltage drop in the entire cathode resistor R-312.

There is one other tap on this resistor which leads directly to the cathode of the type 75 tube. The cathode of this tube is therefore positive with respect to ground by an amount equal to the voltage drop across the 125-ohm section of resistor R-312. This bias is not placed on the 75 diodes since these are connected to the cathode through resistor R-259. The bias is placed on the triode grid, however, since this grid is grounded through the volume-control potentiometer and is therefore negative with respect to the cathode.

Initial bias for the 6C6 i-f tube is



Circuit of International Model 90, together with circuit of attachment for 6- or 32-volt operation.

supplied by the drop across the 500-ohm resistor in its cathode circuit. Bias for the power pentode section of the 12A7 is supplied by the drop in the 1500-ohm cathode resistor.

Power-Supply System

The first point of interest in the power-supply system is the heater connections. It will be noted that the heaters of all the tubes are connected in series and supplied by a heater winding on the power transformer having the correct voltage rating for this arrangement. The high-voltage winding for the half-wave rectifier section of the 12A7 is shown directly above the heater winding in the diagram. One side of this winding is grounded and the other side connects directly to the rectifier plate. The high voltage dc is taken from the cathode of the rectifier. This circuit includes the filter choke T-605 and two 4.5-mfd filter condensers.

So much for the standard power-supply arrangement for use on 110-volt ac lines. To the left of this in the diagram is the supplementary power-supply unit with which the receiver may be operated from a 6-volt storage battery or a 32-volt farm lighting plant. This is seen to consist of the usual form of vibrator transformer which converts the 6 volts dc to 110 volts ac—or. with a different vibrator transformer in circuit, 32 volts dc to 110 volts ac. Both the input and output circuits are well filtered to prevent hum or hash from entering the receiver circuits. This unit is provided with a standard ac socket to take the receiver ac line plug.

Intermediate Frequency

It will be noted from the diagram that two i-f peaks are listed. Sets bearing serial numbers under 6501 use an intermediate frequency of 262 kc. Sets bearing serial numbers over 6500 use an i-f of 456 kc.

Receiver Alignment

The standard ac output meter should be used to indicate signal strength. It should be connected from the plate prong of the 12A7 amplifier section to ground. The signal from the test oscillator must be kept at a very low level to get below the avc action.

To adjust the i-f circuits, first turn the tuning condenser to a setting of approximately 600 kc. Do not short out the oscillator section of the two-gang condenser. Set test oscillator to correct intermediate frequency for the particular receiver under test, and attach to antenna lead. Adjust primary and secondary of the first i-f transformer for maximum reading on meter. Repeat with second i-f transformer and then go over all adjustments a second time. A fibre screw-driver and socket wrench are necessary for accuracy.

Next set the test oscillator to 1500 kc. Turn the gang condenser so the plates are just slightly meshed (about 1/8 inch). Adjust trimmers on both sections for maximum signal.

If coils have been changed, it may be necessary to bend plates at 1000 kc and 550 kc. Do not bend plates on the oscillator section (rear) unless absolutely necessary.

Special Notes

Keep the green wire on the antenna section of the two-gang condenser as far as possible from the oscillator.

Keep antenna coil as far as possible from the sockets.

Keep ac power cord clear at the end of chassis.

If the set is microphonic, push a piece of rubber between the speaker unit and chassis base.

Speaker Adjustment

To adjust speaker, remove cover plate from speaker unit. Two screws will be found at each end of the unit within the magnets. When adjusting either pair of screws, one is to be loosened slightly and the other tightened You will notice this moves the armature slightly to one side. The air gap on both sides of the armature should be the same.

Six-Volt Power Unit

The 6-volt power unit should deliver between 110 and 120 volts ac under the load of the set. Low output usually indicates a poor vibrator or the set may be drawing an abnormal amount of current.

Operating Voltages

The voltages in the diagram are based on a line voltage of 115. All voltages given should be measured from points indicated to ground.

NEW "ABC" CIRCUIT

(*Continued from page 293*)

push-pull 56's, the latter in turn being coupled to the push-pull output stage, which uses a pair of 2A3 tubes. The input transformer is resonant at about 55 cycles with condenser C.

The two additional tubes, a 55 and a 57, supply the automatic bass compensation. The grid of the 57 is connected to the volume control through condenser C-2, making it effectively in parallel with the grid of the 55 triode in the main amplifier. The plate circuit of the 57 is coupled by means of a tuned impedance (resonant at 75 cycles) through C-3 and bass-control resistor R-5, to the grid of the 55 abc tube. The triode of this latter tube is used primarily as an impedance-matching device to enable the abc amplifier to feed effectively into the input transformer. The grid of the 55 abc tube is connected to a slider on the grid leak, called the "Bass Control" (R-5), the adjustment of which controls the amount of compensation introduced at low output levels. The diodes of the 55 abc tube are connected to the plate of one of the 2A3's through condenser C-4, thus securing the automatically varying bias to control the amount of compensation as the audio output of the amplifier varies. A switch is provided to short the grid of the extra 55 to ground when it is desired to cut out the abc system without disturbing the setting of R-5.

Operation

At high outputs, a large negative bias voltage is built up in the diode load resistor R-7, and this voltage is transmitted through the filter network, R-4, R-2 and the condenser to ground, to the grid of the 57, rendering it inoperative. Under this condition the amplifier has its normal flat-frequency characteristic.

As the output of the 2A3 stage decreases the negative voltage at the abc diodes decreases, until at a certain output level the decreased bias on the 57 permits it to become operative. A further decrease in the output decreases the negative voltage at the diodes still further, until finally the point is reached where the supplementary 57 a-f amplifier is delivering maximum gain.

Philco 89

Effective May 1st, waveband switch part number becomes 42-1123 instead of 42-1040 formerly used.

De Wald I-F Peak Table

The following lists the models and peaks of De Wald (Pierce Airo) receivers.

Model	*I-F Peak*
440	456
503	456
504	456
505-R	456
600 A-R	456
802	456
803	456

Models 440 and 505-R are ac/dc units.

Sparton Alignment Instructions

For Models 57-A, 57-B, 58, 70, 77, 81, 81-A, 82, 105-X, 134, 135, 136, 594, 655, 685, 835

The above listed Sparton models employ the basic chassis and circuits of other Sparton models, the detailed alignment instructions of which appear in the various sections of Sparton Radio Service Manual Bulletin No. 3-E.

This data serves to correlate the various chassis, and also includes any special instructions:

MODELS 57-A, 57-B, AND 594

Follow alignment instructions for Model 57. (Section 3, Bulletin No. 3-E.)

MODELS 58, 81, 81-A, AND 82

The alignment of these battery-operated models should follow the same general procedure in that the i-f condensers should be adjusted first. (Refer to Bulletin Nos. 4-E and 27-E for chassis diagrams).

Note: Use Model 81-A Chassis Diagram also for Models 58, 81, and 82.

Connect antenna of test oscillator to grid cap of type 1A6 first detector-oscillator tube and oscillator ground to chassis frame. Set oscillator frequency at 456 kc and adjust first and second i-f condensers. Both the hexagon nut and the center screw must be adjusted in each stage.

Be sure variable condenser plates are flush when dial reads 530 kc.

Connect antenna of test oscillator to antenna lead of chassis and set oscillator trimming condenser (C-2 in chassis diagram) until the dial pointer, when tuned to the oscillator signal, reads exactly 1500 kc.

Adjust antenna compensating condenser for maximum output at 1500 kc.

Note: This condenser must be re-adjusted after receiver is connected to its regular antenna.

Models 58 and 81-A are equipped with wave trap. Adjust by feeding a strong 456-kc signal into antenna of chassis and turning the wave-trap condenser (located at side or back of variable condensers) for minimum output.

Models 81, 81-A, and 82 have a short-wave band.

Adjust S. W. trimming condenser (located at front of chassis) as follows: Turn band selector switch to S. W. position. Tune receiver and test oscillator to 1650 kc and adjust condenser for maximum output.

MODELS 70 AND 77

Follow instructions for Models 67, 68, and 691, (Section 5, Bulletin No. 3-E.)

Note: The Models 70 and 77 include two intermediate-frequency stages whereas the Models 67, 68, 691, have but one. Therefore, the Models 70 and 77 have an extra i-f transformer with adjustable condensers. (Refer to the chassis diagram, Bulletin No. 19-E, for location of these condensers.)

Always adjust the i-f condensers starting with the last stage, proceeding to the first stage.

MODELS 105-X, 135, AND 835

Follow instructions for Models 80, 83, 84, 85-X, 86-X, and 104. (Section 6, Bulletin No. 3-E.)

MODELS 134 AND 136

Follow instructions for Model 76. (Section 2, Bulletin No. 3-E.)

Note: The first detector tube of the Models 134 or 136 is a type 2A7; therefore, in adjusting the intermediate-frequency condensers, the test oscillator antenna lead connects to the grid-cap of a 2A7 instead of a type 57 tube.

Refer to Bulletin No. 30-E for the chassis diagram of the Models 134 and 136. The location of the adjustable condensers shown in Fig. 4, Page 10, Bulletin No. 3-E, is the same for the Models 134 and 136.

Dial lights are removed from these models in the same way as from the Model 76, described on Page 11.

MODEL 655

Follow instructions for Models 65, 65-T, 66, and 66-T. (Section 4, Bulletin No. 3-E.)

Note: Model 655 is equipped with a wave-trap and separate broadcast band antenna tuning condenser. Adjust wave-trap condenser as with Model 58 (see Page 1). Adjust broadcast band antenna tuning condenser as the antenna compensating condenser with Model 58. (See Page 1.)

MODEL 685

Follow instructions for Models 67, 68, and 691. (Section 5, Bulletin No. 3-E.)

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Stewart-Warner Speaker Adjustments

This data is for the following receivers:

R-125 Series (Receiver Models 1251 to 1259).

R-126 Series (Receiver Models 1261 to 1269).

R-127 Series (Receiver Models 1271 to 1279).

ADJUSTING R-225, R-226 AND R-227 SPEAKERS

In order to facilitate proper centering of the voice coil should it ever become necessary to service models R-225, R-226 and R-227 Stewart-Warner Speakers, there have been made up two special centering ring tools.

The following procedure should be used in all cases where speaker rattles are caused by the voice coil being off-center or when replacing the diaphragm assembly:

(1) Loosen the two machine screws holding the spider in place until the spider can move freely.

(2) Loosen the four speaker assembly screws in order that the shell assembly can be moved with respect to the field assembly but leave the screws tight enough so that the shell assembly cannot move too freely.

(3) The voice coil should then be approximately centered on the pole piece by moving the shell assembly with the spider screws still loose until the air gap looks uniform. Then tighten the four speaker assembly screws.

(4) Insert the proper centering ring and tighten the two spider screws.

If the speaker still rattles after centering the voice coil, the trouble may be due to particles in the air gap; loosened cement on the cone or spider; or loose turns on the voice coil. Particles in the inner gap can be blown out by compressed air, but if they are in the gap between the outside of the voice coil and the field plate, the speaker must be taken apart and cleaned. This can be done by unsoldering the leads running from the output transformer to the shell assembly and removing the four assembly bolts. Then lift the diaphragm and shell assembly *straight up* from the field assembly, being careful not to injure the voice coil.

Loose parts or turns may be fastened back in place by applying a thin coat of Ambroid, Duco Household Cement or some similar product.

When reassembling the speaker, follow the procedure given above for properly centering the voice coil.

•

Stewart-Warner I-F Peaks

The following table gives the i-f peaks for the latest Stewart-Warner receivers.

Model	*I-F Peak*
R-130 Chassis	456.0
R-131 Chassis (auto)	177.5
R-1322 (auto)	177.5
R-1332 (auto)	456.0

The R-130 Chassis includes Models 1301 to 1309, while the R-131 Chassis includes Models 1311 to 1319. The Models R-1322 and R-1332 are the latest Firestone-Stewart-Warner sets.

(*Continued on page* 306)

ON THE JOB . . .

CAPACITY MEASUREMENT

A Simple Method of Accurately Measuring the Capacities of Mica, Paper and Electrolytic Condensers

By R. M. FISKE

Contrary to the opinion of many Service Men, the accurate measurement of capacity is a relatively simple matter. The equipment necessary consists of a suitable source of alternating current, an a-c voltmeter and an a-c milliammeter. If the capacities of electrolytic condensers are to be measured it also requires a direct-current source of voltage higher than the peak voltage of the alternating current being used for measurement. The formula used is so simple that anyone having even the sketchiest knowledge of mathematics should be able to obtain the correct answers.

Fig. 1 shows the circuit necessary for measuring paper and mica condensers.

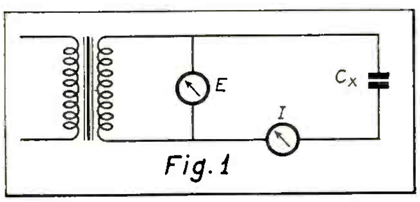


Fig. 1

Circuit for measuring paper and mica condensers.

Data given subsequently will enable the reader to determine the a-c voltage desirable in connection with the meters available and the capacities to be measured.

The formula which applies to all types of condensers, including the electrolytic, is:

$$C_x = \frac{I}{2\pi fE} \text{ where,}$$

C_x = capacity of condenser under test, in farads,

I = alternating current in amperes, and

E = a-c voltage in volts.

As an example, suppose we desire to measure the capacity of a condenser that is presumed to be rated somewhere between .1 and .5 mfd. Our a-c voltage may be 110 volts, 60 cycles and we find our milliammeter shows 9 mils, then

$$C_x = \frac{.009}{2 \times 3.1416 \times 60 \times 100} = \frac{.009}{41469} = .000000217 \text{ or } .217 \text{ mfd.}$$

MEASURING ELECTROLYTICS

Fig. 2 shows the circuit for measuring electrolytic capacities. The condenser across the output of the filter circuit must be very large, 50 to 100 mfd, or even larger being advisable. If the voltage is kept low this large capacity can be obtained in very few units. The d-c voltage is unimportant except that it must exceed the peak a-c voltage. If the a-c is 25 volts the d-c voltage should exceed $E(2)^{1/2}$ or $25 \times 1.414 = 35.4$ = peak a-c voltage.

Using the above, let us find the capacity of an electrolytic condenser marked 8 mfd.

I = 70 ma

$$C_x = \frac{.070}{2 \times 3.1416 \times 60 \times 25} = \frac{.070}{9425} = .00000743 = 7.43 \text{ mfd.}$$

(*Continued on page* 300)

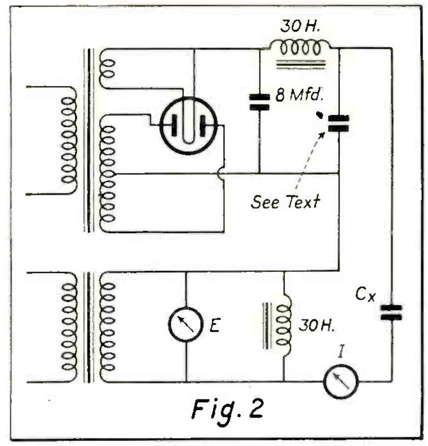
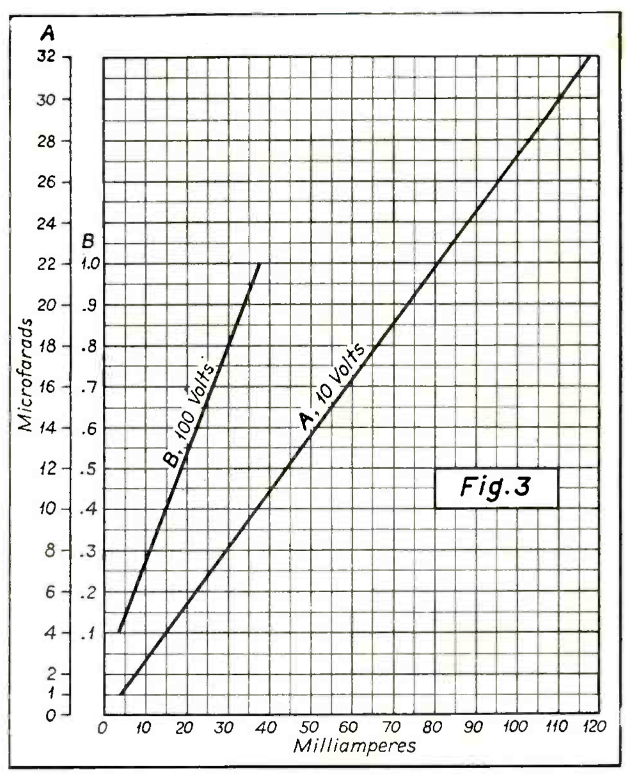


Fig. 2

Circuit for measuring electrolytic condensers.

Capacity in microfarads	*Current in milliamperes for* 10 volts a-c	100 volts a-c	300 volts a-c
.01	....	.4	1.1
.05	.2	1.9	5.7
.1	.4	3.8	11.3
.5	1.9	18.9	56.7
1.0	3.8	37.7	113.0
5.0	18.9	188.5	567.0
10.0	37.7	377.0	....
20.0	75.4	....	....
50.0	188.5	....	....



Typical curves, such as may be plotted for the rapid determination of condenser capacities.

Measuring Small Capacities

When very small capacities are measured the current flowing through them will be small and a low-range current meter must be employed or else the voltage raised. Never use a voltage higher than that at which the condensers being tested are rated. The accompanying table will give the approximate currents to be expected when testing various capacities.

It will be seen that curves may be easily plotted for various testing voltages making the accurate determination of capacities a very simple matter (see Fig. 3).

R. M. Fiske,
Service Manager,
International Radio Corp.

THE SERVICING PROFESSION

By M. K. Barber

IT has been said that "the *legitimate* radio Service Man makes a *specified fixed charge* for a call and a *standard charge* for the various service operations." Four questions arise from this statement: (1) What *determines* his *legitimacy*; (2) what is the *fixed charge*; (3) what is the *standard* charge; and, (4) *on what basis* are the charges fixed and standardized, if any? The following analysis of the subject is made in an effort to answer these questions in the mind of this writer, since he knows of no law which either legalizes or prohibits the practice of radio servicing by any one, or which prescribes any fixed or standard charges for same.

"Fixed Charges"

On the contrary, he believes that the fixing of standard charges is illegal from a commercial standpoint, and also impractical and unethical from a professional standpoint. He believes that any radio Service Man who can and does render satisfactory service to his clients is legitimate, regardless of what he charges for his services, or by what method he computes his charges for same. He believes that proper and profitable charges can be determined by the individual Service Man for the individual service and billed to the client in a professional manner without consulting either a table of rates or "B cube." He believes that any Service Man who adheres strictly to the precept quoted above will overcharge a majority of his clients and also lose rightful fees from no small proportion of them, though he may minimize the latter by fixing his standard charges high enough to cover the more difficult jobs which he will be obliged to undertake.

Conditions Not Uniform

Any attempt to base the fees for radio services on either a flat rate of so much per job, or of so much per unit operation, or to fix a definite rate for each of the multitude of service operations, is subject to the following handicaps: (1) That no two jobs are alike; (2) no two clients are alike; (3) not even two radios of the same model will develop the same combination of defects more than occasionally, if at all; and (4) the possible number of unit operations, which might have to be performed on any one of several hundreds of different models, is not small, and would have to be multiplied by the total number of different models in use if a comprehensive list of flat rates, which would be equitable to both client and Service Man, were to be compiled. Such a list would be cumbersome, indeed, and might well fill a large catalogue.

Receiver Accessibility

If rates from such a list were quoted on an itemized bill for services, many of the rates would seem exorbitant to the client, when compared to the charges for similar repairs on a different model, for the reason that a great many radios have been engineered with utter disregard for the necessity of future service maintenance, other than tube replacements, in the field. The result is that so simple a thing as replacing a volume control, in some models, requires considerable dismantling of the chassis, while in other models, the same operation can be performed in a few minutes. The replacement of a broken or leaky tube socket is a major operation in some sets, requiring that a good share of the wiring and parts be removed and afterwards replaced, often followed by complete realignment of the tuned stages, yet in other sets a socket can be changed without disturbing any major part. Explaining this to clients is unwise.

Mr. Barber has brought out some very pertinent points in connection with a highly controversial subject . . . servicing charges. For one thing, he leans toward the belief that a Service Man should exercise the same altruism as exercised by a doctor, and scale his charges according to the client's pocketbook rather than turn down the job for lack of profit. Many may not agree with such an attitude, but may, nevertheless, support Mr. Barber in his contention that radio servicing should be conducted on a professional basis rather than on the basis of a "trade." On the whole, the article is constructive and contains some excellent suggestions on billing and the computation of charges on a profitable basis. Mr. Barber is of the opinion that charges cannot be fixed but must be worked out by each Service Man to meet his own conditions in his own territory, and, moreover, based on the nature of the particular job in question.—The Editor.

Itemized Bills Impractical

Even if a flat rate catalogue could be made both complete and accurate, the use of it to itemize a bill for radio services would be as unprofessional as an itemized bill for market produce, with the further disadvantage that the items would be much less tangible to the client. It would necessarily ignore the fact that any two or more needed operations could be performed on one job for a smaller fee than could the same operations on separate jobs. It could neither allow for any job as a whole, for variation between different Service Men's operating costs and volume of business, nor for ability of clients in different circumstances to pay for service.

Hourly Basis

On the other hand, the system of estimating the total fee for radio services on the basis of time consumed in the service for the individual client, at so much per hour, seems to be the most equitable method for both client and Service Man. Assuming that the Service Man is experienced and equipped for the job at hand, this system fixes the total cost to any one client as being directly proportional to the combined considerations of: (1) The total repairs or other service required by that client; (2) any extra difficulty caused by the engineering design of his particular radio; (3) the total number of hours devoted to his service, which is determined by the first two considerations; and, (4) a recognition of his ability to pay for the service, which will be consistent with the minimum operating expenses of the Service Man and, where possible, include a fair profit.

Computation of Rates

The minimum rate per hour is fixed periodically by the individual Service Man, and is equal to his operating expenses divided by the number of working hours as estimated from his records of past business periods. His salary is

(*Continued on page* 304)

Vacuum Tubes and Their Applications

The sixth of a series of thumb-nail sketches on the characteristics and functions of vacuum tubes and how they are applied to modern radio-receiver circuits. . . . THE EDITOR

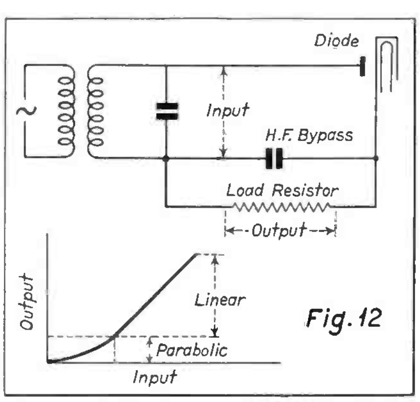
Just as there are exceptions to nearly every rule, so there is to this one. Take the case of the diode detector, the copper-oxide rectifier, or the old and nearly forgotten crystal detector. Most of these devices have a parabolic or square-law characteristic at small inputs, but their characteristics are practically linear at large inputs. This is illustrated by Fig. 12. Thus it will be noticed that the characteristic curve of the diode circuit is parabolic near the origin (i. e., the output is proportional to the square of the input) and linear further away from it. Of course, since these circuits are quite often operated at or near the origin, a part of the operating characteristic will always produce even order (i. e., second, fourth, sixth, etc.) harmonics. However, the larger the input the smaller the percentage of harmonics becomes, compared to the fundamental; and if the input is very large the harmonic content becomes negligible by comparison. For this reason it is advantageous to feed a comparatively large signal voltage to a diode detector.

This brings us to one of the fundamental laws of physics and mathematics (or of nature, for that matter) which plainly stated is: "It is characteristic of nature that there is no sudden transition from one state to another but a gradual blending of one state into another." Moreover, there are very few things in nature that are exact. Thus the parabolic portion of the diode characteristic is not exactly parabolic, but it does come far closer to obeying the square law than any other simple law. Furthermore, the parabolic portion of the curve of Fig. 12 gradually becomes a straight line as the input is increased. It is therefore necessary for the physicist, mathematician and engineer to base predictions on approximations to fact rather than on exactitudes. It is probably this fact that caused Mr. Bassett Jones to remark in one of his treatises on economics that "An engineer is a man trained to base intelligent guesses on insufficient data," and Leonardo da Vinci to state that "Experience is never at fault; it is only our judgment that is fallacious, promising effects which are not indicated by experience." The reader should therefore be forewarned that he is dealing with an inexact science in which approximations to exact laws are used in order to simplify understanding of phenomena.

Filament Requirements

Before passing on to multi-element tubes and their circuits, it appears appropriate to deal in more detail with the simpler tubes and their characteristics. So far nothing has been said of the cathode, which is the heart of the tube and from which the tube receives its lifeblood. The first requirement of the cathode or filament of any tube is that it must emit a sufficient number of electrons to operate satisfactorily. To boil off electrons requires the application of heat and to generate the heat power is required. The ratio of the number of electrons emitted to the power consumed in heat is termed cathode or filament efficiency. Stated in another way, cathode efficiency may be measured as the milliamperes of space current emitted by the cathode per watt of power supplied.

If the electrons emitted or the current emission of a cathode were plotted as a function of the power supplied in heating, it would be noticed that equal successive increments of power would produce greater and greater increases in emission. This is the same thing as saying that the cathode efficiency would rise as the power or temperature was increased. Of course, the life of any given filament decreases as the operating temperature is increased. Consequently the designer must decide what temperature gives the best solution to his particular problem, whether it be short life at high efficiency, or longer life at lower efficiency. Life of the filament is not necessarily determined by a burnout but rather by the available electrons being boiled out.



Input-output characteristic of diode, illustrating parabolic and linear portions of curve.

Coated Filaments

The filaments of the early types of receiving tubes were largely of tungsten. In these tubes it was found that after a given period the filament emission dropped to an unusually low value, but that increasing the temperature restored the emission. This process could be continued until the filament actually melted. Later thoriated tungsten filaments came into general use. These filaments consisted of tungsten together with some reducing agent such as carbon and a small quantity of thorium oxide. When thoriated filaments lost their emission they could be reactivated by removing the anode or plate voltage, flashing the filament for one or two minutes at three or four times normal voltage and then applying twice normal voltage for several minutes. Flashing raised the temperature to a point at which the reducing agent reduced some of the thorium oxide to metallic thorium. The subsequent baking operation allowed the metallic thorium to diffuse to the surface and form a layer of metallic thorium one molecule deep to act as the seat of the electron emission. During operation, the thorium evaporated, but was replaced to some extent by diffusion from the interior of the filament. Such filaments could ordinarily be reactivated several times.

A discovery by a German physicist, Wehnelt, however, soon revolutionized the old technique of making filaments. The discovery was that a copious supply of electrons might be had from barium or calcium oxide heated in vacuum and that the required temperature was much lower than that required for tungsten. Platinum or nickel wires coated with barium or calcium oxide were accordingly developed for filaments and are in general use today. Not only do oxide-coated filaments supply a greater number of electrons at a much lower temperature than tungsten, but the power required for a given amount of emission is greatly reduced.

(To be continued)

Auto-Radio . .

VIBRATORS—THEORY AND PRACTICE

By ALLEN S. NACE*

The first of a series of three articles dealing with the design and operation of vibrator-type power-supply units. The second article will appear in August issue.

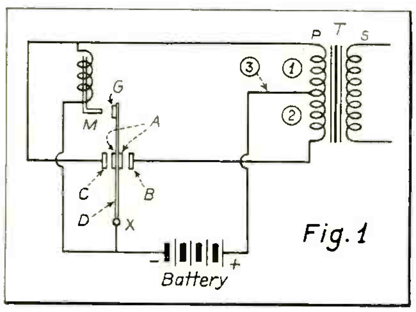
SOMEWHAT upwards of two and one-half million automobile drivers now cruise the highways and city streets from one end of this country to the other, alternately reeling off miles and stopping for traffic lights, to the tune of Paul Whiteman's dance music, the droll tomfoolery of Stoopnagle and Budd, the news comments of Lowell Thomas and Boake Carter, or the sage advice of the Voice of Experience—all because some bright young man discovered that the 6-volt direct current on tap at the ordinary automobile battery could be changed into alternating current by the use of a vibrator.

It is not our aim here to attempt to apportion credit to the various individual brains that have contributed so much to radio in first devising a practical method of utilizing a vibrator for the purpose it now fills so effectively; nor will we take time or space to trace the history of vibrator development from the first crude, half-wave series type to the present highly efficient, long-life, full-wave shunt vibrator. Rather our purpose is to attempt to dispel the haze of mystery that seems to surround the vibrator.

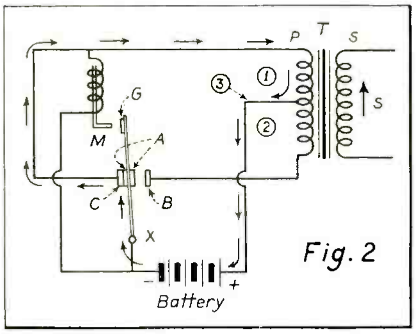
Vibrator Function

Since this is an elemental discussion, it is important that we consider first things first, so let us begin with a clear definition of the purpose of a vibrator in a radio receiver. This is: To change the direct current furnished by the 6-volt auto battery into alternating current. Once this has been accomplished the rest is simple. The a-c current, with the aid of a transformer, is stepped up to approximately 300 volts. Then it is rectified, filtered, and we have 250 volts of smooth direct current ready to be used at required plate voltages.

* Director of Vibrator Research, The Radiart Corp.



Circuit of typical full-wave shunt vibrator.



The first functional position of the full-wave shunt vibrator.

The working of the full-wave shunt vibrator is anything but complicated, as a brief study of Fig. 1 will show. The circuit contains a vibrator, a transformer, a magnet coil (M), and a 6-volt battery. The vibrator is represented by the armature and points A, A, B, C and D. A, A are two contact points, one on either side of the armature or reed, which is made of finely-designed spring steel and fastened securely at X. G is a small counterweight, while B and C are contact points mounted on additional spring arms. In normal or neutral positions, points A, A on the armature are midway between but not in contact with points B and C.

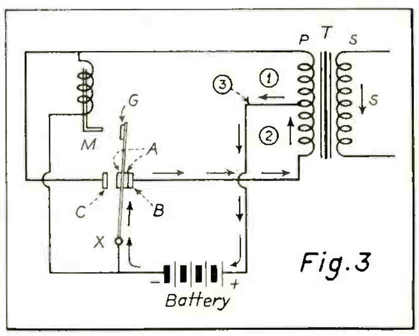
Full-Wave Vibrator Operation

In operation, current flows from the ground side of the battery through magnet M, producing a magnet energy which exerts an attraction on counterweight G, drawing the armature until contact is made at A-B. Result of this contact is that current now flows from ground up the armature, across contact A-B, on around through the upper half of the primary (1) and out at the center tap (3), to return to the high side of the battery, all in the direction as shown by the arrows in Fig. 2. Now it is elementary that current flowing through the primary of a transformer will set up current flowing in the opposite direction in the secondary of the transformer. This direction is indicated in the secondary by the arrow S.

An examination of Fig. 2 will show that with the closing of the contact A-B, magnet coil M has been shunted out of the circuit. This has caused the magnet to lose its energy and likewise its attraction for the counterweight on the armature. The spring action of the reed causes it to break contact at A-B, and begin a movement toward its normal position. The momentum of the reed, however, carries it past this normal position until it reaches the point where contact is made at A-C. While the magnet has again been exerting force on the counterweight, this attraction has not been sufficient to overcome the spring action of the reed.

With contact at A-C, current flows up the armature, but this time crosses point A-C, and flows around through the lower half of primary (2). The result is the action seen in Fig. 3, with current flowing in the opposite directions in both the primary and secondary as in Fig. 2. When the spring action of the armature causes it to break contact A-C, the magnet is again placed in the circuit and successfully exerts its pull on the armature as described in the original action.

Thus we see that the result of the continuous working of the vibrator is that current from the battery has been made to flow first in one direction and then in the other in the secondary of a transformer. In other words, 6-volt direct current has been changed into alternating current, at the same time stepping up the voltage in the secondary of the transformer. This high-voltage alternating current now may be changed back into high-voltage direct current through the aid of a rectifying tube much in the conventional manner, and, after being filtered, is available for all high plate potentials.



The second functional position of the vibrator, creating reversal of current flow.

The Synchronous Vibrator

Up to this point we have been considering the non-synchronous vibrator. Now let us take a look at the synchronous type. The difference between these two types of vibrators is that the non-synchronous vibrator requires the addition of a rectifying tube in its power-supply circuit, while the synchronous vibrator is self-rectifying and does not need the rectifying tube.

The synchronous vibrator has both its advantages and its disadvantages. There is the elimination of the rectifying tube with the resultant saving of space and price of the tube. The synchronous vibrator also is capable of carrying a higher current output than the 84 type rectifying tube, making it desirable in circuits that require a heavy plate drain. On the other side of the ledger is the added precaution necessary in filtering extra r-f disturbances in the power supply and radio receiver set up by this type of vibrator.

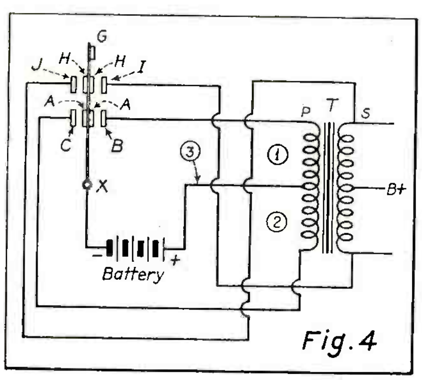
Additional Points

The synchronous vibrator includes four additional contact points not found in the non-synchronous type. These are points H, H, I and J. See Fig. 4.

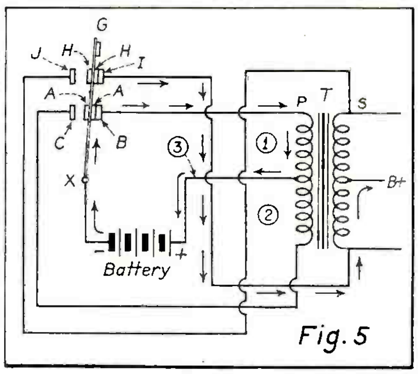
Let us return to Fig. 2 for a moment. We see that when contact is made at A-B, current flows through primary (1) or the upper half of the primary of the transformer indicated by the arrows, causing current to flow in the secondary of the transformer in the opposite direction.

Fig. 3 shows the other phase of the operation of the full-wave vibrator. Contact is made at A-C, causing current to flow through the primary (2), or lower half of the primary of the transformer, with the result that the direction of the flow of current in the secondary has been reversed. Thus we have current flowing first in one direction and then another, or alternating current.

With these principles of operation well in mind, let us look at Figs. 5 and 6 and determine what additional action has taken place by the addition to the vibrator circuit of the four contact points previously mentioned. Fig. 5 shows the armature in position to make contact at A-B, with the result that current is flowing through primary (1) of the transformer, and current is flowing through the secondary in the opposite direction. Now with the armature in this position there also is contact at H-I. We determine a constantly positive terminal by a center tap in the secondary of the transformer. Therefore, current is now flowing in the direction shown by the arrow in the secondary, from the ground up the armature, across contact H-I, through the secondary and out at the center tap. Fig. 6 shows the vibrator action with the armature at the opposite end of its stroke. The direction of the flow of the current in the secondary has now been changed, crossing to the armature at contact H-J, and continuing through the secondary and out at the center tap, as shown.



Circuit of typical full-wave synchronous rectifier.

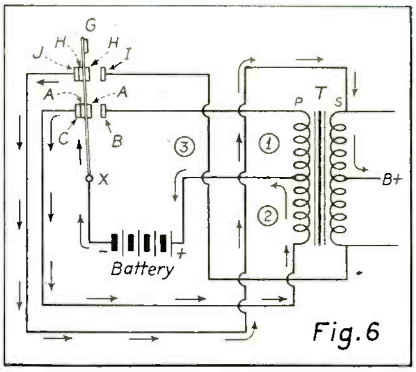


First action of the full-wave synchronous vibrator.

It will be observed now that our efforts to obtain a direct current have been successful. Regardless of direction of flow in the secondary, the center tap is always positive, and the negative terminal likewise is constant. All that is now necessary is to filter any remaining a-c component from the circuit.

Design Problems

The high efficiency of the present-day full-wave shunt vibrator has been achieved only as the result of years of intensive application on the part of vibrator engineers. Though the vibrator is simplicity itself, its construction and manufacture must be held to critical standards. Engineers have spent many laborious hours in research to determine what specifications make the most efficient vibrator reed. Exact size, weight and spring tension are of the utmost importance. Endeavors are made to hold the distance between the contact points of the vibrator to .001 inch. Naturally, such work requires close inspection and critical workmanship, as well as the aid of the latest developments in scientific instruments.



Second action of the full-wave synchronous vibrator.

Vibrator design and construction is made more difficult by the wide variety of automobile-battery conditions under which the vibrator must operate. There is the problem of starting the vibrator when it is working in connection with a partially discharged or low-voltage battery. The vibrator must start its full action immediately. A slow start will result in the vibrator freezing at the point of magnetic attraction.

"No Load" Operation

A more difficult problem to overcome is the operation of the vibrator at "no load" when being fed by an overcharged or high-voltage battery. This frequently occurs when the auto-radio set is first turned on and the generator is charging at a high rate. During the period required for the tubes to warm up and start drawing current, there is no load on the vibrator. Under this condition, improper design or construction will result in a heavy arc across the vibrator points, resulting in a burning of the points and eventual sticking. This may cause the vibrator or the set, or both, to burn out.

For these reasons the vibrator must start instantly at a voltage as low as 3 volts, and operate efficiently at "no load" at 8 volts. The 8-volt "no load" test is the most difficult any vibrator has to meet. The fact that the modern vibrator does meet such conditions has made possible an automobile-radio receiver that is comparable to many of the better types of home receivers, and is a fine tribute to the vibrator manufacturers.

(To be continued)

Stewart-Warner Model R-131 Chassis

The Model R-131 Chassis is used in receiver Models 1311 to 1319. The Model 1311 circuit is similar to the Model R-118 which it supersedes, except for an important improvement in the oscillator circuit. A 77 tube is used as a combined oscillator and first detector instead of the more conventional 6A7. The 77 is not only a much simpler tube and therefore less subject to service replacement, but the unique circuit used enables a considerable reduction in "B" drain, thus increasing vibrator life, besides cutting down battery current consumption and increasing "B" voltage supply.

Receiver Changes

In addition to this circuit change the following differences between the R-118 and the R-131 are worthy of note:

Dial calibration has been made easy by providing the dial pointer with a slotted extension rod that extends through the back of the control head. To calibrate the set, after installation, merely tune it to some station whose frequency is known, insert a screwdriver blade into the slot in the pointer extension, hold the knob, and turn the pointer until it reads correctly.

Special Load Resistor

The special Globar resistor (No. 12 in the circuit diagram) has been retained across the secondary of the power transformer to protect the filter system. This resistor has the unique property of dropping rapidly in resistance as the voltage across it rises, so that when the set is first turned on and secondary voltage is high, it acts as a temporary load on the power transformer and keeps the voltage below the danger point until the tubes warm up and take their normal current. When the secondary voltage drops to normal the protective Globar resistor increases its resistance to about 500,000 ohms so that it draws no appreciable current while the set is in use. Because of its unique voltage characteristics, the Globar resistor cannot be tested with an ordinary ohmmeter since it will show a resistance of several megohms.

Circuit Details

Referring to the circuit of the R-131 Chassis, the incoming signal is tuned and amplified in the 78 r-f stage. Further amplification and frequency conversion to 177.5 kc take place in the 77 combination first detector and oscillator tube.

The 177.5-kc signal is amplified in the i-f stage, using a type 78 tube, and then rectified in the diode section of the 75 second detector tube. The rectified current produces a modulated dc voltage across the diode load resistor No. 7. The audio component of this voltage appears across the 500,000-ohm volume control. Any part or all of this audio signal may be impressed on the triode section of the 75 tube where amplification takes place.

The modulated drop across resistor No. 7 is filtered and applied to the grids of the 78 r-f and i-f tubes to provide avc.

Self bias for the r-f and i-f tubes is supplied by the drop in resistor No. 45 in the cathode circuit of the r-f tube. The 77 detector-oscillator tube has its own bias resistor, No. 38. The type 75 tube is also self biased (resistor No. 2) but bias for the type 41 power tube is supplied by the drop in voltage across the filter choke in the negative leg of the power supply.

It should be noted from the circuit that there are two vibrator r-f chokes, No. 14, a filament r-f choke, No. 16, and a "B"-supply r-f choke, No. 17. These filters prevent ignition and vibrator noise from reaching the receiver circuits.

Alignment

The i-f trimmers are located on the top of the i-f transformers which may be reached by removing the front cover. Connect the test oscillator to control grid of 77 tube and ground. Peak i-f transformers at 177.5 kc. For r-f alignment, connect test oscillator to antenna and ground and set it at approximately 1400 kc. Tune the set very carefully for maximum output.

Adjust the output of the oscillator to the minimum value which will give sufficient output meter deflection. Adjust the two trimmers nearest the shaft end of the gang condenser for maximum output.

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THE SERVICING PROFESSION

(*Continued from page* 300)

of course included in his operating expenses, and the size of his clientele, the average number of jobs per day, and the average number of hours per job, are all considered in estimating the hourly rate.

This is not as complicated as it may seem, but it does require that the Service Man have both experience and records of that experience obtained through proper bookkeeping methods. For example, if his total expenses for a year averaged twelve dollars per working day when divided by, say, three hundred working days per year, and he estimated his average working day as eight hours, then his minimum average rate per hour would be fixed at one dollar and fifty cents.

He could break even on this, but there would be no profit unless he had set a high salary in his expenses. Not having allowed an excessive salary, he would then allow, say, fifty cents above his minimum rate per hour, making his average rate to be charged to his clients two dollars per hour. This would allow him to use his professional judgment as to whether he should charge a certain client, who might be in poor circumstances, a fee of two dollars, three-fifty, or four dollars for a two-hour job. For, as a professional radio Service Man, it is both his right and his duty to render satisfaction to his client at a cost which his client can afford, at a profit to himself where possible, but even at a loss if it be necessary. This does not refer to the practice of undercutting the other fellow's estimate, nor condone such tactics.

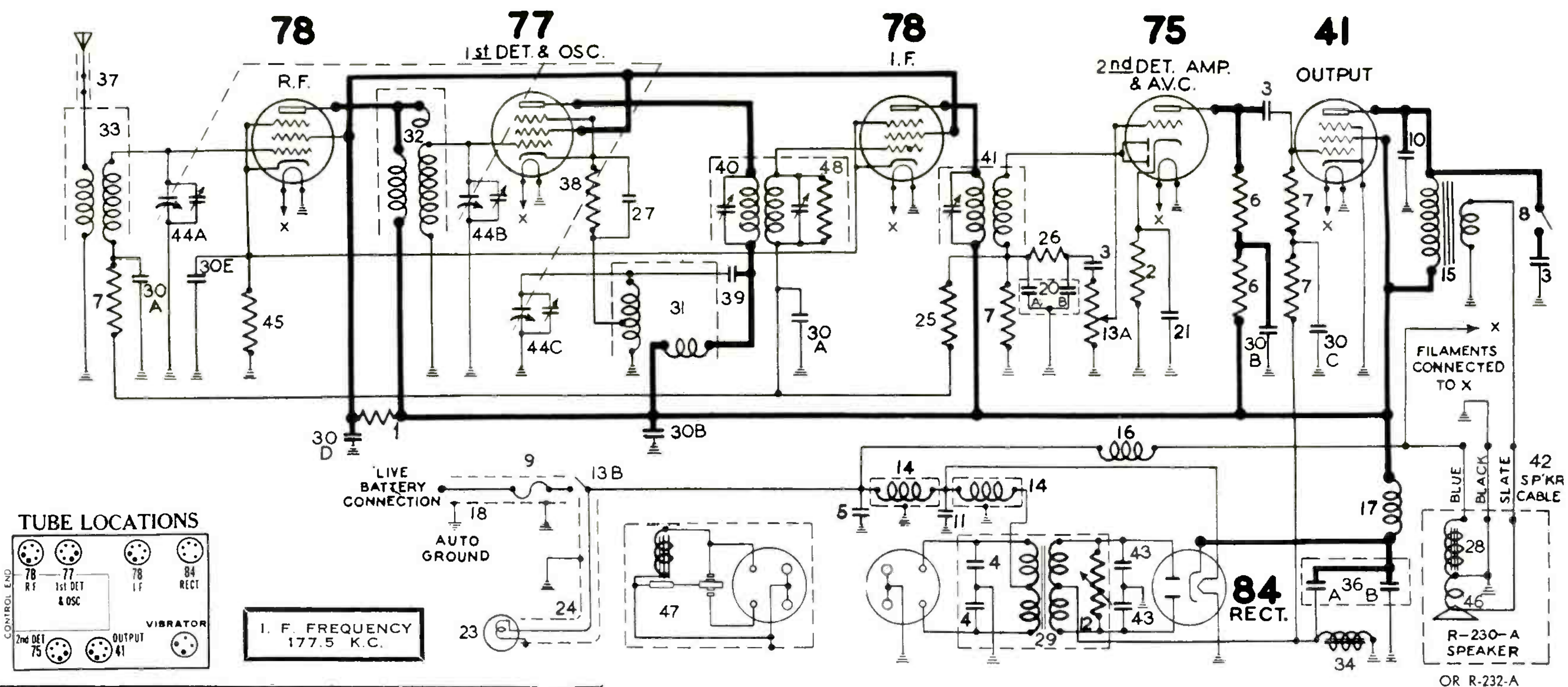
Disadvantages

Yet to bill the client for the service by quoting any definite number of hours at any definite amount per hour would be fully as objectionable as to quote flat rates for unit operations. It would be setting a price mark upon a real "service" as though it were common labor. A mark which other local Service Men might either feel obliged to meet, in the case of low rates, or be tempted to undercut, in the case of high rates. The client naturally expects one to work as cheaply as another, regardless of differences in operating expenses or quality of services. This method of billing would be just about as professional as to bill the client for shoveling ten tons of coal at fifty cents per ton, with the coalheaver having the advantage of being able to show his employer where the pile of coal had been and where he had moved it to, something the radio Service Man can seldom do to the understanding of his client or his own satisfaction.

Listing Work on Bill

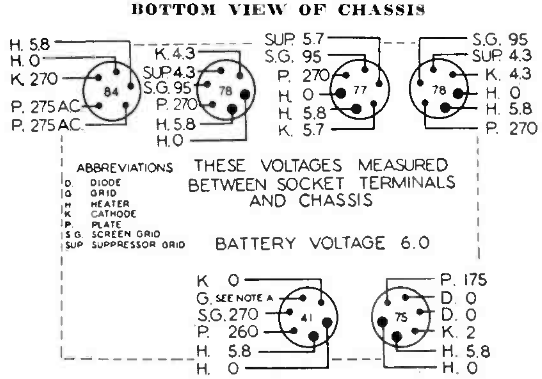
If instead, however, the unit service operations comprising the service were generalized on the bill under a single short title such as: Analysis and Repairs, Repairs to Blank Receiver, Installing Aerial System, or simply the one word, Service, followed by one price quotation for the complete service, the amount of which had been previously computed from the total time consumed, any replacements made or accessories sold being separately itemized of course, and the bill then totaled in the usual manner.

(*Continued on page* 306)



SOCKET VOLTAGES

BOTTOM VIEW OF CHASSIS



IMPORTANT: Use high resistance voltmeter of 1000 ohms per volt. Readings will vary depending upon range of meter. Make allowances for battery voltage variations.

NOTE A: The actual bias on the grid of the 41 tube is —23 volts which must be measured from chassis to the ungrounded filter choke terminal. Due to the high resistance of the grid leak, the voltmeter will show only about —1 volt at the grid.

MODEL R-131 PARTS LIST

Diag. No.	Part No.	Description
1	66023	60,000 ohm 1 watt carbon resistor
2	67580	6,000 ohm ¼ watt carbon resistor
3	83007	.02 mfd. 600 volt paper condenser
4	83058	.25 mfd. 100 volt paper condenser
5	83063	.5 mfd. 100 volt paper condenser
6	83080	51,000 ohm ¼ watt carbon resistor
7	83082	260,000 ohm ¼ watt carbon resistor
8	83179	Tone control switch
9	83207	15 ampere fuse
10	83706	.006 mfd. 600 volt paper condenser
11	83714	1.5 mfd. 100 volt shielded condenser
12	83725	Special Globar resistor
14	83730	Vibrator R.F. Choke
15	83731	Output transformer
16	83742	Filament R.F. choke
13A	83728	500,000 ohm volume control
13B	83728	Line Switch
17	83770	"B" supply R.F. choke
18	83777	Battery lead and fuse housing
20	83785	Dual .0005 mfd. molded mica condenser
21	83803	12 mfd. 25 volt dry electrolytic condenser
23	84058	6 - 8 volt dial light bulb
24	84099	Dial light cable
25	84235	1.1 megohm carbon resistor
26	84238	11,000 ohm ¼ watt carbon resistor
27	84282	.001 mfd. molded mica condenser
28	84791	Field coil and housing (R-230A only) (Part 85118 for R-232A)
29	84798	Power transformer
30A	84806	.05 mfd. 300 volt paper cond. (green-white)
30B	84806	.1 mfd. 400 v. paper cond. (red or red-white)
30C	84806	.25 mfd. 100 volt paper cond. (green lead)
30D	84806	.25 mfd. 300 volt paper cond. (white lead)
30E	84806	.5 mfd. 100 volt paper cond. (orange lead)
31	84814	Oscillator (O) coil and shield assembly
32	84822	R.F. (B) coil and shield assembly
33	84825	Antenna (A) coil and shield assembly
34	84827	"B" supply filter choke
36A	84829	4 mfd.—400 volt dry electrolytic condenser
36B	84829	8 mfd.—400 volt dry electrolytic condenser
37	84831	Antenna lead and plug
38	85051	8000 ohm ¼ watt carbon resistor
39	84833	.00007 mfd. molded mica condenser
40	84838	1st. I.F. transformer assembly
41	84842	2nd. I.F. transformer assembly
42	84845	Speaker cable
43	84850	.03 mfd. 750 volt paper condenser
44A, 44B, 44C	84866	Three gang variable condenser with mounting plate and shaft coupling
45	84888	300 ohm. ½ watt flexible wire resistor
46	84891	Diaphragm, voice coil, and shell assembly (R-230A only) (Part 85119 for R-232A)
47	84904	Vibrator
48	83072	510,000 ohms ¼ watt resistor
38	85051	8000 ohm ¼ watt carbon resistor
28	85118	Field coil and housing (R-232A only)
46	85119	Diaphragm, and shell assembly (R-232A only)

Complete schematic diagram of the Stewart-Warner Model R-131 chassis. Socket voltages are given separately, in the lower left corner; chassis tube locations, above.

Public Address . . .

"PUBLIC ADDRESS" FROM THE RADIO RECEIVER

By E. M. PRENTKE

A SIMPLE, efficient and inexpensive attachment for converting any good radio receiver into a practical public-address amplifier, without detracting from the receiver in any way, has been designed by the author and found to be a new source of profit. The attachment can be sold or rented to those who have need of a small public-address outfit and wish to obtain good results without a large expenditure of cash.

The Attachment

The circuit of the attachment is shown in Fig. 1. It consists of a high-gain triode-connected 6C6 or 75 tube, resistance coupled into the triode section of the second detector tube in the radio receiver through an auxiliary volume control and "Radio-Microphone" switch.

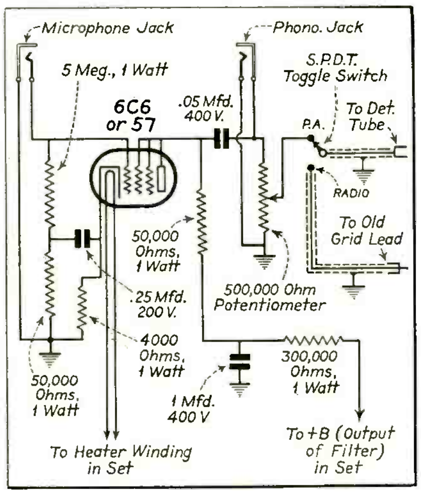


Fig. 1. Circuit of the pre-amplifier for public-address work.

This circuit must precede at least two high-gain stages. In many of the table model sets of late design, the second detector is a diode, such as the 55 or 75, or other diode-triode tube whose triode section feeds a 42 or 2A5. Such a set is well adapted to this circuit.

The components, including the volume control, switch and microphone and phonograph jacks, are mounted on a metal chassis of a size and shape that can be mounted inside the radio cabinet if possible. Leads are provided for the following external connections: Two wires for heater leads, chassis ground, shielded lead to control grid of second detector tube, and shielded lead to original control-grid wire.

The circuit is self-explanatory and includes all parts values.

Application

The attachment as described can take care of small restaurants, beer parlors, night clubs, etc., using a diaphragm-type crystal microphone, or high-impedance phonograph pickup. (Be sure to ground the chassis when using the set with this pre-amplifier attachment. Also be sure to shield the tube in the pre-amplifier.)

Of course, the greater the audio output of the radio receiver with which the attachment is used, the greater will be its usefulness. A receiver with an output around 10 watts can cover a lot of space.

A more convenient pre-amplifier attachment can be devised by including an individual power supply. This is by no means a necessity, but might prove more attractive to some buyers.

THE SERVICING PROFESSION

(*Continued from page* 304)

the client would have nothing upon which to base adverse criticism, except in the event that he either had received unsatisfactory service or was truly being overcharged by an unscrupulous operator. It is believed that the ethical Service Man will enclose with his bill a guarantee covering defective material and workmanship on all repairs and replacements made by him, and that he will further assure himself that his client has been satisfied with his services.

Minimum Fee

Thus far, no minimum fee for the average call has been considered, but it is believed that each Service Man should establish such a minimum rate to cover all calls where the complete service is rendered within a space of, say, less than two hours, in which case it is believed that this minimum rate should always equal the Service Man's maximum hourly rate for one hour, regardless of whether the time consumed is only thirty minutes or nearly the full two hours. In the event that the service consumes two hours or more, then the regular hourly rate would usually be applicatory. This leaves the Service Man free to make an unhurried and unbiased analysis on each call, including tube replacements where needed, and often other minor repairs or adjustments.

GENERAL DATA

(*Continued from page* 298)

Stromberg-Carlson I-F Peaks

The following table provides the i-f peaks for the new Stromberg-Carlson receivers.

Model	*I-F Peak*
No. 58	465
70 Series	260-370
No. 82	465

The 70 Series, which includes Nos. 70, 72 and 74, have one of two i-f peaks as indicated above. The proper i-f value is stamped on the chassis.

General Electric I-F Peaks

The i-f peaks for the new General Electric receivers are given in the accompanying table.

Model	*I-F Peak*
D-50 (auto)	175
M-50	460
D-51 (auto)	175
M-51	460
M-51-A	460
D-52 (auto)	175
M-52	460
M-55	460
M-56	460
M-61	460
C-62	460
M-62	460
M-66	460
C-67	175
D-72 (auto)	175
M-81	460
M-85	460
M-86	460
M-89	460
M-106	460
M-107	460
M-655	460

The Model C-62 is a battery-operated receiver, while the Model C-67 is a 32-volt dc unit.

International Models 105 and 1050

In these models the 2-gang condenser is cushion mounted to eliminate vibration of the plates. Do not allow the dial to touch the escutcheon plate on the cabinet or a microphonic condition will be created.

Pilot Lights

In the earlier productions of these models, the pilot lights were wired in series and 3.8-volt bulbs were used (Part No. E-405). If they burn out in an unreasonably short time, it is suggested that the sockets be rewired to parallel connection and the Part No. E-472, 6.8-volt bulbs be used.

RECEIVER CASE HISTORIES

Atwater Kent 37, 38, 40, 42, 44

Volume-control resistor break: Remove flat strip volume control and solder it at the break in the resistor. Replace by bending the flat strip back in the opposite direction, so that arm of volume control rides over opposite side of control. *George F. Baptiste*

•

Atwater Kent 310, 510

Audio oscillation: Caused by mismatched 2A5's in push-pull audio system. Replace these tubes with well-matched 2A5's. *George F. Baptiste*

•

Atwater Kent 345

Cuts out entirely on any of three bands: Replace 2A7 detector-oscillator. *Edward J. Brockway*

•

Bosch 402

Howls: This is an a-c, d-c set. Howls when heated, no signals. Replace 6F7. *Edward J. Brockway*

•

Brunswick 15

Intermittent reception and crackling: These sets make use of a unique type of volume control, the principle being that of a variable coupling condenser between plate of first r-f tube and grid of second. An insulated brass rod telescopes within an insulated tube, the whole being actuated by a rack and pinion arrangement. Trouble is often experienced with sliding rod due to flexible lead breaking at point of contact. Pull the cotter pin holding the pinion to volume-control shaft, allowing rod to slide out of mesh. Drill hole in side of chassis about 1 inch below level of top of chassis and just far enough from the front to clear first partition in tuning condenser by 1/16 inch. The rod will be directly in line with hole (3/8-inch diameter). Remove flexible lead and slide rod out through hole in chassis and condenser frame. After joint has been soldered, rod and lead may be returned through hole and lead fished around condenser shaft with pair of tweezers. Care should be taken to mesh rack and pinion properly so that volume control may operate over full range. *Francis C. Wolven*

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General Electric K-51

Low volume level: Caused by defective series padding condenser in the 2A7 circuit. Check oscillator and i-f adjustments. Replace series padding condenser and 2A7 tube. *George F. Baptiste*

General Electric K-60

Oscillation and motor-boating: Can usually be stopped by touching the cap of the 2B7. This is due to loss of capacity in C-30 (see page 3-15, Rider's Manual). Replace with 4-mfd, 600-volt, paper-type condenser. *Francis C. Wolven*

•

Grebe M 3-4

Fading: Test all fixed condensers in the set separately with a high voltage and neon light, replacing those that leak or open intermittently. *Jim Kirk*

•

Grunow Chassis 5B

Motor-boats with some local signal coming through: This is due to open filter condenser, either 20-mfd open red lead to green lead or 8-mfd open red lead to black lead. Strap new units across these or replace whole bank. It is best to replace whole bank with units having newer type lead connections.

Loud a-c hum: Due to pilot light being shorted out on variable-condenser gang. Remedy by twisting insulating washer around until pilot light does not touch condenser frame and apply some form of cement to top of insulating washer to hold it in place. *Keith F. Martin*

•

Grunow Chassis 7A, 8A, 9A

Subject to cutting off: Especially in noisy locations, due to too much delay in avc circuit. Replace all 0.1-mfd bypass condensers in grid circuits of 78 tubes with 0.01-mfd, 600-volt units. Two of these are in a can riveted to rear of two coil shields, the leads being brought out through the coil shields. The two posts on this can are blanks and tone-control condenser is fastened between them. Take a small knife blade and run it down between condenser can and coil shields. Cut both wires loose. These leads can be brought out through the front of coil shields and serve as leads for new condensers.

Resistor Burnout: The burning out of the 14,700-ohm screen-grid resistor is another common fault. This resistor is first section of voltage divider with white wire coming off of second connection. Replace with 15,000-ohm, wire-wound, 10-watt unit.

Bad tone is another common complaint. On inspection set will have plenty of punch but very bad tone. Remove shield from over electrolytic condensers and check to see if condensers have leaked over and are shorting the negative side to ground. Replace with new 8-mfd electrolytic condensers and leave shield off. *Keith F. Martin*

•

Grunow 650, 660, 670, 750, 1151

Noisy volume control: Remove control from chassis and take switch off of back. Solder very small wire to rocker of volume-control arm and pull back to center connection and solder. A small, short piece of copper wire can be slipped under one side of rocker and soldered. This keeps the rocker from moving back and forth and eliminates noise. *Keith F. Martin*

•

Grunow 670 or 6D Chassis

Set dead: Shorted red lead in electrolytic-condenser block. New condenser cannot be strapped in as negative lead is tied inside the block. Replace whole block. *Keith F. Martin*

•

Grunow 750 or 7B Chassis

Noise: These sets become very noisy on A band and in some cases will not operate at all. Remove grounding arms which hold the variable condensers in place. Clean arms with fine sandpaper and replace. *Keith F. Martin*

•

Majestic 66 Auto Radio

Fuse blows frequently: May be caused by defective 6Y5 rectifier tube. Tests in a tube checker will not necessarily show fault. However, good 6Y5 will operate at higher temperature than a defective one. *Super Radio Service Co.*

•

Majestic 70-B

Error: Some of these sets are not built according to specifications. Often the positions of the a-f and r-f bias resistors are reversed under terminal strip. Check with ohmmeter before making replacements.

Open neutralizing coil: In case neutralizing coil inside r-f transformer develops an open circuit near the ground connection, drill hole in coil form near chassis, remove half a turn and thread through hole with tweezers, connecting the end to ground. This applies only when open is in ground lead of coil. It will probably be necessary to increase capacity of associated neutralizing condenser. *Francis C. Wolven*

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Motorola Auto Vibrator

Replacement: When replacing 0.1-mfd condenser across points in Motorola vibrator use a 1000-volt type. *Edward J. Brockway*

(*Continued on page* 310)

Philco 45

Low volume: Caused by shorted turns in secondary of i-f coil. Replacement necessary. *Edward J. Brockway*

Philco Model 57-C Wax

On some Model 57-C ac compact Philco sets, the power transformer has an excess of impregnating wax. The transformer is mounted directly over the condenser gang with the inevitable result that the surplus wax melts out of the transformer and drips down into the condenser gang where it immediately hardens, binding the plates. The wax can be removed from the condenser easily enough by the use of carbon tetrachloride which dissolves it, but the most important thing is to prevent a recurrence of the trouble.

This is accomplished by loosening the transformer, disconnecting only the wire from the pilot light and pulling the transformer free from the chassis (there is plenty of length to the wires leading down from the transformer to permit this). Then remove the shell from the transformer and using a putty knife, remove all of the wax, especially in the bottom half of the shell. Due to the possibility that all of the surplus wax has not been drained from the windings, it is necessary that the transformer be heated and drained before reassembling into the shell. The writer accomplished this by simply placing the transformer in a shallow metal pan on top of a gas hot plate and heating it for an hour (or until the surplus wax has run into the pan).

A piece of asbestos is used to protect the chassis from the heat of the hot plate—as the chassis must necessarily be placed in close proximity to the source of heat inasmuch as all but one of the transformer wires are connected. The above kink has been used by the writer on numerous occasions during the past year without a single comeback and the actual time spent on the job, exclusive of the melting-out process, is about half of that used in installing a new transformer on this extremely compact set.

R. E. Walters.

Pilot 55 or 43

Volume Control: Considerable improvement may be made in volume-control circuit by returning detector screen bleeder to ground instead of r-f cathodes and substituting 10,000-ohm unit for original control. No change need be made in value of R-10 since two 58's should draw 20.8 mils total plate and screen current. This makes certain that 3-volt minimum bias will be just that. With original model it was higher due to bleeder current. If this change results in oscillation, volume control should be set for 100- or 200-ohm minimum. *Francis C. Wolven*

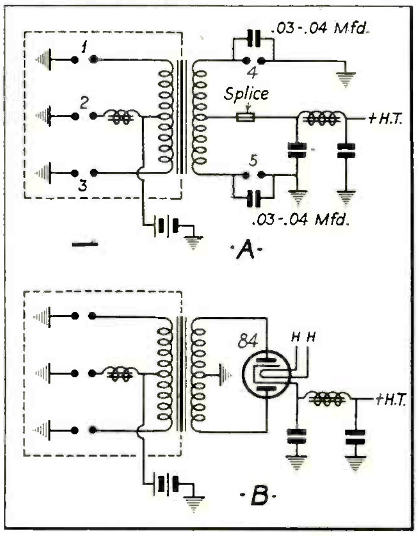
Radiola Superette, R-7, R-8, R-9 R-10

Abnormal screen voltages: Caused by deterioration of resistors supplying the screen voltage. The Superette used a 14,300-ohm, 2-watt and the others a 16,000-ohm, 2-watt carbon resistor to drop the screen voltage. In either case an 8,000-ohm bleeder was used. The 8,000-ohm units generally decrease their resistance and burn up. The 14,300- and 16,000-ohm units generally reduce their resistance to a very low amount. The 14,300-ohm size can be obtained, and I use a 15,000-ohm, 10-watt and a 7,500-ohm, 2-watt as replacements for others. Quite large variations are permissible as long as the 2-to-1 ratio is maintained. *Francis C. Wolven*

RCA M-34 Auto Vibrator

Low plate voltage and vibrator hash: After replacing several of these units the following cure was developed.

The cure consists of cutting out the rectifying portion of vibrator, biting prongs from 84 tube short to base, soldering wire leads to what is left of prongs, making necessary connections to power transformer, breaking the splice from the power-transformer secondary center tap to filter block, grounding center tap and connecting filter lead to 84 cathode, and making any necessary vibrator adjustments. Original connections shown at A and modified unit at B in accompanying illustration.



The materials used consist of a decent set of points on opposite sides of spacer block, an 84 tube, 2 feet of wire, and solder. *S. W. McCochrane*

RCA R-37, R-38

Oscillation and motor-boating: (See General Electric K-60.)

RCA 38-P

Oscillation: Caused by shielded lead running to cap of second detector. Shielded lead should fit tightly in slot in tube shield and should be well grounded to the chassis. Also, replace tube with new 2B7. *George F. Baptiste*

Silvertone 36, 37, 41 and 1172

To increase volume and sensitivity: Where the volume is controlled by the primary coil moving in and out of the secondary coil, loosen the set screw on the rear end of the volume-control shaft and move the primary coil 1/8 to 1/4 inch into the secondary coils. Tighten set screw on volume-control shaft. Replace the type 24 tubes in the r-f section with 35's. Align condenser gang to cut out oscillation. *Super Radio Service Co.*

Silvertone 1732

To increase volume: Increase the screen-grid voltage from 55 to 80 volts. This is done by using a 10,000-ohm bleeder resistor from plate supply to screen-grid supply in place of the 15,000-ohm unit. *Ed. Tischler*

Sparton 931

Oscillation; two-spot tuning: Caused by worn bearing in tuning-condenser shaft which caused plates to run out of alignment. Condition not necessarily noticeable from operation of tuning dial. *Ralph D. Hodges*

Fading Tip

Nine out of ten sets have had the r-f grid lead of the coil and/or of the tube connected to the tuning condenser by means of a lug and screw. Vibration and sometimes expanding and contracting of the usual bakelite mounting causes this screw to loosen. The resulting poor contact acts the same as a variable grid suppressor. Solder the leads directly to the stator or use a lock washer. *A. A. Burkmann*

Association News . . .

INSTITUTE OF RADIO SERVICE MEN REPORTS

IRSM QUALIFICATION PLAN

Members of the Institute of Radio Service Men within the last month have directed the Board of Trustees to approve the Qualification Plan developed by the Committees and Chapters of the IRSM during the last three years.

The Qualification Plan is the result of the most intensive investigations. Starting in 1932 with a world of information at its disposal, the Institute sought to effectuate some means to set the qualified Service Men throughout the country apart from those whose qualifications are not known or are subject to question.

The Committee began its research on the basis of securing the enactment of legislation that would make it necessary for a Service Man to be licensed. However, it was found in a short time that such legislation handled bv states or municipalities could not be economical; if the various states or cities were to derive sufficient income to properly and effectively enforce the measure, the service field could not be kept on an economic basis; and there was a strong likelihood that many of the irregularities now existant in radio servicing would be legalized as a result of the legislation. It was found further that the enactment of state legislation would be detrimental to the welfare of the radio industry.

The Committee foresaw the dangers that existed if the Institute were to assume the responsibility for passing upon the qualifications of radio Service Men. History shows that no organization that has assumed the responsibility of regulating the ability of those engaged in the business has been successful either in its attempt to effect such regulation or anything else that an organization should do in order to justify its existence.

It would be foolhardy to set down any hard and fast rule of procedure, one that is not subject to change. The experiences during the last three years (the Committee has worked on numerous ideas that have appeared at first glance to be perfectly harmless and at the same time effective only to learn after several meetings that the furthering of the idea would be detrimental to the welfare of some other parts of the industry) have proved conclusively that a Qualification Plan must be flexible enough to permit it being changed readily in order to meet the requirements.

Therefore, the Qualification Plan that now has the approval of the membership of the IRSM and which needs only the official stamp of approval from the Board of Trustees will start off as a "proving ground." Any shortcomings will be remedied without delay; superfluous measures, if there be any, will be eliminated; things that are lacking will be added.

The Plan will start as quickly as the machinery can be put into operation. Chapters of the Institute have been editing the Questions and Answers prepared by the Committee. The questions that remain are now in the hands of specially appointed committees in several of the Chapters who are going over them and making them ready to be put into the "Questions and Answers Handbook" which will be loaned to the Service Men who make application to take the examination.

The Board of Trustees at its meeting to be held in Rochester will agree upon certain details that have to do with the giving of the examinations and the granting of the qualification credentials. Then the plan will be ready to turn over to the National Board of Radio Service Standards, a body on which every part of the radio industry and the public will be represented.

The Committee is also engaged upon the preparation of the publicity that will go forward to tell the set users about the plan. All sorts of publicity media will be employed, and the Committee finds that there is a most remarkable positive reaction concerning the project and a desire to let the public know that they are to be given a very definite answer to the time-worn question, "Where can I find a *good* Service Man?"

Eastern Convention and Trade Show

The Third Annual Eastern Convention and Trade Show will be held at the Hotel Pennsylvania in New York City, October 25 to 27.

Preparatory to the forthcoming Convention, the Executive Committees of all Chapters in the New York Metropolitan Area have been holding joint meetings, simultaneously forming a Regional Committee headed by Fred Horman of the New York Chapter. A. S. Cooke of the Newark, N. J., Chapter is Secretary of the Regional Committee.

In a meeting held at the Hotel Pennsylvania on June 5 Messrs. Asch, Reddy, and Podell were appointed to serve on the Convention Publicity Committee; and Messrs. Mandeville, Barton, McGee, and Hughes were appointed to serve on the Committee on Arrangements.

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ROCHESTER I.R.S.M. CONVENTION

The Rochester Section of the Institute of Radio Service Men is sponsoring a Radio Show and Convention in conjunction with the annual Exposition which is this year celebrating its Silver Anniversary.

The Show will be open Labor Day, September 2nd, and will continue through Saturday, the 7th.

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N.R.I.A.A. (BALTIMORE LOCAL)

A splendid, successful meeting was held May 21st at Fishpaw's Hall by the Baltimore Local of the National Radio Institute Alumni Association. Mr. Cowman, of the Baltimore Gas Light Company, sponsored the lecture, which was presented in a dual manner.

The two companies participating were the Galvin Radio Company and the Hygrade Sylvania Corporation.

Mr. George C. Conner. Commercial Engineer of Hygrade Sylvania, opened the evening's program with a discourse on tubes and led to a description of auto radios and their troubles in general.

Mr. Yoeman, of Galvin, then gave a detailed talk on a Motorola receiver, dissecting the circuit in detail.

Various other speakers prominent in radio circles were introduced and gave enlightening comments.

Two reels of movies were then shown and refreshments served.

At the last meeting of the Local, it was decided to open a school to teach radio operating to the Membership. This plan received enthusiastic approval of the entire group present. Any man connected with radio in any of its branches should be an efficient operator.

In times of national emergency, such as the last war, men familiar with this profession immediately stepped into good paying positions with both the Government and commercial companies.

Knowledge of code work also opens up other avenues to men—aircraft, ship and amateur.

All Members wishing to take part in this class get busy now and prepare yourselves by learning the code. After the class gets under way it will be hard for the beginner to catch up. So start now and get in on the ground floor.

W. B. Giese

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R.T.A. (CLEVELAND) NOTE

For the benefit of radio Service Men in northern Ohio who would like to make application for membership in the Radio Technicians Association, Inc., kindly communicate with Mr. A. Patterson, 14013 Glenside Ave., Cleveland, Ohio. This will insure your application going to the proper committee chairman.

Mr. Ralph Borden, our vice chairman, made a motion that our association should make arrangements to attend the Affiliated Radio Servicemen's Association's meeting in Altoona, Pa. Plans were made for this, and Mr. E. Myers, Mr. G. Rosell, Mr. R. Dresser and Mr. C. J Benedict made this trip—getting there just in time.

The Radio Technicians' Association extend their sincere thanks for the royal welcome the members of the Affiliated Radio Servicemen's Association gave their men.

C. J. Benedict

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R.T.G. NEWS

The June issue of the R. T. G. News has a brand new cover—and a real snappy one. Albert C. W. Saunders, the Editor, undoubtedly follows the axiom that "those who stand still never get any place."

We are taking the privilege of quoting a few pertinent paragraphs from "Editorial Notes" in the June issue of the R. T. G. News:

"The present poor condition of the radio service industry is not caused by the public, manufacturer, or jobber—the Service Man is at fault. The public needs good reception of radio programs. The manufacturer has pulled away from making $5.00 radio receivers, advertising better radio, and schooling the Service Man. The jobber interests himself in the welfare of the local Service Men, and does everything in his power to boost organization in their respective localities.

"The Service Men should put on the finishing touches."

Telegram: "CONGRATULATIONS TO YOUR ENGINEERING DEPARTMENT ON THE WONDERFUL SUCCESS OF THE MODEL SIXTY-TWO AMPLIFIER STOP I TRULY THINK IT IS THE MOST WONDERFUL THING I HAVE EVER HEARD STOP LETTERS OF RECOMMENDATION WILL FOLLOW"
Signed—(Name on request)

Shown with leveling device extended, ready for front-seat operation by the driver, featuring accessibility, perfect operation and complete control.

MOBILE
P.A. SYSTEM
Model No. 62

A complete, compact, Unit-Matched combination of Operadio engineering excellence—including amplifier, turntable and controls—all contained in a neat case equipped with an ingenious false bottom leveling adjustment for front-seat operation by the driver. A 6-volt storage battery operated unit providing 16 watts of undistorted Class "A" amplification. Has three power switches for turntable, filaments and "B" supply; plug-in for microphones and auto radio. It's an Operadio ADVANCED product and the finest portable P. A. System offered to service men. *Write for Bulletin No. 94 which describes it in detail.*

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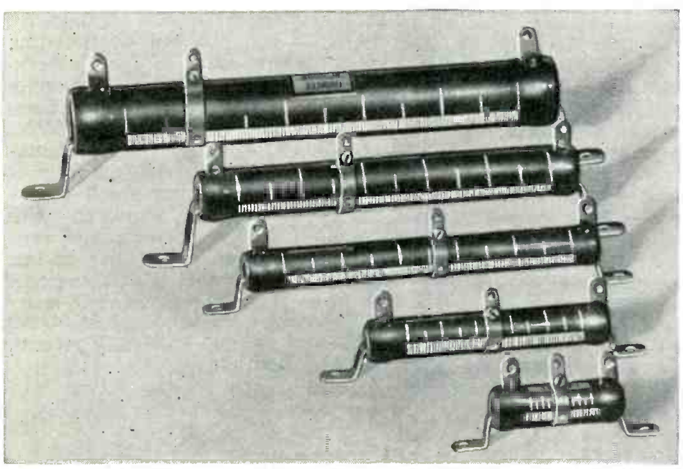

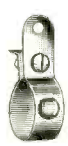

TIME SAVERS!

Don't waste hours combing the town for a special replacement part when an odd resistance value is needed. Use DIVIDOHMS—instantly adjustable to the exact value wanted. They make ideal replacement voltage dividers.

DIVIDOHMS are wound over porcelain cores, and covered with special Ohmite moisture-resisting vitreous enamel. A narrow strip along one side is left bare to make contact with the "ball point" of the adjustable lugs. A number of lugs may be used without shorting out any appreciable amount of resistance. A patented percentage-of-resistance scale on each unit simplifies setting lugs for correct value. Made in five wattage ratings, and many resistances through 100,000 ohms. Ask your Jobber, or write us.

Write for Catalog 14 Just off the Press!

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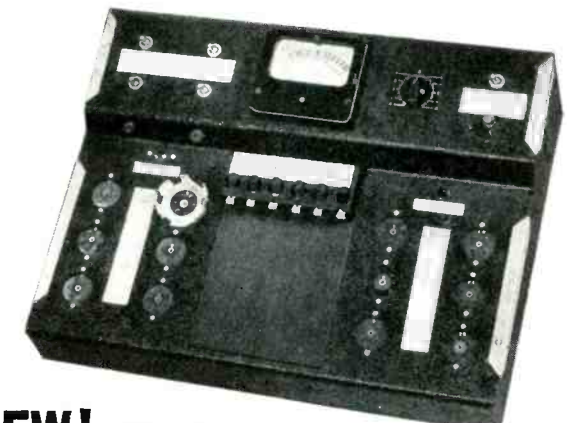
AHEAD AGAIN!



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VIBRATOR TESTER
at a POPULAR PRICE!

After months of painstaking research and investigation Day-Rad offers the VIBRATOR TESTER, an instrument that can actually make you hundreds of dollars before winter. It puts you into the Auto Radio field in a big way by making quick, accurate and visual tests of Vibrator performance. You "clean up" on replacement, adjustment or repair. Although your biggest market is in the summer when more cars are on the road, you can keep up a fine work-volume with this tester all year 'round. And the more auto radios that are sold, the bigger your chance for profit. Get this low cost Tester and get busy!

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COMPLETE
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CHECK THESE SPECIFICATIONS

- Dimensions—18 x 13⅝ x 5½
- Weight—16 pounds.
- Finish—All steel cabinet finished in black crackle, nickel trim.
- Meter—4-inch square black bakelite English reading—Full vision dial — including Battery Voltage Readings on Scale — insuring positive proper voltage at time of test.
- Adjustable control to cover all makes and types of vibrators. Flexible for future types.
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- Short Indicator—Short circuits shown instantly.
- Shock Proof Test Base for lead type vibrators.
- Single test for all vibrators regardless of make or type. Unnecessary to make three or four readings and calculations.

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Send me complete information regarding your new Day-Rad VIBRATOR TESTER, also your new catalog of Day-Rad RADIO SERVICE INSTRUMENTS.

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Street ....
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THE FORUM . . .

ADVISES STUDY

Editor, SERVICE:

I am writing this in an attempt to help the Service Men whose letters were published in the May issue of SERVICE, namely, Mr. F. B. Guthrie, Mr. Fred Jeffrey, Mr. I. N. Faurot, and hundreds of others who wish to become better Service Men. I am not trying to down these men but I am endeavoring to help put them on the right track.

Service Men come into this shop and tell us that we should hire them because they can repair any receiver on the market. Do they know Ohm's law? No, it is not necessary, it is so seldom used. There is seldom one hour in the day that I don't use Ohm's law and feel glad that I have it to use.

Mr. Guthrie, you have asked SERVICE to print fundamental theory. Neither SERVICE nor any other magazine can keep printing these articles for every newcomer to the radio industry.

Some call themselves Service Men and can not even figure out resistances in one of these ac/dc cigar boxes. . . . I have reference to tubes of different voltages, line resistances, etc. Such Service Men should get themselves a little radio book on theory and learn Ohm's law and its applications. This simple little formula can be learned and applied within a week. With this information at hand such simple little problems can be easily and correctly solved in thirty seconds.

In regards to information on aligning receivers, nine out of every ten can be realigned and work better for it. No one has to twiddle the screws to put the set out of whack. There are lots of other conditions present that will do the same thing.

Mr. Jeffrey doesn't care for "radio engineering" but does want to be a first class Service Man. Why doesn't he first learn the fundamentals of radio and then go ahead? I think he should be interested enough to get these little things.

Fellows, why not get these much needed facts, learn them by heart, and then figure your IR drops, wattages, etc.? You won't have to refer to your bibles (Rider's) all the time; and you ought to know by this time that all the sets on the market today are not in any manual.

W. A. LOVELL,
Washington, D. C.

(Some of the boys see the handwriting on the wall; others seem blind to it. Those who see it will continue in business along with Mr. Lovell.—EDITOR.)

•

AGAINST "PRODUCTION METHODS"

Editor, SERVICE:

I have just read, for the second time, the article on page 52 of the February issue of SERVICE. I do *not* agree that there will ever be a time when radio receivers can be efficiently serviced in a given time or hurriedly. While this is especially true of radios, it also applies to autos, watches, and any complicated and delicate mechanism.

Let me quote an instance of an automobile agency! This agency serviced and sold high-quality cars, their repair work was painstakingly and carefully done, and they had a host of satisfied customers. Then they changed to a cheap line of cars. The factory installed the latest servicing system and machinery. Every job was to take just so long and to cost just so much. The new servicing equipment was to insure this . . . the "help" could dispense with their craftsmanship, for the human element was not so important. I've had my car in that shop four times . . . serviced by the same men as in the old "quality days" but under the new "efficiency" system . . . and every time the work was unsatisfactory. True, the bills were low, but the quality of the work was lower. When I spoke to the service manager, he replied, "Of course, these men can do better work but that takes care, and care takes time. Time runs up the cost and the factory says our service must be cheap."

The factory named it. It is cheap. And, I most emphatically disagree with the policy!

And while on the subject of factories, I might mention that we have unpacked many radios from their factory-sealed crates and containers that would scarcely play, others that performed poorly or refused to operate at all. Inspection has disclosed poor workmanship, sloppy final adjustment and testing as the cause in most instances. Auto dealers will relate the same story. Factories have cut their costs and have shifted much of the final adjustment and inspection on to the shoulders of the dealer.

All this harangue has been for the purpose of driving my point home . . . complicated machinery requires careful, unhurried servicing.

Five years as an outstanding radio Service Man in my town has proven my contention that to guarantee our work we must test every job from one to three hours before delivering it. You have no idea of the number of noisy tubes, leaking condensers, sputtering resistors, noisy audio transformers, humming power packs, etc., that show up after that first hour of testing. Nor can you fail to consider the number of satisfied customers and saving in call backs this system guarantees.

Does it cost money? Yes, but the customer willingly pays for results. Does it take time? Yes, but we do not hesitate to charge for quality work.

Five years of operating a store, the income of which is derived 90 percent from service, has taught us the wisdom of this policy. We buy the finest of testing equipment, read and study the latest magazines and texts pertaining to our business and use Rider's Manuals; but no mechanical aids or systems can supplant careful, painstaking craftsmanship. It takes time, it costs money, but it builds clientele.

RUSSELLS RADIO SERVICE,
Rochester, N. Y.

(You certainly have the right slant, but we don't particularly approve of the example you offer. There is no getting away from the fact that precision testing equipment, properly handled, is the superior means of checking faults. Make that equipment automatic, or semi-automatic, and the time required for servicing a given device is bound to be reduced. To use your own example—precision equipment for the testing and adjustment of automobile brakes is superior to a purely human check. It eliminates the trial-and-test repeated over and over again that is otherwise necessary, with the result that a BETTER job can be done in a SHORTER time, even though the worker is conscientious and painstaking. Precision testing and adjusting equipment DOES offer the temptation of a hurried job—we will grant you that—but used as an aid to better work, it is highly advantageous.—EDITOR.)

•

READ THE MAGAZINES

Editor, SERVICE:

So Mr. I. N. Faurot (May) says he is going to leave us. Well you can't please everyone.

Surely, Service Men, you don't expect a technical publication to exactly fit the needs of a class A, B, and C radio man. One article in a magazine not exactly in your class may yet compensate you for the whole subscription. That is one reason why all of us do and must continue to subscribe to three, four or five different magazines. The expense is almost negligible in comparison to the amount of information we usually glean during a year.

At present I take *Radio News, Radio Retailing,* and SERVICE. Each deserves the highest praise. Many of us owe much of what we have learned to the efforts of the various editors in going after and giving us the type of material which they knew we wanted. Sometimes I feel that these men know more about what we want than we do.

Keep SERVICE right where it is, between the engineering and newsstand publications. Improve it, if you can, but do not drag it down to where some of the tinkerers would like to have it. The type of Service Men attending the many technical lectures held during the last 12 months at the Hotel Pennsylvania (New York) are representative of the trade, and although the lectures are fairly technical, they are well understood by the majority. And so with SERVICE, for I believe the average well-informed Service Man starts on page one and digests all but that 56/100 percent right up to the back cover. Even if many Service Men can only understand 50-44/100 percent instead of the 99-44/100 percent, they will still learn plenty.

GEORGE LAVER,
New York City.

•

MORE "CUT-OUTS"

Editor, SERVICE:

I have been reading SERVICE for about a year, and I always look forward to receiving my copy. I believe you are entitled to a bit of praise, especially after reading the last few letters from your readers.

Here is my experience. From the start, I have been cutting out the articles which interested me. These I have indexed in a scrap book. As Ripley would say, "believe it or not" about all that's left are the covers and advertisements when I finish.

The day is at hand when the fellow with the screw driver and soldering iron has started to fade out of the picture. Prices for radio repairing are going up for the fellow who is keeping up with radio.

HAROLD H. STEVENS,
Angola, Indiana.

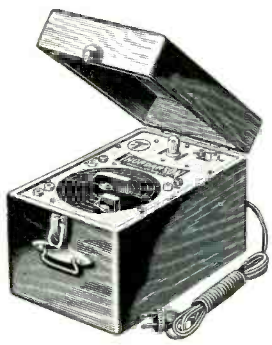
(Why not file the copies of SERVICE—or is our indexing system inadequate?—EDITOR.)

THE MANUFACTURERS . . .

THORDARSON CONDENSER CAPACITY-LEAKAGE TESTER FOUNDATION UNIT

Two service instruments combined in one "build-it-yourself" design is the feature of the Thordarson Condenser Capacity-Leakage Tester Foundation Unit.

The Thordarson Electric Manufacturing Company, 500 W. Huron St., Chicago, Illinois, have produced a foundation unit consisting of a portable walnut instrument



case, an etched and drilled metal panel with a scale calibrated in microfarads, matched panel mounting screws, and complete instructions and assembly plans for a condenser capacity-leakage tester.

Most of the additional parts required to complete this unit are stock items carried by radio Service Men. The completed unit will measure capacity between 0.001 to 50 mfd and indicate leakage on a neon glow lamp. The capacity-measuring portion operates from 105 to 120 volts, 60 cycles a-c employing the Wheatstone Bridge principle. The leakage-tester derives its power from the receiver in which the condenser is used and thus tests the condenser under actual operating conditions.

The foundation unit is available through distributors at regular dealer discounts.

•

NEW BELL MOBILE P-A SYSTEM

A new 6-volt mobile public-address system, known as Model M-6, has recently been introduced by Bell Sound System, Inc., of Columbus, Ohio, manufacturers of an extensive line of sound systems. The Model M-6 is entirely operated by a 6-volt storage battery, making it suited for sound trucks, cars or any other place where 110 volts a-c is not available.

The turntable and amplifier are built into one compact unit, but with each having its separate volume control. A special

leveling arrangement maintains the unit in a level position when placed on the seat by the operator. The amplifier is the Class A, 4-stage type, which develops a power output of 18 watts. It has an overall gain of 97 db, it is said.

Three separate power switches are provided, which effect a saving in total current consumption.

The complete system comes with two 8-ohm speakers. It is said that one feature of this system of special interest is the high-fidelity crystal microphone. It eliminates the rattle, aggravating noises and need for special handling, customary to the older types of microphones.

The overall size of the turntable-amplifier unit is 16" wide, 19" long and 8½" high. When desired, trumpets can be supplied for the speakers. For further information write for Model M-6 Bulletin.

•

WIND-POWERED 6-VOLT GENERATOR

To provide a simple means of charging the storage batteries used by a half million or more farmers throughout the country, the Pioneer Gen-E-Motor Corporation of Chicago has brought out, for the first time, a wind-powered 6-volt generator unit providing 5 amperes of direct current which may be used in keeping the battery charged for radio set operation or for lighting operation.

The generator unit is said to be completely weather-proof and is provided with overload relay and cut-off as well as a

tipping arrangement which is thrown into operation by too great a wind velocity and which throws the unit out of operation.

The unit may be mounted directly on the house or barn roof or it may be supported by means of the small steel tower which is sold separately.

A circular describing this new charging device will be sent without charge by the Pioneer Gen-E-Motor Corporation, 460 W. Superior Street, Chicago, Illinois, on request.

•

NEW WESTON TUBE CHECKER

A modern-tube checker which represents a striking departure from former types, in external appearance, electrical and mechanical design, and in convenience to the user, has just been placed on the market by the Weston Electrical Instrument Corporation, Newark, N. J. The tester has socket mountings covering all pin combinations for glass and metal tubes now commercially available, with provision for combinations which may be introduced in the future.

The circuit assembly of the new unit incorporates a fundamental advance in testing tubes on the basis of total emission, in that three separate loads, one for general purpose tubes, one for battery types and one for diodes, are available as required at the throw of a switch. Thus, total emission tests for each type of tube may be obtained on a specific load basis, and without possibility of damage to the tube structure itself.

A group of seven individual electrode switches, grouped on the center operating panel, provides a highly flexible means of setting up the various electrode combinations for any type of tube. Individual portions of all tubes may be checked, no matter how complicated they may be, including individual diode readings and separate portions of double tubes, without removing the tube from the socket.

A complete inter-element neon short test, carried out while the tube is hot in the socket, used for emission readings, is made simply by throwing the "short-test" switch previous to the regular test operation.

A self-contained transformer supplies all necessary potential from a 105 to 130-volt a-c line. The line voltage adjustment on the center panel, operating in conjunction with a direct meter reading, is connected through a toggle-switch to permit a check on line-voltage at any time while a tube is under test.

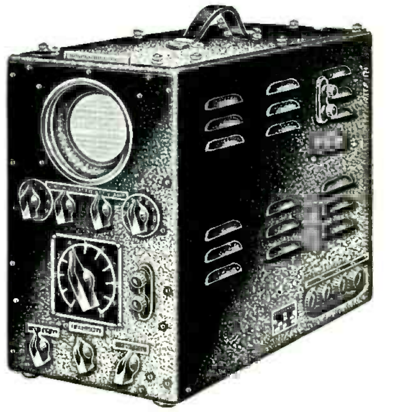
The unit is completely enclosed in a durable cast aluminum case, divided in the center by an engraved bakelite panel section carrying the indicating instrument and all controls. The meter itself is of modern rectangular shape with an easily read scale. Switch handles and trim of red bakelite add to the appearance of the tester. Four sockets are located on each side of the center panel, providing all standard pin layouts from 4 prongs to 8 prongs inclusive. A spare 8-prong socket and the neon lamp socket complete the symmetry of the arrangement.

A guard plate mounted on the bottom of the tester completes the dust-proof housing. Fuses within the bakelite plug on the line cord provide added convenience by making it unnecessary to open the instrument for fuse replacement. Overall dimensions of the instrument are 12 x 9¼ x 6 inches. A compact carrying case for the unit may be obtained if required.

CATHODE-RAY VISUAL RECEIVER SERVICER

A number of entirely new features are said to be introduced in this new cathode-ray equipment for servicing radio receivers, which has just been announced by the Clough-Brengle Co., of 1134 W. Austin Ave., Chicago, Ill.

Among these is an entirely new sweep system that produces on the cathode-ray tubes a receiver selectivity curve that is accurately calibrated and can be read directly in kilocycles width. This is secured by maintaining a uniform width of sweep



(plus and minus 15 kc) at all test frequencies from 100 kc to 30 mc.

Another new feature in receiver servicing made possible with this equipment is the feeding of an r-f wave modulated by a 400-cycle sine wave into the receiver at antenna and ground and then observing the shape of the wave at the speaker voice coil, as pictured by the cathode-ray tube. This test will show overall receiver audio distortion, including such distortion as may occur in first detector, second detector, avc, and audio stages.

A complete Cathode-Ray Visual Radio Servicer is composed of the Model OM Signal Generator with built-in frequency modulator and the Model CRA or Model CRB Oscilloscope.

The Model OM Signal Generator has a built-in frequency modulator oscillator and motor-driven condenser unit. It is essentially similar to the usual r-f oscillator

except that it has a second modulated oscillator that wobbles the output of the first oscillator plus and minus 15 kc when it is desired to use with a cathode-ray oscilloscope. With the wobble circuit switched off, the Model OM may be used as a standard 400-cycle modulated oscillator for output meter indications.

Two new cathode-ray instruments are offered in the Clough-Brengle line. The Model CRA is a complete Oscillograph with built-in linear sweep circuit, input amplifiers, and complete power supply for operating the standard 3-inch cathode-ray tube.

The Model CRB Cathode-Ray Oscilloscope is identical with the above instrument, with the exception that the linear sweep circuit is not included. This circuit is not required for securing receiver selectivity curves when the Model OM Modulated Oscillator is used, as well as in many other applications.

Kendall Clough, chief engineer of the Clough-Brengle Company, has just written a 24-page booklet on Cathode-Ray Test and Analysis, which is of unusual interest to every Service Man. Copies may be secured from your jobber or by sending 25 cents in stamps to the manufacturer.

•

IRC RESISTANCE INDICATOR

Primarily designed to enable radio Service Men and amateurs to determine resistance values for best results in any circuit, the IRC Resistance Indicator recently introduced by the International Resistance Company is proving to have many uses outside of the field of radio work. For instance, it is frequently employed as a rheostat for controlling the speed of small electric motors, fans, toy trains and other electrical appliances; for dimming lights; as a calibrated potentiometer or voltage divider for tapping off fixed voltages from a source of supply and for a wide variety of other uses both in the home and in the experimental laboratory.

This resistance indicator is only 7½" long. It is built in the form of a calibrated variable wire-wound resistor. Two

scales, 0 to 10,000 ohms and 10,000 to 100,000 ohms, permit accurate readings from 100 to 100,000 ohms. This range may be extended indefinitely by the addition of fixed IRC Metallized Resistors in series. A ball-bearing, spring-cushioned slider running along a rod at the top makes it possible to tap off any desired resistance value or voltage.

The IRC indicator is protected from accidental overloads by a readily renewable fuse.

•

MUTER CERTIFIED RESISTANCE BRIDGE

To meet the demand, from both shop and laboratory, for an accurate Wheatstone type Resistance Bridge at a price that makes it practical to have a sufficient number of them for general use, The Muter Company has designed the Muter Certified Resistance Bridge.

The Muter Resistance Bridge is recommended for use by Service Engineers to replace the comparatively inaccurate "ohmmeter." Commercial laboratories, it is said, find that its low cost allows the simultaneous use of individual bridges in various experiments. Radio and electrical apparatus manufacturers are finding that its rugged construction makes it especially adaptable for use on production lines.

The internal construction of the new Muter Certified Resistance Bridge is unusual. The resistor elements are wound in strip form, the taps being set to an extreme degree of accuracy. Thorough

vacuum impregnation insures freedom from variation due to changes in humidity. A special alloy resistance wire is employed to maintain constant resistance regardless of reasonable changes in temperature.

It is stated that each Muter Resistance Bridge is checked and certified by a graduate electrical engineer before shipment.

•

NEW ARCTURUS TUBE LINE

The Arcturus Radio Tube Company, Newark, N. J., has developed and marketed a new line of tubes, designated as the "G" series, which is identical in electrical characteristics and pin connections to the all-metal tubes. It is stated that several of the larger set manufacturers and many smaller ones have already developed circuits employing these new "G" tubes. Early announcement of some of these radio receivers is expected.

Carrying the same type numbers as do

the all-metal tubes, the letter "G" is suffixed to denote the glass envelope type.

As announced to date, the Arcturus "G" line comprises the following types:

6A8G	Pentagrid Converter
6C5G	Detector-Amplifier Triode
6D5G	Power Output Triode
6F5G	High-Mu Triode
6F6G	Power Output Pentode
6H6G	Double Diode
6J7G	Detector-Amplifier Triple Grid
6K7G	Super Control-Amplifier Triple Grid
6L7G	Pentagrid-Mixer-Amplifier
5Y3	Full-Wave Rectifier (Interchangeable with 5Z4)

These tubes are directly interchangeable with corresponding type numbers of all-metal tubes. The photograph illustrates a type 6K7G tube and shows the general appearance of the "G" line with the all-metal tube base connections and guide pin.

(*Continued on page* 320)

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 shortcut 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 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.

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.

Write up those ideas now and send them into the . . .

ON THE JOB DEPARTMENT

HIGHLIGHTS . . .

MUTER 1935 GENERAL CATALOGUE

The Muter Company, 1255 South Michigan Ave., Chicago, Ill., have available for distribution, their new 1935 general catalogue listing the many Muter products, such as, the Certified Resistance Bridge, Dependable Interference Filter, DeLuxe All-Wave Tuning Selector, Ajax All-Wave Tuning Coupler, 32-Volt "A" Battery Eliminator, etc.

Of special interest to the Service Man is the 6-page section given over to a listing of Candohm replacement resistors, and their values, for most of the manufacturers' receivers.

•

"SMALL PANEL INSTRUMENTS"

A new 8-page bulletin describing panel-type electrical measuring instruments has just been issued by the Weston Electrical Instrument Corporation, Newark, N. J. The bulletin includes specifications, dimensional drawings, illustrations and prices for the 2, 3 and 4-inch line of instruments in both the round and rectangular types.

Specifications are given for the following instruments: D-C: voltmeters, ammeters, milliammeters, microammeters, ohmmeters, volt-ohmmeters, high sensitivity microammeters. A-C: voltmeters, ammeters, milliammeters. A-C (rectifier type): voltmeters, milliammeters, microammeters; wattmeters; thermo-instruments.

Information concerning the new line of 3-inch rectangular panel instruments recently announced by the Weston organization is a feature of the bulletin.

•

RCA ISSUES ELABORATE PARTS REFERENCE BOOK

A comprehensive, 92-page parts catalogue, crammed with a wealth of technical information for the radio Service Man and dealer has just been issued by the RCA Manufacturing Company for selective distribution through wholesale RCA radio and parts distributors.

In it are listed all of the numerous radio replacement parts and specialty apparatus with their electrical and mechanical characteristics and specifications so that the Service Man can get all the information he needs on a part or piece of apparatus at a glance. There are also profuse illustrations, schematic diagrams and technical information on the functions of the various parts in their circuits. Prominent space is devoted to an assortment of recently developed RCA test and measuring apparatus, such as the cathode-ray oscillograph and beat-frequency oscillators. Sections of the book deal with such subjects as short-wave and noise-reducing antenna systems, public address and sound reenforcement, phonograph modernization, and many others.

A particularly useful feature is the inclusion of an exhaustively cross-indexed chart of all the important replacement parts for the RCA Victor radio receivers and the corresponding models of the General Electric, Graybar and Westinghouse Companies, with stock numbers and prices. For handy reference, all the items covered in the catalogue are indexed and cross-indexed. Items intended for resale to the public are shown with retail list prices so that they may be sold to the customer direct from the catalogue if desired.

•

NEW ARCTURUS EQUIPMENT DEALS

The Arcturus Radio Tube Company, Newark, N. J., announces a new cooperative deal on Triumph Tube Testers, All-Wave Signal Generators and Multi-range Meters. This plan enables dealers and Service Men to secure all three instruments at a price lower than the cost of a good tube tester alone.

The plan is flexible so that should a dealer or Service Man already possess a tube tester he can, under the Arcturus plan, secure the other two instruments at a great saving in cost.

The Arcturus laboratory has tested and approved all three units as being highly efficient. It is stated that the Triumph tube tester is already equipped to test the new all-metal tubes. Arcturus distributors throughout the country have the details of this attractive plan.

•

LEOTONE PURCHASES BALKITE-ABOX BUSINESS

The Leotone Radio Co., 63 Dey Street, New York City, has purchased the entire stock of parts and the factory sales and service business of Balkite radio and Abox eliminators from Marthens, Schroter and Co., Inc. The Leotone company will continue in its speaker business and operate the Balkite-Abox business as a separate department.

•

NEW SPRAYBERRY OSCILLOGRAPH PUBLICATION

A publication incorporating four complete lessons covering the Cathode-Ray Oscillograph from every radio service and amateur standpoint is now being offered by F. L. Sprayberry, 2548 University Place, N. W., Washington, D. C. Originally a part of the course, Sprayberry's Practical Mechanics of Radio Service, these lessons have recently been fully revised and enlarged and are now offered as a seperate publication at only $2.00.

Section I covers the principles of the Cathode-Ray Tube and shows how they are utilized in the Oscillograph. The Lissajou figures are clearly explained. Various frequency patterns are identified and practical application of the instructions demonstrated.

Section II shows how to duplicate original factory adjustments. Instructions are given on the correct staggering of stages to get a satisfactory "overall" curve for receivers. Sensitivity and selectivity terms are fully explained and analyzed.

Section III demonstrates how to test through a receiver so that one may be absolutely certain of the set's condition and the exact condition of a part before passing on to the next. The first describes a dynamic test that is superior to any other work bench test. The final part deals with audio tests for distortion, frequency response, hum and the like; tests that are applicable to all types of p-a systems and theatre equipment as well as radio receivers.

A descriptive pamphlet may be obtained by writing to Mr. Sprayberry.

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MANUFACTURERS

(*Continued from page* 318)

CONVERSION RESISTOR PLUG

The Conversion Resistor Plug is a new device recently introduced by ten resistor manufacturers and is intended to replace the ballast tube used in some makes of battery receivers so that these receivers may be satisfactorily operated from the Eveready Air Cell "A" Battery instead of a Dry Cell "A" Battery.

The voltage of the Eveready Air Cell "A" Battery is so nearly constant during its 600 ampere hours of service as not to require regulation by a ballast tube. Therefore, the ballast tube may be replaced by a simple fixed resistor of the correct value which is mounted in a suitable plug for insertion in the ballast tube socket.

It is said that this not only makes it possible to obtain the advantages of Air Cell "A" power on these receivers but in addition, the initial cost of the conversion resistor plug is less than for any ballast tube and the conversion resistor plug will last indefinitely as there is nothing to burn out or wear out, whereas ballast tubes must be replaced just like any other radio tube.

The conversion of ballast tube receivers by means of the conversion resistor plug is very simple as it is only necessary to put the proper type of plug in the ballast tube socket. No tools,—no soldering.

A special data sheet gives the part numbers of the ten manufacturers of these plugs and only seven different types of plugs will take care of thirty-one different models of receivers.

A copy of this data sheet will be sent to any dealer or Service Man upon request to the National Carbon Company, Inc., 30 East 42nd St., New York, N. Y.

•

BURTON RADIO SET TESTER

The Model 30 radio set tester announced by C. W. Burton Company, 755 Boylston Street, Boston, Mass., is said to have a number of interesting features. This unit handles all octal-base tubes and sockets, is fast and easy to use, has a universal test meter, and there are only two jacks, all ranges being switch-selected.

The set tester has the following ranges: Volts a-c, 15-150-1500; volts d-c or ma (1000 ohms per volt), 7.5-15-75-150-750; ohms. 0-1000-100,000-1,000,000.

Auto-radio servicing features have been given special consideration, resulting in simplification of suppressor, vibrator, power-supply and chassis testing problems, it is stated.

The unit measures 9 inches by 11 inches by 5 inches. The meter is of the 3¾-inch flange precision d'Arsonval type. Standard 5-foot cord and plug with associated adapters and test leads are included. Furnished with tube-base chart, instruction manual and is built in a sturdy leatherette covered case with removable cover. The weight is 6 pounds.

INDEX TO ADVERTISERS

THE Group Subscription Plan for *Service* enables a group of service men, dealers or jobbers to subscribe at one-half the usual yearly rate.

●

The regular individual rate is $2.00 a year. In groups of 4 or more, the subscription rate is $1.00 a year. (In Canada and foreign countries, $2.00.)

●

The service departments of thousands of dealers, independent service men, etc., have used this Group Plan for years, in renewing their subscriptions to *Service*.

●

Each subscriber should print his name and address clearly and state his occupation—whether a dealer, jobber, independent service man, service organization, etc.

●

Remember this Group Plan when *Your* Subscription Expires

●

(Service)

Bryan Davis Publishing Co., Inc.

19 East 47th Street New York, N. Y.

COUPON
MAIL THIS TODAY

Free for the Asking!

☐ "Multi-Tap" Guide, listing 2114 models of radios which you can immediately service with one of only five (5) "Multi-Tap" Power Transformers.

☐ Auto-Radio Vibrator Guide listing 220 models of radios on which you can replace the vibrator with one of 22 General Units.

☐ Amateur Progressive Transmitter power unit Bulletin.

Check the items you are interested in.

GENERAL TRANSFORMER CORPORATION

502 S. Throop Street — Chicago, Ill.

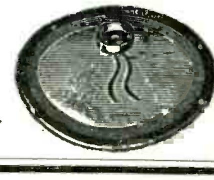
LEOTONE EXPANDS

Leotone Radio Co., manufacturers of speaker cones and field coils since 1921, has purchased the entire stock of parts and good will of the factory sales and service business for the repair and replacement of BALKITE and ABOX radio power units from Marthens, Schroter & Co., Inc. Also, the service agency for BALKEIT radio sets.
The service station for repairs and replacement parts for these units is located at 63 Dey Street, serving dealers and servicemen in the entire eastern territory. All replacement elements, rectifiers, electrodes and acid solutions carried in stock. Efficient and prompt service.

For BALKITE—
ABOX—BALKEIT

Write or call for detailed information and prices.

Leotone Radio Co.
63 Dey St., New York City
Telephone—WOrth 2-0284



New! 6 Volt Mobile P.A. System by BELL

With CRYSTAL Microphone

Bell Sound Systems, Inc.
61 E. Goodale St.
Columbus, Ohio

For cars or where 110 current not available. Operates from 6 volt storage battery. Complete, with turntable; Class A, 18 watt amplifier; 2 heavy duty speakers; and CRYSTAL MICROPHONE. Compact, dependable and easily operated . . . and priced right.

Write for details on the Bell Line of P.A. Systems.

OK

—say Servicemen and Dealers

Thousands of OK's for new Arcturus price plan—preserves and protects serviceman's profit. Arcturus set-up is serviceman's best bet. Write for details to Arcturus Radio Tube Co., Newark, N. J.

ARCTURUS
RADIO TUBES

Ken-Rad
Radio Tubes

Ken-Rad Radio Tubes are made to give clear, dependable reception. They satisfy customers and build good will for dealers. Write for full information.

THE KEN-RAD CORPORATION, Inc., Owensboro, Ky.
Division of The Ken-Rad Tube and Lamp Corporation
Also Mfrs. of Ken-Rad Incandescent Electric Lamps

NEW PHOSPHOR BRONZE DIAL CABLE

The Handiest Spool Made
Nothing Like on the Market

SAMPLE SPOOL 25 FT. 50c
Only One to a Dealer
ALL OTHER ORDERS THRU YOUR JOBBER

We Can Furnish Your Complete Requirements for Wire Goods and Antenna Equipment

ALL WAVE ANTENNA KITS . . $2.16
Send for Catalogue Sheet
Regular Aerial Kits, Complete . . . 49c

RIVARD MFG. CO.
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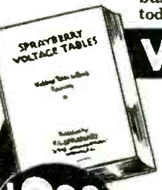

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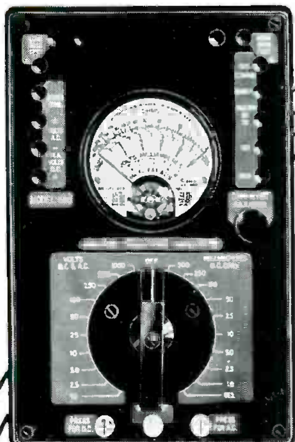

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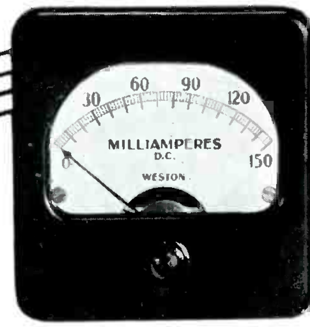

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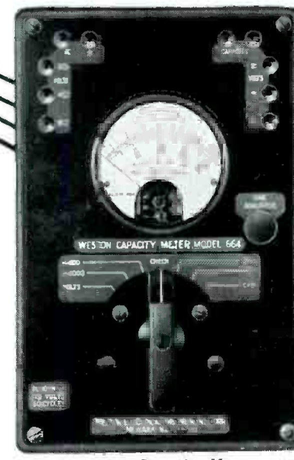

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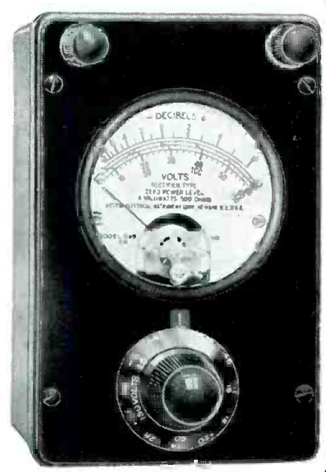

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