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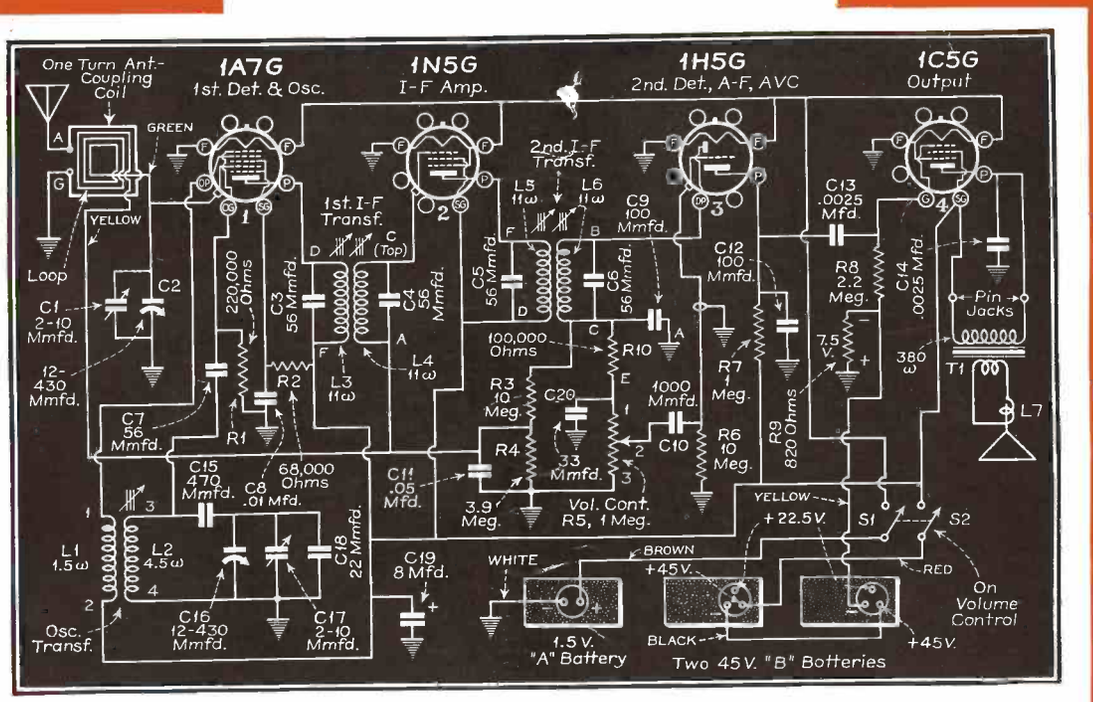

Portable Receiver

(See page 20)

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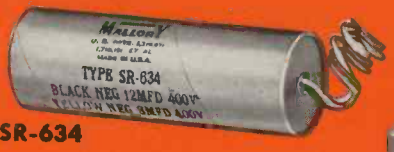

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Edited by
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Contents

SERVICE
A Monthly Digest of Radio and Allied Maintenance
January, 1939 Vol. 8, No. 1
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FEATURES

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Antenna

FACSIMILE

IN THE last issue we mentioned that considerable interest was evidenced in facsimile. Since that time Crosley Radio Corporation has introduced their facsimile receiver and has announced experimental programs. This should bring the advent of facsimile almost simultaneous with television.

WE PRESENT

ON PAGES 7, 8 and 9, inclusive, we present "Iron-Core Coils," another in our series on vital receiver parts. In this article, J. J. O'Callaghan discusses the design and use of cores and coils in receiver and replacement circuits.

GADGETS to help you keep your shop neat might be worthy of attention. On page 10 are pictured a number of metal cabinets for that purpose.

IN A contest recently conducted among Service Men by a large test equipment manufacturer the question was asked "What test equipment would you need to make your shop complete?" A vacuum-tube voltmeter was indicated in over 40 percent of the replies. This by far outnumbered any other single piece of equipment mentioned.

Such ardent desire on the part of Service Men for a vacuum-tube voltmeter seems to indicate that they have intuitively recognized the merits of the instrument but have refrained from purchasing it for want of sufficient factual data. The article "Vacuum-Tube Voltmeters" by R. Lorenzen on pages 12 to 17, inclusive, should provide the missing information.

BRICKBATS AND BOUQUETS

FOR many months we have been soliciting, directly and indirectly, your comments on the material and makeup of SERVICE. It has been our desire to make this magazine reflect your needs. Between blushes of modesty we reprint some of the recent comments.

George H. Koether, Jr., Round Bay, Md., writes "Your articles are far in advance in quality over those of other publications. Your indexing system is especially excellent. . . . In an effort to improve a really swell magazine, I would like to voice my opinion. . . . I think your schematics would be better with a black background and white lines. . . ." Humbly extending our thanks for the former we hasten to say that book publishers and typographic experts are unanimous in agreement that *black lines* on a *white background* are much more legible and also less tiring. We vary from this rule only to improve layout. *F. V. Epperson,* Chicago, Ill., expresses his "sincere appreciation for the auto-radio data listed on page 34 of the November issue. . . . We are wondering if you have similar information of other popular makes of auto-radios. It seems that gear ratio, dial direction, etc., has been most difficult to accurately determine and we feel confident all auto radio service stations will be as grateful for this information as were we." We inform Mr. Epperson, and our other readers, that similar information on practically every auto radio ever made will be published in subsequent issues of SERVICE. *James J. Reeves,* Staten Island, N. Y., says "I, like other Service Men, depend upon SERVICE for technical, particularly up-to-date, information. I don't buy the magazine for pictures or amusement as there are much better magazines for that purpose, but rather, I buy SERVICE for a conservative study of its contents . . . the front cover schematic, too, is symbolic of the contents of such a magazine. . . . It's my Bread and Butter, and I think it's an excellent way to bring an unusual or recent circuit to my attention." Thanks Jimmie, we'll remember you in our will. *W. C. Ward,* Spiro, Okla., thanks us "for publishing the case history shown on page 26 of the November issue. There is more real information that will fit the Service Man who owns an oscillograph on those two pages than they can dig out of a good many pages of instruction manuals. I hope you will give us more of this sort of dope with photographs." Howard J. Surbey please note the above and rush that article on Hum Testing with the Oscilloscope. . . .

SERVICEMEN CONTINUE TO PRAISE THE RIDER Chanalyst

• NAPLES, N. Y.

The Chanalyst helped me crack one of the toughest intermittent sets I've ever worked on. This set sure was tough. The Chanalyst should be on every Serviceman's bench. Those who haven't one don't know what they're missing.

Charles Rose

• ELBOW LAKE, MINN.

Have used Chanalyst and sure like it fine. Have repaired a few radios that have been stickers to other servicemen and the job was done in about one hour's time.

P. A. Peterson

• WILLIAMSON, W. VA.

This is the best service instrument I have ever seen, and compared to it really makes all other service instruments become obsolete.

Eugene Ferrell

• NEW CASTLE, DEL.

The Chanalyst does all that John Rider claims it will, and I have been very well pleased with its performance. Through my recommendation and demonstration, Radio Electric in Wilmington has sold three Chanalysts so you see that I am well pleased.

B. N. Carpenter

• CHICAGO, ILL.

The Chanalyst is all and even more than you claim. I make this statement not only from the angle of speed and ease with which troubles may be located in more complicated sets but rather because it affords a means of being absolutely positive that a receiver is RIGHT after repair.

Ray Pentecost

• VAN NUYS, CAL.

The value of such a piece of service equipment (the Chanalyst) is not fully appreciated until you have seen the usual grief jobs come and go with the same ease as the normal run of repair jobs. There is no praise too great for the Chanalyst.

Don Gehlke

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR JANUARY, 1939

IRON-CORE COILS

By J. J. O'CALLAGHAN*

IRON-CORE r-f and i-f coils are not new. They have been used in communication apparatus for many years. The difference between the modern iron core and the early one, however, is fully as great as that between today's streamlined automobile and the original horseless carriage.

Core Materials

The original cores were either wires, laminations or filings of metallic iron. The modern core is a molded slug of iron powder which usually has its individual grains insulated from each other. The grains are mixed with a suitable binder and molded under sufficient pressure to give the completed slug the desired characteristics.

The iron powder may be obtained by grinding pieces of solid iron or by chemically reducing powdered iron oxide. The reducing process is the reverse of rusting and produces metallic iron dust.

Some of the so-called iron cores are made of the magnetic oxide of iron. These are familiarly known as Magnetite cores to distinguish them from cores of metallic iron.

Iron cores are made with a variety of characteristics to meet the requirements of different design problems. Some perform best in the audio range, others in the supersonic or in the i-f range and some in the broadcast and police ranges. Core and coil engineers work together closely to obtain a combination which will produce the best results.

According to type of service, iron-core coils are divided into the following classes: *fixed* inductance, *adjustable* inductance and *variable* inductance.

Fixed Inductance

Iron-core coils with fixed inductance are used in antenna, r-f and i-f coils. There are several advantages of this type of coil over the air-core type. The former can be made with a higher Q than any air-core coil of commercially acceptable size. It can also be made smaller than an air-core coil of the same Q and in many cases is smaller than an air-core coil of much lower Q. Furthermore, the cost of manufacture is lower than an air-core coil of the same Q, when the Q is high.

When used in the antenna circuit, iron-core coils of proper design give better signal-to-noise ratio, better selectivity, better image ratio (in superheterodynes) and better gain. In i-f transformers their use results in better selectivity and better gain. Iron-core coils are seldom used in r-f oscillators but are sometimes used in audio or supersonic frequency oscillators to produce high Q circuits to reduce harmonics. In antenna couplers and in certain special r-f or i-f transformers either singly tuned or untuned, iron cores are used to increase the coupling coefficient to a high value for better efficiency.

Variable Inductance

Variable inductance iron-core coils cover that group in which the cores are moved by means of a mechanical linkage connected to a knob and a calibrated dial. In such cases the variable inductance coils (with fixed condensers) are replacing conventional fixed inductance coils with variable condensers.

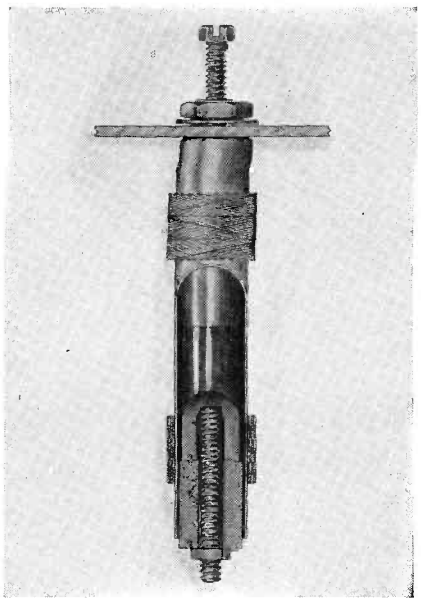
Under certain circumstances there are definite advantages for this type of permeability tuning. A high degree of fixed circuit capacity can be tolerated, thus permitting the tuning mechanism to be mounted some distance away from the tube circuits, and to be connected thereto by means of long shielded wires. This has been done by one manufacturer of auto radios and permits the use of a relatively small tuning mechanism mounted on the instrument panel with the remainder of the receiver on the firewall of the car.

The moving system in a permeability tuned mechanism, has less inertia than a gang condenser and may be better adapted to push-button selectors which are operated by means of cams. In addition, the former usually cost less than gang condenser tuning when used with a properly designed cam action push-button station selector.

The permeability tuned circuit also permits values of inductance heretofore unheard of to be used for tuning the low-frequency end of the broadcast band with attending improvement in circuit performance.

The coils used are usually single layer solenoids of plain enameled wire wound on thin-walled bakelite tubes from ¼ in to ⅜ in in diameter. The windings are from 1½ in to 2 in long and the bakelite tubes project beyond one end of the coils at least 1¼ times the length of the coil so that the core, which is as long as the winding, may be completely withdrawn from the coil without dropping out of the tube.

Fig. 1. Where only one adjustment is desired for both antenna and oscillator coil, in permeability tuned station selectors, both moving iron cores are mounted on a single adjusting screw.



Adjustable Inductance

Adjustable inductance iron-core coils cover those that are set, by means of a screwdriver or other adjusting tool, to a desired value and are then permitted

*Meissner Manufacturing Co.

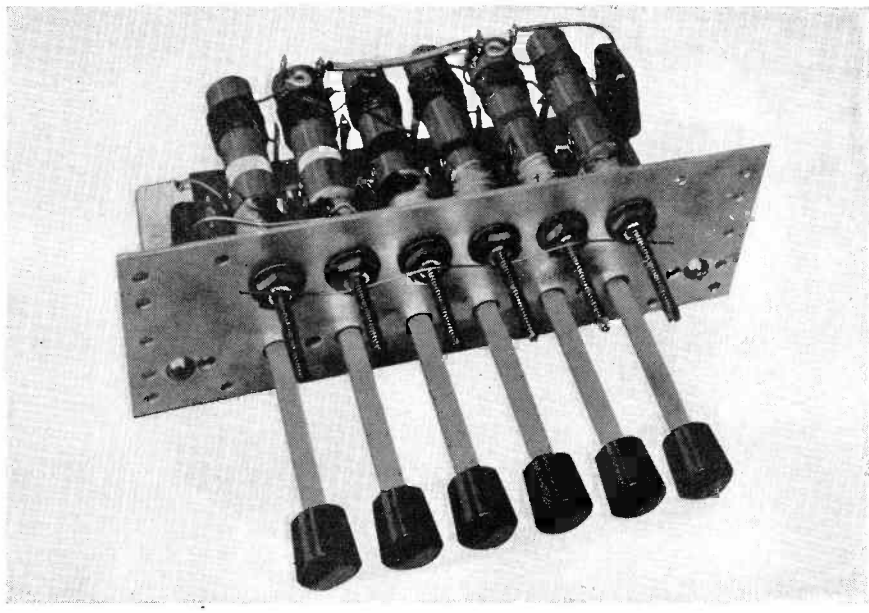


Fig. 2. The coils and cores are mounted directly on the push-button switch assembly.

to remain undisturbed. Such coils are used in permeability tuned station selectors, i-f transformers, wave traps and replacement antenna, r-f and oscillator coils.

The principle advantages of permeability tuning over capacity tuning are that it is cheaper than air di-electric tuning and much more stable than tuning by means of compression mica condensers.

In permeability tuned station selectors the oscillator is tuned by the variable inductance. Where only one adjustment is desired for both the antenna and oscillator coil, the antenna coil is permeability tuned as well as the oscillator, and both moving iron cores are mounted on a single adjusting screw. The exact details of such a device vary between different manufacturers, but for purposes of illustration, the construction shown in Fig. 1 is typical. When these coil and core assemblies are mounted on a switch and properly connected, a unit similar to Fig. 2 results. This unit is used by a number of set manufacturers as the station selector for their push button receivers. A typical circuit for a single button of such an assembly is shown in Fig. 3.

The permeability-tuned wave trap is a simple variation of the idea used in the station selector. A typical unit is shown in Fig. 4.

Permeability tuned i-f transformers are of two general types illustrated in Figs. 5 and 6. It will be seen that as the cores are moved to tune the coils, the distance between cores changes considerably. If it were not for the fact that the coils are wound in multiple pi and that at resonance the cores usually occupy only two, or at most, three pi, the mutual inductance, and hence the coupling between primary and secondary, is determined to a large extent by the coupling between the primary pi nearest the secondary and vice versa.

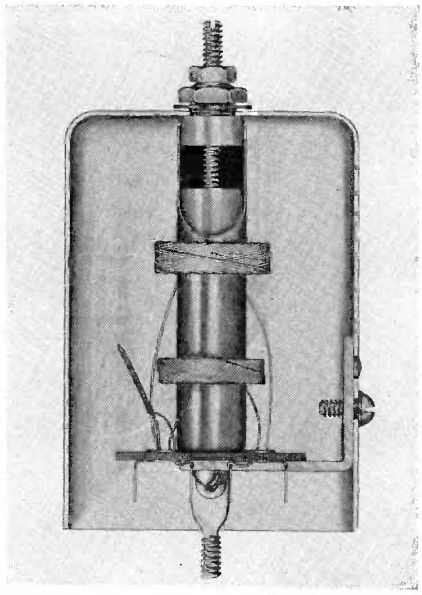


Fig. 7. (Above) Permeability adjustment of replacement coils has the advantage in time saved by tracking with a simple screwdriver adjustment of inductance instead of the laborious process of removing turns.

If the equivalent single pi construction is attempted it will be found that the coupling varies too much with tuning to be practical.

The construction illustrated in Fig. 6 gives more uniform coupling than the end-to-end type and gives the added advantage of having both tuning adjustments on one side of the can whereas the latter (Fig. 5) requires one adjustment to be made from the top of the coil while the other is made from the bottom.

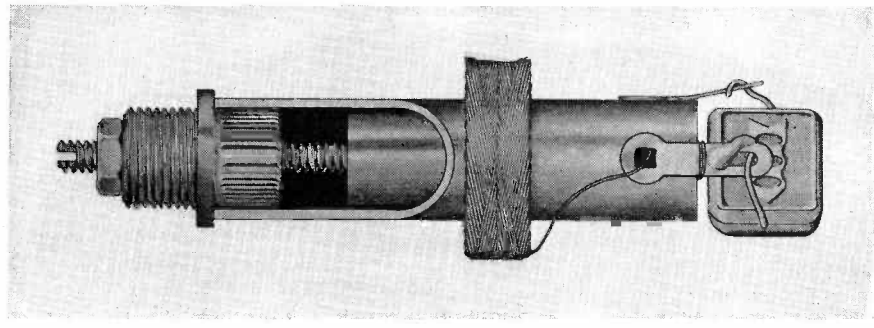
Replacement Coils

Permeability adjustment of replacement antenna, r-f or oscillator coils has the principal advantage in the time saved by tracking replacement coils with a simple screwdriver adjustment of inductance instead of the laborious process of removing turns. When a replacement coil of this type is installed in a receiver the process of tracking and aligning is very simple.

The problem is first to adjust the coil to the proper inductance and then to trim the circuit to align with the other coils in the receiver. Since it is desired to adjust the inductance of the coil without regard to its distributed capacity, the matching is best done at a low frequency. It is recommended that the match be made at 600 kc which is the standard IRE low-frequency test point for the broadcast band. The receiver should, accordingly, be set to 600 kc, with a suitable output indicator, and a signal generator properly connected. The screw adjustor on the replacement coil is rotated by means of a screwdriver until maximum signal output is obtained. The receiver and signal generator are next set to 1400 kc and the trimming condensers adjusted in the normal manner. A final touch-up of inductance at 600 kc is recommended, after which the adjusting screw should be sealed.

When replacing an antenna or r-f coil on a superheterodyne, essentially the same practice is followed with the exception that, since the oscillator determines the dial calibration, if the adjustments thereon have been dis-

Fig. 4. (Below) The permeability-tuned wave trap is a simple variation of the idea used in the station selector.



turbed, it is necessary to readjust the oscillator circuit to agree with the dial calibration at the checking points before adjusting the inductance of the new coil or aligning it.

If a new oscillator coil is installed, an aid to rapid adjustment of the new coil to proper inductance is an undisturbed padding condenser adjustment. There are innumerable combinations of oscillator inductance, padding capacity, and trimmer capacity that will track an oscillator circuit at two places in the broadcast band. These various combinations, however, give varying degrees of mistracking throughout the remainder of the band. If the padding condenser has not been disturbed, one of these variables is eliminated and with only inductance to adjust for proper alignment at the low-frequency end of the band, and capacity to adjust at the high-frequency end, the replacement is practically as simple as that of an antenna or r-f coil.

If the oscillator padding condenser has been disturbed, it will be necessary to track the oscillator with the remainder of the receiver in the same experimental manner as used in the determination of the original design values. To arrive at a satisfactory alignment, the following experiment should be conducted systematically, writing down the answers obtained, so that the data will not become confused.

(1) Align the i-f amplifier at the frequency specified by the manufacturer.

(2) Adjust the padding condenser to some value known to be *much lower* in capacity than its normal adjustment. (Unscrew padder.)

(3) Set the dial and signal generator (of known or checked accuracy) to 600 kc and adjust the oscillator inductance by means of the screw in the top of the can until a signal is heard. If no signal is heard within the range of the oscillator inductance adjustment, screw the adjustment as far in as possible and increase the padding capacity until a signal is heard.

(4) Attempt to align the oscillator trimmer condenser to agree with the dial at 1400 kc. If the adjustment cannot be made, again increase the capacity of the padding condenser and reduce the inductance (by turning the screw out) of the oscillator coil to obtain a new setting at 600 kc. This process should continue until both 600 and 1400 kc are correctly indicated.

(5) When both 600 and 1400 kc are correctly indicated, tune the receiver to the generator set at 1000 kc and make a sensitivity measurement which should be recorded.

(6) Now increase the padding condenser capacity slightly, decrease the inductance to give a 600 kc signal, align at 1400 kc and again measure sensitivity at 1000 kc. If the sensitivity at that point is better than it was before, repeat this operation until the sensitivity measurements show greatest sensitivity and then start falling off again. If the steps in the process have been written down, recording the number of revolutions and fractions thereof on the adjusting screw of the inductance, it should be easy to return to the adjustment giving maximum 1000 kc sensitivity. When this adjustment is set, seal it with some satisfactory cement and then give the receiver a complete alignment.

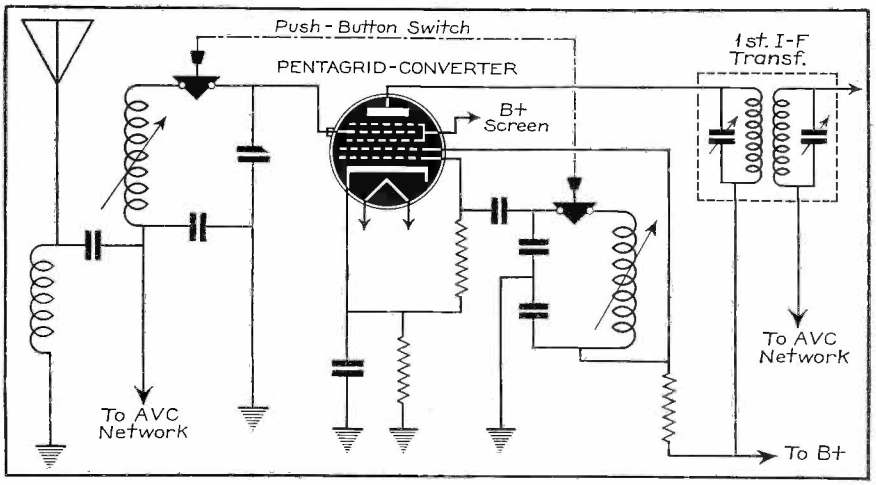


Fig. 3. Operating one button connects one of the iron-core coils to the control grid and another to the oscillator grid of the converter tube. All other tuning circuits are disconnected automatically.

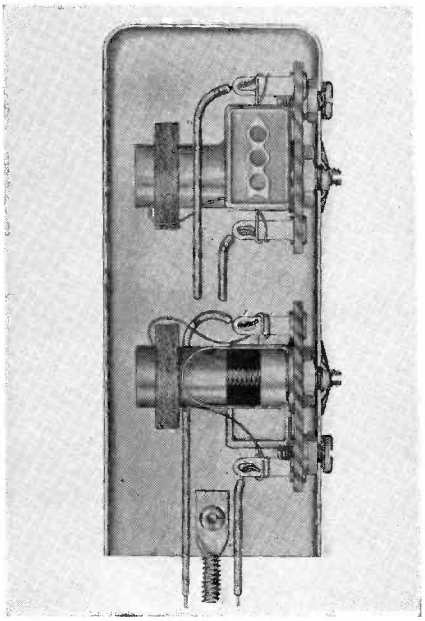


Fig. 6. (Above) More uniform coupling can be obtained with the construction illustrated and, in addition, both tuning adjustments are on one side of the can.

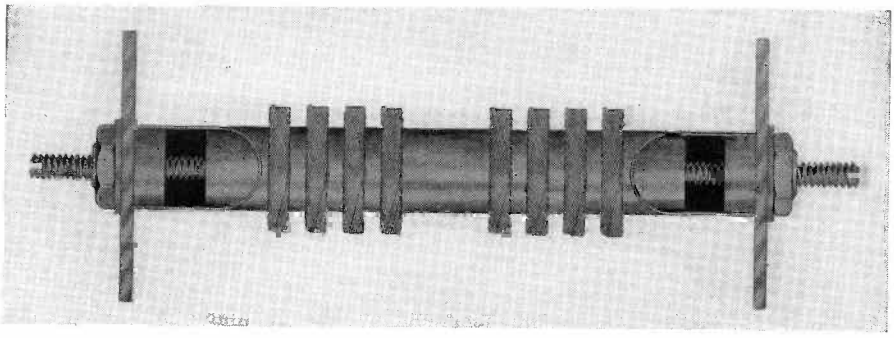


Fig. 5. (Below) End-to-end construction of i-f transformers requires one adjustment to be made on top and one on bottom.

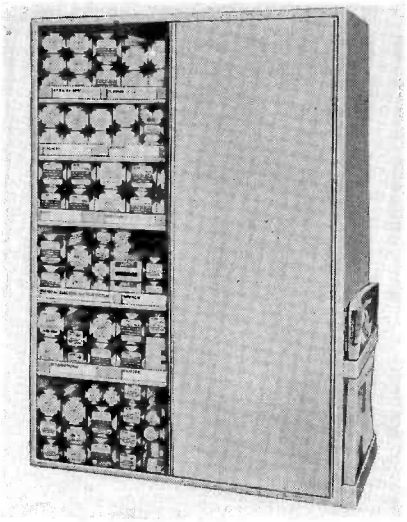
Regeneration

When a circuit containing air-core coils is highly regenerative, little improvement can be made in selectivity by substituting high Q coils. The regeneration existing in the circuit has already increased the effective Q of the coils in the circuit. Substituting coils with higher natural Q usually makes the circuit oscillate, in which case the gain of the stage must be reduced to prevent oscillation and the performance of the circuit is quite near its former state if it is adjusted to be about as far from oscillation as with lower Q coils. Far more can be done with regeneration than can be done with coil design as far as selectivity is concerned, but it is extremely difficult to obtain uniform results on highly regenerative sets, and the day to day variation of sensitivity in a given set is far greater in a receiver employing large amounts of regeneration than in a receiver having little or no regeneration.

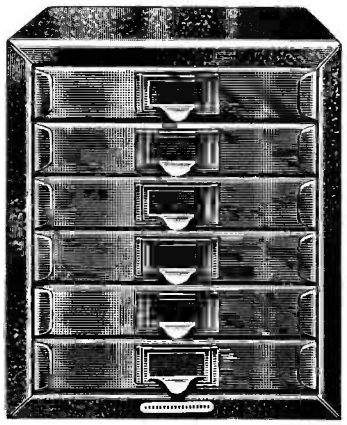
DRESS UP SHOP

JANUARY is generally the time for inventory. It would undoubtedly be advantageous, at the same time, to attempt some sort of pre-spring cleaning. A few storage cabinets, of the type shown in the accompanying illustrations, can do a great deal toward making a well ordered shop.

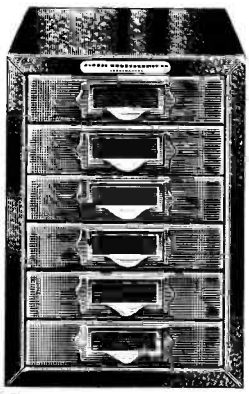
It would indeed be superfluous to mention the many items which could be stored to advantage in such cabinets. It can be said without exaggeration that they would more than pay for themselves through elimination of loss and depreciation or shelf life, to say nothing of the steps and time saved in finding materials.

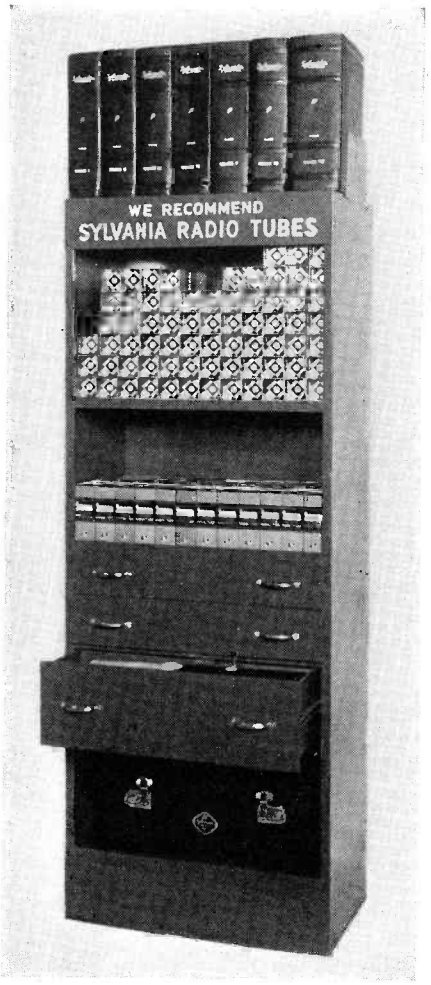


The cabinet shown has sliding doors and is designed for storing exact duplicate condensers and similar stock. *Aerovox Corp.*, New Bedford, Mass.



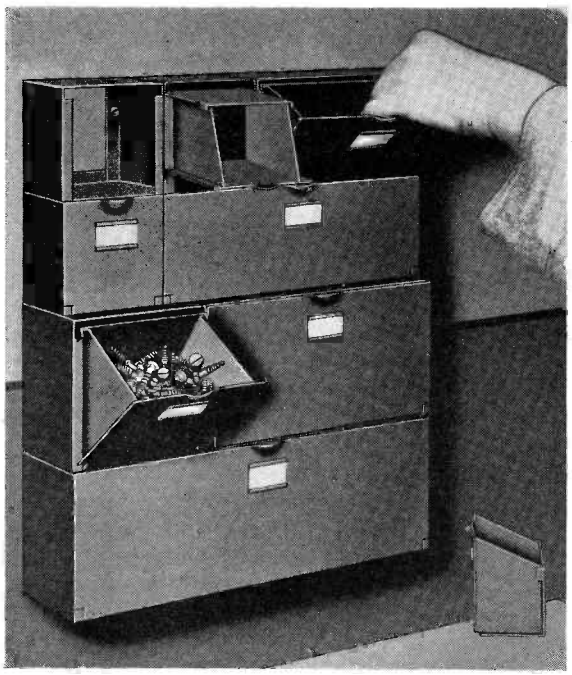
These cabinets (left and right) can be obtained with sectionalized drawers of 4, 8, 12 or 16 sections. *Kennedy Manufacturing Co.*, Van Wert, Ohio.



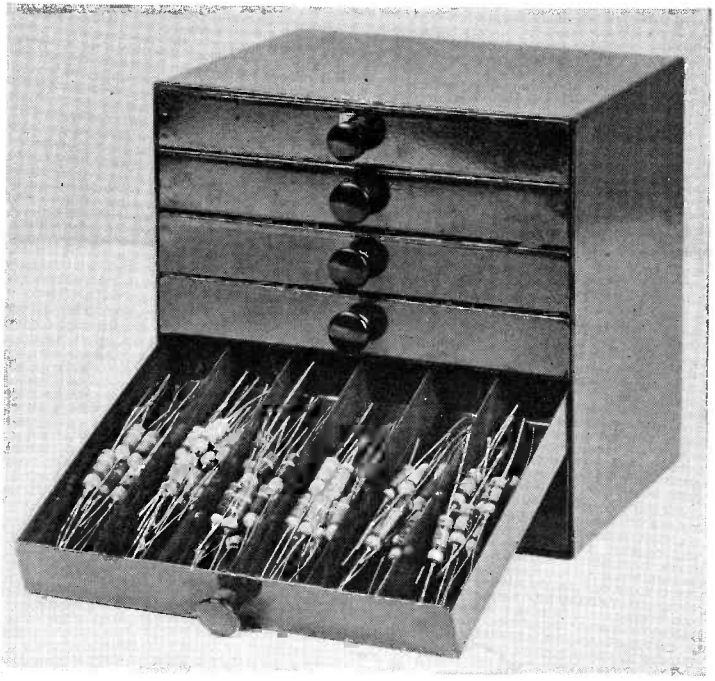


For storing tubes as well as small stock the Stock Boy is hard to beat. *Hygrade-Sylvania Corp.*, Emporium, Pa.

Finding the right resistor is simplified with the cabinet pictured below. *Tilton Electric Corp.*, New York City.



The Ad-A-Bin comes as separate sections and can be made up to any desired size. Additional bins may be added from time to time. *Noggle Products Co.*, Ann Arbor, Mich.



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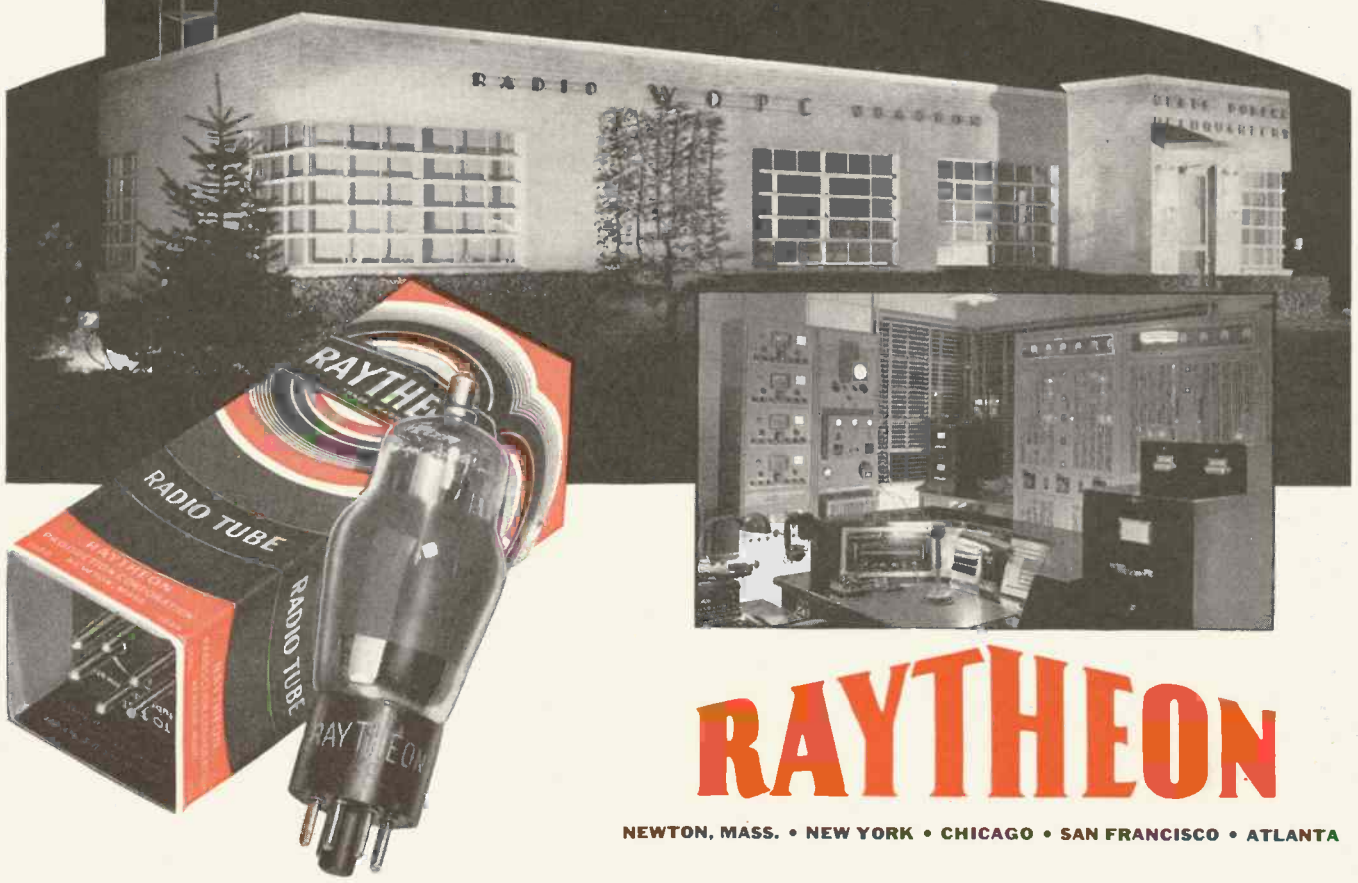

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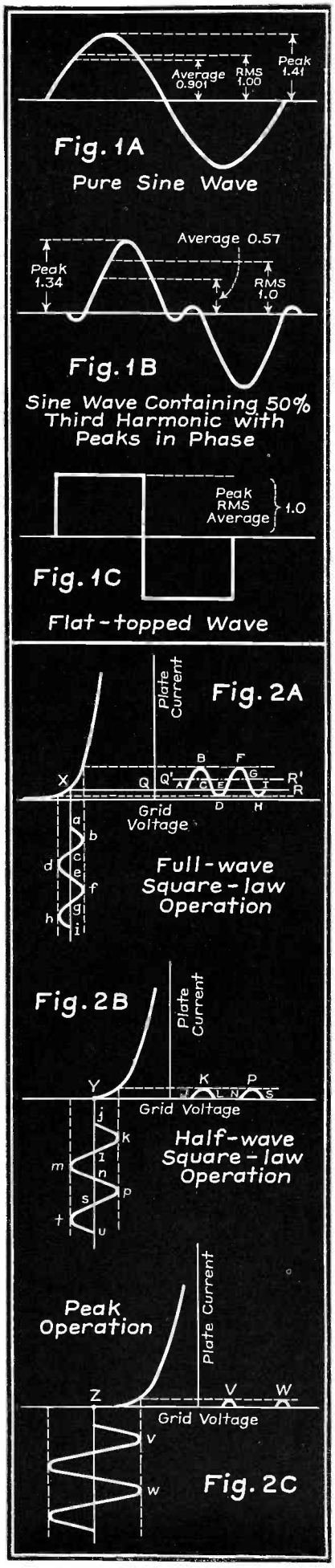


IT IS the purpose of this article to evaluate the relative merits of various types of electronic voltmeters and to give information pertaining to those commercially available.

Need

The customary D'Arsonval type of d-c voltmeter employed by Service Men has a sensitivity of 1000-ohms-per-volt. The sensitivity (ohms divided by volts) of a-c voltmeters is usually but a fraction of that for the corresponding d-c type. A D'Arsonval type voltmeter rarely incorporates a sensitivity in excess of 20,000-ohms-per-volt, for beyond this

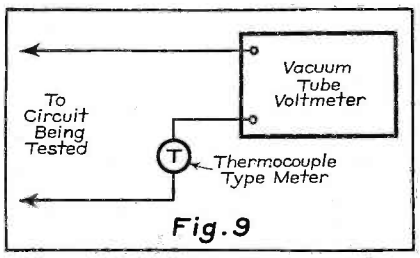


figure the instrument becomes not only very delicate and easily damaged but also becomes very expensive.

Voltmeters having a low internal resistance draw current from the circuit under test. If the circuit measured is of high impedance the voltmeter reading will be so greatly in error as to mean nothing.

The vacuum-tube voltmeter, on the other hand, has such a large input impedance that it is loosely said to possess "infinite input impedance". Although this is far from true for some types of electronic voltmeters, it is a fairly accurate statement for other types, particularly for d-c and a-f.

For all ordinary uses of commercial v-t voltmeters likely to be encountered by the Service Man it may be considered that they do not constitute a load upon the circuit to which they are connected. This means that the voltage reading obtained on the v-t voltmeter is the actual operating voltage of the circuit.

Average, RMS, and Peak Voltage

Vacuum-tube voltmeters, depending upon the circuit used, are capable of measuring either root-mean-square, average, or peak voltages.

Consider the pure sine-wave voltage depicted in Fig. 1A. The *peak* (or *maximum*) voltage is the greatest amplitude of the voltage. This definition also holds true of non-sinusoidal voltages, such as those shown in Figs. 1B and 1C. Electronic voltmeters which measure the peak value of a voltage are either called *peak v-t voltmeters*, or, less commonly, *crest v-t voltmeters*.

The average voltage between two limits is the mean value of voltage between those limits.[1] The average voltage, although of considerable theoretical importance, is rarely used in practice.

The *root-mean-square* (rms) voltage is always assumed in a-c measurements, unless otherwise stated. It is the voltage reading obtained on conventional a-c voltmeters and is frequently called *effective* voltage. The rms voltage is the square root of the average of the squared instantaneous values of voltage.[2]

In the case of a pure sine wave it is immaterial whether the vtvm measures the peak, average, or rms voltage, as these bear a definite relationship to each other, as follows: $E_{eff} = 0.707\ E_{max} = 1.11\ E_{av}$; $E_{max} = 1.41\ E_{eff} = 1.57\ E_{av}$; $E_{av} = 0.637\ E_{max} = 0.901\ E_{eff}$; where E_{eff} = effective or rms voltage; E_{av} = average voltage; E_{max} = maximum or peak voltage.

Given any one type of voltage, the others can be easily computed. In the case of non-sinusoidal waves, however, such simple and definite relationships no longer hold. Assigning the value of

General Radio 726A.

1 THE AVERAGE VALUE OF A FUNCTION IS MATHEMATICALLY GIVEN BY

$$\left.\begin{array}{l}\text{MEAN VALUE OF } \phi(x)\\ \text{FROM } x=a \text{ to } x=b\end{array}\right\} = \frac{\int_a^b \phi(x)\,dx}{b-a}$$

2 THE EFFECTIVE VALUE OF A FUNCTION IS MATHEMATICALLY GIVEN BY

$$\left.\begin{array}{l}\text{EFFECTIVE VALUE OF } \phi(x)\\ \text{FROM } x=a \text{ to } x=b\end{array}\right\} = \left[\frac{\int_a^b \phi^2(x)\,dx}{b-a}\right]^{\frac{1}{2}}$$

VOLTMETERS

By R. LORENZEN

unity to the rms value, the relationship of peak, rms, and average voltage is given for three representative voltage waves in Figs. 1A, 1B, and 1C.

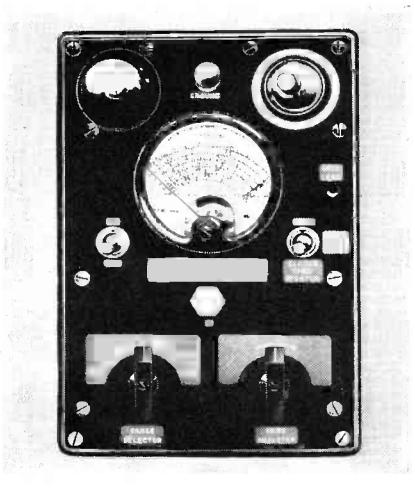
The preferable scale calibration for v-t voltmeters is either rms or peak values. Generally speaking, the peak voltage calibration is preferable for non-sinuosoidal waves, while the rms voltage calibration is more desirable when sine-wave voltages are to be measured.

Since v-t voltmeters are generally used to measure sine-wave voltages, the scale can be calibrated in rms volts regardless of whether the type circuit employed gives average, rms, or peak volts. For non-sinusoidal voltages this rms calibration may be in error by an amount depending upon the percentage of harmonics present.

Square-Law vs Linear Action

For a vtvm to have a rms calibration requires that the deflection on the indicating meter be proportional to the square of the input voltage. This is generally accomplished by operating a vacuum tube at the lower bend of its grid voltage-plate current characteristic curve.

Fig. 2A shows the effect when a sine-wave input signal abcdefghi is impressed upon the grid of a vacuum tube



Weston 669.

which is operated at point X. Change in plate current is proportional to the square of the effective voltage impressed upon the grid. Operation in this manner is called *full-wave square-law*. A vtvm which is operated in this fashion and which has been calibrated with a sine wave will give the effective or rms value of the voltage measured, regardless of the number or phase of any harmonics which may be present in a non-sinusoidal wave.

If the operating point is moved near the cutoff point, as shown in Fig. 2B, the action is called *half-wave square-law* operation. The plate current change is proportional to the square of the impressed voltage for moderately large signals, but is directly proportional (and therefore linear) to the effective value of the positive half cycles when the input voltage is large.

This method of operation will cause

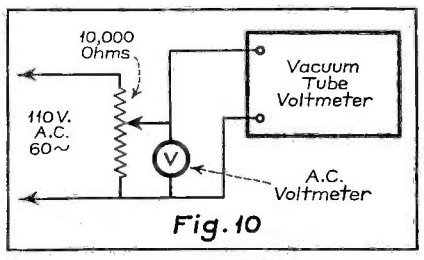


Fig. 10

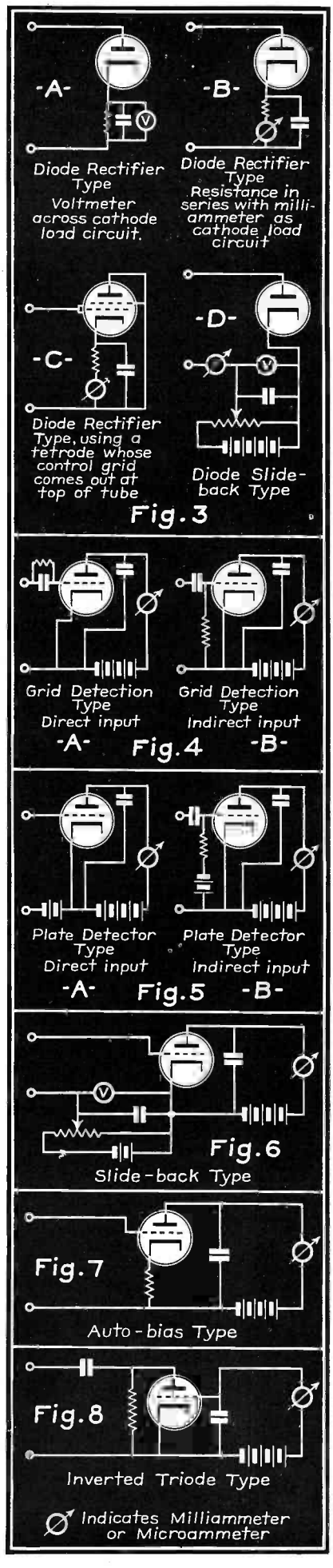
the reading of a vtvm, which has been calibrated with a sine wave, to be dependent on the magnitudes and phases of the harmonics in a non-sinusoidal wave.

Operation at a point Z which is beyond the cutoff of the tube, as shown in Fig. 2C, is known as *peak operation*. Only the peaks of the positive half cycles are effective in producing plate current. The readings of v-t voltmeters working on this principle and which have been calibrated with pure sine waves are dependent on the magnitudes and phases of the harmonics in a non-sinusoidal wave.

A square-law calibration requires that the scale readings be crowded at the lower end of the scale. Since such crowding prevents accurate readings from being made, it is necessary to have a large number of overlapping scales in order to make equally precise readings for all voltage values.

Furthermore, when a vacuum tube is operated at a bend in its characteristic, any minute deviation from the operating point at which the vtvm was calibrated will cause relatively large variations in the plate current, thereby mitigating against permanence in calibration. Small changes in operating potentials will affect the precision unduly, while replacement of a tube may necessitate a new calibration.

A linear scale, that is, a scale which



is uniformly divided, possesses the advantage that almost equally precise readings can be made over the entire scale, and therefore does not require that the various scales overlap each other to any appreciable extent.

Turnover

In measuring certain unsymmetrical waves, notably those containing even harmonics, it may be found that the v-t voltmeter may give two different readings when the leads are interchanged. This phenomenon is known as *turnover*. The average of these two readings, namely

$$\frac{E_1 + E_2}{2}$$

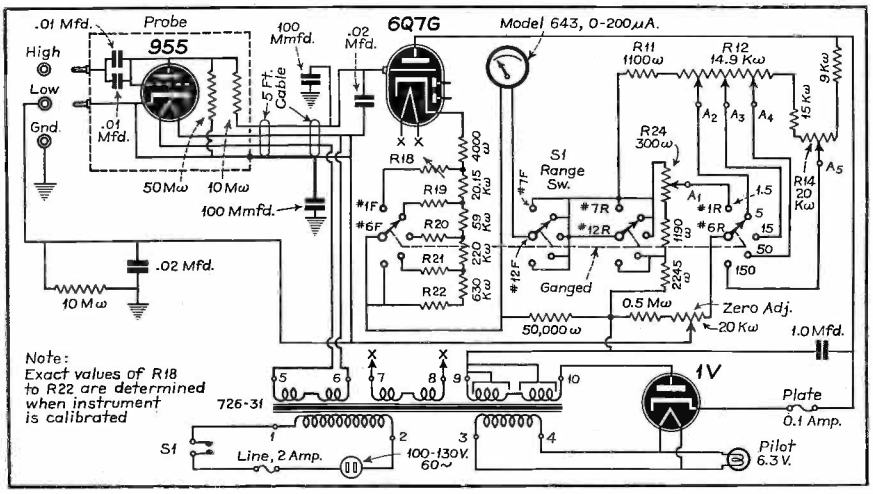
will give the correct voltage.

Desirable Characteristics

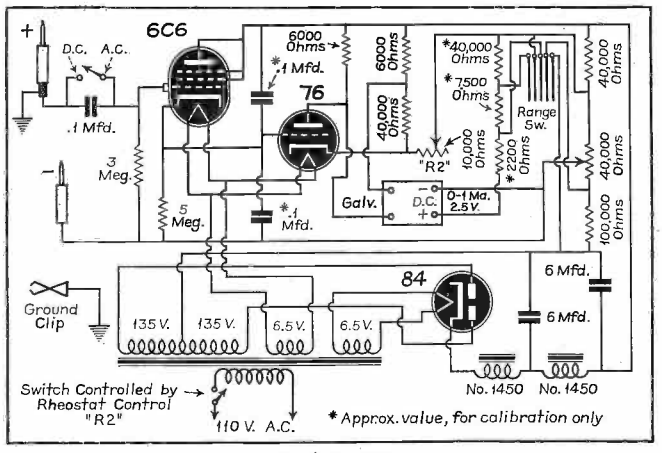
There are a number of desirable characteristics which a vtvm should possess in order that the instrument be of maximum utility to the user. Since all of the various advantageous features are not incorporated in any particular instrument, it is necessary for the Service Man to determine in which field of measurements he is most concerned, namely, audio frequencies, radio frequencies, or ultra high frequencies.

One of the most important characteristics required is a *high input impedance*. This requisite is obvious, for the very fact that the vtvm draws negligible power from the circuit under test is its distinguishing characteristic. In general, it is advisable that the input impedance be well in excess of 1 meg.

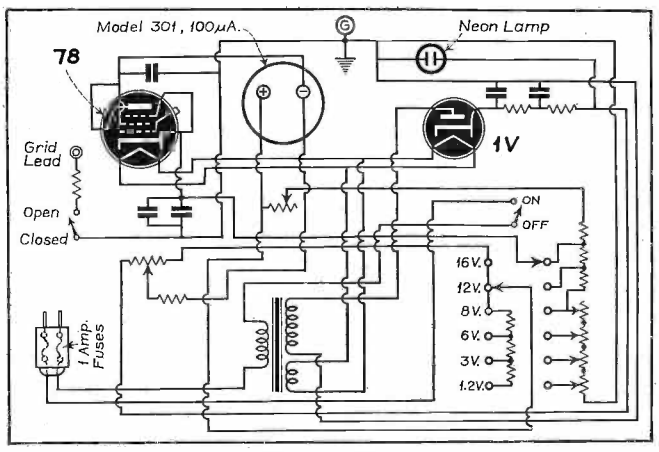
Stability of calibration is another important feature which a vtvm should possess. Small variations of the operating voltages due to line voltage fluctuations should not appreciably affect the precision of the scale readings. Neither the change in the characteristics of the vacuum tube with increasing age nor its replacement when its useful life has terminated should unduly affect the precision of the instrument. It is preferable that the instrument employed should not be too complicated as this increases the chances of instability. For example, an amplifier, whether preceding or following the rectifier, will increase the voltage range that can be covered, but it also decreases the possibility of maintaining calibration stability. Vacuum tube voltmeters should be recalibrated rather frequently —at least once a year, and preferably more frequently. This is not a serious difficulty as the calibration is easily per-



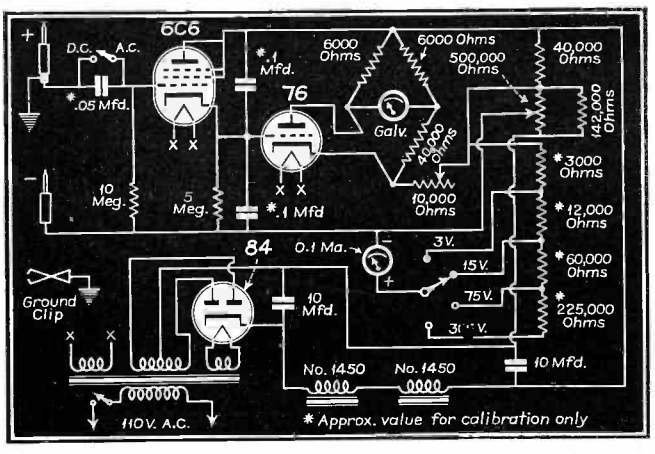
General Radio 726A.

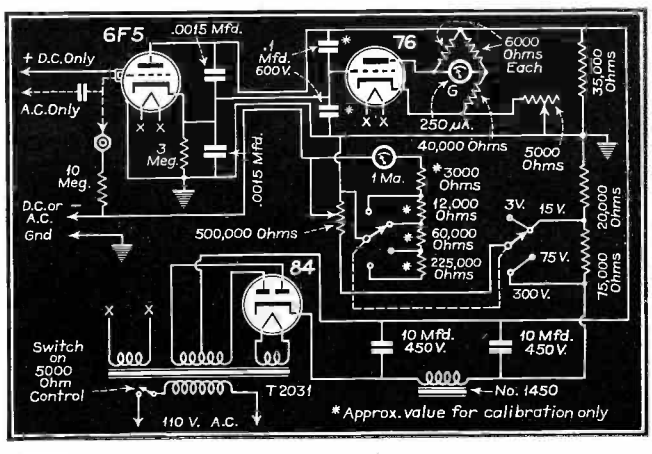


Triplett 1250.



Weston 669.





Triplett 1251 and 1252.

VACUUM-TUBE VOLTMETERS V

Compiled from specifications supplied by the manufacturer

M'F'R	Model	Price	Voltage Ranges (Volts)	Circuit Type	Freq. Range	Accuracy	Tubes Used	Input Impedance	Stability	Wave Form Error	Probe Tube	Dimensions (Inches)	Weight Lbs.	Power Supply	Comments
Ballantine Laboratories, Inc.	300	-	RMS .001-.01 .01-.1 0.1-1.0 1-10 10-100 Also 0-20db	*	10 to 100,000 Cycles	2% over most of range 3% Maximum	3 6J7 1 6H6 1 6X5	Equal to a resistance of 500,000 ohms shunted by a 25 Mmf.	1% Change with variation in power supply from 110 to 120 volts. Effect of change in tubes less than ½ of 1%	†	No	4½ High 5¾ Wide 11 Long	9½	105-125 V. 60~	Logarithmic Scale. May be used as an amplifier having a gain of 70 db; output variation ± 1 db. at 100,000 cycle. ; output impedance 20,000 ohms.
Clough-Brengle Company	88A	45.50	RMS 0-1.2 Peak 0-10 0-100	Slide-back	25 Cycles to 30 Megacycles	2% from 25 Cycles to 4000 Kc. 5% to 30 Megacycles	1 6F5 1 5Z4	With tube inside case .42 mmf. across 10 Megohms With tube extended on cable 8 mmf. across 10 Megohms.	Unaffected by tube renewal. Zero and peak bias adjustments compensate for 25 volt line variation	Negligible on RMS scale due to square-law response. Turnover on peak scale	Can be used with probe tube or not, as desired.	9¼ High 10¾ Wide 4¼ Deep	12	115 V. 50-60~	—
General Radio Company	726-A	165.00	RMS 0-1.5 0-5 0-15 0-50 0-150	Modified diode type in conjunction with degenerative amplifier	20 Cycles to 100 Megacycles	1% from 20 Cycles to 50 Megacycles 3% at 100 Megacycles	1 955 1 1V 1 6Q7G	5 Megohms shunted by 6 mmf.	Independent of tube characteristics and line voltage variation	Instrument is peak voltmeter calibrated to read RMS values of sine-wave. On distorted wave forms % deviation may be as large as % harmonics	Can be used with probe tube or not, as desired	9½ Wide 14 Deep 8½ High	17½	100-130 V. 60~	Available for 50 and 42 cycle power supply. Severe overload will not damage instrument.
Million Radio and Television Laboratories	XM	24.95	RMS 0-3 0-15 0-30 0-150 0-300 0-600 0-800 0-1500 0-3000	*	30 Cycles to 56 Megacycles	†	†	*	Unaffected by an 8 volt power line variation	†	Can be used with probe tube or not, as desired	9¼ Wide 12½ Long 3¾ Deep	†	110 V. A.C.-D.C.	Scale selection by push-buttons.
Triplett Electrical Instrument Company	1250	36.67	Peak 0-2.5 0-10 0-50	Modified slide-back	†	†	1 6C6 1 76 1 84	†	Unaffected by tube renewal	†	No	†	†	103-120 V. 60~	—
	1251	47.67	Peak 0-3 0-15 0-75 0-300	Modified slide-back	†	†	1 6F5 1 76 1 84	†	Unaffected by tube renewal	†	No	†	†	103-120 V. 60~	—
	1252	48.33	Peak 0-3 0-15 0-75 0-300	Modified slide-back	20 Megacycles	3% for D.C. 5% for A.C.	1 6F5 1 76 1 84	10 Megohms	Unaffected by tube renewal	No turnover	Yes	7⅞ 6⅝ 4⅜	8¾	103-120 V. 60~	—
Weston Electrical Instrument Corp.	669	50.63	RMS 0-1.2 0-3 0-6 0-9 0-12 0-16	Auto-bias	50 Cycles to 50 Megacycles	3% at Low Frequencies 6% for entire range	1 78 1 1V	5 mmf. with 6 inch leads	Independent of line voltage variation. Instrument must be recalibrated when 78 tube is replaced.	†	No	8¼ 5½ 5¾	6½	105-130 V. 40-60 ~	Calibration curves must be used for D.C. measurements. Two multipliers supplied with instrument to extend each range 10 times. When used, the calibration accuracy is decreased by 2%

V The instruments listed in this chart function solely as V.T. voltmeters. Combination instruments such as the Rider Chanalyst, The Aerovox Capacity Bridge, and the Philco Circuit Tester, will be discussed in a succeeding issue.

† No information supplied.
* Insufficient " "

formed. (See Fig. 10.)

Frequency independence is another essential characteristic. Usually, although not always, this is closely related to input impedance. It is readily seen that for convenience of use the calibrated scale readings should apply regardless of the frequency of the voltage under test. Independence of frequency is possible over wide ranges but is ultimately limited by input capacitance, which, obviously, should be as low as possible.

A vtvm should be *capable of measuring a wide range of voltages,* that is it should possess a large number of scales. This item, although important, is rather difficult of execution, in contrast to the ease with which it can be accomplished in the D'Arsonval type of voltmeter.

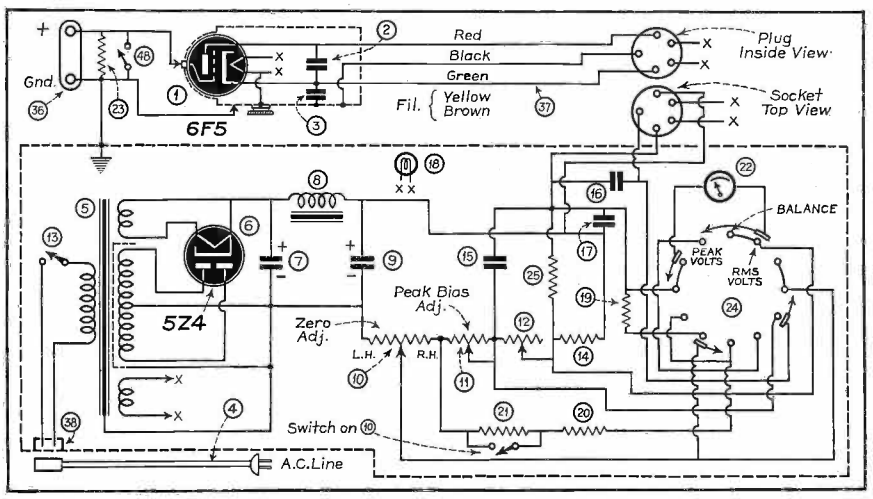
The readings of the vtvm should, except in special cases, be *independent of the waveform* of the measured voltage when this voltage is non-sinusoidal in character.

Sturdiness is another desirable characteristic. Certain circuits require extremely sensitive and therefore delicate indicating meters. This should be avoided, not only because the initial expense is quite high but also because the delicacy of such instruments makes them particularly susceptible to injury.

Ease of operation is another item to be considered. It should not be necessary to manipulate too many controls in order to make a measurement, for otherwise the possessor of such an instrument will find that so much time is consumed in making a measurement that there will be a tendency to use the equipment less frequently. This feature is also related to the type of scale calibration, for lack of facility results if it is necessary to multiply the reading obtained by some factor in order to obtain the rms voltage value.

Portability is important since the nature of a vtvm is such that it is almost invariably located close to the circuit under test.

Last, but not least, the *price should not be excessive.*



Clough-Brengle 88A.

Types

All v-t voltmeters are essentially detectors of some sort. Since an electronic voltmeter is intended to be used as a measuring instrument, it will be found that the characteristics which make for a good detector in a radio receiving set are not necessarily those which contribute to the excellence of a vtvm as a measuring device.

Of the multitudinous possible circuits, practically all will be found to be but a variant of the fundamental types given here. The discussion will be limited to the detector circuit. The addition of amplifiers or other refinements does not alter the fundamental design principles.

Diode Rectifier

The *diode rectifier type,* a typical example of which is shown in Fig. 3A, operates on the principle that when an alternating voltage is impressed upon the diode, rectification occurs, in consequence of which d-c, together with a-c components, flows in the diode load resistor. The unwanted alternating components are by-passed by means of a condenser shunted across the diode load resistor, and this condenser should possess a low reactance to the lowest frequency which will be measured. A suitable d-c voltmeter placed across the diode load resistor will read the average voltage of the applied signal.

Except for signals of very small amplitude a diode rectifier type voltmeter will have a linear scale.

In Fig. 3B a milliammeter (calibrated in volts) is connected in series with a resistance to serve as the diode load. By changing the value of this series resistor different ranges of voltage readings are obtained.

An internally shielded type is depicted in Fig. 3C. A tetrode in which the control grid comes out at the top of the tube is used, this control grid serves as the diode plate. The screen grid and plate are connected to the cathode return circuit and thereby act as an internal shield which minimizes the pickup from unwanted external fields.

The diode rectifier types represented in Figs. 3A, 3B, and 3C, give the average value of the impressed voltage regardless of the presence of harmonics in the voltage measured. There is, therefore, no possibility of turnover.

Unfortunately, the diode rectifier type draws current from the circuit being measured. For certain values of diode load resistance the power drawn from the measured circuit may be so appreciable as to make this type of instrument no better in its loading effect on the circuit under test than an ordinary voltmeter. For use where a high input impedance is required this type of electronic voltmeter is usually unsuitable. It is generally conceded, however, that v-t voltmeters of the diode rectifier type are especially suited for use at ultra high frequencies, such as, for example, at television frequencies.

Fig. 3D represents the *diode slide-back type* of electronic voltmeter. Unlike the preceding diode types described which give average voltage readings the diode slide-back type indicates peak voltages. Except for the fact that a diode is used, the characteristics are similar to that for the triode slide-back type which is discussed below.

Grid Detection

The *grid detection type* is also known as the *grid leak type,* the *grid-circuit triode type,* and the *grid rectifying triode type.* Typical circuits are given in Figs. 4A and 4B.

The grid-cathode circuit rectifies the applied input voltage somewhat similarly to the action of the diode detector just discussed. The rectified voltage builds a charge across the grid leak and condenser, this charge is amplified and results in a change in plate current which is measured by the plate circuit milliammeter (calibrated in volts). Since the indicating meter in the plate circuit reads a maximum when there is no input signal, the indicating meter cannot be damaged if a large voltage is inadvertently impressed upon the input.

The grid detection type is very sensitive to small voltages and is, accordingly, particularly useful for measurements less than one volt. The scale readings are linear for part of the scale while the remainder is square-law. It is not subject to turnover.

The range of measurement of this type is rather limited. The calibration is quite unstable and is influenced by changes in operating voltages and by the changing characteristics of the tube due to aging. Like the diode type it has a low input impedance and draws power from the circuit under test.

Plate Detector

The *plate detector type* goes under a variety of designations, namely, *plate-circuit type, anode-detector type, bias-detector type,* and *anode-bend type.*

There are three main methods of operation for a plate detector type, when the grid voltage-plate current characteristic is considered, namely, at less than cutoff, at cutoff, or beyond cutoff. For operation at less than cutoff (See Fig. 2A) and for small input voltages, square-law action is obtained and consequently a rms scale. When operation is at cutoff (See Fig. 2B), for moderate input amplitudes square-law action results, while for large input voltages the response will be linear. Operation beyond the cutoff point (See Fig. 2C) causes the response to be dependent on the peaks of the applied signal.

It is thus seen that the plate detector type is a rather versatile instrument, for the mere alteration of the grid-bias voltage enables it to have either a square-law or linear scale, and also that it can be used either to give rms or peak readings.

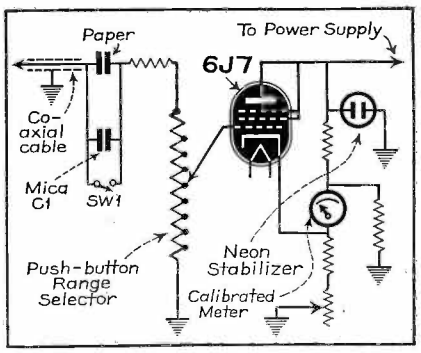
This type of electronic voltmeter, however, has a limited voltage range, for the applied input voltage must not exceed the grid bias voltage in order to prevent grid current flow. Furthermore, the indicating meter must be rather sensitive. Moreover, this circuit is liable to change of calibration, for the calibration is influenced by the operating voltages and to the change in vacuum tube characteristics due to the aging of the tube.

The chief advantage of the plate detector type is the fact that it has a high input impedance.

Slide-Back

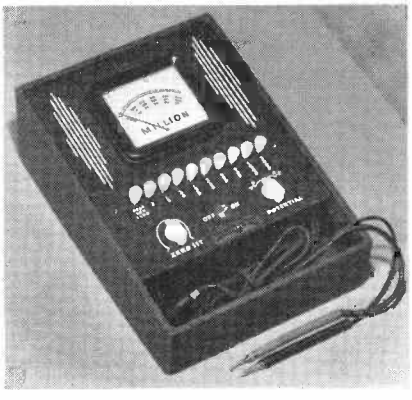
The *slide-back* or *substitution type* (Fig. 6) is based on the principle that a d-c voltage is made equal to the peak value of the a-c voltage measured, and this d-c voltage is then measured with a d-c voltmeter.

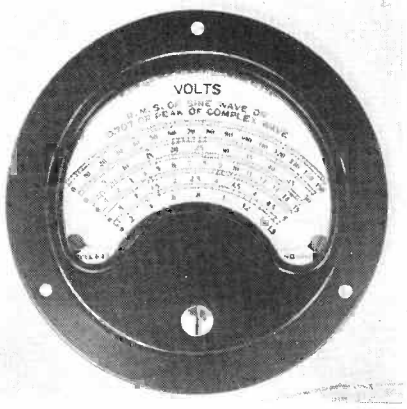
In practice, the input terminals are short circuited and the slide-back voltage is adjusted until the plate current is reduced to some definite but small value. The input terminals are then connected to the circuit under test and the slide-back voltage is readjusted until the plate current reads the same as when the input terminals were short circuited. The peak voltage of the cir-



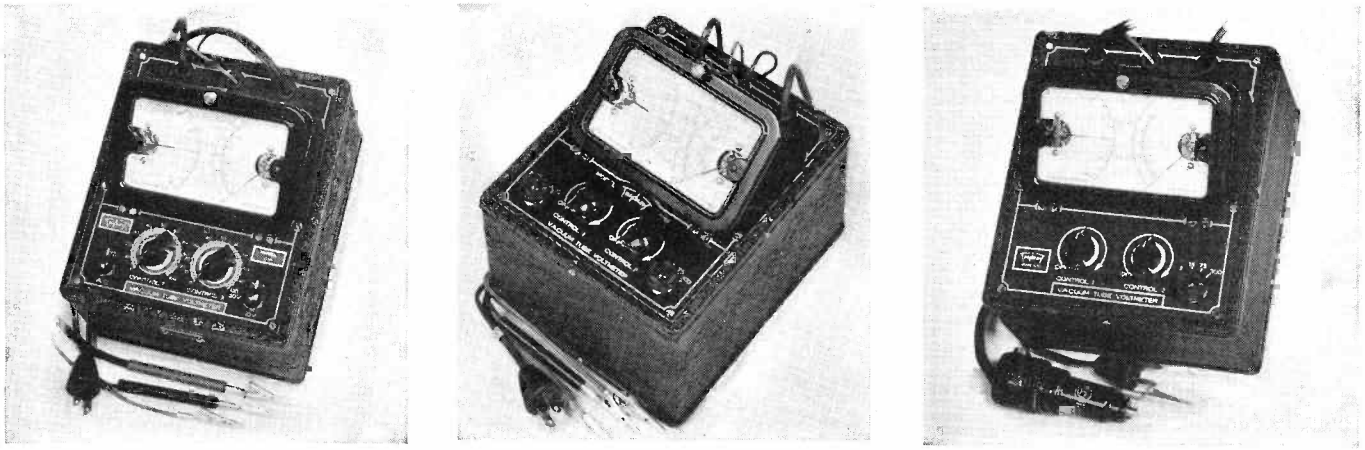
Million instrument. A partial circuit is shown above.

Clough-Brengle 88A.





General Radio vtvm scale.



Triplett 1250, 1251 and 1252.

cuit under test is the difference between these two voltage readings. Of course, the variable slide-back voltage must be capable of exceeding the unknown peak voltage impressed on the input. Provision should be made to obtain both coarse and fine adjustments of this slide-back voltage.

Due to the method of operation the slide-back type is self-calibrating and the readings on the d-c voltmeter are used without further calibration. Since peak voltages are thus obtained it is unfortunately necessary to multiply these readings by 0.707 in order to obtain rms voltage values, providing, of course, that it is a pure sine wave. In the latter case, however, the dial can carry the rms calibration as well as the peak to eliminate the computation.

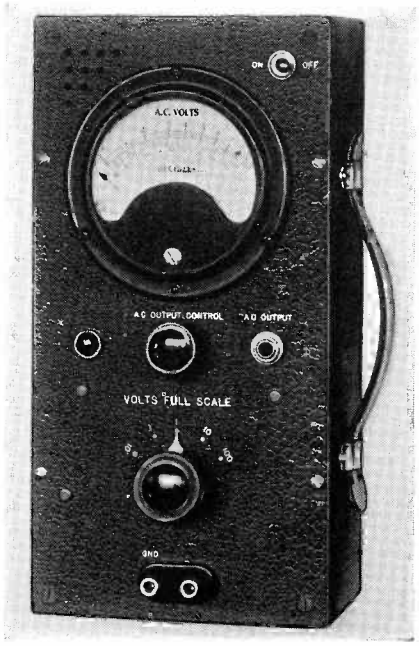
Two meters are required, however, of which one, the plate current indicating meter, must be rather sensitive. This type of vtvm is particularly subject to turnover.

Despite its disadvantages the slide-back vtvm is possessed of many important advantages. It has a very high input impedance, in consequence of which it does not load the circuit under test. It is almost completely independent of variations in operating voltages and of changes in vacuum tube characteristics. A wide range of voltages can be measured merely by increasing the slide-back supply voltage. The voltmeter scale may be linear.

Auto-Bias

The *auto-bias type,* otherwise known as *automatic grid bias* or *reflex type,* is depicted in Fig. 7.

The cathode resistor is common to both the cathode and plate circuit. This arrangement results in a somewhat insensitive circuit since a voltage applied to the input will simultaneously effect an increase in the negative grid bias and an equal decrease in plate potential. The degeneration afforded by this circuit results in great overall stability so that changes in vacuum tube characteristics or in operating potentials have practically no effect on the calibration.



Ballantine 300.

This circuit is generally adjusted so that the maximum meter deflection corresponds to zero input voltage, thus insuring against any possibility of injury to the indicating meter. The instrument gives the average voltage and the scale is almost linear.

The auto-bias type does not require an extremely sensitive and therefore expensive meter. Furthermore, the proper selection of cathode bias resistors enables a large number of scale ranges to be obtained.

This type of circuit is not well adapted for the measurement of very high voltages, in view of the fact that the plate voltage must be somewhat greater than double the maximum peak input voltage.

Inverted Triode

In the *inverted triode type* (Fig. 8) the grid and plate connections are interchanged. When an input voltage is applied to this instrument the electronic flow from cathode to grid is reduced. The grid current through the indicating meter is thereby decreased. Since a maximum indicator meter deflection corresponds to zero input voltage and since an applied voltage causes a decrease in current through this meter, it is readily seen that the indicating meter cannot be damaged by the application of an excessive input voltage.

Unfortunately, since the grid current flow cannot be very large, a sensitive, which means an expensive indicating meter must be employed.

Television

A good vtvm is indispensable for work on television receivers. Since it does not seem possible to incorporate all of the desirable characteristics in any single instrument the main stress, for television usage, should be placed upon frequency independence.

The input capacitance of the vacuum tube, vacuum tube socket, input circuit wiring, and test leads, acts as an input shunt admittance which increases as the frequency rises and therefore absorbs more power. Furthermore, the input circuit wiring and test leads offer an inductive reactance which may affect the voltage reading at high frequencies. The error will be particularly great when the input capacitance and the wiring and lead inductance become resonant.

These difficulties can be partially overcome by the use of a probe tube, for this tube can be applied directly to the circuit under test without the intervention of test leads. It should be remembered, however, that it is quite difficult to use a probe tube in a cramped space.

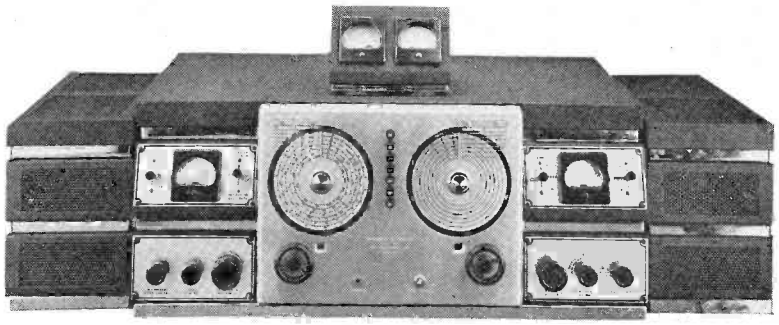
The by-pass condenser, shown in Figs. 1 to 8, is employed to keep r-f from entering the indicating meter. Since this by-pass condenser must be large it usually consists of a paper condenser, which, due to its method of manufacture, may become inductive at very high frequencies, and thereby introduce frequency error.

(*Continued on page* 40)

General Data

HALLICRAFTERS DD-1 DIVERSITY RECEIVER

By S. GORDON TAYLOR



The tuner is flanked at either end with the separate power supply and power amplifier units.

THE principle of diversity reception takes advantage of the fact that the instantaneous level of a fading signal may be widely different on two antennas which are spaced a few hundred feet apart or are of different polarization (as when placed at an angle of 90° or more to one another). By combining the outputs of the two or more such antennas a very definite improvement in the average level of a fading signal is obtainable, oftentimes making a really good signal out of one which on a single antenna might be fading hopelessly.

Unfortunately, the outputs of two antennas cannot be effectively mixed or combined at radio frequencies. Most fading is the result of a signal arriving at the antenna over different paths. If these separate components arrive in phase they aid each other, but if out of phase tend to cancel. With any variation in the length of one or more paths the phase relationship is altered and the signal rises or falls accordingly. Similar variations occur when combining the outputs of two antennas, with the result that at one instant their outputs may be aiding each other and at the next moment partially cancelling. This is true regardless of whether the outputs are mixed directly or are first fed through separate r-f amplifiers and then mixed. It is only by first rectifying the signals and then combining them at audio frequencies that they can be made additive.

In practice this means that the most effective form of diversity reception involves the use of a separate receiver with each antenna, mixing the outputs of these receivers in a common audio amplifier. This is the method employed in the transoceanic telephone and telegraph receiving stations. It is also the method employed in the Hallicrafters DD-1 "Dual-Diversity" receiver.

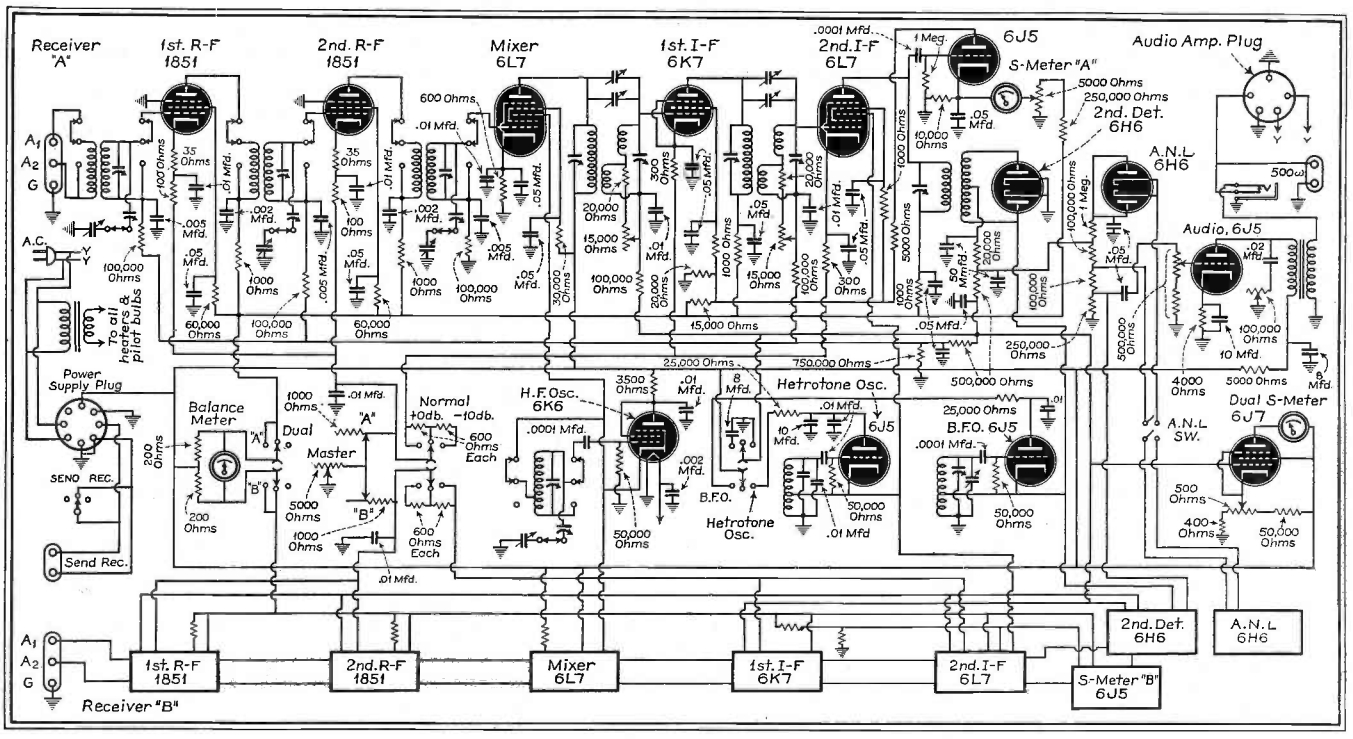
The circuit of this receiver is shown in Fig. 1. The following discussion will be limited to the special features involved in its diversity application.

Essentially, the DD-1 consists of two separate superheterodyne receivers mounted on a single chassis and feeding into a common audio amplifier. Each utilizes two r-f stages with 1851 tubes. Following this in each channel is a mixer, 2-stage i-f amplifier, diode detector and avc, noise limiter diode, and "S" meter amplifier stage.

A single r-f oscillator serves both receivers. This makes single-dial tuning practical and at the same time avoids the beats and birdies that would be almost impossible to eliminate were two separate oscillators employed. The oscillator voltage is fed to the parallel injector grids of the 6L7 mixers. These constitute a heavy capacitative load and if coupled to the oscillator in the conventional way would seriously limit its tuning range. By using a power oscilla-

(*Continued on page 20*)

Two complete r-f and i-f channels are employed in the Hallicrafters Model DDI dual diversity receiver.



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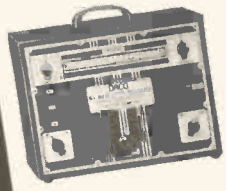
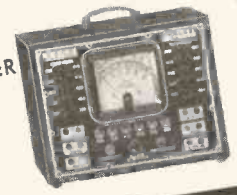


ALL-WAVE SIGNAL GENERATOR



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HALLICRAFTERS DD-I

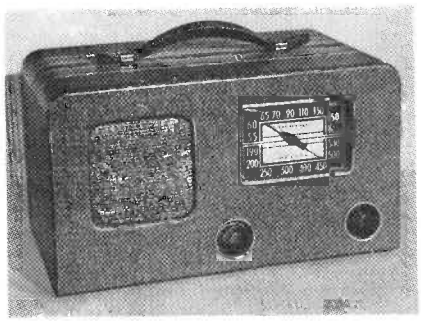
(*Continued from page* 18)

tor it becomes possible to couple the injector grids at the oscillator cathode. While only a fraction of the oscillator output is available at this point, it is ample and the shunting effect of the parellel injector capacities is minimized. Moreover, this coupling arrangement results in greater oscillator stability.

While each channel has its own avc system, the two are interconnected so that the combined avc voltage is applied equally to both receiver channels. This is an important feature, because it means that when the signal is strong in one channel but weak in the other the relatively high control voltage developed in the avc system of the stronger channel will be applied to both and the noise which would develop with the weaker channel running wide open is eliminated. At no time does either channel operate at full gain except in instances where the signal is below avc threshold in both receivers. It is for these reasons that "diversity" offers a marked improvement in signal-to-noise ratios. In this connection it is interesting to note that the usable sensitivity of the DD-1 model is better than 0.29 microvolt from 7 mc to 25 mc. These figures represent the "equivalent noise sideband input" measurements made in accordance with standard practice.

The use of the same i-f peak in both receivers makes it practical to employ a common beat-frequency oscillator. In other receivers for best cw reception it is desirable to cut out the avc, but without avc diversity effectiveness is lost. For this reason a "heterotone" oscillator is provided. This is simply an audio tone oscillator, the output of which is fed into the injector grid of the 6L7 second i-f amplifier stages to modulate any carrier that may be present. Unlike the output of the beat-frequency oscillator, this does not tend to load the avc system. With no signal tuned in the tone is not heard but as soon as a carrier is tuned in it becomes audible in the form of a tone modulated signal.

RCA 94BP4 portable receiver is entirely self contained. A loop antenna located on the bottom of the portable case is sufficient for reasonable reception.



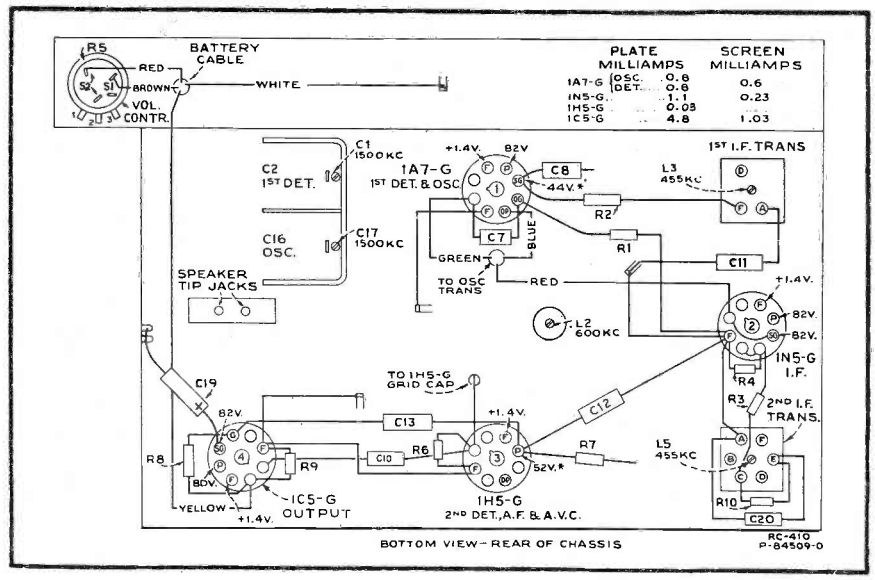


Fig. 2. The trimmer adjustments shown in the underchassis can be reached through holes provided in the portable carrying case.

Diversity action is most effective when the average outputs of the two channels are equal. Inasmuch as the pick-up of two antennas is likely to be unequal, compensation is accomplished by adjusting the gain of the individual r-f amplifiers. To simplify this operation the two controls are ganged to a single "balancing" knob and so designed that at mid-position of this knob maximum gain is available from both receivers. If the output of channel A is shown by its S meter to be greater than that of channel B the knob is moved to the left of center. This leaves the gain of channel B at maximum but reduces that of channel A. Or, if the output of B is higher the knob is rotated to the right of center to achieve a balance.

Other refinements included in the circuit are a switch by means of which either receiver can be cut off when diversity is not needed; an overall S meter actuated by the combined outputs; connections for plugging in a twin meter, one serving for each individual channel; variable adjacent-channel interference rejector system; push-button band selector switch; band-spread tuning control and dial; master r-f gain control and i-f gain control in three steps by means of 3-position switch.

PORTABLE RECEIVER

(*See Front Cover*)

WITH the advent of low-drain 1½-volt tubes, the receiver manufacturers are introducing completely self-contained portable receivers. The diagram on the front cover is RCA's contribution to this field.

The chassis is a high-gain, 4-tube superheterodyne with remarkably low battery drain. The entire receiver draws less than ¼ amp A battery current and only 9.0 ma for the total plate supply. The volume is ample and the tone quality good.

Service Data

An antenna and ground may be connected to "A" and "G" at the bottom of the cabinet. If the total length of the antenna and lead-in is more than 150 ft, a 300 mmfd capacitor should be connected in series with the lead-in.

In the chassis layout (Fig. 2) some voltages are shown with an asterisk (*). These are the actual operating voltages and do not take into account the voltmeter loading. In all cases the measured value will be less than this value by the amount of the voltmeter loading. Measurements are made to the chassis unless otherwise indicated, with

RCA 94BP4 ALIGNMENT OPERATIONS

Connect Generator to	Dummy Antenna	Generator Frequency	Dial Setting	Peak Trimmer
1N5G Grid	0.001 mfd	455 kc	550 kc	L5, L6
1A7G Grid	0.001 mfd	455 kc	550 kc	L3, L4
Antenna Term.	200 mmfd	1500 kc	1500 kc[1]	C17, C1
Antenna Term.	200 mmfd	600 kc	600 kc[2]	L2[3]

Repeat antenna and oscillator adjustments.

[1]*Use bottom of the 1 for 1500-kc calibration point.*
[2]*Use center of 0 in 60 for 600-kc calibration point.*
[3]*Rock dial for best adjustment.*

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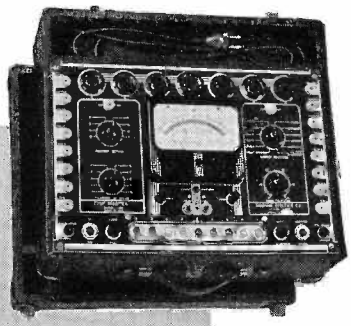

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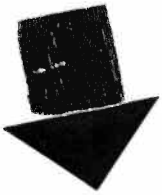

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the set tuned to a quiet point. Values should hold to approximately + or — 20 percent with rated battery voltage.

Specifications

Cabinet: Portable leatherette.
Cabinet dimensions: 7¾ in high by 14 in wide by 8⅛ in deep.
Weight: 16 lbs with batteries.
Tuning: Manual; dial ratio: 8 to 1.
Range: 550 to 1560 kc.
I-F: 455 kc.
Power Supply: One 1½-volt A and two 45-volt B batteries.
Current consumption: A, 0.24 amp; B, 9.0 ma.
Power output: 0.1 watt, undistorted; 0.21 watt, max.
Speaker: 5-in, p-m; voice coil: 2.2 ohms at 400 cps.
Pilot lamp: None.

Lead Dress

Dress the speaker leads down to the chassis. The green lead from the loop to the antenna section of the gang condenser should be dressed between the output and detector tube shields and pulled toward the far corner of the loop by means of the rubber band. The spiral shield on the first a-f grid lead should be brought as close as possible to the grid cap. Leads to the high side and tap on the volume control should be dressed down to the chassis and away from the output plate lead.

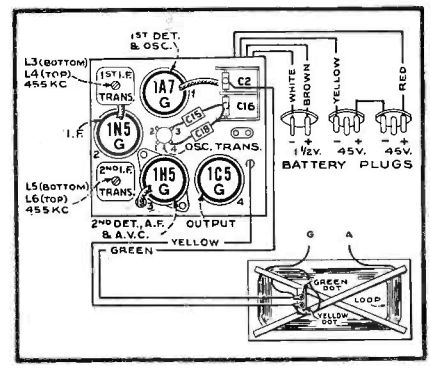


Fig. 3. Four 1½-volt tubes are used in the RCA 94BP4 portable.

AIRLINE 62-550, 62-1550, 62-2550

Connect Generator to	Dummy Antenna	Generator Frequency	Dial Setting	Peak Trimmer
1D7G grid	0.1 mfd	465 kc	1735 kc	1, 2, 3, 4
Antenna	200 mmfd	1735 kc	1735 kc	6
Antenna	200 mmfd	1400 kc	1400 kc[1]	7
Antenna	200 mmfd	600 kc	600 kc[1]	8[2]

[1] *Tune receiver to signal.*
[2] *Rock dial while making this adjustment.*

AIRLINE 62-550, 62-1550, 62-2550

THESE models are 5-tube superheterodyne receivers using 2-volt tubes and designed for operation from battery power.

Only two sets of batteries are used the A and B. Bias for the output stage is obtained from the drop caused by connecting the B battery return to a 450-ohm resistor (R12). The voltages shown on the socket layout (Fig. 1) were taken with a 1000-ohm-per-volt voltmeter between the various socket terminals and the chassis. The batteries were in perfect condition at the time of the measurements.

Alignment operations are given in the accompanying chart, and a chassis layout showing the locations of the various trimmers is given in Fig. 2.

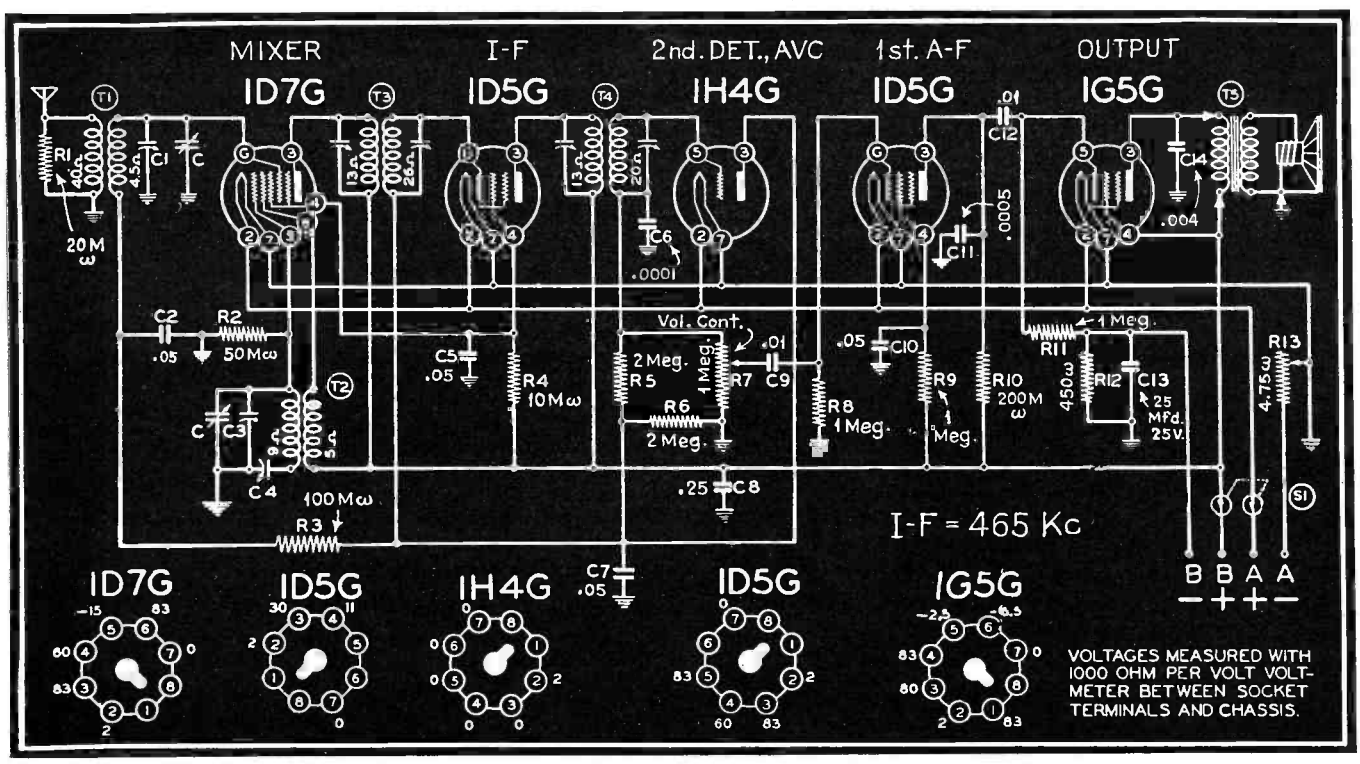
Specifications

Tuning: Manual.
Range: 535 to 1735 kc.
Power Supply: 2-volt storage battery, or 3-volt dry A and 2-45-volt B batteries.
Power Consumption: A, 360 ma; B, 15 ma.
Power output: 0.15 watts undistorted, 0.25 watts max.
Speaker: 6-in p-m.

The purpose of the rheostat on the rear of the chassis is to reduce the 3-volt A battery to the 2 volts required by the tubes. If the receiver is used about 3

(Continued on page 33)

Fig. 1. Airline 62-550, 62-1550, 62-2550 circuit diagram. Bias for the output stage is taken from the drop in resistor R12.



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RCA Victor RADIO TUBES

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Auto-Radio

GOODYEAR 01501

THIS model is a 6-tube auto-radio receiver with cam type push button tuning. The complete circuit is given in Fig. 1 with voltage and current values lettered directly on the diagram.

Automatic Tuner

This unit is mechanically operated by means of a cam and lever action designed to rotate a shaft 90°. Since the gang condenser shaft must rotate 180°, a 2 to 1 step up gear ratio is incorporated. Two gears are used to transmit the operation of the push-button to the variable gang condenser, one a small circular spit gear (with a spring incorporated to eliminate backlash) attached to the gang condenser shaft and a large sector gear attached to the tuner shaft.

The plunger bar that retains the screw type push buttons also holds a cam. This cam floats on the rivet proper and is locked into position with a small square plate, floating in the plunger bar. To lock cam into position, screw the push-button knob toward the right (clockwise). The end of the push-button screw will then force a small square plate known as a brake shoe against the periphery of the cam. The push-button must be tightened firmly after the position of the station selection is determined. To change the setting of the cam, the push-button knob must be loosened by rotating it toward the left (counter-clockwise). When this push-button screw is loosened, it will automatically release the brake shoe from the cam, leaving the cam free to rotate and set its new position to the setting of the lever bar.

If it becomes necessary to realign the tuner in relation to the gang condenser, the following procedure should be followed to assure perfect tuning operation:

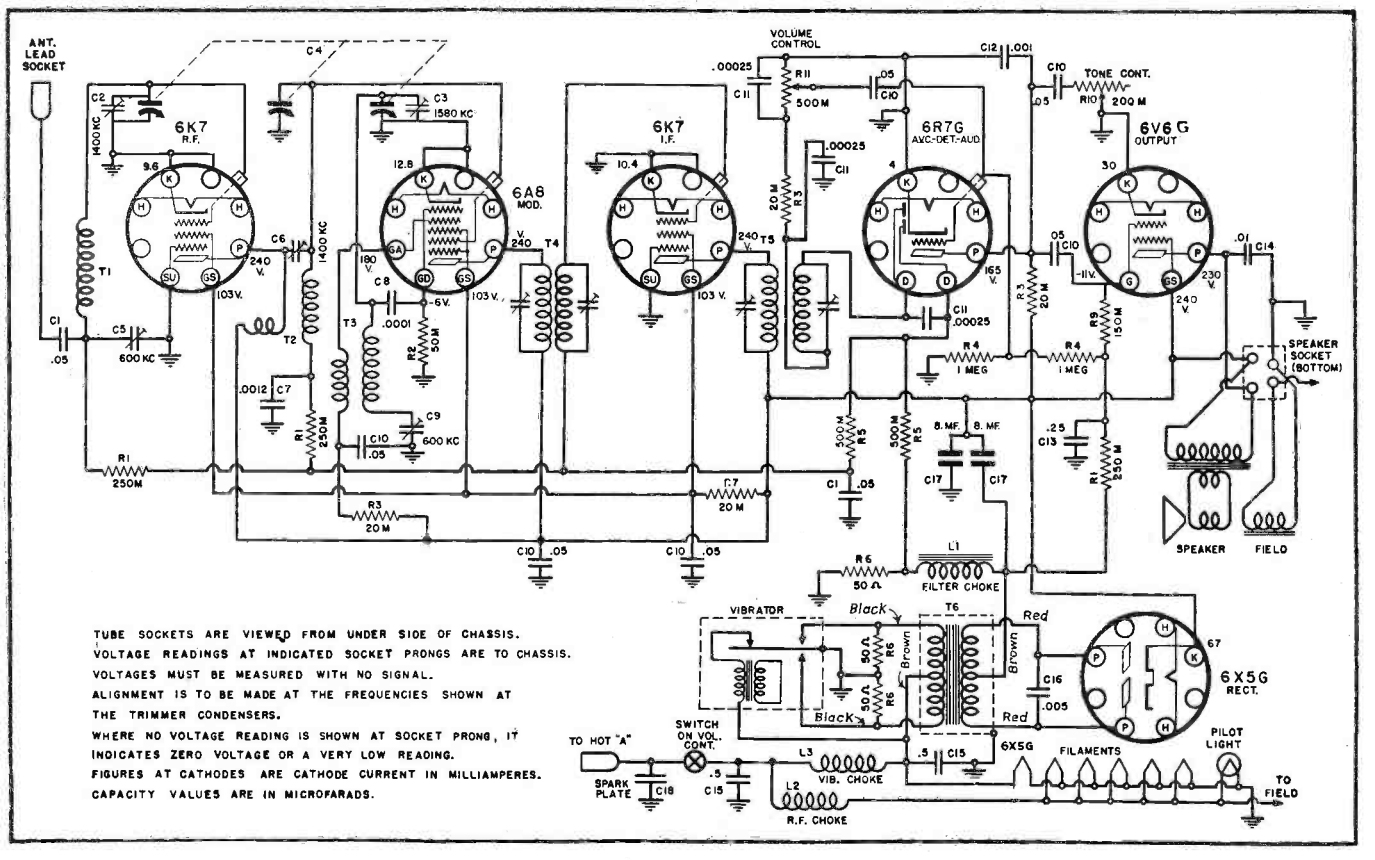
(1) Attach circular split gear (without spring) to the condenser shaft, in such a position that the clearance between split gear and string drum is approximately 3/32 in, making sure that the knurled edge of drum comes in contact with rubber pinion only, when the manual tuning shaft is pushed in to rotate drum. Proper care must be taken to prevent brass washer at the end of the rubber pinion from rubbing against knurled edge of drum. Slip drum away from split gear (towards condenser)

GOODYEAR 01501 ALIGNMENT OPERATIONS

Connect Generator to	Dummy Antenna	Generator Frequency	Dial Setting	Peak Trimmer
6A8 Grid	0.1 mfd	262 kc	535 kc	T5, T4
Antenna	200 mmfd	1580 kc	1580 kc	C3
Antenna	200 mmfd	1400 kc	1400 kc	C2, C6
6K7 R-F Grid	0.1 mfd	600 kc	600 kc[1]	C9
Antenna[2]		600 kc	600 kc	C5

[1] *Rock dial for best adjustment.*
[2] *The antenna adjustment should be made with the receiver installed in the car and the signal generator output connected to a short wire placed near, but not connected to the car antenna.*

Fig. 1. Delayed avc is employed in the Goodyear 01501 auto-radio receiver.



and tighten the set screws of the split gear securely.

(2) Replace drum in alignment position and with condenser fully open, place string hole approximately 20° to the top right of the perpendicular center line, while looking towards the shaft end of condenser and tighten both set screws.

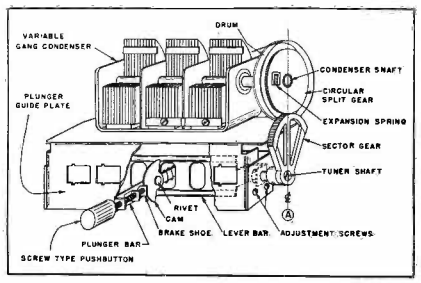


Fig. 2. Cam operated levers are used to tune six preset stations.

(3) To mount sector gear to the tuner shaft, adjust variable condenser to 90° position (half way). The circular split gear consists of two separate sections, one attached to the hub, and the other free to rotate. Revolve these two sections in opposite directions (while inserting the expansion spring) in such a manner that the spring is compressed approximately 1/8 in. While holding the split gear in this manner slip on the sector gear to the tuner shaft

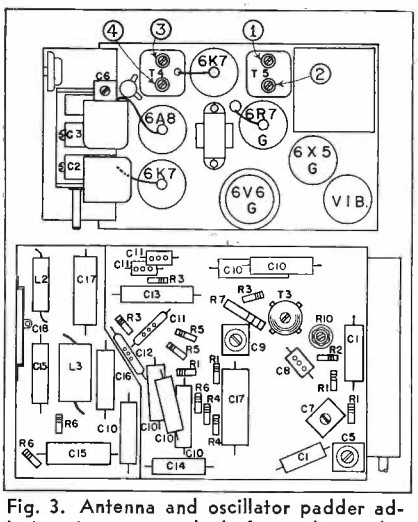


Fig. 3. Antenna and oscillator padder adjustments are reached from the under chassis, whereas the trimmer adjustments are made from the top chassis.

so that the center leg of the sector gear is directly in line with the condenser shaft (see A, Fig. 2). Before tightening the set screws of the sector gear be sure that the lever bar is placed in the tuner so that its surface is parallel to the plunger guide plates.

If, after following this procedure, the sector gear and split gear do not mesh properly you will find four screws (two at each end of the tuner proper) that can be loosened. This will permit the

(*Continued on page 37*)

Sound Facts

THORDARSON 15-WATT AMPLIFIER

THIS Model is a 6-tube, 15-watt beam-power amplifier distributed in kit form. A high-impedance microphone and high-impedance phono channel with independent controls accommodate any type of microphone and crystal or magnetic pickup. Amplifier gain is sufficient to obtain full output from the microphone and pickup under normal operating conditions.

The Circuit

Beam Power 6V6G output tubes are used in a class A^1 circuit employing inverse feedback. The output transformer contains a separate feedback winding which produces a voltage 10 percent of that developed in the primary. This voltage is fed out of phase into the grid returns of the input transformer secondary. The input transformer has a split secondary winding which is essential when this method of feedback is employed.

The circuit diagram shows two speaker sockets. If electrodynamic speakers are used, 10 watts of field excitation is available for a 5000-ohm or one or two 2500-ohm fields.

Speaker voice coil or line connections are made at 3 and 4 and at C and D of the speaker sockets or the output terminal board. The output transformer (T2) incorporates a terminal board with jacks and a plug for selecting the proper output impedance.

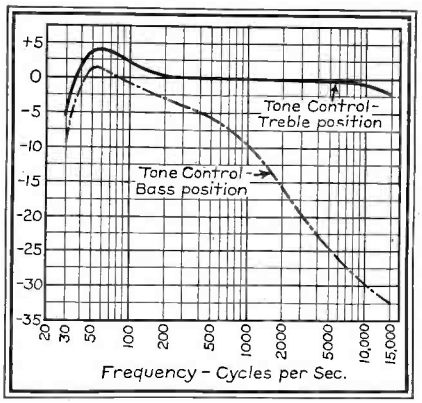


Fig. 2. The maximum position of the tone control attenuates 10,000 cycles 28 db.

The terminal board marked POL-V is provided to supply a polarizing voltage for static types of microphones or a photo electric cell. When a static microphone is used connect a jumper wire to terminals 1 and 2 which completes the circuit. Under no conditions should this jumper be left in place when a crystal, dynamic or velocity microphone is connected to the amplifier.

Photo electric cells of the gas filled type usually require 90 volts. Since the normal voltage supplied to the input plug is approximately 270 volts, this should be reduced by connecting a 5-meg, 1-watt resistor from the junction of C1 and R2 to ground. In the event that a static microphone or photo cell is never to be used R1, R2 and C1 may be eliminated.

Assembly and Wiring

Assembly of the amplifier is usually started by mounting tube sockets, controls, transformers and chokes on the chassis.

It is quite important to use shielded wire as indicated in the circuit diagram, since hum and unwanted feedback is liable to result otherwise. Where the schematic shows shielded resistors and condensers, this is accomplished by first inserting the part in a piece of varnished cambric or spaghetti tubing and then covering with shield braid. The shielding of the parts so indicated is also important in the reduction of hum.

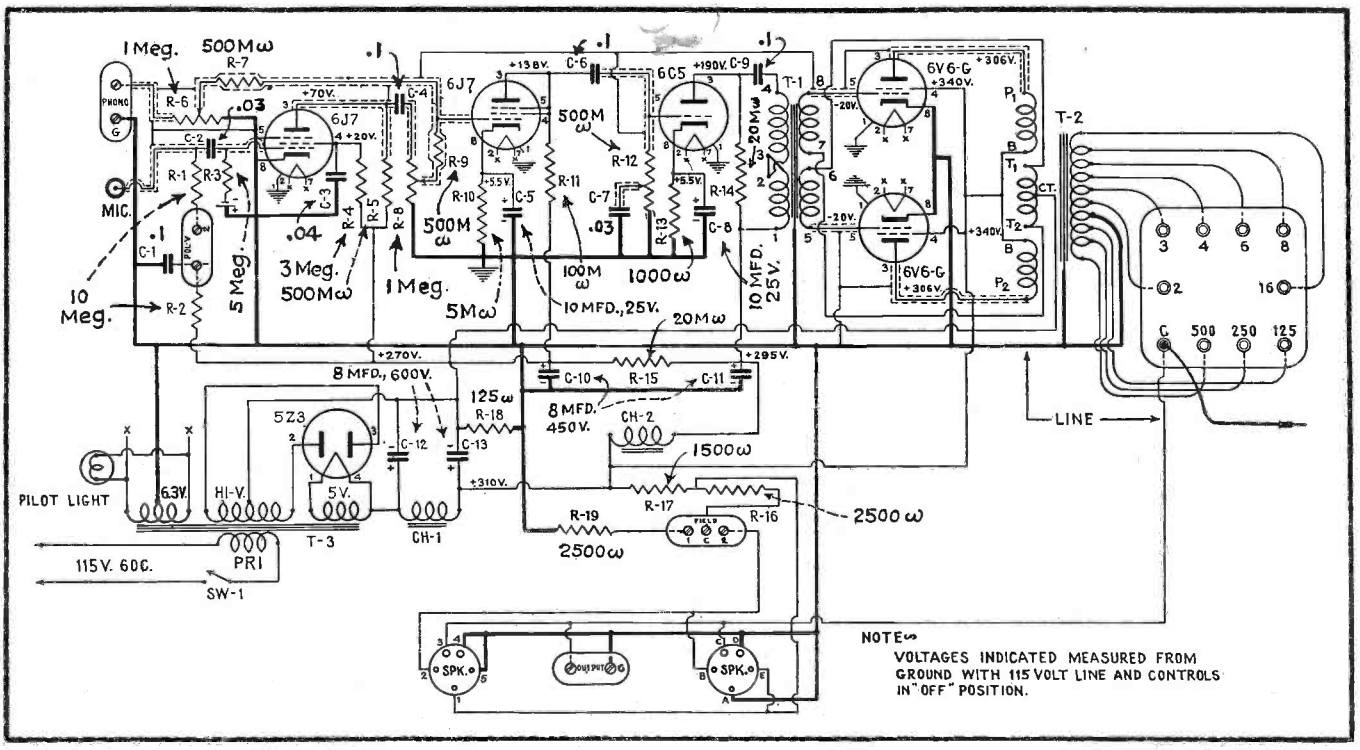
It is advisable to measure all the voltages and the power output before the amplifier is placed in service. This will prevent overloading of the tubes or parts due to improper adjustments, bad connections or oscillation.

Oscillation

Due to the high power sensitivity of

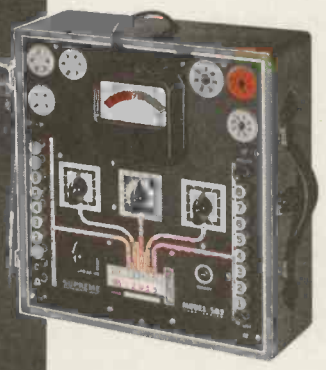
(*Continued on page* 41)

Fig. 1. A special winding is incorporated on the output transformer, in the Thordarson 15-watt amplifier, to feed back 10 percent of the signal voltage.



THE SHOW MUST GO ON!

PARAMOUNT'S B&K THEATERS *avoid sound track emergencies* WITH SUPREME INSTRUMENTS



PATRONS in Paramount's Balaban & Katz Theaters do not suffer the exasperating interruptions from sound outage. Every show is a perfect show—especially from the standpoint of sound. That's because B & K sound engineers avoid sound track emergencies by practicing a "preventive maintenance" plan—which consists of frequent periodic sound system check-ups with Supreme instruments.

THE stability of the Signal obtained from the new Supreme Model 571 Signal Generator (shown at left) enables them to make the most accurate check on the amplifier. And with the Supreme Model 546 3" Oscilloscope (shown at right) on the output, the slightest variation from normal in the amplifier is faithfully recorded.

SUPREME Instruments are fast winning favor in the theater sound field—just as they have in the radio service field. Which accounts for the fact that **more radios are tested each day with Supreme Instruments than with any other kind!**
See your Parts Jobber now. He sells Supreme Instruments on the lowest terms in radio history! Or mail the coupon for full information.

NEW MODEL 503 TUBE TESTER

Quick Facts:

- A complete test of all tubes; television video amplifiers—loctal tubes including "7" series—"S" single-ended tubes—gaseous rectifiers—magic eyes—ballast tubes—pilot lights—glass types—"G" types—metal tubes—spray shield—1.4 volt tubes.
- "Arrow-way" testing system, with easy replaceable rotary tube chart. Set controls from left to right. Just "follow the arrows."
- Future tubes taken care of by the patented SUPREME "double floating" Filament Return Selector Push Button System.
- "Hot" leakage test at R M A standard sensitivity between Heater and cathode. Super-sensitive "hot" leakage test between all other elements.
- Open, short, all element and sectional quality tests of all tubes.
- **CASH PRICE $39.50**
  S. I. C. Time Payment Plan $4.34 down and $4.34 per month for 9 months.

SUPREME

SUPREME INSTRUMENTS CORP.
GREENWOOD, MISSISSIPPI, U. S. A.
EXPORT DEPT., Associated Exporters Co., 145 W. 45th Street, New York
Cable Address: LOPREH, N. Y.

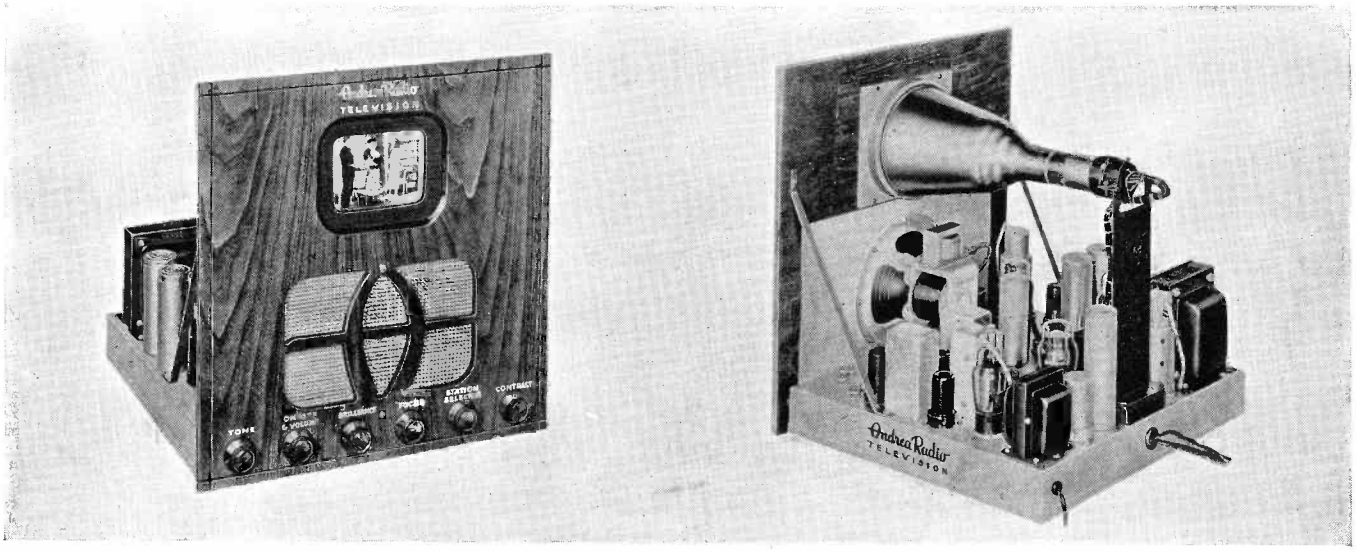
MAIL COUPON TODAY!

SUPREME INSTRUMENTS CORP., Dept. S-2.
Greenwood, Miss.

Please RUSH me your newest information on SUPREME Instruments:

Name_____
Address_____
City_____ State_____

Television



Andrea KTE5 Televisor is available either as a completed receiver in a table model cabinet for $185 or in knock-down form for $79.50 less tubes.

ANDREA KTE5 TELEVISOR

THE Andrea Model KTE5 is a 16-tube television sight and sound receiver available either as a factory built set in a table model cabinet or in knock-down form for set builders and Service Men. The construction kit, shown assembled in the accompanying illustrations, includes the front panel cut out and finished, the drilled steel chassis and bottom pan, all the parts, hardware and conductors. The tuning circuits come completely assembled, wired and preset at the factory. The unit comprises a base plate on which are mounted the station selector switch, condensers, coils and resistors. It provides preset tuning on 44 to 50 and 50 to 56 mc, the frequencies assigned to the NBC and CBS transmitters in New York City.

SPECIFICATIONS

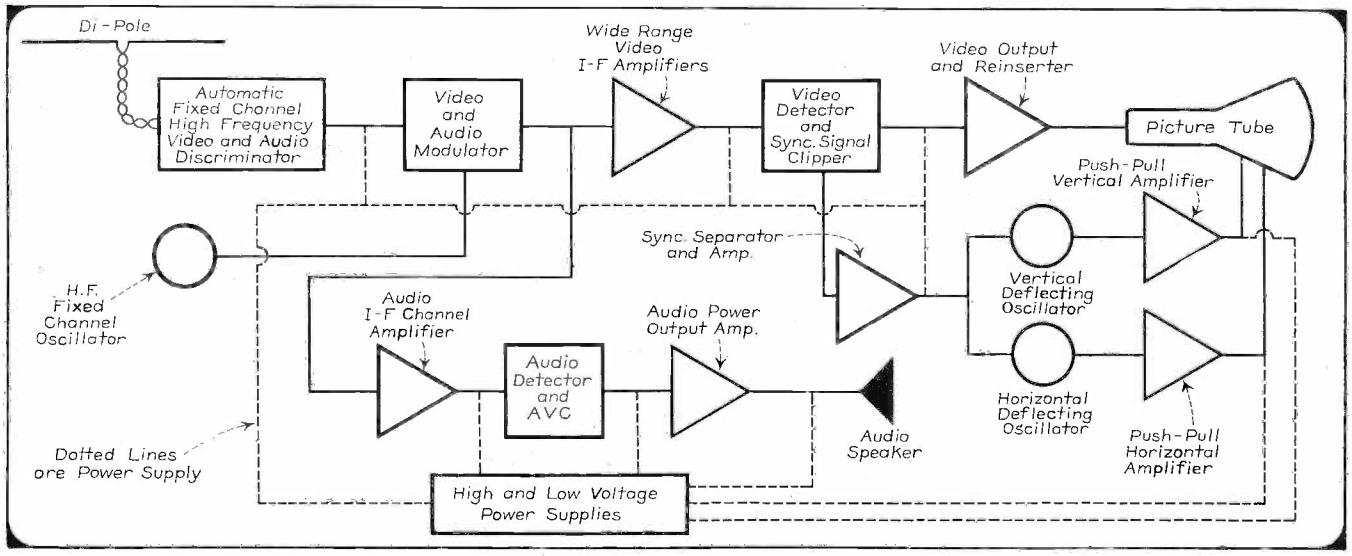
Range: 44 to 50 and 50 to 56 mc.
Tubes:
- Modulator (first detector).
- U-H-F oscillator.
- Video i-f amplifier (2).
- Sound i-f amplifier.
- Second picture detector and sync signal separator.
- Video amplifier.
- Sync signal amplifier.
- Second sound detector and first sound amplifier.
- Sound power.
- Vertical deflecting oscillator.
- Vertical deflecting amplifier.
- Horizontal deflecting oscillator.
- Horizontal deflecting amplifier.
- High-voltage rectifier.
- Low-voltage rectifier.
- 5-in cathode-ray tube.

Scanning: 441 lines.
Frame frequency: 30 per second.
Field frequency: 60 per second, interlaced.
Deflection: Electrostatic.
Power supply: 105-125 volts, 50-60 cycles.
Picture size: 2¾ by 3¼ in, approx.
Picture color: Black and white.
Controls:
- Sound tone.
- Sound volume and off-on switch.
- Picture brilliance (brightness of spot).
- Focus (size of spot).
- Station channel selector.
- Contrast (difference between lightest and darkest parts of picture).

Overall dimensions: 16½ in wide by 15½ in high by 14½ in deep.

(*Continued on page* 33)

Andrea television receiver is tuned by means of individually controlled circuit positions to assure uniform performance and maximum sensitivity.



Test Equipment

SIMPSON 333 TUBE TESTER

THE Simpson Model 333 tube tester is a small, light weight instrument designed for portable or bench work. The circuit is of the dynamic mutual conductance type and gives comparative indications on an English reading Good-Bad scale. A 4¾-in fan shaped meter is used and is provided with an additional 0 to 100 scale for matching and comparing tubes. A jack is located on the front panel so that a noise check may be obtained if desired.

Double filament switching reducing the possibility of obsolescence, is provided for testing special tubes such as 5X4G, 5Y4G, 6A5G, 6P7, etc. No adapters or special sockets are required. In more recent production a loktal socket has been included for testing this new series of tubes. The connections for this addition are indicated on the accompanying circuit diagram. Service Men who already have this model without the loktal socket may add this feature as shown.

Model 333 is a small light weight instrument.

SPECIFICATIONS

Finish: 2-tone metal panel, leatherette case.
Dimensions: 7½ by 10½ by 5 ins.
Weight: 7 lbs.
Controls: 9 toggle switches, filament return selector, filament voltage selector, tube selector, circuit selector, line adjustment and test button.
Power Supply: 100 volts, 60 cycles.
Tests: All types of tubes including loktals; pilot lamps, Christmas tree bulbs; plug-in resistors; gas filled rectifiers.
Meter: English reading and percentage scales. 4¾ in fan shaped.
Circuit: Standard RMA.
Tubes:
O1A rectifier.
Neon tube short tester.

BLIND SERVICE MAN

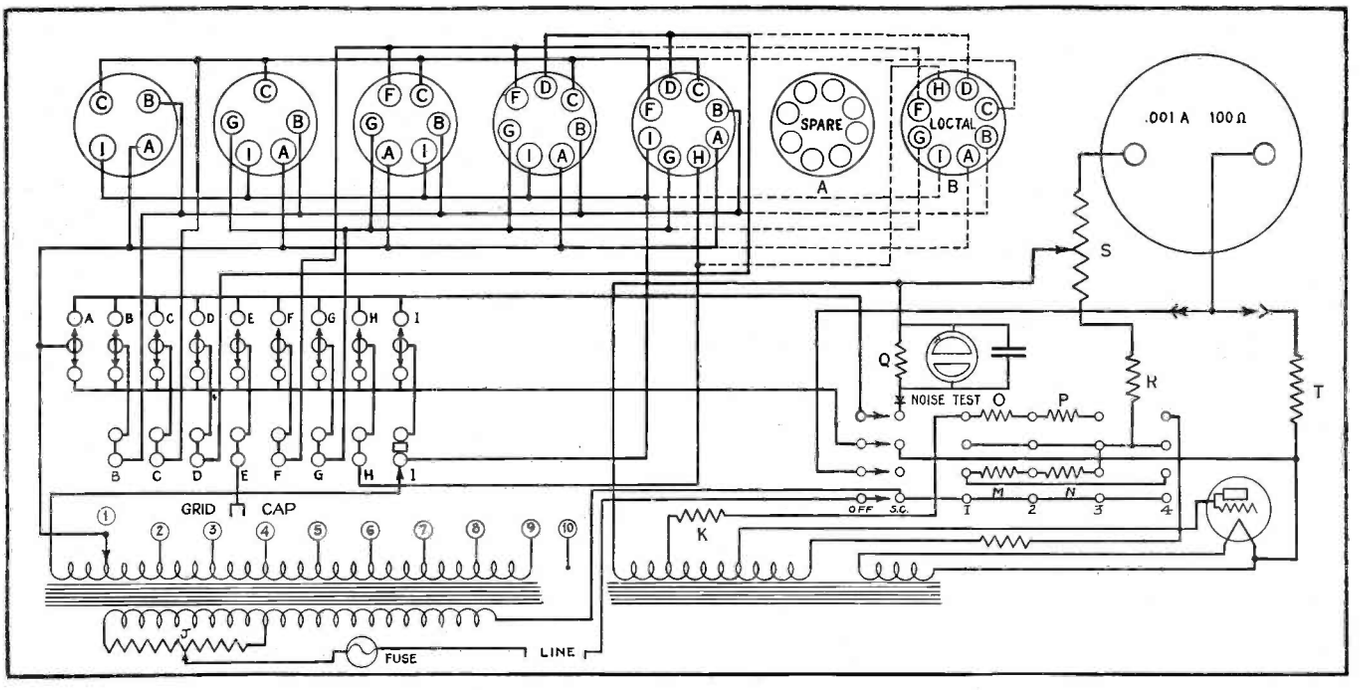
CECIL MINARD, Sandusky, Mich., is blind, yet is able to operate the regular Supreme 506 push-button tester. He has had made a special Braille tube chart which he uses in place of the regular 506 roll chart. He can tell whether the tube is good or bad by listening to the amount of hum emitted by the tube tester transformer.

Mr. Minard has been in the radio business since 1925 and has serviced receivers by listening to their reproduction or by making continuity tests with a battery and an earphone. He has built up his business so that now he owns and operates his own radio store and has a Service Man to do the repair work.

Mr. Minard testing tubes.

To facilitate Mr. Minard's operation of his model 506, Supreme has arranged through the Lifsey Distributing Co., Flint, Mich., his jobber, the building of a special instrument with a hinged meter case so that he can feel the position of the meter pointer. A special jack has also been added to enable him to hear when a tube is shorted or leaky by means of earphones.

Simpson 333 tube tester is now wired to test loktal tubes.



IT'S "PIE" FOR CENTRALAB

If we were to show the replacement business of the serviceman as a pie the failure of the average Fixed Resistor would account for a slice that is more than a quarter of the whole pie. That means, of course, that Old Man Centralab plays an important part in the replacement business.

And with a resistor hard-as-stone, impervious to moisture, shocks, excessive temperatures, and vibration, the wise serviceman finds it "easy as eatin' pie" to completely satisfy that Resistor need with CENTRALAB.

Always specify—nay, insist, on Centralab at your jobber.

CENTRALAB: Division of Globe-Union, Inc., Milwaukee

A special bulletin showing engineering data available on request. Specify Bulletin 630.

Centralab

FIXED RESISTORS

Case Histories

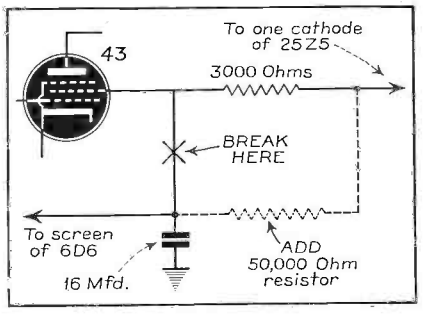
ARVIN 10A

Noisy: This is often caused by loose i-f cans. Use split lock washers under the mounting screws.

T. Henshaw

BOSCH 370E

Intermittent operation: This is often caused by poor contact in the wave-change switch. Clean with carbon tetrachloride *T. Henshaw*



CLINTON 52

Increasing sensitivity: To increase the sensitivity and reduce interstage reaction in these models the screen of the 43 output stage should be isolated from the remaining screen circuits. This may be accomplished by using a 50,000-ohm, ¼-watt resistor as shown in the accompanying sketch.

Willard Moody

DETROLA C1, T1

Hums between stations when tuning electrically: This defect may often be eliminated by changing the 75 tube. The tube will check OK in a tube tester and will work well in other sets but will cause a peculiar hum in these models.

Keith F. Martin

DETROLA C1, C2, C3, C5, T1

Electric tuning stops off stations: Look for a burned spot on the ribbons fastened to the drums. Clean with emery cloth and carbon tetrachloride.

Dial pointer jumps back and forth when tuning stations electrically: There is a small spring on the end of the motor armature shaft which may lose its tension and permit the motor to run too fast. The dial pointer will then slide past the insulated spot on the contact ribbon and jump back and forth. Tighten the spring to eliminate the trouble.

Keith F. Martin

FADA 350W

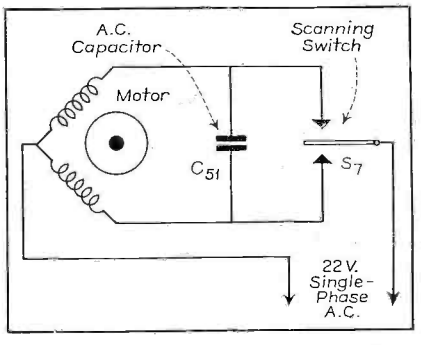
Low sensitivity: Low sensitivity in this model is often caused by a shorted i-f padder located underneath the chassis. The electrolytic condenser is mounted directly above this padder and wax dropping down from the former will short the padder. Clean the padder and readjust.

Willard Moody

G. E. G105, G106

Push-button tuning inoperative: The tuning motor received about 22 volts, a-c from the transformer but would not turn over. The motor used is a split-phase type and uses a 60-mfd, 40-volt, dry a-c electrolytic condenser (C51) shunted across the extreme ends of the winding to obtain the phase shift necessary for starting torque. If this condenser is open the motor cannot start.

Willard Moody



RCA 5T

Low voltages throughout receiver: Check 200-ohm resistor (R16) connected to the high-voltage center tap of the power transformer. If open replace with 10-watt wire-wound resistor.

Keith F. Martin

RCA 88K

Inoperative: A shorted 0.0047-mfd condenser (C6) on the first-detector coil will usually burn up the 1000-ohm resistor (R2) in series with the plate supply to the r-f tube. The set will be inoperative and the plate voltage on the 6K7 r-f tube will be missing or very low. In all cases where this condenser is shorted or leaks badly, it is advisable to replace the 1000-ohm resistor as well.

Keith F. Martin

RCA 811K

Poor tone: This is often caused by a shorted, or leaky 0.01-mfd condenser (C29) connected to the phono input panel. Replace if suspected

Inoperative on broadcast band: Check the oscillator coil (L13) for continuity. Repair if open.

Keith F. Martin

RCA 811K, 812K, 813K

Noisy between stations when using electric tuning: Dirty shorting contacts (on the face of the tuning motor) will cause excessive noise between stations in these models. The contacts can be cleaned with carbon tetrachloride.

Keith F. Martin

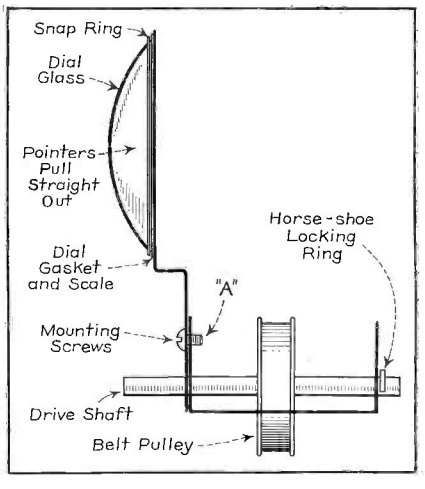
RCA C13-2

Poor tone, no avc: Check 0.05-mfd condenser (C29) connected from the low end of the second i-f coil, in the avc lead, to ground. Replace where necessary.

Keith F. Martin

ZENITH 5S56 (CHAS. 5513, 5513A)

Dial cable replacement: These models present a rather difficult dial cable replacement problem. The original cable is wide and flat somewhat like a shoestring. A knot is required in the replacement cable whether you use a heavy cord, shoestring or leather strip. The trouble then is that this knot will not pass through the two small slots in the



chassis base provided for the dial cable.

I have found a suitable solution by using thin silk fish cord, as follows: Wind the cord around once and tie the knot. Clip off the surplus ends. Repeat this five times more. Each time make sure that the knot is tied away from any other knot. Paint each knot with speaker cement.

These small knots will pass through the cable slots one at a time as the dial is rotated but a larger knot would not. *T. Henshaw*

AIRLINE 62-550, 62-1550, 62-2550

(*Continued from page 22*)

hours each day the listener should advance the knob one mark each week. However, the knob should be turned down as low as possible consistent with proper reception. Whenever a new battery is installed the knob must be returned to the starting point. Turning

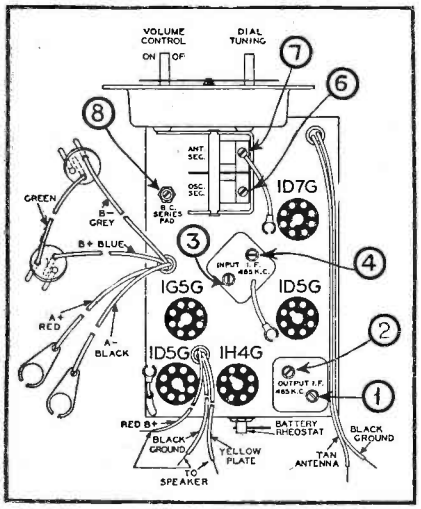


Fig. 2. Airline 62-550, 62-1550, 62-255C tube and trimmer locations.

the knob higher than necessary will cause serious damage to the tubes.

When a 2-volt storage A battery is used the knob should be turned to the point marked storage battery and left there at all times.

ANDREA KTE5 TELEVISOR

(*Continued from page 28*)

DESCRIPTION

The block diagram shows the arrangement of the various receiver circuits. Instead of using separate receiving sets for sight and sound, a single oscillator, beating with the video and audio carriers produces two intermediate frequencies which are amplified in separate i-f circuits, one terminating at the speaker and the other at the picture tube controls.

The sight and sound receiver is tuned by means of individually controlled circuit positions to assure maximum sensitivity and uniform performance of the wide-band amplifiers.

The 5-in black and white picture tube has an overall length of only 12⅝ in in contrast to the conventional tube which has a length of 16¾ in. This reduces the depth of the chassis and the size of the cabinet.

M. B. Sleeper

ZENITH 9S365 (CHAS. 5906)

Howling off resonance: This may be caused by a defective 0.05-mfd condenser in the avc circuit. Replace with one having a 400-volt rating.

Willard Moody

Associations

RADIO SERVICEMEN OF AMERICA

RSA WILL welcome, shortly, additional chapters in St. Joseph, Mo.; Scranton, Pa.; Ft. Wayne, Ind.; Springfield, Ill., and Williamsport and Allentown, Pa. In a large number of other communities, chapter formation is in progress.

Alton

On Nov. 21 the Alton, Ill., Chapter heard Russ Lund, of Clough Brengle, explain "Dynamic Testing of Radio Receivers. After the lecture refreshments were served to all those in attendance.

Boston

The Boston, Mass., Chapter was fortunate in having Glenn Browning give a complete discourse on servicing with the scope and the vacuum tube voltmeter. He explained alignment, avc, afc, checking all circuits and finding distortion, and alignment of remote circuits. Many of the instruments used in the lecture were loaned by the H. Jappe Co.

On Nov. 21 a gadget meeting was held in which all members of the chapter exchanged ideas on service instruments and service tricks. On Dec 4 Sylvania sent us George Connors, who spoke to a full house, as usual.

Chicago

The outstanding event of the month was a lecture on television, by Walter Kensworth of RCA Institutes, Chicago, on Dec. 14. It was the privilege of our members to gain an insight into the ramifications of television by means of this excellently executed technical paper. We'll try to follow up with more on the subject in the near future.

The rest of the evening was devoted to nomination of officers for 1939. Parallel to these proceedings, there was a meeting of the partially organized women's auxilliary in an adjoining room. The women's group aims to promote such events and doings as will contribute to the social status of the chapter. Wives, sweethearts, sisters, etc., of our members are cordially invited to participate actively. Direct inquiries to Mrs. John Polay or to any chapter officer. We'll arrange an extra room to accommodate the ladies.

The annual election on Dec. 28 retained Ray Manson as pres., and Robert L. Storey as secy. Harold Cunningham was elected vice pres., and O. S. Dawson, treas.

Danville

Chairman Cummings received at least one of his Christmas presents ahead of time. At the regular meeting on Dec. 9 he was presented with a gavel made from an old radio set. Messrs. Goth and Welch handled the presentation ceremony—as well as they handled a discussion on resonance and alignment earlier in the evening.

There is considerable controversy here over the advent of television and Robert Keeling, appointed as a committee of one to investigate, reported at the Dec. 30 meeting. His conclusion, concurred by those present, was that we should constantly be on the alert for the developments in spite of the fact that it was believed television would not reach our own community for some time.

Our listing of bad credit customers at the beginning of each meeting seems to be meeting with widespread approval.

Detroit

The Detroit (Mich.) Chapter began the new year with an open meeting, Jan. 5, at the Detroit News Conference room. The Pontiac Chapter was invited. A. G. Mohaupt of the Radio Training Assn. discussed "Alignment Procedure under Dynamic Testing."

Freeport

The Dec. 20 meeting was held at the Radio Service Laboratories on S. Galena Ave. We have planned an active and aggressive program for the next 12 months.

The application for membership of La Verl L. Jacobs, Freeport, was read and accepted.

Houston

A proposal that our members begin the systematic study of television receivers at future meetings in order that we may lead the parade, instead of following it, is being given serious consideration. At a recent meeting it was generally agreed that television would be here before we realized it. Once it took hold of the public's fancy, it would spread like radio did in the early days of broadcasting. Television data from SERVICE and other trade papers was presented by T. F. Stephenson and Secretary Stone.

To faciltate study it was suggested that a projector to project diagrams, etc., on a screen either be purchased or built. The matter is in the hands of a committee consisting of Messrs. Fagan, Stephenson and Stone.

Jamestown

Johnstown Chapter reports that the full 1938 membership has already paid up for 1939. We have some new members to put through this year and predict a greater organization before 1940.

Johnstown

The Tri-County Chapter is holding meetings regularly. Two new members were recently added. We are glad to hear from the secretary of the Lehigh Valley Servicemen's Assn. that they have applied for an RSA charter.

Chapter Pres. Galasso and Kenneth A. Vaughan, director of district No. 16, plan several visits to investigate the prospects for new chapters.

Lansing Chapter

The 1939 Board of Directors of the Lansing (Mich.) Chapter of RSA was elected on Dec. 13. Ed Bloom, L. W. Aubil, J. H. Howe and Max Huntoon were elected for the two-year term. E. J. Budd, C. Kachelski, H. Carlisle and R. Bell will serve for one year.

The new by-laws of the chapter were read at this meeting, and were found satisfactory with one minor exception. A section of Article 5 was changed to read: "No amendment shall be put to a vote until at least ten days' notice has been given each member."

Newark

Radio Servicemen of New Jersey have just completed the job of ridding the community of several uudesirable trade practices which were endangering legitimate business and undermining public confidence.

Assistance was obtained from the Postal Authorities, the Racket Squad of the Newark Police Department and a newspaper publisher. The case concerned a firm advertising "Any Radio Repaired for Only 75 Cents, ONE YEAR GUARANTEE." Newspaper ads, handbills placed in mailboxes and billboards were used by this advertiser.

The first step in the campaign to remedy the situation was a strong letter of protest to the newspaper publisher. The result of that move was a satisfactory change in copy.

We then complained to the Postal Authorities, since handbills of postcard size were placed in mailboxes contrary to regulations. Then our organization, through Chairman Carl Rauber, lodged a complaint with the Police Department's Racket Squad, charging fraud, misleading advertising and dishonesty. As a result the matter will be presented to the Essex County grand jury.

Another move to clean up a situation was instituted when a certain dealer began advertising "Free Radio Service." Again a letter to the newspaper brought favorable results.

These two examples of employing already existing mechanics of procedure have given the Radio Servicemen of New Jersey a new sense of responsibility and a new fighting spirit. Morale has been raised and we feel that a way has been found to police other such situations should they arise.

New York

Over nine hundred Service Men were guests of the Metropolitan New York Chapter, Dec. 12, at the Capitol Hotel, when John F. Rider explained and demonstrated the Rider Chanalyst.

With television advertised to make its appearance at the opening of the World's Fair, a number of forward-looking Service Men are preparing themselves. These men are members of a special RSA class which is engaged in an intensive study of television apparatus, of three months' duration at RCA Institutes.

During December a number of members pooled their expenditures and put over a nice advertising campaign, over the RSA name, in one of the New York City evening newspapers.

St. Paul

Charles W. Fox has been elected to the presidency of the St. Paul Chapter. Also elected at the same time were Paul Davis, vice pres., and Noel J. Granger, secy.-treas. Directors are to be elected at one of the January meetings.

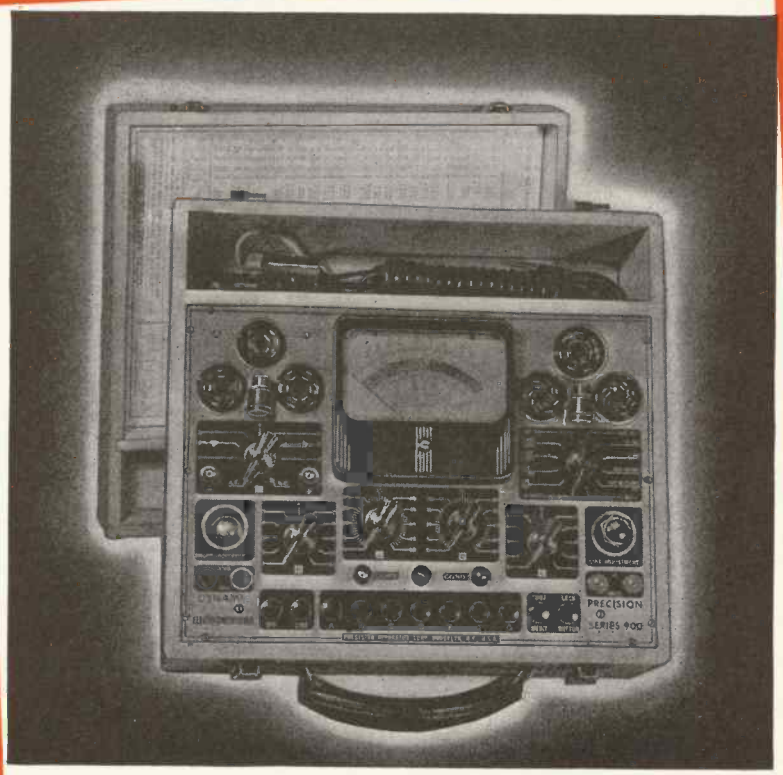
As the result of a decision reached on Dec. 8, the first open forum was started Dec. 22. Questions offered for discussion were handled without the identity of the questioner being known.

At the conclusion of the Christmas meeting, members exchanged gifts and enjoyed a supper provided by Pres. Fox.

(*Continued on page* 49)

"PRECISION" features THE LATEST in quality TEST EQUIPMENT...

Tested and proved engineering refinements, mechanical skill, superior materials, craftsmanship and painstaking care are combined in the construction of every "PRECISION" test instrument . . . each tester being INDIVIDUALLY calibrated and checked against laboratory standards to maintain CLOSE ACCURACY. Each one of the 12 PRECISION models will give you stellar performance at surprisingly low prices.



SERIES 900

DYNAMIC ELECTRONOMETER

A MODERN "push-button" operated dynamic mutual conductance tube tester . . . combined with a 25 multi-range A.C. and D.C. volt-ohm-decibel-milliammeter . . . plus a ten ampere range for complete point to point set analysis . . . includes ballast test facilities. . . . Ability to accommodate FUTURE tube releases . . . telephone cabling . . . wire wound shunts and matched metallized multipliers of 1% accuracy. . . .

REMEMBER

All "PRECISION" Tube Analyzers are equipped for the NEW LOCTAL TUBES

SEE this "900", as well as any of the 12 "PRECISION" models at your local jobber. . . . Ask him to open a "job" and note the "PRECISION" construction. . . . It is your insurance of "freedom from troubles.". . . If there is no jobber near you, write for catalog No. S-39.

★ SERIES 800

Push Button Tube Analyzer, combined with Ballast Test facilities.

★ SERIES 510

A Modern Tube Analyzer with Ballast Test facilities, same as the Series 800, but employing toggle switches in place of push buttons.

★ SERIES 815

Tube Seller with Ballast Test Facilities, Push Button operated, featuring large 9-inch meter.

EXPORT DIVISION
458 BROADWAY - NEW YORK, N. Y. U. S. A.- CABLE ADDRESS: MORHANEX

PRECISION APPARATUS CO.

821 EAST NEW YORK AVENUE BROOKLYN, NEW YORK

MAIL-ORDER CATALOGS

Charles F. McNulty, Clearfield, Pa., writes "Of late SERVICE has carried many articles on how to get the most profit. Thanks for these articles, they are very helpful. I believe, however, there is one thing that has caused the Service Man to lose much of his profit and prestige which these articles so far have not discussed. This is commonly called mail order parts catalog business.

There are, no doubt, dozens of so called wholesale houses that send out their catalogs to anyone from a WPA man to the banker. Do they read them? *You bet.* Do they use them on the Service Man? *They do.*

So far most articles have placed the failure of Service Men entirely on the Service Man himself; but I place a reasonable percentage of it on quack jobbers; who try to cheat the Service Man out of a fair profit on his parts by sending out catalogs promiscuously.

When a Service Man charges a customer full list price for parts, the customer with catalog knowledge immediately classes him as a highway robber. Boy, does that get the Service Man's goat. Often, to save the few remaining hairs on his head and to uphold his moral character in his community, he weakens and the parts go at a discount.

We as Service Men can not stop these companies, but we can boycott them. Mr. Service Man give your business to the jobber who does not mail out catalogs to your customers."

ITEMIZE YOUR CHARGES

"I HAVE found that the average customer wants to know the actual makeup of labor charges on repairs," D. L. Parker, El Paso, Texas, states. "They feel a whole lot better when they can study them on an itemized invoice, than if they see a lump charge for the whole job or a lump charge for labor."

To this end he has worked out an invoice which impresses many customers, because it is not only clear in every detail but carries some good will messages as well.

For example, one block of copy at the upper right hand corner of the invoice states, "We pledge: 1. To use the highest quality materials. 2. To be thorough in all our work. 3. To handle your property with care. 4. To be fair in our prices."

"Lots of customers have told me that they like this sort of invoice," says Parker, "and many new customers have come to my shop after some friend showed them the invoice and pointed out how well everything was itemized. This may seem like a small thing to some Service Men, but it isn't. Lump sum charges for labor and parts don't set well with anyone, unless they are explained. So why not have such provision for explanations right on your invoice, so that the customer and you yourself have a record of it?"

Martin Francis

PARKER RADIO SERVICE
1200 Wyoming Street
EL PASO, TEX.
PHONE M4600

Service Order No. _____

WE PLEDGE
1. To use the highest quality materials.
2. To be thorough in all our work.
3. To handle your property with care.
4. To be fair in our prices.

Name _____
Address _____
Phone _____ Date _____
Set _____ Model _____

OS	NOS	G	NG	NCHG	COD	CHG	DAH	SHOP

Complaint _____

OPERATION	FINDINGS	CHARGE
Antenna( ) Ground ( )		
Test Tubes ( ) Batteries ( )		
Rebalance RF( ) Align RF ( )		
Check Circuits ( ) Socket Voltage ( )		
Repair Dial ( ) Volume Control ( )		
Replace Part ( ) (Specify)		
Repair Speaker ( )		
Instruct in operation of set ( )		
Repair Phono-Combination		
TOTAL		

MATERIALS	EACH	AMOUNT
TOTAL		

The above charges and repairs are satisfactory. PROFESSIONAL SERVICE
Signed MATERIALS
Time Promised Service Man TOTAL

MEMBER OF THE TEXAS RADIO SERVICE ASSOCIATION

GOODYEAR 1501

(*Continued from page 25*)

tuner shaft to move freely and so the distance between gears can be varied to give perfect meshing. Retighten screws after adjustment is made.

It is essential that all set screws be tightened securely so as to prevent a variation from original setting. If, in any case, where parts have moved from the original setting, it will be necessary to realign the complete unit.

Setting Up Buttons

(1) By means of the station selector knob, tune in the station having the lowest frequency.

(2) Continue to hold it in its exact position firmly, and with the left hand loosen the push-button to be set up for that station by unscrewing the button about one turn to the left (counter-clockwise).

(3) Continue to hold the station selector knob in its exact position and push the button in all the way.

(4) After the push-button has been depressed all the way, tighten it gently toward the right (clock-wise). Release push-button slowly and when in normal position tighten firmly.

The Push-Button tuning sytem is now correctly set up for your first selected station of lowest frequency and the call letter tab for this station should be at the extreme right of the call letter holder. Follow through with this same procedure, setting up the other five stations in the order of their frequency.

Carefully check each push-button for the accuracy of its setting. If, when tuning in any station with its automatic push-button it does not have equal volume or clarity to that obtained with manual tuning, this may indicate the automatic adjustment for that station was not made accurately. Should there be any inaccuracy in any one of the push-button adjustments, correction can be made by repeating the above procedure for that button only.

Specifications

Tuning: Manual and automatic; dial ratio: 5½ to 1.
Range: 535 to 1580 kc.
I-F peak: 262 kc.
Power supply: 6 volts, d-c.
Power consumption: 7½ amp.
Plate current: 60.0 ma total.
Power output: 4-watts undistorted; 5½ watts max.
Speaker: 6-in.; Field: 6 volt.
Vibrator: Non-synchronous.

CAPEHART RECORD CHANGER

Pickup skids across the record before settling into its playing position: In these models the pickup arm swings towards the center of the record and down at the same time. It is guided by a forked stop which sets the pickup down on the 10 or 12 in record edge. In the case under discussion, the arm would drop away from the forked stop before the side motion was completed. There is a small catch which rests against the stop under the pickup arm. To remedy the defect in the mechanism this catch should be bent up about ¼ in to hold the arm in its correct position until the cycle has completed.

Moe Mandel

ZENITH 9S307, 9S324, 9S344, 9S367, 9S369, 12S245, 12S370, 12S371 (CHAS. 5907, 1206)

Distortion: Distortion which seems very much like blocking avc action in these models can often be traced to an open section in the filter condenser. Replace when necessary.

THE CUSTOMER CHOOSES

I sat in my auto at the curb, in a thriving little intermountain city where many tourists stopped. A stranger came up to me.

"Where is the best radio shop in town?" he asked. "Mine's gone wrong and needs fixing."

"There are two shops," I answered. "On the other side of the street. One a block up, and the other in the middle of the block the other way. You can see them both from here." I knew pretty well which was the better shop, but felt it would not do for me to show partiality in my home town.

"Well," he said, "I'll try the one that has those attractive, freshly-painted signs." He crossed to the shop where I knew the proprietor was alert, and his mechanic "top-hole." I looked at the signs. They were clean and fresh looking. The entire shop front had a well-kept appearance.

I mused about the method this traveler used in picking his radio shop, and wondered whether it might work with other stores. Presently, he reappeared, and when he returned to my side of the street, the man nodded in recognition. I beckoned to him.

"Do you always pick your store by a well-painted sign?" I asked.

"How else could I tell?" he answered, good-humoredly. "You did not tell me the best place, so I had to go by appearances."

"You hit it right that time," I told him, laughing. "The mechanic that man has is a wizard. And they'll treat you right."

"I always hit it right," he said. "I have noticed that clean signs, kept free from cracks and chipping paint, go with good store fronts. And within I find efficient merchants, with up-to-date goods. Shoddy signs usually bespeaks shoddy merchandise inside, and generally shabby treatment."

The man's reasoning seemed sound to me. He passed on, and I got out and walked down the street. I observed the signs. And I concluded that the stranger's reasoning seemed to accord with the facts. Even in the professions.

Seedy doctors' signs bespoke the seedy doctor. A warped, checked lawyer's sign board stood at the office door of a warped and unethical lawyer.

Across the street I saw the oldest real estate office in town. In a good location, but the men in charge had lost their business through lethargy long ago. And the signs. They were hardly readable. Old, worn out, weak tokens of a weak business; as colorless as the worn-out men in the office below.

"Yes, a sign board is a good character analysis of the business it represents," I said, to myself. "I'll drop in at the painter's and have him renew my sign."

L. H. Sweetser.

Photo courtesy Hygrade-Sylvania

The store front of J. E. Lemoine, 10985 Ventura Boulevard, North Hollywood, California. This shop is an excellent example of a prosperous, efficient establishment. Mrs. Lemoine, shown with her husband, is his helper.

ZENITH 15S308, 15S346, 15S372, 15S373 (CHAS. 1502)

Dial won't log: This can usually be traced to a loose pk screw in the gang hub gear. Tighten with a shakeproof lock washer.

3 NEW Meissner ADAPTER KITS!

More NEW Profitable Business for YOU!!

MANY of your present and prospective customers have a real need for at least one of these 4 new Meissner Adapter Kits! So, go after this business—now—before someone else gets it! Priced to give you a **real** profit! See these kits at your Parts Jobber today. Or write for further information to Dept. S-1 at the factory.

NOISE SILENCER

A real noise silencer designed to reduce static, man-made interference, and improve short wave reception. Based on the famous Lamb circuit. Operates with any superheterodyne receiver without regard to the number of I.F. stages; an additional stage of I.F. within the Silencer, making a four-tube unit, compensates for losses.

A complete kit—self-powered—takes but a few milliamperes from the receiver. Requires only a few minutes to assemble and wire. For receivers having an intermediate frequency of 450 to 470 KC. Equipped with a six-point adapter for plugging into receiver. Operates on 110 volts, AC or DC.

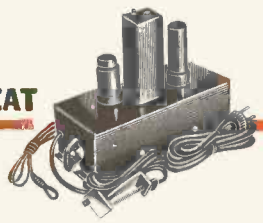
Dealer's Net Price — $6.90

PHONOGRAPH OSCILLATOR

A complete self-contained unit. Connects a phonograph pick-up without affecting performance of radio. Acts as a miniature broadcast station. Just tune radio to its frequency same as you would a broadcast program.

Has its own power supply. Hook-up consists of making two connections—one to antenna post, the other to ground post of receiver. As it can be turned off and on by a switch, you may listen as you wish—to famous recordings—or regular broadcast programs. Operates on 110 volts AC or DC.

Dealer's Net Price — $6.90



BEAT FREQUENCY OSCILLATOR

With this unit even the inexperienced DX hunter now can locate quickly the desired station by the turn of a switch. Self-powered—completely self-contained—operates on 110 volts AC or DC. One connection to the radio and one to your AC outlet is all that is necessary. May be used with any set having 456 to 465 KC I.F. Battery-operated unit also available. **110 Volt Unit** **Dealer's Net Price — $6.90**

Battery-operated Unit — Dealer's Net Price — $3.60

Complete Receiver Kits
I. F. Transformers
Service Parts
Dials • Switches
Tuning Units

Meissner

MT. CARMEL, ILLINOIS

"A FAMOUS NAME FOR TWO DECADES"

VACUUM-TUBE VOLTMETERS

(*Continued from page 17*)

It is customery to calibrate v-t voltmeters at 60 cycles. While this is satisfactory if the instrument is to be used on a-f or i-f, it should be calibrated at a frequency of 1,000 kc or more if much work is to be done at the ultra high frequencies.

Circuit Loading

When it is essential to know whether or not the vacuum tube voltmeter is loading the circuit being tested, a thermocouple type meter may be placed in the electronic voltmeter's input circuit as shown in Fig. 9. The reading on the thermocouple type meter will indicate the extent of loading of the circuit under test.

Calibration

The calibration of a vtvm is very easily accomplished. A typical circuit for performing this is illustrated in Fig. 10. If the range of the instrument is greater than 110 volts, the power supply voltage can be stepped up by means of a transformer.

The a-c voltmeter used in making the calibration should be the best one available as the precision of calibration will be no better than that of the a-c meter.

REFERENCES

"Fundamental Electronics and Vacuum Tubes", by A. L. Albert.

"Radio-Frequency Electrical Measurements", by H. A. Brown.

"Engineering Electronics", by D. G. Fink.

"Radio Laboratory Handbook", by M. G. Scroggie.

Sylvania News, Vol. 7, Nos. 5, 6, 7, 8, 9, 10, 11.

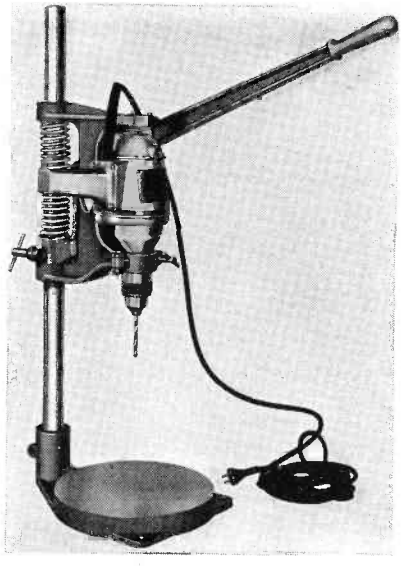
Aerovox Research Worker, Vol. 10, No. 8.

Wireless World, April 21, 1938.

SIGNAL DRILL

The Signal OB-5½-in. drill with the DS-5 bench drill stand can be converted into a stationary drill press. The stand is 32⅜-in. high with an 11-in. base and a 1½-in column.

Additional information can be obtained from *Signal Electric Mfg. Co.*, Menominee, Mich. Service.



THORDARSON 15-WATT AMPLIFIER

(*Continued from page 26*)

beam power tubes they sometimes oscillate at a high inaudible frequency if placement of leads is not correct or shielding and grounds are insufficient. Oscillation can also be caused by improper phasing of the inverse feedback circuit. Reversal of the leads connecting the feedback winding of the output transformer to the grid returns of the

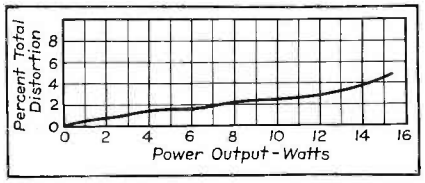


Fig. 3. Distortion is under 5 percent for full output of the amplifier.

input transformer will change the phase relationship of the feedback voltage.

The use of an oscilloscope is recommended in determining when these conditions take place and in correcting them.

SPECIFICATIONS

Finish: Oven-baked black crinkle.
Dimensions: 17 in long by 10 in deep by 9 in high.
Controls: Microphone input control, phonograph input control, tone control and line switch.
Microphone input gain: 113 db (100,000-ohm input).
Microphone input impedance: 5 meg.
Phonograph input gain: 72 db (100,000-ohm input).
Phonograph input impedance: 1 meg.
Power supply: 115 volts, 60 cycles.
Power consumption: 112 watts.
Frequency characteristic: 1 db, 40 to 15,000 cycles, with bass boost of 3.5 db below 100 cycles.
Tone control: Maximum position attenuates 10,000 cycles 28 db.
Power output: 15 watts.
Output level: + 34 db.
Distortion: Less than 5 percent.
Hum: 74 db below maximum output level.
Output impedances: 2, 3, 4, 6, 8, 16, 125, 250, 500 ohms.
Speakers: Two 10- or 12-in speakers recommended.
Field: 10-watts of field power available for one 5000-ohm field or for one or two 2500-ohm fields.
Pilot light: Mazda No. 40.
Tubes:
Mixer voltage amplifier: 6J7 (2).
Driver: 6C5.
Output: 6V6G (2).
Rectifier: 5Z3.

Jerome H. Kleker
THORDARSON ELECTRIC MFG CO.

IN TEST EQUIPMENT Successful Service Men

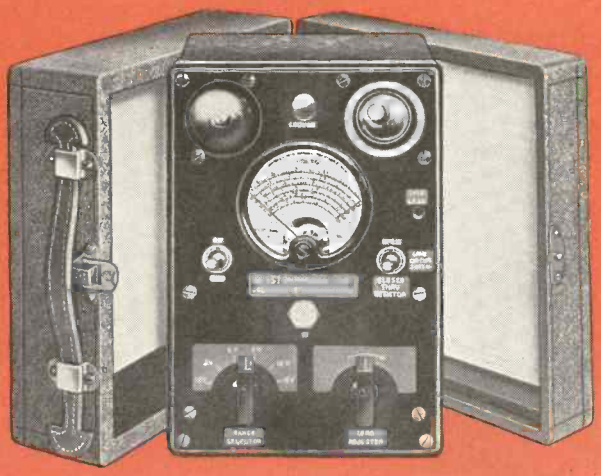
Stick to fundamentals

WESTON Model 772 Super-Sensitive Analyzer (sensitivity 20,000 ohms-per-volt). Big, dependable 50 microampere WESTON meter. Broad ranges meet every test requirement for receivers, transmitters, auto testing, television, sensitive relay circuits, etc.

Successful servicemen stick to test equipment which measures in fundamental quantities. The reasons are obvious:

Fundamental test equipment *never* grows obsolete . . . eliminates those frequent, costly equipment replacements due to circuit changes. The pointer on a good instrument tells, *exactly*, the true condition in the circuit under test . . . leaving nothing to chance or guesswork. In addition, *it's simple for any serviceman to check a fundamental instrument for accuracy.*

Remember, when buying your next equipment, that all WESTON test units measure in radio fundamentals. That's why WESTON radio instruments remain serviceable for years . . . *never discarded, never idle,* because of changes in receiver circuits. Remember, too, that WESTON instruments are used by practically all leading manufacturers because of their greater dependability . . . greater economy. This name also is *your* best assurance of dependability and satisfaction in radio test instruments. The coupon will bring you complete data.



WESTON Model 669 Vacuum Tube Voltmeter. Direct reading, measures gain per stage—r.f. amplitude in oscillator circuit of superhets—all test on AVC circuits, PA systems, and all measurements where high frequency is a factor.

WESTON *Radio Instruments*

WESTON ELECTRICAL INSTRUMENT CORPORATION
581 Frelinghuysen Avenue, Newark, N. J.

Send full information on WESTON fundamental test instruments and WESTON tube checkers.

Name.....

Address.....

City..... State.....

WESTON 773 "quick-test" Tube Seller

Like WESTON fundamental instruments, this attractive counter tube checker has been designed for speed, simplicity and dependability. Minimum number of proved switches assures long, trouble-free operation. Rotator tube chart simplifies test procedure. Makes all tests on all tubes. Impressive looking, in polished wood case. Also available in portable carrying case.

Highlights

JOHNSON JOINS DAYTON-ACME

David E. Johnson, founder and former head of Dayrad has joined Dayton-Acme in the capacity of vice president and general sales manager.

The Dayton Acme Co., Dittman Bldg., Cincinnati, Ohio, manufacture a complete line of test equipment for the Service Man. They are prepared to service and modernize Dayrad test equipment and invite readers of SERVICE to make full use of these facilities. SERVICE.

CLAROSTAT SILENT SALESMAN

A yellow and black counter or wall card holding and displaying an assortment of wire-wound power resistors has been released by Clarostat.

The display card is offered at no extra cost by Clarostat Mfg. Co., Inc., 285 N. 6 St., Brooklyn, N. Y., to the jobbers ordering the assortment. SERVICE.

PRESTO MOVES

Presto Recording Corp. will move their offices and equipment manufacturing plant to 242 W. 55 St., New York City. The move was necessitated by a 48 per cent increase in the company's business during 1938. SERVICE.

WESTON BENCH PLANS

The third issue of the Weston Pointer contains complete plans and specifications for building a service bench identical to the one awarded as first prize in the recent Weston contest.

Copies of the Weston Pointer may be obtained by writing to Weston Electrical Instrument Corp., Newark, N. J. SERVICE.

RECOTON DISPLAY

Recoton Corp., 178 Prince St., New York City, have released a four-color display to assist their dealers in selling the the Recoton three-purpose liquid record renewer.

The displays may be obtained directly from Recoton. SERVICE.

CORNELL-DUBILIER CATALOG

The Cornell-Dubilier catalog No. 165A, containing information on the popular items in the C-D line, has been released recently. The 12-page capacitor catalog may be obtained directly from the Cornell-Dubilier Electric Corp., South Plainfield, N. J. SERVICE.

STANCOR REPRESENTATIVES

Gerard Cole at Chicago and William E. McFadden, 256 E. Gates St., Columbus, Ohio, have been appointed direct sales representatives of the Standard Transformer Corp., 1500 N. Halsted St., Chicago. SERVICE.

TUNG-SOL OUTDOOR SIGN

An attractive outdoor metal sign has been announced by Tung-Sol Radio Tube Division, Newark, N. J. The sign is 20 by 15 in., painted in five colors. Copy features radio repairs.

Write to Tungsol Radio Tube Division, Newark, N. J., for details. SERVICE.

RADOLEK PROFIT GUIDE

The latest edition of the Radolek profit guide is available to readers of SERVICE. Copies may be obtained from Radolek Co., 601 W. Randolph St., Chicago. SERVICE.

AEROVOX MOVES TO MASSACHUSETTS

Aerovox Corp., manufacturers of condensers for every application, announce the removal of their plant and general offices to New Bedford, Mass. SERVICE.

ARCTURUS TUBE CHART

In addition to giving complete data on 179 Arcturus tube types together with pin connections, etc., the Arcturus tube characteristics chart contains a complete listing of ballast tube data.

The chart has been prepared for either wall mounting or for standard data files. Copies may be obtained directly from Arcturus Radio Tube Co., Newark, N. J. SERVICE.

EBY MOVES

Hugh H. Eby, Inc., have moved to their own building at 4700 Stenton Ave., Philadelphia, Pa. SERVICE.

HOYT METER CATALOG

A catalog describing the entire line of Hoyt meters can be obtained from Burton-Rogers Co., 857 Boylston St., Boston, Mass. SERVICE.

ATR VIBRATOR GUIDE

A vibrator guide covering the complete ATR line of auto and farm radio replacement vibrators can be obtained from American Television & Radio Co., 300 E. 4 St., St. Paul, Minn. SERVICE.

DUMONT TELEVISION CATALOG

A table and a console model television receiver, providing an 8- by 10-in. picture and the synchronized sound, are illustrated in a 2-color catalog issued by Allen B. DuMont Labs., Inc., 2 Main Ave., Passaic, N. J. SERVICE.

TRANSDUCER BULLETIN

Transducer Corporation, 30 Rockefeller Plaza, New York City, have recently issued an interesting bulletin on their Co-X coaxial cable. Description and characteristics are given. In order to secure a copy of this bulletin write to the above organization.

WEBSTER APPOINTMENT

The Webster Company, Chicago, announces an important addition to its executive staff. Donald MacGregor became general manager and treasurer beginning with the New Year. He has resigned as executive vice president and general manager of a cabinet manufacturing plant in eastern Pennsylvania to return to Chicago.

JENSEN EXPORT MANAGER SAILS

G. J. Corrigan, Jensen Radio export manager, together with Mrs. Corrigan, sailed from New York, December 17th, on the S. S. "Santa Lucia" for an extended visit to Jensen customers throughout South America. His first call will be in Lima, Peru, and thereafter other principal West Coast cities will be visited before he crosses the Andes to Buenos Aires, Rio de Janeiro and other principal East Coast centers.

KENYON CATALOG

A revised edition of the Kenyon replacement transformer catalog, R-3, is now ready for distribution. This new edition contains several new items for universal replacement use. A copy of this new catalog can be obtained through any Kenyon jobber or directly by addressing Kenyon Transformer Co., Inc., 840 Barry St., New York, N. Y.

HOME STUDY

In 1891, upon his nomination to the presidency of The University of Chicago, Dr. William Rainey Harper introduced correspondence study to the academic world. And recently a home study program of integrated courses of instruction in engineering made its appearance in the field of commercial education.

This occurred with the introduction of a course of home study. The plan of formal academic instruction is said to be founded upon the accepted principle that a successful engineering career must be based upon a sound educational foundation which will be sufficiently flexible to permit the individual to adapt himself to new technological developments as they arise.

The career of the professional engineer is based upon exacting educational requirements. Quoting The Engineering Foundation, "The engineer of today and tomorrow is not the mechanic, the man who himself builds things, but rather the man who directs the work of others, who makes plans for others to carry out."

Home study on the college level comprises accredited courses in the professional fields of civil, electrical, radio, and mechanical engineering. They are designed specifically for students qualified to pursue college studies and wish to earn credits for transfer to engineering colleges; as well as for those who, while not interested in the Bachelor of Science degree, desire equivalent engineering college training.

Graduate engineers who are unable to attend graduate courses in residence are offered equivalent instruction in the higher mathematics and advanced science.

Manufacturers

IRC HIGH-VOLTAGE RESISTORS

IRC resistors for high-voltage protective and measuring devices have been developed through employing metallized type element in a spiral formation on a ceramic base. These units are available in numerous power and voltage ratings.

Additional information can be obtained from *International Resistance Co.,* 401 N. Broad St., Philadelphia, Pa. SERVICE.

MECK TUBEMASTER

The pattern 20-A tubemaster has been added to the John Meck Instrument Line. The unit is said to test tubes for mutual conductance, power output and emission quality on a good-bad scale. It is equipped for testing 35-volt and loktal tubes.

Additional information may be obtained from *John Meck Instruments,* 164 N. May St., Chicago. SERVICE.

A-B ELIMINATOR

An A-B battery eliminator that operates on any 6-volt storage battery, wind charger or other 6-volt power source is announced by *Electro Products Labs.,* 549 W. Randolph St., Chicago.

Additional information may be obtained directly from the manufacturer. SERVICE.

AMPERITE KONTAK MIKE

The Amperite Kontak mike is designed for attachment to string instruments to enable them to be played, electronically, through a radio receiver or an amplifier.

Additional information may be obtained from *Amperite Co.,* 561 Bway., New York City. SERVICE.

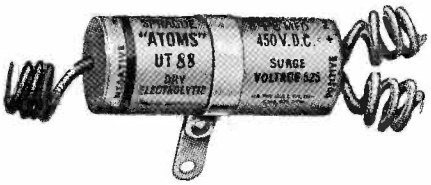
MONARCH GAIN INDICATOR

The Monarch Model 44 Gain Indicator is designed to simplify the measurement of power amplifiers. The gain of the amplifier under test can be read directly in db.

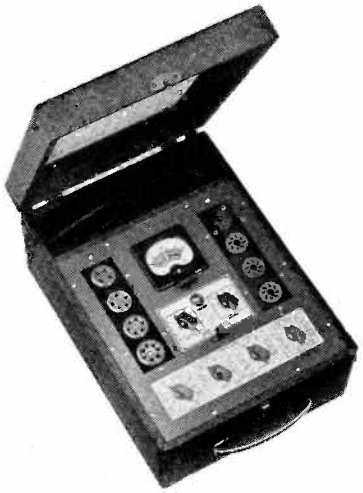
The unit consists of a constant impedance attenuator network in single units and in units of ten. The meter is shunted across the gain indicator attenuator input and a switch on the panel allows it to be connected to the amplifier output.

Additional information can be obtained from *Monarch Manufacturing Co.,* 3341 Belmont Ave., Chicago. SERVICE.

Monarch gain indicator.

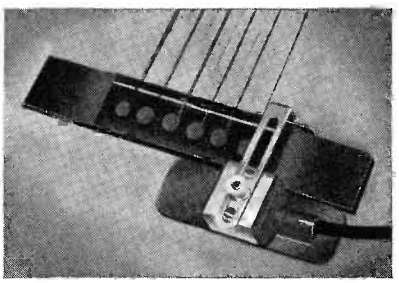


Sprague dual Atom.



Meck tubemaster.

A-B eliminator.



Amperite Kontak mike.

Micamold ballastons.

SPRAGUE DUAL ATOMS

Sprague Atom midget tubular dry electrolytic condensers are offered in a full line of dual combinations as well as the original single units previously obtainable.

Additional information may be obtained from *Sprague Products Co.,* North Adams, Mass. SERVICE.

CONSOLIDATED WIRE RESISTORS

Consolidated Wire have announced a line of moulded, moisture-proof, non-inductive carbon resistors in all ranges with tolerances guaranteed to within plus or minus 10%.

Additional information can be obtained from *Consolidated Wire & Associated Corp.,* 518 S. Peoria St., Chicago. SERVICE.

MICAMOLD BALLASTRONS

The Micamold types X, Y and Z ballastrons have a simple means incorporated on the base to adjust them to replace the larger percentage of plug-in resistors now on the market.

The X and Y ballastrons replace standard and special octal base plug-in resistors while the Z ballastron replaces the four-prong types.

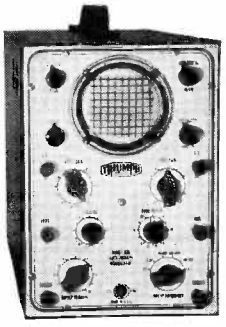
Additional information can be obtained from *Micamold Radio Corp.,* 1087 Flushing Ave., Brooklyn, N. Y. SERVICE.

OSCILLOGRAPH WOBBULATOR

A 3" cathode-ray oscillograph with a built-in frequency modulated, 1000-kc oscillator is announced by Triumph. It is called the Model 830 oscillograph wobbulator. The new instrument performs all the regular functions of an oscillograph plus alignment of tuned radio circuits by the resonance curve method and overall analysis of audio-frequency amplifiers. In this latter function a signal is generated which changes in frequency from 0 to 10,000 cycles, 60 times a second; the resulting pattern on the oscillograph shows the amplitude characteristic of the audio amplifier under test. Audio-frequency response of amplifiers or audio coupling units may be tested over any band of frequencies between 0 to 25,000 cycles.

Triumph Manufacturing Co., 4017 W. Lake Street, Chicago, Ill. SERVICE.

Triumph oscillograph-wobbulator



Book Reviews

THE RADIO HANDBOOK, fifth edition, by the editors of "Radio," published by Radio, Ltd., 7460 Beverly Blvd., Los Angeles, Calif., 1938, 592 *pages, paper covers, price* $1.50 *in continental U. S. A., elsewhere* $1.65.

The new revised edition of this useful handbook contains a number of short wave and u-h-f circuits of receivers and transmitters which should prove of interest.

The chapter devoted to receiving tube characteristics is a reprint of the "Characteristics Chart and Socket Connections" which was issued by RCA recently. Data on the latest tube types, therefore, will not be found here.

The authors are to be highly praised for their practice of marking with an asterisk those tube types which they particularly recommend to amateurs designing new equipment. To anyone considering building a transmitter these recommendations will undoubtedly be valuable. The usefulness of these data is somewhat decreased, however, because of the non-alphabetical, non-numerical arrangement.

Also useful in designing a transmitter are the block diagrams showing the comparative outputs of various cw, radiotelephone, and combined cw and radiotelephone transmitters.

The audio amplifier block diagrams should prove advantageous not only for transmitter construction but also in designing public address systems. The section on decibels is the best elementary treatment that the reviewer has seen.

D. B.

HOW TO BUILD RADIO RECEIVERS, published by Meissner Manufacturing Co., Mt. Carmel, Illinois. 1938, 120 *pages, paper covers, price* 50 *cents.*

The complete line of 1939 Meissner receiver kits are described in this book. Detailed schematic and pictorial diagrams are given, the former to enable the Service Man to determine the electrical features of the circuits, and the latter to show the recommended disposition of the component parts.

Kits are described which employ from one to 14 tubes, and cover such diverse receivers as those for the broadcast band only, combination broadcast and short wave, up to the elaborate communications receiver. In all, 20 different receivers are discussed. In addition to the foregoing, the constructional details of 8 other kits are given, including such items as a phonograph-oscillator adapter unit, a noise-silencer adapter unit, a beat-frequency oscillator adapter unit, and a push-button converter.

The first seventeen pages of HOW TO BUILD RADIO RECEIVERS is devoted to a brief but excellent discussion of the theory and practice of radio receiver construction. It is felt that every Service Man could read these with profit. D. B.

OPERATING INSTRUCTIONS FOR THE RIDER CHANALYST, published by Service Instruments, Inc., 404 *Fourth Avenue, New York City,* 1938, 71 *pages, paper covers, price* $1.00.

So many and diverse are the tests which the Rider Chanalyst can make upon radio receivers that it requires a seventy-one page book to describe them all.

Separate chapters are devoted to the operating instructions for each of the 5 channels of the Chanalyst. In addition there is a special chapter on alignment and another on intermittent receivers.

Judging from OPERATING INSTRUCTIONS FOR THE RIDER CHANLYST it would appear that this instrument is a miniature laboratory

D. B.

TELEVISION, Volume 2, published by RCA Institutes Technical Press, 75 Varick Street, New York City, 1937, 435 *pages, paper covers, given free as a complementary book dividend with a subscription to the RCA Review at* $1.50 *a year.*

Like its predecessor, Volume 2 is composed of a series of 29 essays on various phases of television. It is similar, also, with regard to the amount of knowledge assumed to be possessed by the reader, the articles ranging from those which could be read by a lay reader to those which require a command of vector analysis. Fortunately for the Service Man, the majority of the essays are either completely non-mathematical in character or else require the employment of mathematics of the most elementary type.

Several of the essays are particularly recommended for the Service Man's perusal. "RCA Developments in Television" by R. R. Beal gives a brief description of the Iconoscope and Kinescope and also discusses scanning and frequency band width. "Television Problems — A Description for Laymen" by A. Van Dyck presents what is probably the clearest description ever written of the broad aspects of television. For the Service Man who wishes more specific details regarding the iconoscope and kinescope the article "Iconoscopes and Kinescopes in Television" by V. K. Zworykin is recommended. "Television Pickup Tubes with Cathode-Ray Beam Scanning" by H. Iams and A. Rose is an unusually interesting article on photoelectric pickup tubes of which the iconoscope is typical.

R. L.

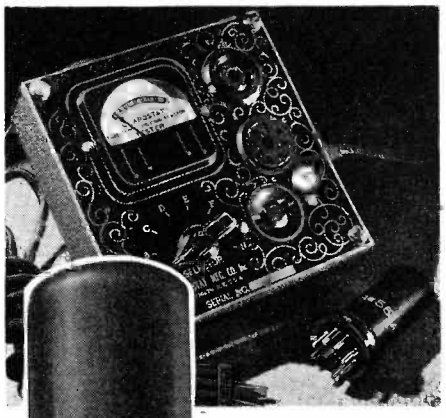
SHORT-WAVE RADIO, by J. H. Reyner, published by Pitman Publishing Corp., New York City, 1938, 159 *pages, price* $2.75.

This book gives a brief survey of the transmission, reception, and characteristics of short waves and what is known about them at the present time. The treatment is non-mathematical in nature, the few equations that do appear not being essential to an understanding of the subject matter.

Figs. 42(a) and 42(b) on page 90 should be interchanged in order to make them correspond with the text.

The Service Man already familiar with short waves will probably find no new material in this book to interest him. On the other hand, to those interested in television, but who have not followed short wave developments, this book may serve as an interesting short-cut to a knowledge of high frequency technique.

It should be noted, however, that if the size of this book is taken into account the price asked for it is too high. R. L.



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ASSOCIATIONS

(*Continued from page 34*)

S. New Hampshire

"New Year's resolutions are in order. First, let it be resolved that 1939 will be the making of a bigger and better RSA. Let's get after those prospective members and get them into the organization. We have started to grow. Let's keep the ball rolling!"

That's the lead to one of the articles contained in the Christmas number of "The Radioman," monthly publication of the Southern New Hampshire Chapter.

It sincerely reflects our point of view and our determination to move ahead in the new year.

On Dec. 6, George Connors, of Hygrade Sylvania Corp., gave an interesting talk on service problems and the servicing of ten-dollar midgets at a profit.

Steubenville

The Ohio Valley Chapter is off to a flying start. Walter Stephanovich is the new treas., Paul Wright, vice pres., and Leonard Roberts, Jr., secy. Dick Harris is pres. During the present year chapter meetings will be held in the Maccabee's Hall, 151 N. 4 St. Rental arrangements were completed last Nov.

Two new members are Bill Carter and L. V. Williamson. A. C. (Clarky) Clark has been advanced from honorary to regular membership.

P. A. Boyd, National Union Radio Corp., and former station relations manager for Westinghouse, spoke at the Dec. 5 meeting. At the unanimous request of the boys he remained after the close of the session to recount additional experiments which he had conducted at KDKA.

Washington, D. C.

Applications were received at the Hamilton Hotel meeting, late in Nov., from J. E. Abel, Herman Cohn, Ira P. Denning, Alvin P. Hines, W. B. Jones, Herbert A. Lewis, Webster A. Lovell, D. B. McLaughlin, A. L. Nichols, Norman T. Pirkey, Frank Russ, William L. Smith, Harold F. Winterburn, and Russell G. Wright.

Speakers at the Dec. 6 meeting at the Capitol Radio Engineering Institute were W. B. Jones and Gordon C. Howard of Columbia Wholesalers, Washington. They discussed the new wireless remote control radios and the thyraton tube used therein.

W. B. Jones and George W. Cook were appointed to the membership committee; Jesse Channel was named chairman of the public relations committee, and H. Strickland a member of the same committee.

The entertainment committee as now constituted consists of Gordon C. Howard, chairman, and Messrs. Franklin Kral and Herman Cohn.

PARTS SHOW

As the new year began the total contracts for space at the 1939 National Radio Parts Trade Show were already more than 1/3 of the total space occupied in last year's show.

Companies who contracted for booths by Jan. 15 will participate in the annual drawing for space allotment in Chicago, Jan. 25. Such allotments will be made in accordance with preference indicated by each exhibitor.

MANUFACTURERS

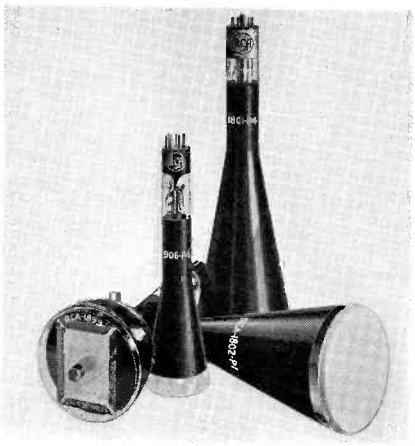
(*Continued from page 44*)

TELEVISION CATHODE-RAY TUBES

RCA is making available 4 new cathode-ray tubes for use by the amateur and experimenter in experimental television equipment. These new types are as follows: RCA-906-P4 Kinescope (electrostatic-deflection type with medium-persistence white phosphor—3" screen); RCA-1802-P1 Kinescope (electrostatic-deflection type with medium-persistence green phosphor—5" screen); RCA-1802-P4 Kinescope (electrostatic-deflection type with medium-persistence white phosphor—5" screen); RCA-1899 Monoscope (electromagnetic-deflection type).

In connection with the first three tubes, the letter P stands for Phosphor (screen material), and the numeral indicates the kind of phosphor.

The 906-P4 is a small Kinescope for the reproduction of television pictures in black



and white. Except for its phosphor, it is identical with the RCA-906.

The 1802-P1 and 1802-P4 are medium-size Kinescopes. They have high deflection sensitivity and are identical except for phosphors. Both types are suitable for television reproduction. The 1802-P1 gives a green reproduction, while the 1802-P4 gives a black-and-white reproduction. Because of its high visual efficiency, the 1802-P1 is also suited for oscillographic work. Both types have the new large-wafer magnal 11-pin base.

The 1899 is a special form of cathode-ray tube identified by the name Monoscope. This tube is designed to produce a video signal of a test picture or pattern built into the tube, and is intended for use primarily in testing the performance of television equipment and for demonstrating television principles.

Additional information on these tubes is available from *RCA Radiotron Division, RCA Manufacturing Co., Inc.*, Harrison, N. J. SERVICE.

BOGEN DEMONSTRATION RACK

The Bogen rack is designed to assist dealers and Service Men in the display of their amplifiers. The rack accommodates 4 amplifiers and is equipped with a phonograph motor mounted on a switching panel. The switching panel also provides for dual microphone input and switching of these to any one of the 4 amplifiers.

Additional information can be obtained from *David Bogen Co.*, 663 Bway, New York City. SERVICE.

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Advertising Index

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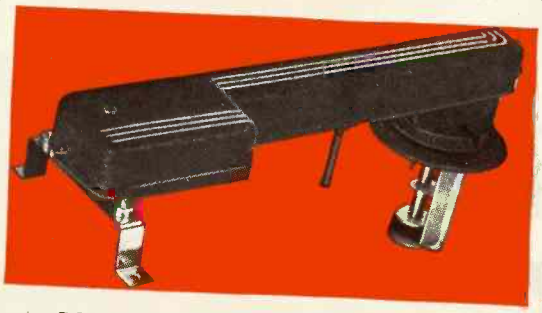
☆ **RCA Junior Crystal Pick-up** . . . has every important feature necessary for fine record reproduction—is exactly the same as that used on RCA Victrola attachments. Plays either 10″ or 12″ records, has completely sealed crystal, offset needle position assures true tracking. Swiveled pick-up arm easily raised to vertical position for needle insertion. Finished in attractive brown wrinkle lacquer. Frequency range 70 to 7000 cycles. Stock No. 9842, List Price **$4.95**

☆ **RCA Senior Pick-up** . . . similar to that used in 1939 RCA Victor combinations and Victrolas. Features top needle loading and automatic needle ejection. Has a built-in shorting switch. Frequency range 70 to 7000 cycles. Attractive brown wrinkle lacquer finish. Stock No. 9847, List Price **$6.95**

Needle box and pick-up rest for No. 9847 Pick-up, Stock No. 9848, List Price 75c



☆ **RCA de Luxe Crystal Pick-up and Arm** . . . furnishes the very finest in record reproduction. Frequency range 45 to 7000 cycles. Has adjustable spring counter-balance and offset crystal to insure minimum record wear. Rubber cushioned to prevent vibration pick-up. Furnished with chromium plated combination arm rest and needle positioning bracket. Brown wrinkle lacquer finish with chromium trim. Stock No. 14818, List Price **$14.95**

☆ **RCA Synchronous Reaction Motor and Turntable** . . . This fine new motor is used on many RCA Victor combination and record players. Has shock-proof mountings and is free from "wows." A soft rubber spindle cap prevents vibration pick-up by records. Plays any size record up to 12″ in diameter. Finished in an attractive brown flock. Stock No. 9841, List Price **$6.50**

☆ **RCA Manual Motor Board Assembly** . . . This is a splendid self-starting unit which features top-loading crystal pick-up, automatic stop, combination needle box and needle ejector and pick-up shorting switch. It is suitable for use with all radio receivers or amplifiers. Has new spindle cap which prevents vibration transfer to the record. In addition, it has shock-proof spring mounting suspension. Attractive brown wrinkle lacquer finish. Stock No. 9850, List Price **$29.95**

☆ **RCA Automatic Record Changer** . . . Plays seven 12″ or eight 10″ records automatically, repeats last record. Plays any size records manually. Has top-loading crystal pick-up with automatic needle ejector and receptacle. Shock-absorbing coupling between motor and turntable avoids transfer of mechanical vibration to motor board. Shock-proof mounting parts furnished. Attractive brown wrinkle lacquer finish with chromium trim. Stock No. 9844, List Price **$74.95**