APRIL 1948 35 CENTS

EVERYTHING IN TELEVISION • RADIO • ELECTRONICS
FOR THE RADIO SERVICE • TECHNICIAN

RADIO MAINTENANCE

NEW FM SIGNAL GENERATOR

DB CALCULATIONS MADE EASY

GET THE MOST FROM YOUR VTVM

AFC IN FM

YEARLY SUBSCRIPTION $3.00

BOLAND & BOYCE INC., PUBLISHERS MONTCLAIR, N. J.

"REACH FOR KEN-RAD--
You'll never find a better tube!"

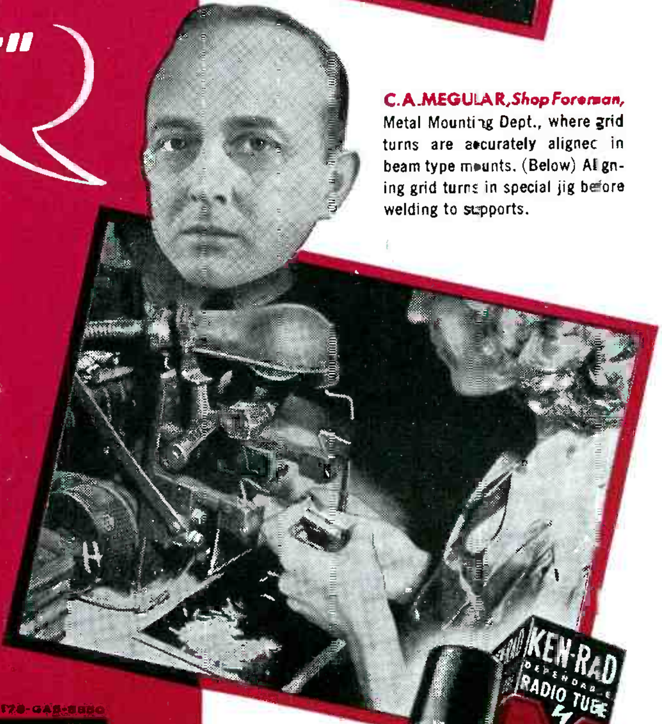
LES SINGER, Singer Radio Service, 6016 Madison Road, Cincinnati, Ohio
Like thousands of outstanding servicemen, Les Singer has been using Ken-Rad tubes ever since he started in business. He judges tubes by experience alone.

Ken-Rad tubes have been built for 26 years on the idea that when you please the serviceman—you please everybody!

By actual tube experience, servicemen know Ken-Rad research and engineering are outstanding. They know Ken-Rad production is painstaking—with test after test to make doubly sure there's no higher standard of performance.

Dependability, above everything else, is why servicemen everywhere say, "Reach for Ken-Rad—you'll never find a better tube."

"We build tubes to build YOUR REPUTATION"



C.A. MEGULAR, *Shop Foreman,* Metal Mounting Dept., where grid turns are accurately aligned in beam type mounts. (Below) Aligning grid turns in special jig before welding to supports.

Practically every radio serviceman knows Ken-Rad tubes. He depends on them.

And there's plenty of reason for this confidence. Ken-Rads are made exclusively to meet the exacting demands of servicemen. They're *quality* tubes, with *stamina* and *endurance.*

This is important. Because it takes more than good service to build repeat business.

It takes good tubes, too. Ken-Rad tubes.

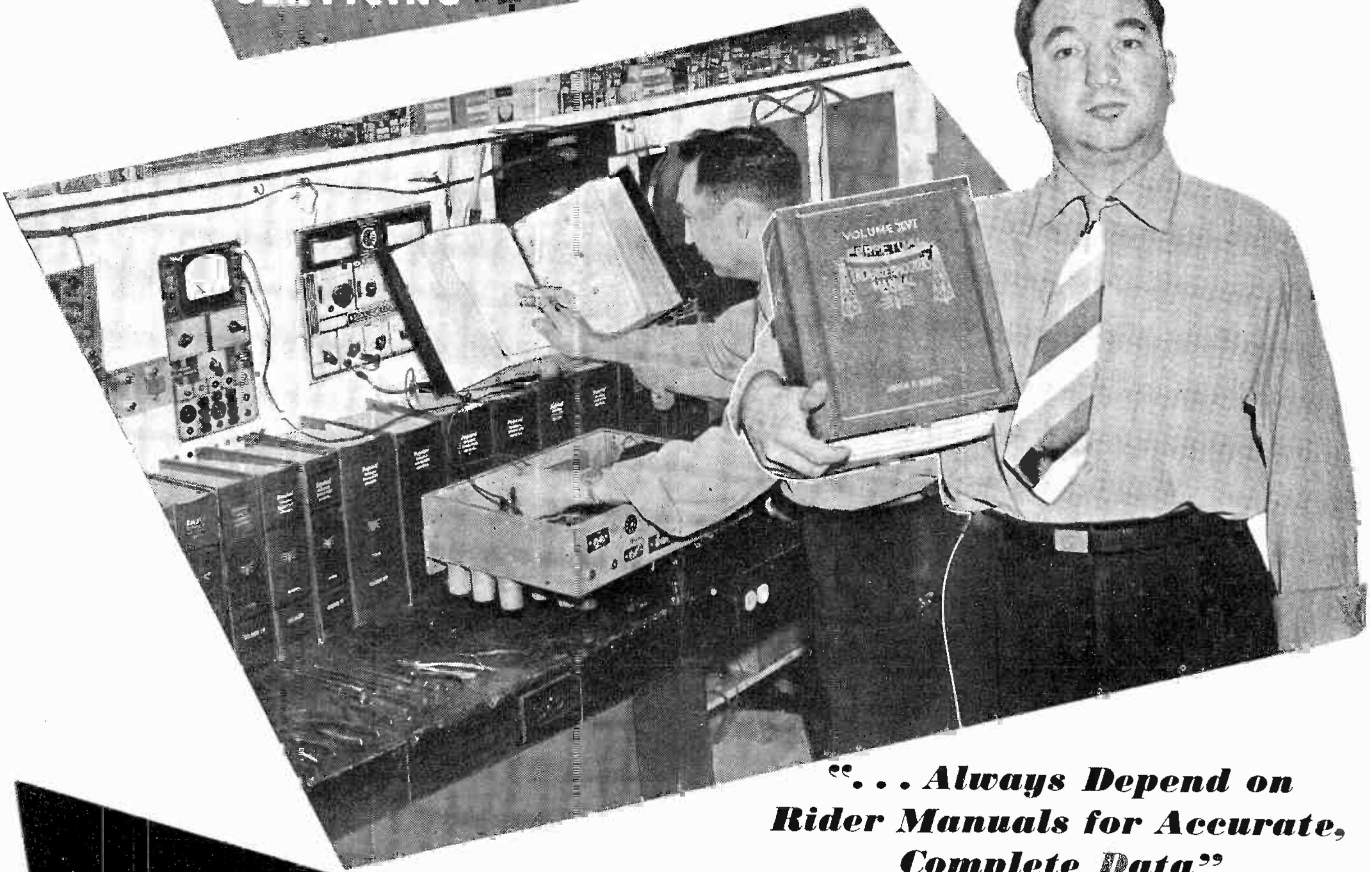
Use them and you can count on customers coming back, satisfied.

KEN-RAD *Radio Tubes*
PRODUCT OF GENERAL ELECTRIC COMPANY
Schenectady 5, New York

The Serviceman's Tube

RIDER MANUALS *Mean* **SUCCESSFUL SERVICING**

BELL HAS ALL 16 (AND VOLUME XVII ON ORDER)



"... Always Depend on Rider Manuals for Accurate, Complete Data"

VOL XVII (Brings your Rider Manuals up-to-the-minute)

JUST OUT!

1600 PAGES—Plus "How It Works" Book

$15.00 (Less than a penny a page)

Your Jobber is taking orders for **DELIVERY NOW!**

"We have always depended on Rider Manuals for accurate, complete radio servicing data. They have never let us down, in fact they have contributed to the profitable operation of our shop," says Sam Spaber of Bell Radio Co., Bell, Calif.

So say successful servicemen everywhere, over whose benches you will find well-used copies of all 16 Rider Manuals. For, during the past seventeen years, money-making shops have depended upon "The World's Greatest Compilation of Radio Servicing Data" for authentic presentations of manufacturers' original servicing data on American-made receivers issued since 1920. This is vital information.

Rider Manuals keep pace with the manufacturers' releases. Volume XVII, just out, contains both FM and AM sets, record changers and wire recorders. The separate "How It Works" book explains theory and complexities of new receivers. Hundreds of Rider-exclusive "Clarified-schematics," time-saving breakdowns of multi-band jobs, are also in Volume XVII.

Nowhere else but in Rider Manuals will you find such coverage!

Watch for Publication Date in Late Spring **RIDER TELEVISION MANUAL**

You NEED ALL 17—ORDER TODAY

VOLUME XVII	$15.00
Volume XVI	8.40
Volume XV	18.00
Volumes XIV to VII (ea. vol.)	15.00
Volume VI	11.00
Abridged Manuals I to V (one vol.)	17.50
Record Changers and Recorders	$ 9.00
Master Index, (covering Manuals, Vols. I to XV)	1.50

NOTE: Individual Volumes VI, VII and VIII will be replaced after this year by a single Abridged Manual Vol. VI to VIII.

JOHN F. RIDER, PUBLISHER, Inc., 404 Fourth Avenue, N. Y. 16

Export Agent: Rocke International Corp., 13 E. 40th St., N.Y.C. Cable ARLAB

Give Your Shop the Sign of Successful Servicing **RIDER MANUALS**

ELECTRONICALLY SPEAKING

Hytron Radio & Electronics Corp. has planned a radio serviceman's contest which will start in May and run for six months. Each month first, second, and third prizes will be awarded to the winning contestants. These monthly winners will then be eligible for an additional grand prize. The nature of the contest will be disclosed soon in advertising and publicity in RADIO MAINTENANCE. A Board of Judges has been selected. This board is composed of the editors of six radio magazines and includes Joseph Roche, editor of RADIO MAINTENANCE.

The General Electric Co. has announced that list price reductions have been made on home radios and receivers. These reductions range up to 30 per cent. This new schedule of prices is a part of the General Electric program of overall price reduction. In one of the television sets, the reduction amounts to $150.

The Town Meeting of Radio Technicians held in Philadelphia in January was so successful that plans seem to be already taking shape for future meetings of the same sort. These meetings now being planned by the RMA will make full use of the experience obtained in Philadelphia. New and different experiments for the benefit of radio servicemen as well as already proven types of meetings will be used.

Mr. Harry A. Ehle, of Philadelphia, Chairman of the Town Meeting says "The meeting clearly demonstrated that every branch and phase of the industry can cooperate on a non-commercial basis on the behalf of the radio technician." There were approximately 1200 radio men at the meeting of whom 47 per cent attended all sessions. A questionnaire given to the attending servicemen indicated that 97 per cent felt that they got enough out of the meeting to justify their efforts in attending and 98 per cent would like a meeting of that kind in Philadelphia each year.

RADIO MAINTENANCE

INCLUDING
ELECTRONIC MAINTENANCE

Volume 4 APRIL 1948 Number 4

CONTENTS

Radio Maintenance is published monthly by Boland & Boyce, Inc., at 34 No. Crystal St., East Stroudsburg, Pa., U.S.A.; Executive and Editorial Office, 460 Bloomfield Ave., Montclair, N. J. Subscription Rates: In U. S., Mexico, South and Central America, and U. S. possessions, $3.00 for 1 year, $5.00 for two years, single copies 35 cents; in Canada, $3.50 for 1 year, $6.00 for 2 years, single copies 40 cents; in British Empire, $4.00 for 1 year, $7.00 for 2 years, single copies 50 cents; all other foreign countries, $5.00 for 1 year.

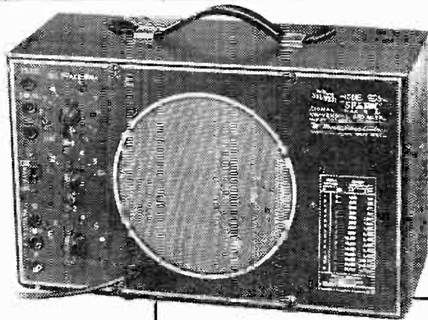
Entered as Second Class matter July 13, 1946, at Post Office, East Stroudsburg, Pa., under the Act of March 3, 1879.

Change of address: Four weeks' notice required for change of address. When ordering a change, please furnish an address stencil impression from a recent issue if you can. Address changes cannot be made without the old stencil as well as the new one.

McMurdo SILVER

ADDS 3 NEW LCETI

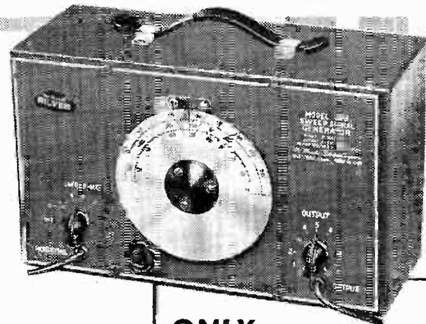
1 NEW MODEL 905A "SPARX" SIGNAL TRACER AND UNIVERSAL TEST SPEAKER



The *new* "SPARX" is here — the **super**-sensitive r.f., i.f. a.f. signal tracer, phono pick-up, microphone and speaker tester. Like all SILVER LCETI, it goes far beyond the ordinary. Built-in is a 6" PM speaker and 8 watt *truly universal* output transformer with two panel switches give impedances of 325 thru 70,000 Ω single or push-pull. In the *new* 905A "SPARX" you get the world's finest signal tracer, the world's most universal test speaker, separately usable universal output transformer — *three instruments for the price of one.*

ONLY $44.50 NET

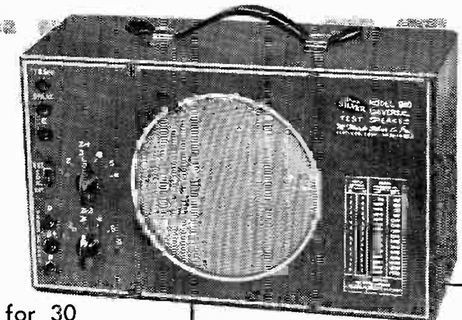
2 NEW FM & TV SWEEP SIGNAL GENERATOR



FM and TV are here — must be serviced by every technician today. Model 909 and any good 'scope does the TV and FM alignment job — visually — easily — simply — perfectly — and fast. Three bands 2 thru 266 mc., linear electronic sweep panel variable from 40 kc. to 10 mc. It's no wonder Model 909 — first announced in late January — is the "hottest" instrument in radio. Model 909 is another "must" for every service laboratory — new Silver inventions make it newest and by far the best. With complete instructions.

ONLY $48.50 NET

3 NEW MODEL 910 UNIVERSAL TEST SPEAKER



Six-inch high-quality PM speaker and 8 watt *truly universal* output transformer of the new "SPARX" give you any transformer impedance, single or push-pull, from 325 thru 70,000 Ω. Panel jacks and switches permit combined or independent use of transformer and/or high-quality 6" PM (3 Ω voice coil) speaker. Chart on panel instantly shows correct switch positions for 30 different impedances — can't get lost. Size and style matches "VOMAX", 906 FM/AM Signal Generator — all SILVER LCETI.

ONLY $22.70 NET

LCETI — L*aboratory* **C***aliber* **E***lectronic* **T***est* **I***nstruments.*
See them at your favorite jobber.

SEND FOR COMPLETE CATALOG. See these and Silver communication transmitters, receivers, "Micromatch", TV preamplifier, pretuned freq. multiplier at your jobber.

OVER 37 YEARS OF RADIO ENGINEERING ACHIEVEMENT

McMurdo Silver Co., Inc.

EXECUTIVE OFFICES: 1240 MAIN ST., HARTFORD 3, CONN.
FACTORY OFFICE: 1249 MAIN ST., HARTFORD 3, CONN.

Speakers that mean business... FOR YOU!

TELEPHONE CHERRY 6373

The Drive-In Theatre Equipment Company, Inc.

Manufacturers of NATIONAL AUTO VOICE in-car Speaker Units

2110-2130 SUPERIOR AVENUE
CLEVELAND 14, OHIO

January 20, 1948

Mr. R. S. Fenton, Sales Manager
Parts Section, Receiver Division
Electronics Department
General Electric Company
1001 Wolf Street
Syracuse, New York

Dear Mr. Fenton:

We would like at this time to express our appreciation for your expeditious handling of our recent rush order for 5¼" PM Speakers.

The speakers used in the Drive-In Theatre in-car units must meet more rigid standards than those ordinarily required commercially. The Drive-In Speaker is subjected to the most adverse weather conditions, and must be able to stand up over a period of years without appreciable impairment of its electrical characteristics. The voice coil form, and the cone proper, must be impervious to moisture or direct rainfall.

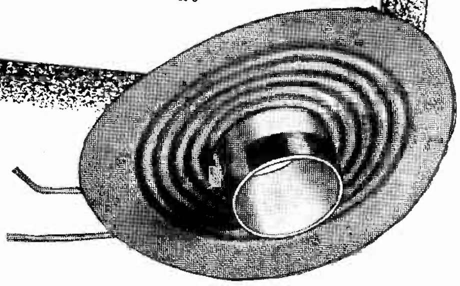
It may be of interest to you to know that after a survey of the speaker field, we chose the GE Speaker as the one best able to meet our exacting requirements. The aluminum voice coil form is ideal for our work, since there is no danger of expansion due to moisture absorption. The speakers met Navy type tests such as shock, vibration, temperature, salt spray, and frequency response requirements.

Since standardizing on GE speakers, our customer reaction has been entirely satisfactory.

Very truly yours,
DRIVE-IN THEATRE EQUIPMENT CO., INC.

E. B. Brady

President

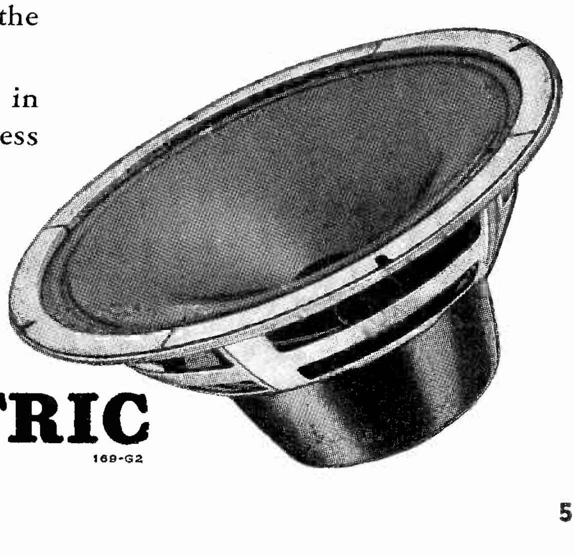


ALUMINUM FOIL BASE VOICE COIL

THE LETTER reproduced here speaks for itself and —G-E Speakers. The superb engineering which makes this speaker ideal for outdoor use, also makes it ideal for replacement in home receivers, where widely varying conditions of dryness and humidity affect speaker performance.

Here is an opportunity to develop the speaker replacement market to its fullest extent and push the outdoor theatre market.

G-E Speakers are competitively priced—and in quality they are outstanding. Build speaker business now. Send us your order.

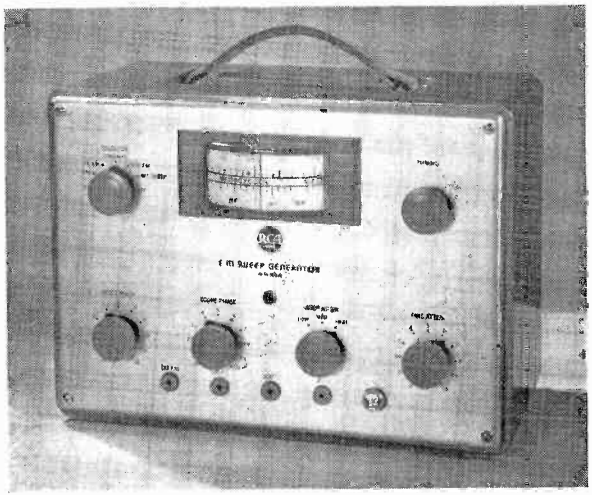


For complete information write:
General Electric Company, Electronics Department, Electronics Park, Syracuse, New York.

GENERAL ELECTRIC

169-G2

NEW
SIGNAL GENERATOR
FOR
FM ALIGNMENT



J. R. James

New test equipment designs continue to be one of the serviceman's greatest interests. This article will be followed by others describing representative new types of sweep generators.

THE RCA WR53A FM sweep generator is designed expressly for use by radio servicemen in aligning FM receivers. It is a portable, self contained unit and provides RF output on either the IF or RF frequencies used in standard FM receivers. Other features include provision for external frequency modulation and an "alternating connector" by which the output can be reduced to a very low level when necessary.

IF Range

There are two frequency ranges available. One of these ranges is for IF alignment. This range extends from 8.3 to 10.0 mc. and is sufficient to include most non-standard IF channels as well as the RMA standard of 10.7 mc. The IF signal is frequency modulated either internally or from an external source of audio frequency signal current. The internal modulation is at the 60 cycle power frequency. The external modulation frequency depends, of course, on the external audio source. The sweep width of the IF output is from ± 200 kc at 8.3 mc. to ± 400 kc at 10.7 mc. External modulating voltage can be from either a "single ended" or a "balanced" line. As can be seen in the photograph in the heading, two "EXT FM" tip jacks as well as a ground jack are provided. Either jack to ground provides single ended input; a balanced line is connected between the two "EXT FM" jacks. Single ended input impedance is 300 ohms; balanced impedance is 600 ohms.

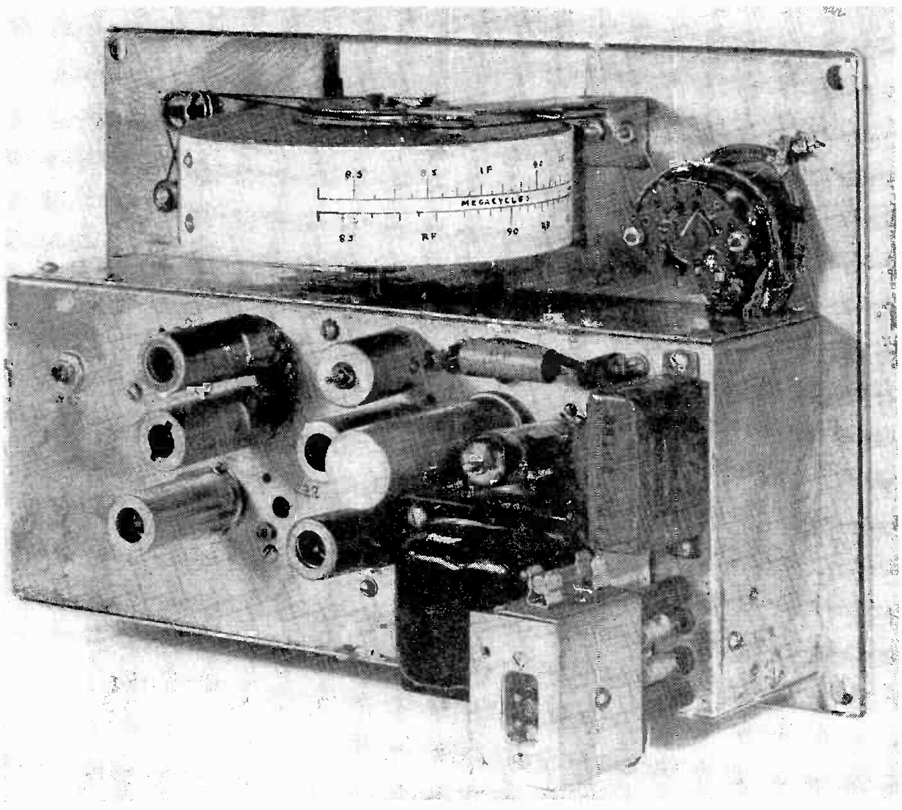


Fig. 1 Rear view of the unit with the chassis removed from the cabinet.

RF Oscillator

A separate tube is used as the RF oscillator. RF frequency range is 85-110 mc. RF output can be either unmodulated (CW) or amplitude modulated. The modulation frequency is twice the power line frequency (120 cycles.)

Attenuators

Two variable attenuators are provided. One is a "step" type and selects either low, medium or high output. The other attenuator ("fine" attenuator) gives smooth control of output voltage between positions of the step attenuator. In addition, there is a special attenuating device in the output lead conductor which permits reduction of output voltage to a very low level to prevent overloading of sensitive receivers. The special attenuating action is obtained by push-

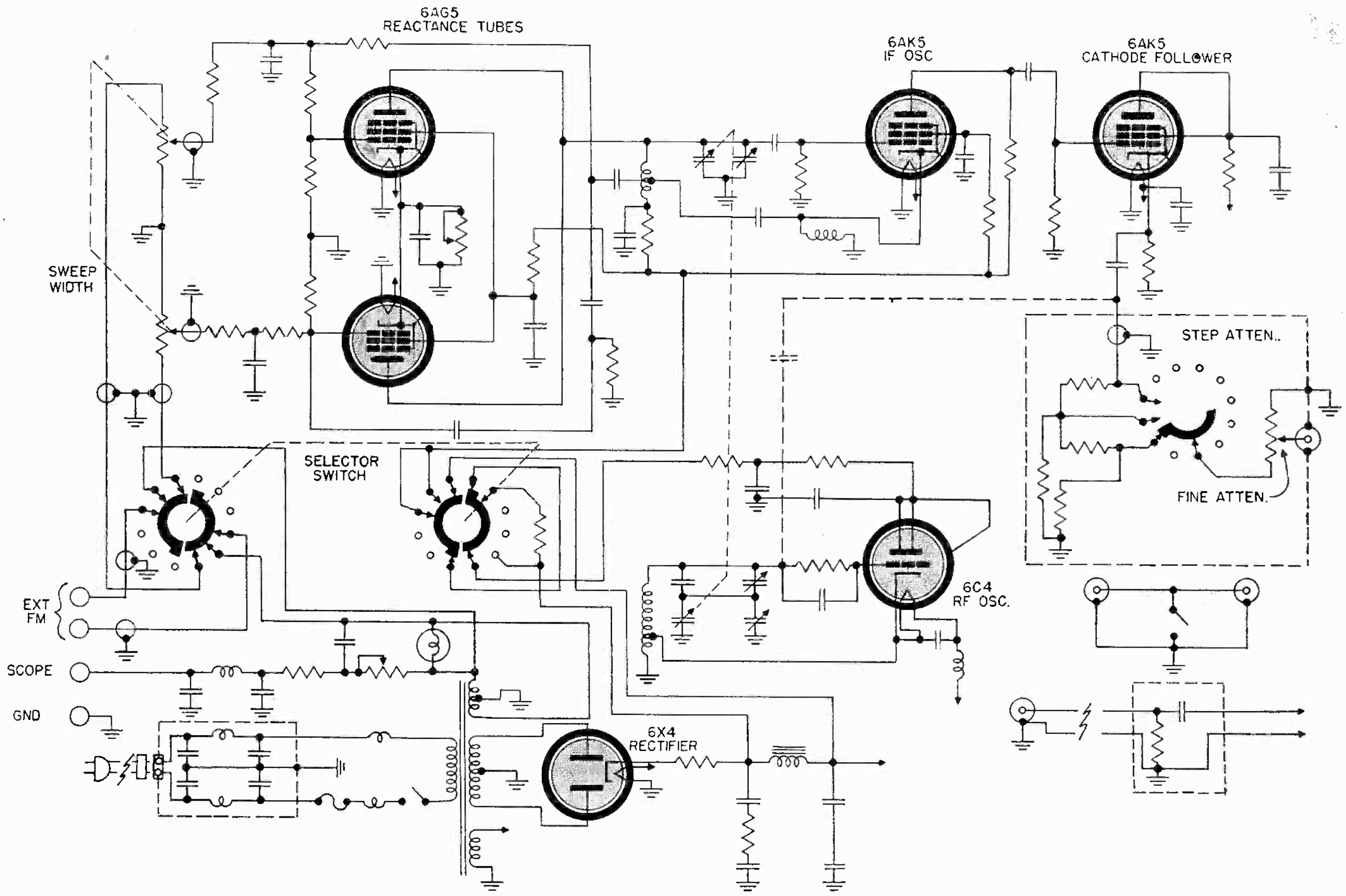


Fig. 2 Complete schematic diagram of the WR53A signal generator.

ing a slide switch mounted on the connector. This places a low impedance across the output cable. By means of the three attenuators just described, output voltage can be adjusted from less than 1 microvolt to 0.1 volts.

Oscilloscope Connections

Another feature of this unit is the provision of jacks on the panel for connection of an oscilloscope for visual alignment. This connection permits application of the FM sweep frequency to the oscilloscope horizontal plates, facilitating synchronization. A phase control is provided. This control enables the operator to adjust visual alignment patterns properly.

Front Panel Controls

The layout of the front panel is shown in the heading photograph. The tuning dial is located at the top in the center, and is enclosed in a plastic guard to keep out dust. The dial is controlled by the knob in the upper right hand corner. To the left of the dial is the selector switch, by which frequency range and operation are chosen. At the lower left is the "sweep width" control, which varies the audio signal, thus changing the deviation, during frequency modulation, from zero to 400 kc maximum. Second from left in the lower row is the "scope phase" knob. This provides variation of the phase difference between the signal and the oscilloscope sweep voltages. The step and fine attenuators complete the array of controls.

Internal Construction

Fig. 1 shows the internal construction of the generator. In the upper right hand corner is a wafer type selector switch, which controls types of operations. Also visible are the tuning dial (upper center) and the sub assembly panel on which are mounted the miniature type tubes used in the generator.

Circuit

A schematic diagram of the unit is shown in Fig. 2. The IF oscillator section is shown in the upper right hand corner. The oscillator itself is a 6AK5 connected in an electron coupled circuit for stability and isolation. Further isolation of the output from the oscillator is provided by the addition of a cathode follower, whose output circuit connects to the output jack on the panel.

In the upper left hand corner are the 6AG5 modulators. These are connected as reactance tubes in a special balanced circuit.

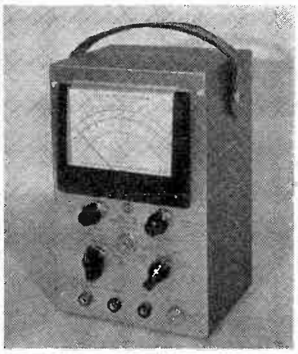
The 6C4 RF oscillator is shown in the lower right hand portion of the diagram. A hartley circuit of the shunt feed (grounded plate) type is used. Output from this oscillator is coupled to the output jack by capacity between the oscillator elements and a short length of wire from the output jack terminal.

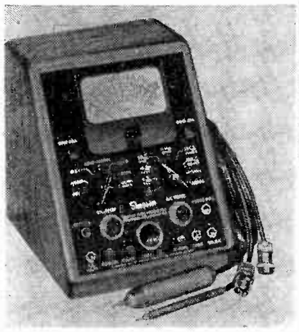
The power supply uses a 6X4 rectifier and a conventional full wave circuit. As can be seen in the lower left hand corner of the diagram, an elaborate line filter is used.

Adjustments

As with all good pieces of test equipment, adjustments other than those provided for on the panel should seldom be required. But if, under special conditions, linearity or calibration adjustments are necessary

→ To Page 44





GET THE MOST FROM YOUR VTVM

A. T. Parker

THE vacuum tube voltmeter is one of the most useful and versatile items of test equipment a radio serviceman can possess. The large variety of applications for this instrument includes nearly all phases of the radio business.

The vacuum tube voltmeter is a voltmeter with a very high impedance or resistance represented across its terminals so that it will not disturb the operation of radio circuits to which it is connected. We will confine the scope of this article to a brief description of some of the many uses the radio serviceman has for a voltmeter of this nature.

Measuring Plate Voltage

Originally, the commercially available vacuum tube voltmeters measured only AC and RF voltages but the modern units will also measure DC voltages. These meters can be used to measure voltages in circuits where no current drain by the meter can be tolerated. For example, it can be employed at the plate of a resistance coupled amplifier tube. In the circuit of Fig. 1, the plate current of the 6SQ7 is about 0.9 Ma. with no signal input. The actual voltage appearing at the plate (assuming a 250 volt source) about 160 volts. Now if a voltmeter is connected between the plate of the tube and ground and the voltmeter requires even one milliampere of current for its operation, the extra current flowing through the 100,000 ohm plate resistor will cause an added voltage drop. The plate voltage drops to 60 volts. An ordinary voltmeter will not truly indicate the plate voltage in this circuit. A vacuum tube voltmeter which requires no current for its operation will indicate the true DC voltage.

Voice Coil Impedance

In replacing speakers in radio receivers or in making proper speaker connections to a public address amplifier, it is sometimes necessary to know the approximate voice coil impedance. When this information is not marked on the speaker, as is most often the case, it is possible to determine the impedance by a very simple method. An audio oscillator is set up in the manner shown in Fig. 2. The VTVM is set up to read AC volts. The variable resistor can be an ordinary 20 or 25 ohm wire wound high wattage resistor. By a series of adjustments while alternately connecting the VTVM for point #1 to point #2 until the meter reads the same at both points, the variable resistor is adjusted to be exactly equal to the voice coil impedance. The audio signal used should be 400 cycles, since most speaker impedances are specified at that frequency. Finally, measure the value to which the resistor has been adjusted. This resistance will equal the value of the voice coil impedance. The photograph of Fig. 3 shows the setup for voice coil impedance measurement.

Power Output

The VTVM can be used to determine the power output in watts of a radio receiver or a public address amplifier. First, replace the speaker in the system with a fixed resistor equal to the speaker's voice coil impedance. Then connect the VTVM across the resistor as shown in Fig. 4. It is best to have a constant input signal. In the case of a receiver, connect a signal generator with tone

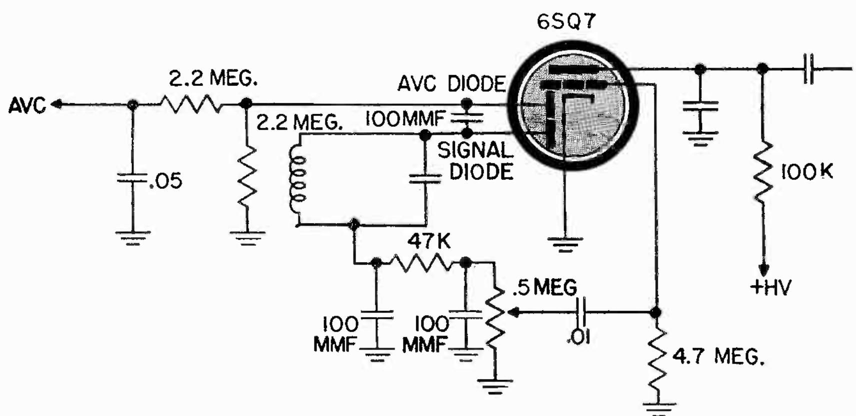


Fig. 1 Typical 2nd detector and resistance coupled audio stage.

modulation to the antenna. In the case of an audio amplifier, use the tone on an organ picked up by the microphone or use a test record and phono pickup. The voltage read at the VT-VM as a result of the input signal may be converted to *watts output* by the simple formula:

$$\text{Watts} = \frac{E^2}{R}$$

For example, suppose the meter reads 4.5 volts, and the resistor load is 8 ohms. The power output is equal to 4.5 X 4.5 (or 20.25) divided by 8. This gives 2.53 *Watts.*

Transformer Response

In most high quality audio circuits, good frequency response is achieved by designing the amplifier to have no inductive reactances, that is, no coils or transformers. Of course it is difficult to match the low impedance of a speaker voice coil to the higher impedance at the plate of the output tube, so an output transformer is necessary. This unit will usually be the determining factor of just how good the quality or response of the system is. The audio response characteristic of a transformer may be readily measured with a simple setup involving the vacuum tube voltmeter. As shown in Fig 5, the transformer is connected with resistors simulating its actual operating conditions. The voltage from the audio oscillator is maintained constant at each frequency of measurement. The voltmeter may be shifted from one circuit to the other, but if two meters are available, so much the better. Since the transformer is connected in reverse of its usual case, the voltage across R_p will be much larger than supplied to the input by the audio oscillator. If, for example, the transformer is used with a 6F6 output tube, resistor R_p would be about 7000 ohms. The secondary may work into an 8 ohm voice coil in which case resistor R_s will be 8 ohms. This combination represents an impedance ratio of 7000 to 8, or 875. The voltage step down from primary to secondary would be the square root of 875 or approximately 30. In connecting the transformer in reverse as in this case, one volt out of the audio oscillator would produce about 30 volts across R_p, assuming no loss in the transformer.

Adjust the voltage from the audio oscillator to one volt for convenience and readjust it to this value at all frequencies at which the tests are made. Write down the voltage across R_p for each of the following frequencies: 60, 100, 300, 500, 700, 1000, 1500, 3000, 5000, 7000, 10000.

It will be found that the voltages obtained at 500, 700 and 1000 cycles will be very nearly the same for an average transformer. The response will fall off at frequencies above and below these. If a curve is drawn using the voltage values, it may be found that there are humps or valleys in the curve at some particular frequency. This is often the case in poorly designed transformers. Dividing the voltage at any frequency into voltage at 1000 cycles will indicate the relative response in DB. If this division results in a number less than 1.12, the response at that point may

→ To Page 18

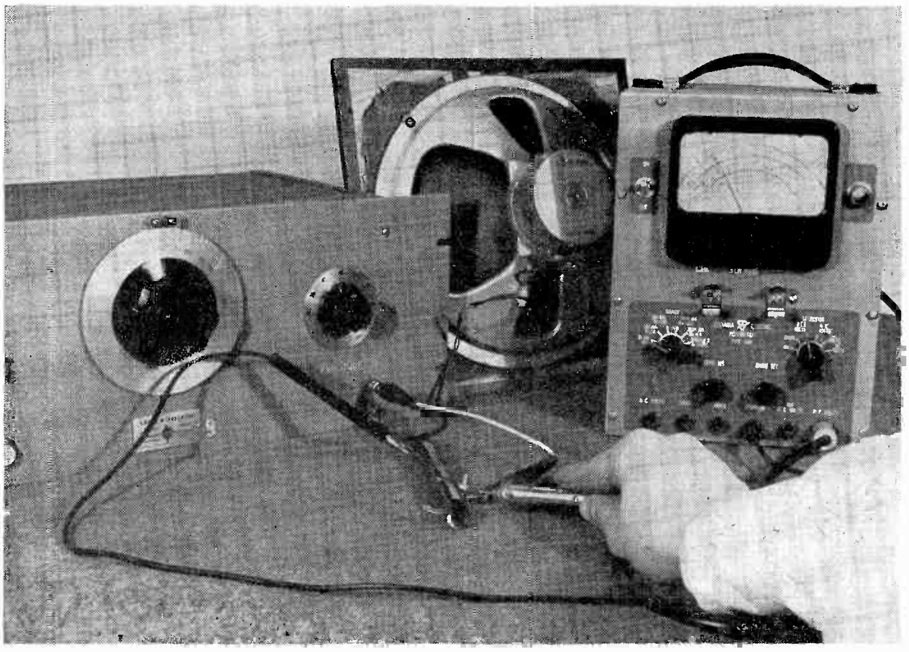


Fig. 3 A typical setup for measuring the impedance of a speaker voice coil.

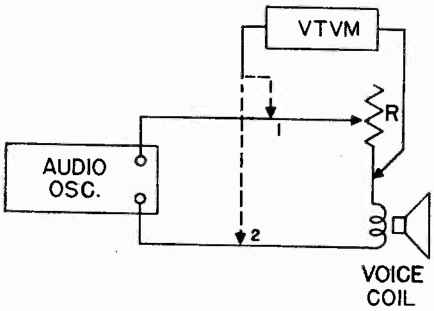
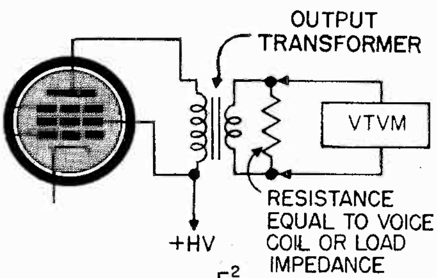


Fig. 2 Diagram showing how a VTVM may be connected to measure voice coil impedance.



WATTS OUTPUT = $\frac{E^2}{R}$

EXAMPLE: VTVM READING = 4.5 VOLTS
LOAD RESISTANCE = 8 OHMS

$$\frac{E^2}{R} = \frac{4.5 \text{ X } 4.5}{8} = \frac{20.25}{8} = 2.53 \text{ WATTS}$$

Fig. 4 Diagram showing how to measure audio output power in watts with a VTVM.

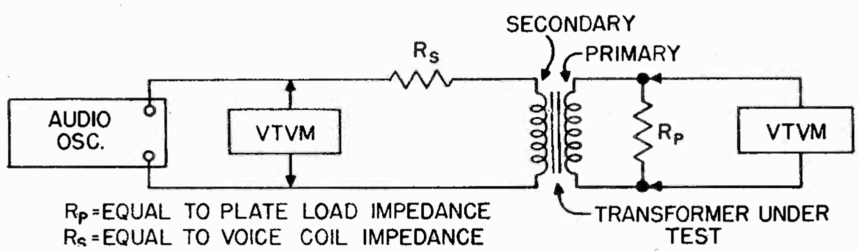
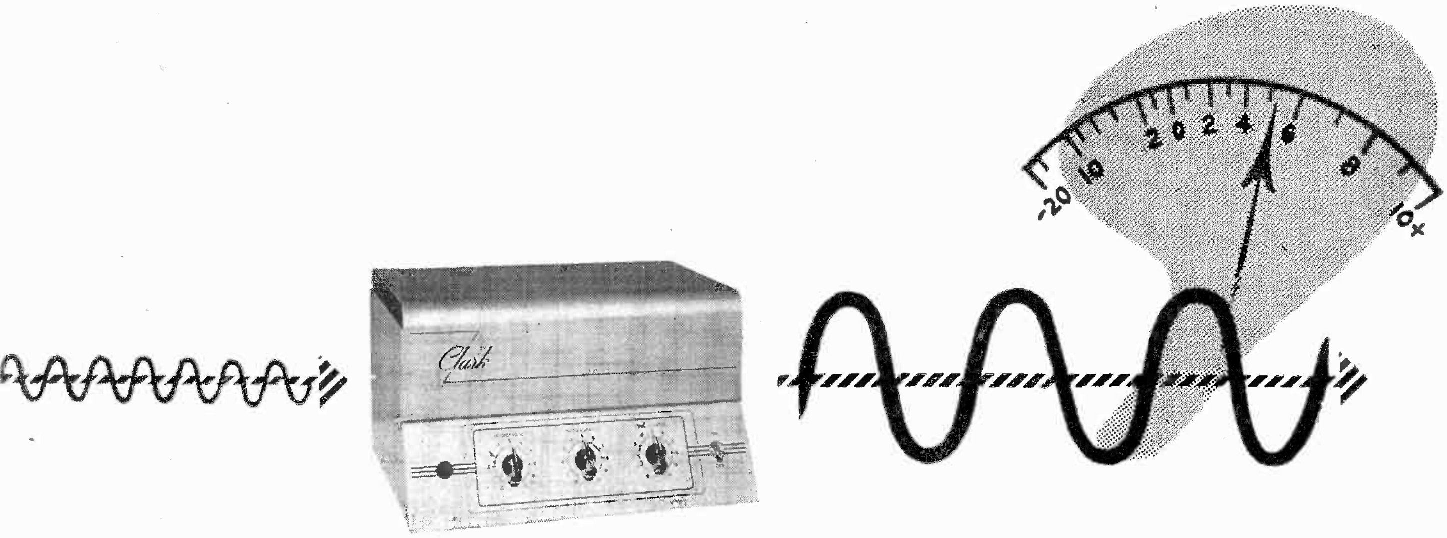


Fig. 5 Measuring the frequency response of an audio transformer.



DB CALCULATIONS MADE EASY

Berthold Sheffield

A Simplified Method of Making Decibel Calculations Mentally.

DECIBELS can no longer be considered merely "engineering" units. The most practical serviceman is bound to encounter them frequently. Some of the specifications which are nearly always given in decibels are:

1. Receiver Signal To Noise Ratio
2. Microphone Output
3. Amplifier Gain
4. Hum Level
5. Antenna Gain
6. Transmission Line Losses
7. Standard Receiver AF Output

Decibels (DB) are used because with them, voltage or power gains of individual stages are *added,* rather than multiplied, to give the total gain. An example is given in Fig. 1, which shows a block diagram of a three stage amplifier with stage gains assured as shown. The upper line of figures ("VG") shows how voltage gains are multiplied to produce the total voltage gain. The other line, marked "DB" shows corresponding DB gains and how they are added to obtain the total DB gain.

Most DB problems can be performed mentally with good accuracy and with very little effort. It is the purpose of this article to show how this useful skill can be acquired with negligible memory work, using only simple calculations. Slide rule or logarithmic tables are not required for this method.

In order to develop our mental slide rule, let us establish some simple mental hitching posts. From the definition of DB, we know that it is a *logarithmic* method of representing relative powers. The formula is:

$$DB = 10 \log_{10} \frac{\text{Power}}{\text{Reference Power}}$$

or

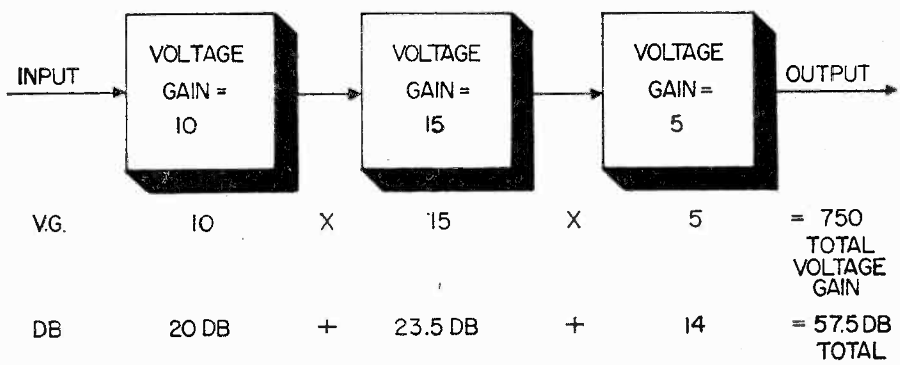
$$DB = 10 \log_{10} \times \text{Power Ratio}$$

For example, if an amplifier delivers 10 milliwatts output when it is driven with 1 milliwatt power input, then the power ratio of output to input is 10. This ratio, expressed in DB, is $10 \log_{10} (10^1)$ or 10 DB. Similarly, a power ratio of 100 or 10^2 is expressed by 20 DB since $10 \log_{10} (10^2) = 20$. We can readily build up a little table of DB vs. power ratios in steps of powers of ten as shown in Table I.

From this table, we note that the power ratios are expressed in powers of ten (i.e. 10^1, 10^2, 10^4, etc.) and that the exponent of this power of ten is obtained by dividing DB by ten. For instance, 70 DB represents a power ratio of 10^7 or ten million. You see, it's quite simple. Suppose you try a few now:

Problem (1): What is the power ratio represented by 60 DB?

Problem (2): If an amplifier has a gain of 60 DB and produces a power output of 60 watts, what power input is required?



The answer appears at the end of this article. NO PEEKING!

Let us develop our mental slide rule a step further by noting that 3 DB represents a power ratio of 2 to 1, with negligible error. For example, if an amplfier delivers 2 watts with 1 watt input power, then the amplifier has a power gain of 3 DB. Again, if a broadcast station emits 1 KW in the daytime and raises its power to 2 KW at night, then its output power at night may be said to exceed its daytime power by 3 DB.

Now we can apply the information that the level increases by 3 DB whenever we double the power. Specifically:

3 DB rise represents twice the power.

6 DB rise represents four times the power.

9 DB rise represents a power ratio of 8.

12 DB rise represents a power ratio of 16.

We are now ready to build a more complete mental slide rule as shown in Table II. The only problem remaining is to find the power ratios corresponding to 1 DB or 2 DB. The solution is relatively simple. Let us just add to Table II the fact that 10 DB represents a power ratio of 10. This is done in Table III.

From this table, we see that a one DB rise, from 9 DB to 10 DB, represents a power increase of 2/8 or ¼. That is, 10 DB represents 1 and ¼ times the power which is represented by 9 DB. We thus arrive at this rule:

A 1 DB rise represents an increase in power of 25%. The new power is thus 1.25 times the original power. (The error involved is less than 1%!)

Similarly, if we reduce power by 1 DB, say from 10 DB to 9 DB, the power ratio drops from 10 to 8. (See Table III.) This shows that a reduction of 1 DB represents a drop in power of 20%. Our second rule is then:

A 1 DB reduction represents a decrease in power of 20%. The new power is thus 0.8 of the original power.

With this information, we can determine the power ratios represented by an integral DB value. Let us, for example, complete Table II in one DB steps. Since a 1 DB rise represents an increase to 1.25 times the original power, 1 DB corresponds

TABLE I.

Power Ratios vs. DB

DB	Power ratios in powers of ten	Power ratio
10	10^1	10
20	20^2	100
30	10^3	1,000
40	10^4	10,000
50	10^5	100,000

TABLE II.

DB	Power Ratio
0	1
3	2
6	(2) (2) or 4
9	(2) (2) (2) or 8
12	(2) (2) (2) (2) or 16

TABLE III.

DB	Power Ratio
9	8
10	10

to a power ratio of 1.25. Similarly, 4 DB corresponds to a power ratio of 2 × 1.25 or 2.5. Again, 2 DB represents 80% of the power represented by 3 DB, namely 1.6. Finally, 5 DB, being one DB below 6 DB, corresponds to a power ratio of 3.2. The reader is urged to complete the table of power ratios vs. DB by this method, without resorting to slide rules or tables. A recommended self-imposed drill is to make up a table of the power ratios represented by 0 to 60 DB in one DB steps.

As a check, the results obtained by this method may be compared with the published tables of DB vs. Power Ratios. Occasional practice of this kind, which can be done while walking to work or while just sitting, will make the use of slide rule or tables entirely unnecessary. After a few jabs at this practie table, the reader is urged to find thke power ratios orresponding to the following DB values without resorting to slide rule or tables: 2, 6, 11, 23, 37, 45, 54. The answers appear at the end of this article.

So far, we have apparently completely disregarded the existence of negative DB values. However, these present no problem at all to the person skilled in calculating positive DB values mentally. Negative DB values imply that the power is reduced by a multiplier instead of being increased. For example, since 3 DB represents a 2 to 1 power increase or gain, —3 DB represents a 2 to 1 power loss. This means that a change of —3 DB represents a reduction to ½ the original power. Similarly, —6 DB represents a power ratio of ¼, and —10 DB represents a power ratio of 1/10. Finally, —57 DB represents a power ratio of 1 (5×10^5) or 2×10^{-6}.

The reader will have no difficulty in finding further examples for self-testing. As a starter, perhaps he would like to try to find, without the use of slide rule or tables, the power ratios represented by —2 DB; also —6, —11, —23, —37, —45, and —57 DB.

Here is a useful application of mental negative DB:

Problem (3): A certain public address system power amplifier delivers a nominal power of 10 watts into 600 ohms. The hum level of this amplifier at full output is 80 DB down (meaning 80 DB below 10 watts). It is required to express the hum level in watts.

This method lends itself readily to finding the voltage ratios corresponding to a given DB gain or less. For example, if a voltage amplifier has a gain of 60 DB, the corresponding power ratio is 10^6, and its voltage gain is, therefore, 10^3. This result is obtained by noting that voltage ratio is the square root of power ratio. That is, since

$$P = E^2/R$$

Therefore,

$$E = PR$$

If we compare two voltages E_1 and E_2 which appear across like valued resistor leads R, then the voltage ratio of E_1 to E_2 is:

$$\frac{E_1}{E_2} = \frac{P_1R}{P_2R} = \frac{P_1}{P_2} = \frac{P_1}{P_2}$$

It is common practice to express in relative DB the response characteristics of amplifiers, filters, and the like. For example, let us assume that a frequency run on a certain audio amplifier showed that at 50 cycles its gain is down 6 DB from the mid-frequency gain. By what

→ To page 26

TABLE IV.

Power Ratio	DB	½ DB	Voltage Ratio
4	6	3	2
6.25	8	4	2.5
16	12	6	4
100	20	10	10

AFC IN FM

Milton Kaufman

THE correct tuning of an FM receiver requires a considerable amount of care even with the use of a tuning indicator. Many set users are incapable of determining when the receiver is in exact tune. In addition, receivers which employ automatic station selectors such as push button tuning, usually require frequent adjustment to maintain proper operation. There is also ever present, the question of oscillator drift which would have the effect of detuning the receiver even after it was originally tuned in properly. With the above facts in mind, therefore, it is seen that a very strong argument exists in favor of a system which will automatically bring the receiver into correct adjustment provided it is manually set within a reasonable value of the center frequency of the carrier wave. AFC is particularly adaptable to FM receivers because the discriminator which is an integral part of an AFC system is normally present in the set and may be used for the dual purpose of supplying an AFC control voltage as well as detecting the FM wave. The two essential components of an AFC system may be classified as:

1. A discriminator which must supply a control voltage, and
2. Some sort of oscillator control circuit, usually a reactance tube which is acted upon by the control voltage and serves to change the local oscillator frequency to a value which will bring about the correct tuning of the receiver.

A block diagram of an FM receiver employing AFC is shown in Fig. 7A. It is easily seen here that the only added tube in the receiver is the reactance control tube. All of the other circuits are normally found in a conventional AM set.

Since the RF circuits are sufficiently broad, it will only be necessary to control the frequency of the local oscillator to achieve proper tuning. While systems have been developed to produce AFC by mechanical means, such methods to date have been expensive and impractical. An inexpensive and relatively efficient method is to control the frequency of the local oscillator by shunting across the tank circuit of the oscillator, a reactance tube circuit which may act as an inductive or capacitive reactance.

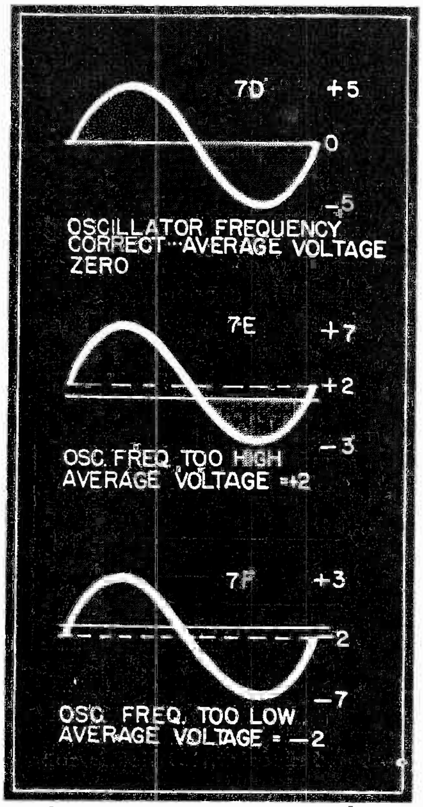
Assuming the oscillator frequency to be above the incoming RF carrier, it would be desirable to use a capacitive reactance tube. A simplified diagram of a shunt fed Hartley oscillator controlled by a capacitive reactance tube is shown in Fig. 7B. A voltage E_t is developed by the L-C tank circuit of the oscillator. A current I_1 is caused to flow through C1-R1. This current leads E_t by 90 degrees and thus the voltage across R1 also leads E_t by 90 degrees. The plate current through the reactance tube thus leads its AC plate voltage E_t by 90 degrees. This condition makes V2 act like a capacitive reactance whose magnitude may be controlled by the DC control voltage from the discriminator. An increase of plate current through V2 will decrease the frequency of the oscillator by causing more capacitive current to be drawn through the L-C tank circuit. Conversely, a decrease of plate current through V2 will cause an increase in the frequency of the Hartley oscillator.

A complete basic AFC system is shown in the schematic of Fig. 7C. A conventional discriminator is shown, but other types of FM detectors such as the Ratio Detector could be used to provide AFC control voltage. The action is explained with the aid of Fig. 7D, EE, 7F. If the oscillator frequency is of the correct value, then the IF produced will be equal to 10.7 mc and the *average* value of the signal at point "A" will be equal to zero. Since this is the AFC control voltage, the reactance tube will not be affected, and the oscillator frequency remains unchanged (7d). The audio component at point "A" is removed by the filter R2, C2, R3, C3.

In the event that oscillator frequency is above normal, a higher IF will be produced, say 10.8 mc. Under this condition, diode V1 will always conduct to a greater extent than diode V2, and the average voltage will shift to a plus 2 volts at point "A." This positive 2 volts is fed to the grid of the reactance tube causing an increase of capacitive current and a consequent reduction of oscillator frequency to the correct value to produce an IF of practically 10.7 mc.

If the oscillator frequency should be tuned below normal, a lower IF will be produced such as 10.6 mc. Now diode V2 will always conduct more, and the average potential at "A" will shift to a minus 2 volts. This will result in a decrease of capacitive current through the oscil-

→ To Page 30



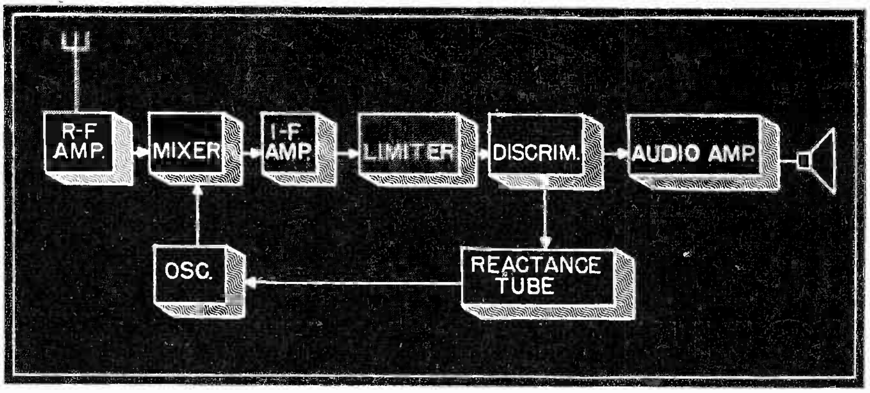


Fig. 7A

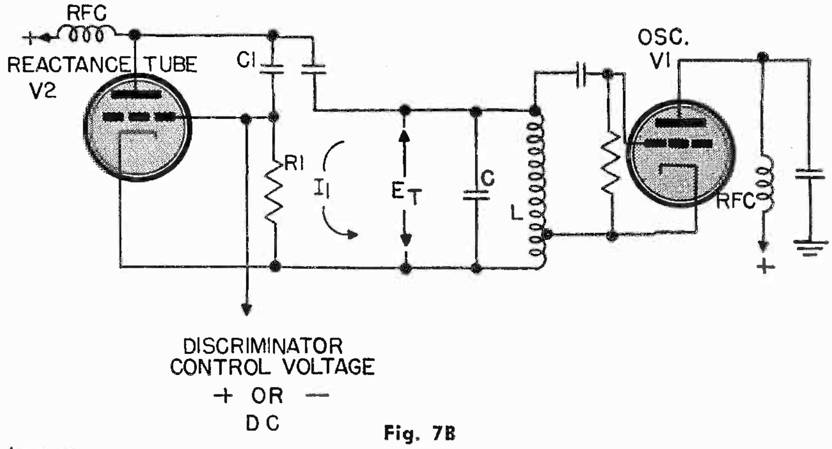


Fig. 7B

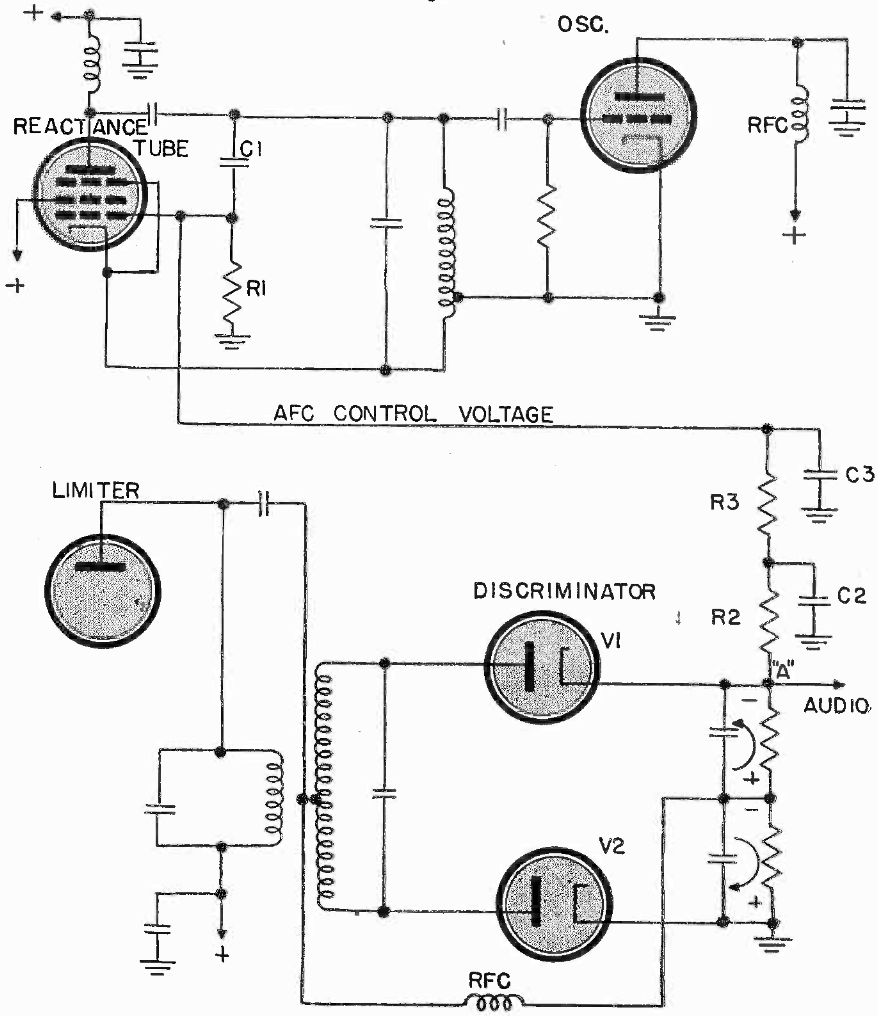
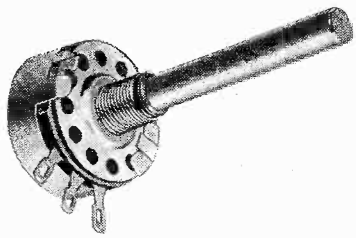


Fig. 7C



VOLUME CONTROL

By John T. Frye

The author discusses the methods used to control loudspeaker volume in all types of receivers.

DID you ever play that game in which you take some simple object—say a button or a grain of sand—and try to show that if you knew *all* there was to know about this humble starting point, you would command the whole field of human knowledge? If not, a couple of trials will convince you that you can start with the study of a bottle cap and proceed step by step to the atomic bomb, the latest sulfa drug, or even the "New Look" of fashion.

It is not too startling, then, to say that anyone who has a complete knowledge of the various methods that have been used to control the volume of sound issuing from radio receivers down through the years will also have a very good grounding in the theory and development of radio itself. It is the purpose of this article to trace and to reveal this close connection between control circuits and the development of the radio receiver.

In the beginning, controlling the volume was not the problem. Getting enough of it was the difficult part. Those of you who recall how, with the regenerative - detector - and - two stages-of-audio sets, you used to lay the earphones in a dishpan and all bend over it with bated breath when the faint tinkle of the piano stopped and it was time for the announcer to give those so-important call letters will heartily agree!

Some control, of course, was had by rheostats in the filament circuits (Fig. 1A), but this emission control was not very satisfactory. Deviation from the correct filament voltage resulted in impairment of the filament. What is more, it was practically impossible to get a nice adjustment of volume in this manner without also affecting the quality of reception.

The volume could be controlled after a fashion by varying the amount of regeneration, either by varying the amount of inductive feed-back with a varicoupler (Fig. 1B) or a variable condenser (Fig. 1C). In the former case, changes in the positioning of the two coils allowed more or less power to be fed inductively from the plate to the grid circuit. In the latter case, increasing the capacity of C1 allowed more RF from the plate to flow through the tickler coil to ground and so transferred more power inductively to the grid circuit. Such methods left much to be desired. Maximum volume was obtained at a very critical setting just below the point of oscillation. A tiny bit less feedback resulted in a great loss of volume and a drop in selectivity; just a little more feedback caused the detector to break into oscillation, with accompanying squeals in your and the neighbors' receivers.

When a couple of radio frequency amplifiers were added to the front end of the receivers and the regenerative detector was replaced by the straight grid-leak detector, there *was*, occasionally, a need for controlling the volume. Filament rheostats in the TRF and audio stages served fairly well, but this method still suffered from the drawbacks pointed out above. Variable coupling to the antenna was tried. Both inductive and capacitive methods were used to accomplish this. Figure 2 shows representative systems. In 2A, a tiny capacitor in series with the antenna lead was switched in and out of the circuit. A "Local-Distance" switch accomplished this. The tiny variable condenser of 2B provided a more flexible method of doing this same thing. In both cases, the high impedance of the condenser limited the amount of RF that was transferred to the primary of the antenna coil from the antenna. In Figure 2C, the physical position of the primary and secondary coils of the antenna transformer could be changed to regulate the magnetic transfer of energy

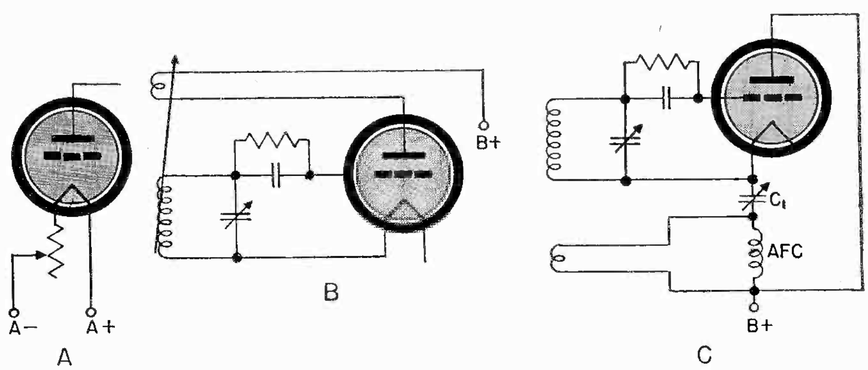


Fig. 1 Earliest methods of control, (A) filament and rheostat, (B) tickler coil variation, (C) capacity feed back control.

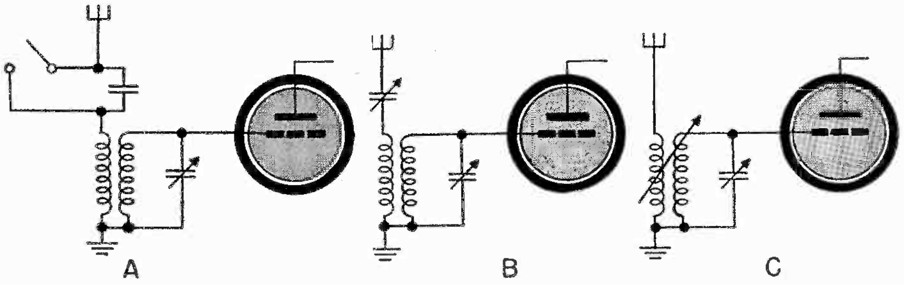


Fig. 2 Early methods used in TRF receivers.

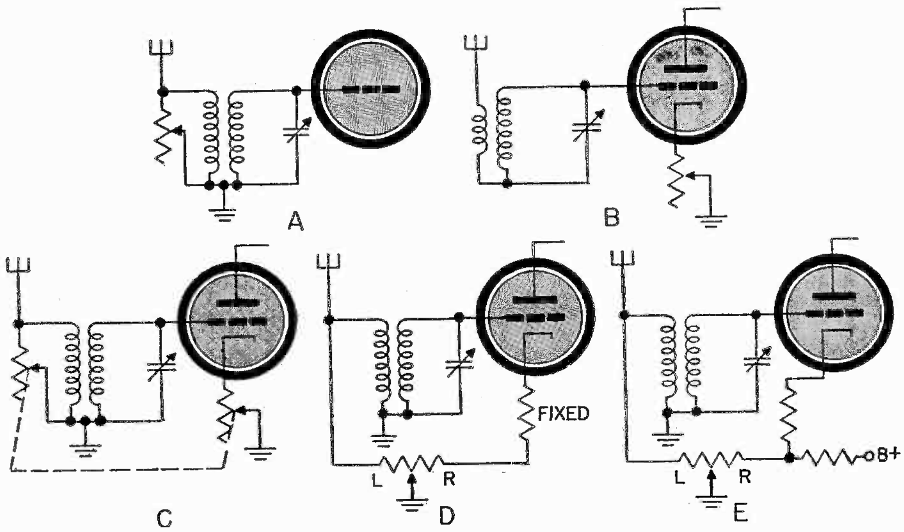


Fig. 3 Antenna shunt and bias method of control.

from one to the other. None of these systems were satisfactory. They were cumbersome and hard to adjust, and they were not effective when the receiver was near a transmitter, for then the unshielded coils and the chassis picked up the signal directly without any help from the antenna; so the "volume control" was bypassed.

About this time A.C. heated tubes were introduced, and the heavy filament currents made it impractical to control the emission by controlling the filament voltage. Antenna shunt resistors became popular (Fig. 3A). As the grounded rotor of the resistor moved toward the end of the element attached to the antenna connection, the primary of the antenna transformer was effectively shorted out; when the rotor moved to the other end of the element, the resistance in shunt with the coil increased until its shorting effect was negligible.

The same shorting system was tried across other coils as well: RF primaries, RF secondaries, and both windings of A.F. transformers; but its loading effect was least harmful across the untuned antenna coil primary. Still, this method of control affected only signals picked up by the antenna itself and was ineffective against signals picked up by the coils directly; moreover, since the resistors were of the untapered wire-wound type, control action was jerky and abrupt.

As soon as the indirectly-heated tubes were developed, the cathode-bias control (Fig. 3B) became the vogue. Plate current flowing through this resistor caused a voltage drop to appear which left the cathode positive with respect to ground; and since the grid was returned to ground, this made the grid negative with respect to the cathode. By making the cathode resistor variable, control of the grid bias, and, in turn, control of the "gain" of the tube was had. Because the detector circuits used were easily overloaded, it was customary to control the radio-frequency rather than the audio-frequency stages in this manner. When this type of control was used with the sharp cut-off tubes (tubes that have their plate current reduced to zero by a relatively small amount of bias voltage) of the day, it was found that sufficient bias to reduce a really strong signal would cause distortion by driving the tube off the linear portion of its curve; so the cathode-bias method was combined with the antenna-shunt means of controlling the volume (Fig. 3C).

In this system, most of the controlling action is taken care of by the antenna shunt resistor, the cathode-bias resistor being depended upon merely to reduce the mutual conductance of the tube to the point where coil or chassis pick-up of strong stations cause no trouble. A single resistor was often used (Fig. 3D) instead of the dual controls. As can be seen, when the grounded rotor moved to the "right" end of the element, it removed all of the resistance from the cathode circuit except the fixed resistance that provided the tube's minimum rated bias. At the same time, the shunting effect on the antenna coil primary was reduced to a minimum. Movement toward the "left" end of the element by the rotor shorted out the antenna coil and increased the bias on the tube or tubes whose cathodes were returned to ground through the variable resistor.

Remote cut-off tubes (tubes requiring high bias voltages to reduce the plate current to zero) used the circuit shown in Figure 3E. This is essentially the circuit of Figure 3D except for the fact that a bleeder current flows to ground through the cathode-bias portion of the control. This extra current through the resistor produces the increased voltage drop necessary for reducing the gain of remote cut-off tubes. In this circuit, most of the control action is obtained through cathode-bias, the antenna shunt being depended upon only to cut out extremely strong signals.

The development of screen-grid tubes gave the radio engineers a new tube element to play with in controlling the volume, and the circuit shown in Figure 4A was developed. Varying the voltage impressed on the screen changed the mutual conductance or "gain" of the tube; however, this system had little or no advantage over the antenna-shunt-cathode-bias system, and it was never used very extensively. Plate voltage control, as shown in Figure 4B was also tried, but it proved to be noisy.

"Losser" circuits (Fig. 4C) were also tried. The introduction of resistance into a tuned circuit introduces losses and so cuts down on the efficiency of the coil, thus reducing the efficiency of the circuit in which that coil plays a part. Unfortunately, such a resistance also lowers the "Q" of the coil and so impairs the selectivity of the tuned circuit. About the only use we see of losser resistors these days is in fixed resistors that can be switched in and out of IF tuned circuits by a "Sharp-Broad" control so as to give the operator a choice of high-selectivity or high-fidelity.

Eventually some genius, tired of riding the gain on his receiver, thought up automatic volume control, or A.V.C. Figure 5 shows the basic circuit of an A.V.C. system. During the time that the diodes are swung positive by the alternating IF voltage appearing across the secondary of the IF transformer, they attract electrons from the cathode which return to ground through the volume control. The D.C. voltage developed across the resistance of the control by this current flow can, after the audio component has been filtered out, be used to bias one or more RF or IF stages. The flow of current is such that the coil end of the volume control is negative with respect to ground; so the lead from this point can go right to the grids of the controlled stages through decoupling resistors.

With this system, a strong signal develops a high voltage-drop across the diode load resistor—in this case, the volume control—and this voltage applied as bias reduces the gain of the stages to which the A.V.C. is applied. A weak signal, on the other hand, develops little or no A.V.C. voltage, and the controlled stages are permitted to run wide open. The net result is the maintenance of the signal level developed across the volume control within very narrow limits, in spite of a wide variation of signal strengths delivered by the antenna to the receiver.

It is necessary to remember that in addition to the D.C. voltage appearing across the volume control, there is also the detected audio voltage. The volume control permits the selection of any amount of this voltage for introduction into the audio amplifier stages.

At first glance, it would seem that the volume control had finally been moved from the radio-frequency portion of the receiver to the audio portion, but a little reflection reveals that this is true only of the *manual* control. What really has happened is that both portions of the receiver have been brought under control, one automatically, the other manually. Both systems, working together, provide a smoother, more-flexible operation than either could provide alone.

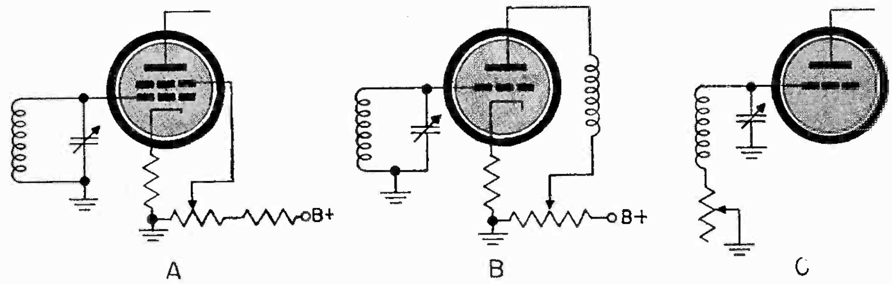


Fig. 4 How volume control is accomplished by variation of the voltage on a tube element.

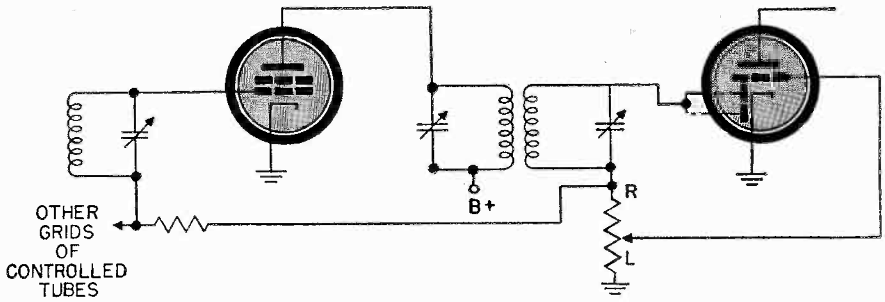


Fig. 5 Modern method of volume control used in superheterodyne receivers. RF gain is controlled by AVC; manual control is in the audio section.

Before leaving the subject of A.-V.C., it should be pointed out that the circuit shown is merely for the purpose of illustration and discussion and by no means represents all that can be done with automatic volume control. In less costly sets, the system described is followed more or less closely; but more expensive receivers use both delayed and amplified A.V.C. There is not room in an article of this general nature to go into detail, but delayed A.V.C. is a system that prevents automatic volume control action from functioning until a signal reaches a certain pre-determined strength. This is of benefit in the reception of weak signals.

Amplified A.V.C. is a method whereby a very small change in the strength of a received signal produces a relatively large change in the A.V.C. biasing voltage. This results in a better control action over a wider range of signal strengths.

It is interesting to note that communications receivers provide for the use of either A.V.C. or manual control of the "R.F. Gain." Manual control is usually achieved by the use of a variable cathode-bias resistor. When receiving continuous wave code signals in which the carrier of the transmitting station is interrupted at a rapid rate, A.V.C. action produces undesirable effects on the code signal; so the A.V.C. bus is grounded and the gain of the R. F. and I.F. stages is controlled manually. On voice-modulated signals, the cathode-biasing resistor is shorted out and the A.V.C. is cut back in, the speaker volume being controlled in the conventional manner with a volume control in the audio system.

A point to be remembered in all volume control work is that the response of the human ear to the intensity of sound is logarithmic, which is a fancy way of saying that you have to multiply the intensity of a sound by ten if you are to make it sound twice as loud to a listener, and by a hundred if you want it to sound three times as loud. In order to allow for this peculiarity, volume controls are constructed with various "tapers" for use in different circuits. A tapered control is one in which the change in resistance between the sliding contact and one end of the resistance element is not directly proportional to the amount of rotation. Instead, the change in resistance is figured so that the volume issuing from the speaker will, as it seems to

→ To Page 30

→ From Page 9

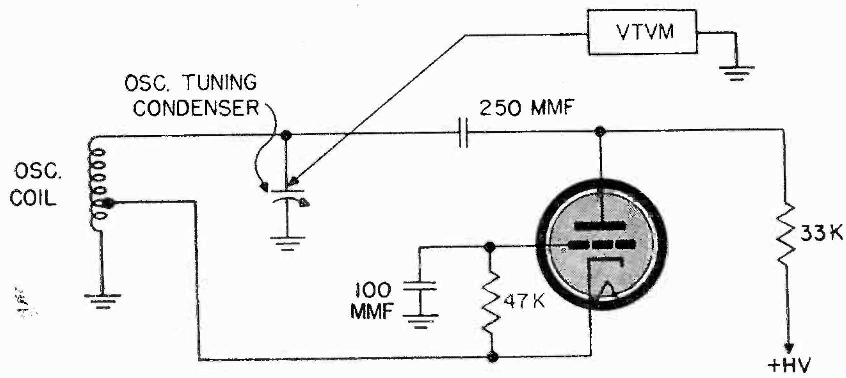


Fig. 6 How to measure the RF output of typical oscillator.

be said to be within one DB of the response at 1000 cycles. If the number is less than 1.25, the response is 2 DB or better. Other ratios are shown by table I. (See also the article in this issue on "Mental DB Calculations").

The VTVM can be used to check the effectiveness of the filter condensers in a receiver without the bother of disconnecting them from the circuit. Referring again to Fig. 1, it is noted that the 47,000 ohm resistor and two 100 mfd bypass condensers form a simple filter to prevent IF signals from getting to the grid of the first audio grid where they would cause overload and distortion. To check the effect of this filter, connect an *unmodulated* signal generator to the input of the receiver and connect the VTVM first from the signal diode plate to the chassis. The signal should be present at this point. Now, shifting the VTVM connection to the audio grid and chassis, there should be no measurable IF voltage. Listen to the set at the same time to be sure that no large amount of hiss or other noise is present which would tend to give a reading on the audio grid. A good trick is to turn up the output of the signal generator to a rather high value to cause the AVC to operate and reduce the sensitivity of the set to extraneous noises.

The filter in the AVC diode circuit of Fig. 1, comprised of a 2.2 megohm resistor and a .05 mfd condenser serves to prevent any audio or IF voltage from feeding back on the AVC bus to the first stages of the set. Only DC should be present on the "bus." This time use a modulated signal input to the set and connect the VTVM through a large condenser, .05 mfd or larger, to the AVC bus at the junction of the 2.2 megohm resistor and the .05 mfd condenser. No voltage should be measurable on the AC function of the VTVM. With the VTVM arranged for DC measurement, and without the .05 blocking condenser, the DC at this point should increase with an increase in signal input.

The .01 mfd coupling condenser from the volume control in Fig. 1 to the audio grid may be checked for leakage quite simply. With a strong modulated signal into the receiver, no DC should be measured at the grid of the 6SQ7. Any DC measured under these conditions would be due to a high resistance leakage in the coupling condenser and it should be replaced. It is well to use mica insulated condensers to replace audio coupling condensers due to their superior power factor and high quality insulation.

The effectiveness of all screen and cathode bypass condensers may be tested with the VTVM without disconnecting them from the circuit. They may first be tested for short circuits by measuring the DC voltage across them at the tube socket. If the condenser is shorted, no DC will appear. The effectiveness of the bypass condensers may be measured by applying a strong modulated signal

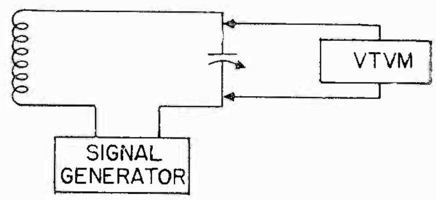


Fig. 7 Measuring the "Q" of tuned circuit.

to the input of the receiver. The modulation frequency or tone should be a very low frequency such as 60 cycles if possible. No RF, IF or

→ To page 45

TABLE I

Voltage Ratio	DB
1.12	1.
1.25	2.
1.41	3.
1.58	4.
1.77	5.
1.99	6.
2.51	8.
3.16	10.

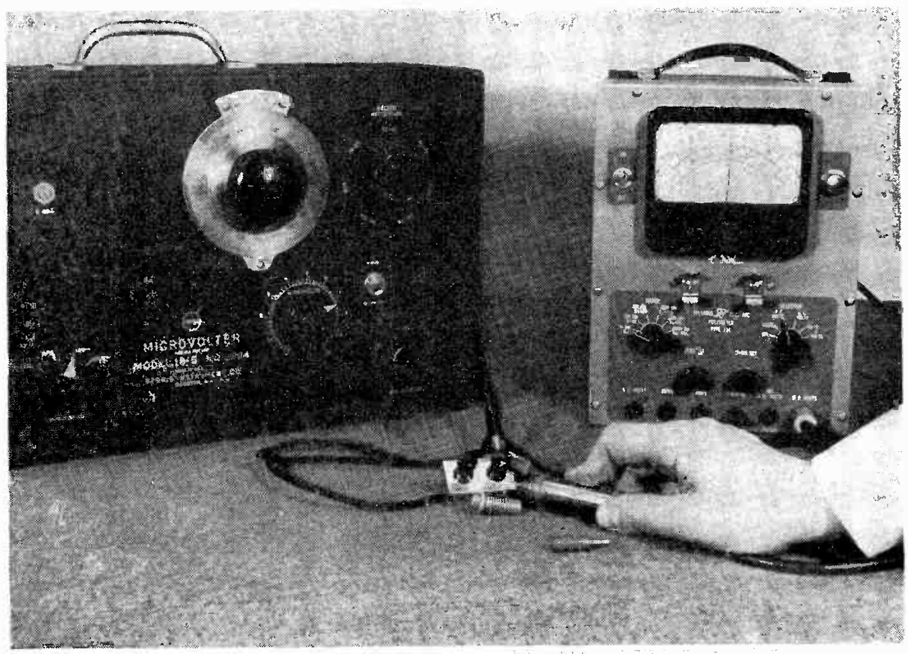


Fig. 8 The Q of a coil is measured by reading the voltage across the resonant circuit. RF energy is provided by a signal generator.

the Organizations

Reports from all over United States and Canada are making it clear that the Radio Service Technician is finding membership in an organization of great benefit. Radio Maintenance has kept you informed by starting this column many months ago, and we have watched group activity grow. If you are an organization member, let's hear from you about your group activities.

The Rhode Island Radiomen's Business Association has recently gone through a period of reorganization. Members, J. J. Costantino, J. Sock, and L. Boonas were chosen as delegates to go to the town meeting of radio technicans in Philadelphia in January. Those members met with Dave Krantz of the PRSMA and with delegates from associations throughout the North Eastern United States. The delegates found both technical and business lectures quite profitable. They were particularly impressed by the drafting of a code of ethics for radio electronic technicans. This code is to be presented to RMA for approval. The RIRBA as a whole expressed vigorous approval of the Philadelphia meeting and hope that soon all associations of radio servicemen will belong to a national federation.

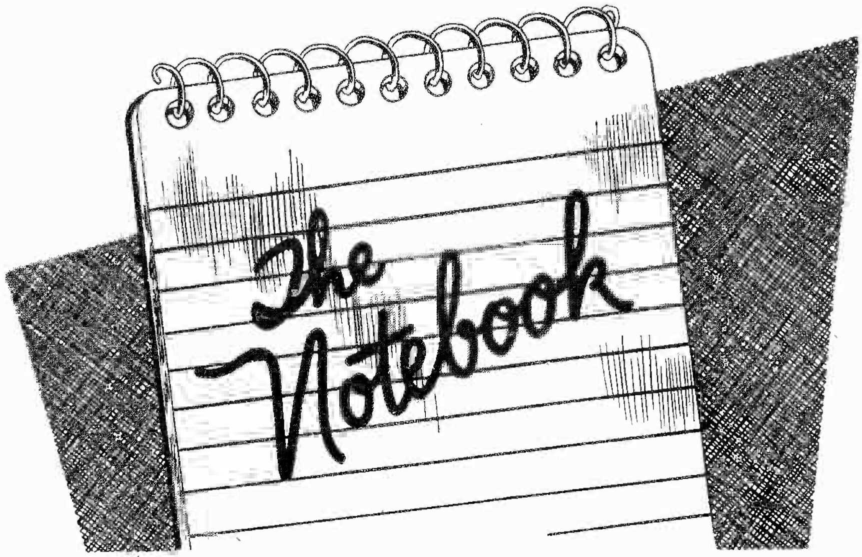
A word from the newly formed **Association Radio Servicemen of New York.** Those who are searching for reliable and competent technicans for radio service work are invited to contact the central district office of this organization or to call its telephone number. The calls will then be routed to the nearest qualified member of the ARSNY. This is the first time New York City has had an organization and a service of this type. No charge is made for the service and a guarantee of reliability and competence is offered.

Radio Maintenance reaches out to the distant Philippines to bring us a very interesting report from Avelino deGracia, President of the **Radiomen's League of the Philippines.** Mr. deGracia tells us that the RLP features monthly meetings with talks by successful men in the radio communication, industrial and educational fields. Classes are held for specification work in radio servicing. In a recent meeting a meter repair man give a very impressive demonstration on how to make meter repairs. Other subjects discussed included how to make good speaker replacements and a variety of other serviceman topics.

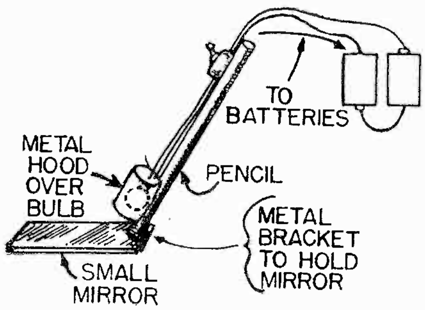
Another unusual field of endeavor in which this organization participates is member employment. Members who for any reason are relieved of a job are given an opportunity for temporary employment in an establishment with which the organization is affiliated. In this way the member is able to earn a living while looking for a new job. The RLP also strives to improve labor relations in commercial companies whenever this seems necessary.

Educational information is given to the Philippine people. The organization is now working on an appeal to the broadcast station of the islands to allow a 15 minute sponsorship of a program. Free ad-

→ To Page 28



Each month the reader sending in the best suggestion receives a crisp ten dollar bill. For all others published, RADIO MAINTENANCE will pay five dollars. Let's hear from you. All entries become the property of Radio Maintenance.



Value Reader

Often we wish to find out the value of a component whose marking faces down so we can't read it. The instrument illustrated permits reading values which would ordinarily be hidden from view. A pencil is used for a foundation and the toggle switch, light, hood, and mirror are fastened as shown in the diagram. Small penlight batteries are used and taped to the pencil. Values can be read by slipping the mirror under the desired component.

Russell M. Summerville
South Bend, Indiana

Hot Chassis Check

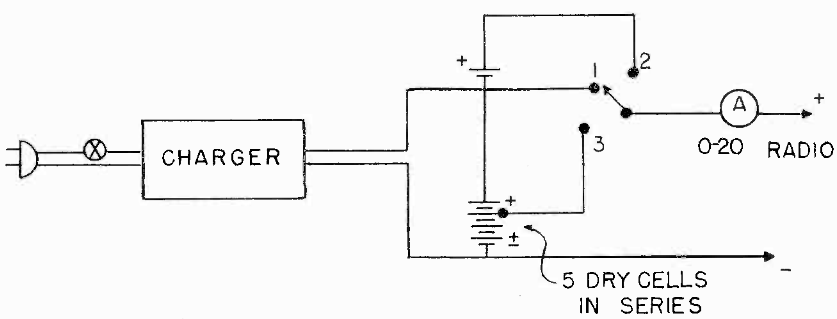
Here's a simple and effective way to determine whether an AC-DC chassis is "hot" with respect to ground. Grasp a neon bulb with your hand on one terminal. The bulb will light if the other terminal is touched to a chassis which is above ground. Leads may be connected to the neon bulb. Hold one of these leads in your hand and touch the other one to the chassis. If the bulb lights, you know the AC plug should be reversed.

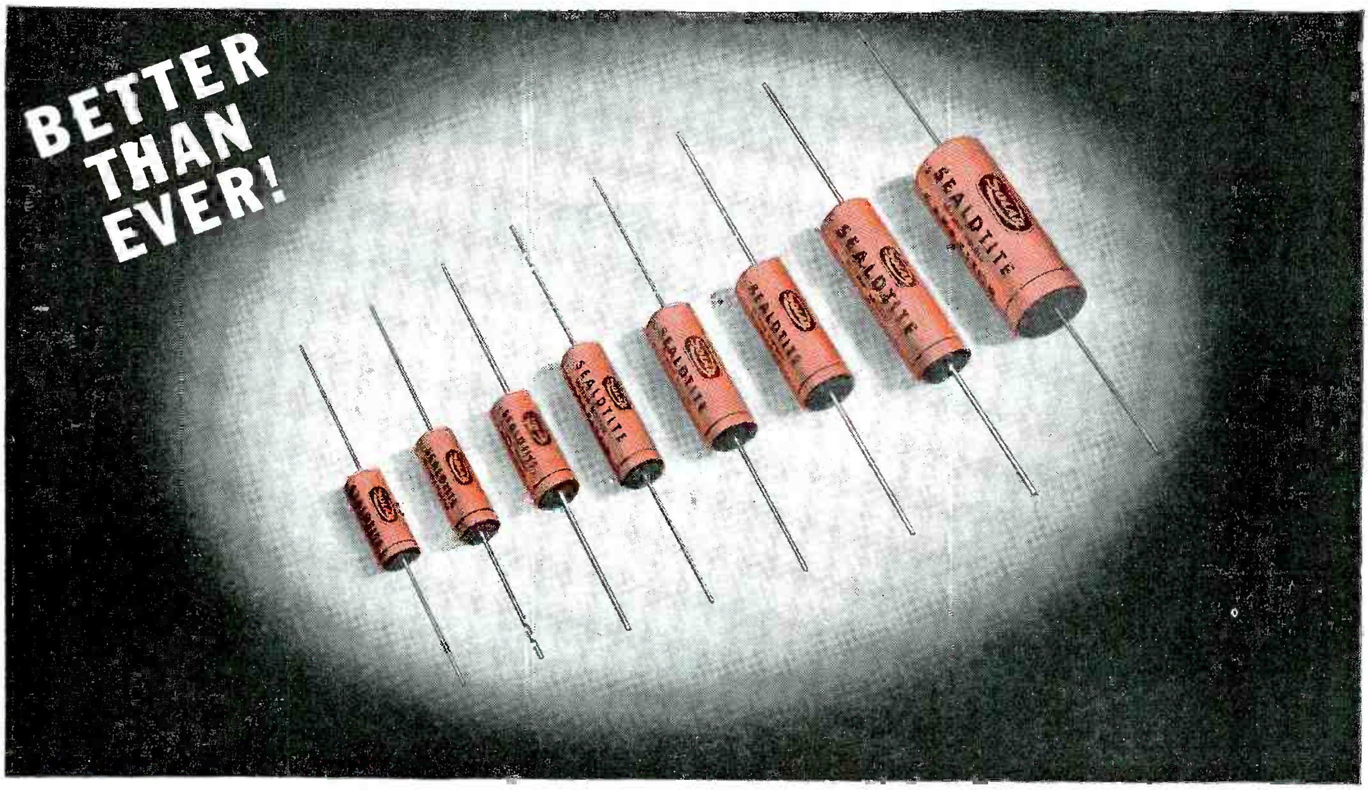
R. J. Moore
Napa, California

A Eliminator

An inexpensive substitute A eliminator can be made by using a battery charger and some dry cells. The charger output terminals are connected across the terminals of the four cells in series. These cells act as a filter and fill in voltage at the low points in the pulsating DC wave form. Most of the full load

→ To page 34





HI-TEMP* SEALDTITE* TUBULARS STAND UP IN HOT SPOTS

Check these advantages:

- ✓ HEAT-RESISTANT TO 100°C
- ✓ PROVEN SUPERIOR MOISTURE RESISTANCE SINCE 1939
- ✓ SQUEEZE-PROOF HOUSINGS OF MOLDED PLASTIC COMPOUND
- ✓ HALOWAX SECTIONS TO 600 VOLTS
- ✓ MINERAL OIL SECTIONS FOR 1000 AND 1600 VOLTS
- ✓ MAXIMUM SPACE ECONOMY
- ✓ EASY-TO-READ RED LABELS
- ✓ NO INCREASE IN PRICE

★ Trade Mark of Solar Mfg. Corp. North Bergen, N. J.

There's one sure way of getting all-purpose paper capacitors. Specify and insist on Solar SEALDTITES.

Solar's new Hi-Temp plastic molding compound makes these pioneer molded tubulars a universal choice for all automobile and home radio applications—bypass capacitors, coupling capacitors, or buffer capacitors.

Securely sealed against atmospheric moisture by a tough molded armor, Sealdtite Capacitors maintain their exceptionally high insulation resistance throughout their extremely long life. Unlike conventional tubulars, Sealdtites have no cardboard tubes to grow soggy, or internal voids to collect moisture.

Hi-Temp Sealdtite Capacitors have attractive red labels in bold, easy-to-read type. Their smooth surface attracts no dust and drips no wax.

BE WISE! STANDARDIZE ON SEALDTITE CAPACITORS

AD-135

SOLAR CAPACITORS

"Quality Above All"

SOLAR

DB Calculations

→ From Page 11

factor is the output voltage reduced at 50 cycles?

Solution: 6 DB represents a power ratio of 4 or a voltage ratio of 2. Therefore, the output voltage at 50 cycles will be half the output voltage obtained at mid-frequency. This illustration gives us a clue to himself of the truth of this statement by recalling that:

$P = I^2R$ and that, therefore,

$I = P/R$

From this last equation, we obtain the formula for the power ratio in terms of current ratio, thusly:

$$\frac{P_1}{P_2} = \frac{I_1}{I_2}$$

For the convenience of the reader,

→ To Page 28

TABLE V.

Comparison Between Mental and Exact Answers

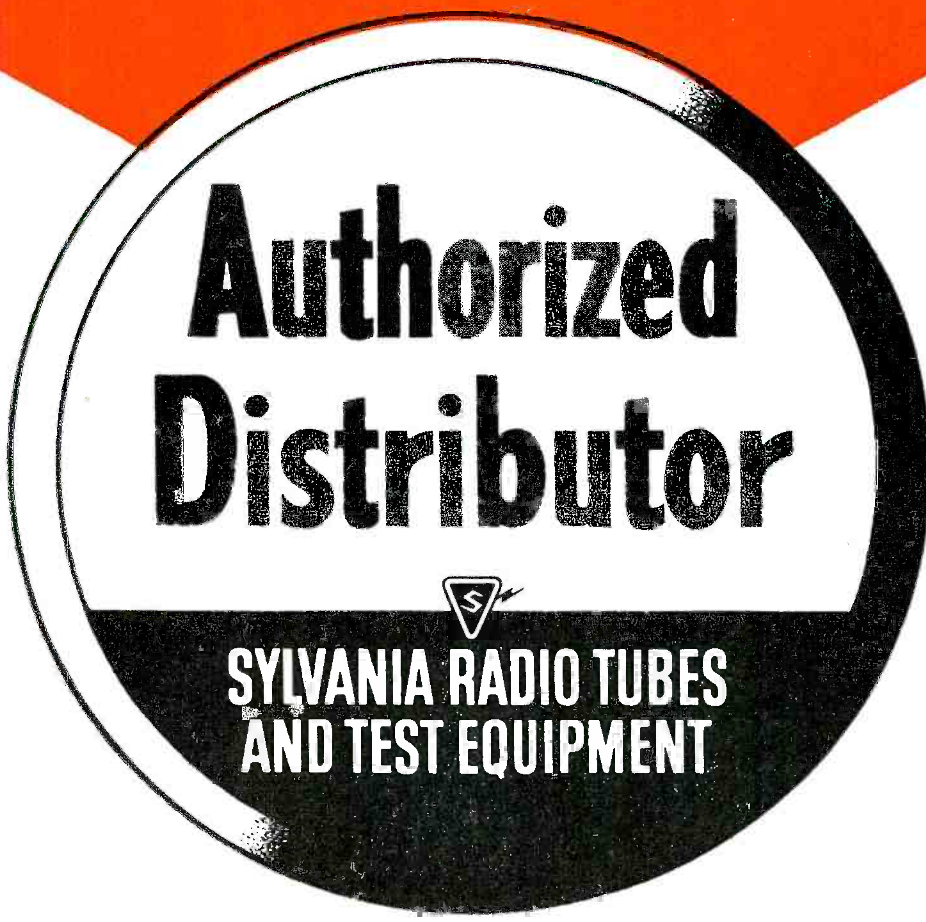
DB	Power Ratio		Voltage or Current Ratio	
	Mental	Exact	Mental	Exact
1	1.25	1.26		1.12
2	1.6	1.58	1.25	1.26
6	4	3.98	2	1.99
10	10	10	3.2	3.16
11	12.5	12.6		
12	16	15.8	4	3.98
14	25	25.1	5	5.01
18	64	63.1	8	7.94
20	100	100.0	10.0	10.0
22	160	158	12.5	12.6
23	200	199		14.1
30	1000	1000	32	31.6
37	5000	1000		70.8
		70.8	100	100
44	25,000	25,100	160	158
45	32,000	31,600		178
50	100,000	100,000	320	316
54	250,000	251,000	500	501
60	1,000,000	1,000,000	1000	1000

a short cut method for finding voltage ratios directly from DB, without taking square roots and without using slide rules. In the above problem, the voltage ratio corresponding to 6 DB has the same magnitude as the power ratio corresponding to 3 DB! Similarly, the voltage ratio corresponding to 20 DB is 10^2 or 10^1. Again, we note that the voltage ratio has the same magnitude as the power ratio corresponding to one half the number of DB. To clarify this simplification further, Table IV shows several values of DB and their corresponding power and voltage ratios, as obtained by our mental calculations.

The reader should convince himelf of the simplicity of this application of mental DB by finding the voltage ratios corresponding to the following DB: 1, 12, 14, 18, —1, —22, —44.

It is sometimes necessary to find the current ratio corresponding to a given number of DB. This current ratio is the same as the voltage ratio, where like resistances are involved. The reader can convince

Look for the distributor who displays this sign!



As a part of its 1948 program, Sylvania Electric will supply each of its authorized distributors with this new decal, printed in red, yellow, black and three shades of green. It's worth your while to look for this sign on his windows, doors and trucks — it is your assurance that this distributor will supply you with genuine Sylvania radio tubes and top-quality test equipment — and that you can count on prompt, courteous service as well!

Sylvania Electric Products Inc., Radio Tube Division, Emporium, Pa.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

DB Calculations

→ From Page 26

a brief table appears below giving the answers to all the DB problems in this article. This table shows clearly the negligible errors which are involved in the mental method. More complete tables may be found, for example, in the ARRL Handbook.

ANSWERS TO PROBLEMS

(1) 10^6 or one million
(2) $60/10^6$ watts or 60 microwatts
(3) a) 10×10^{-8} or 10^{-7} watts or 1/10 mikrowatt
b) 10 watts/600 ohms = 40 VU
Hum level = +4 — 80 =

The Organizations

→ From Page 20

vice and consultation are always available to radio set owners. Certainly radio sericemen's organizations have made great strides in the Philippines and probably some of the more local organizations will be able to learn a few things from them. The organization is still open for new members and we feel that radio servicemen of the islands should feel it an honor to belong to such a group.

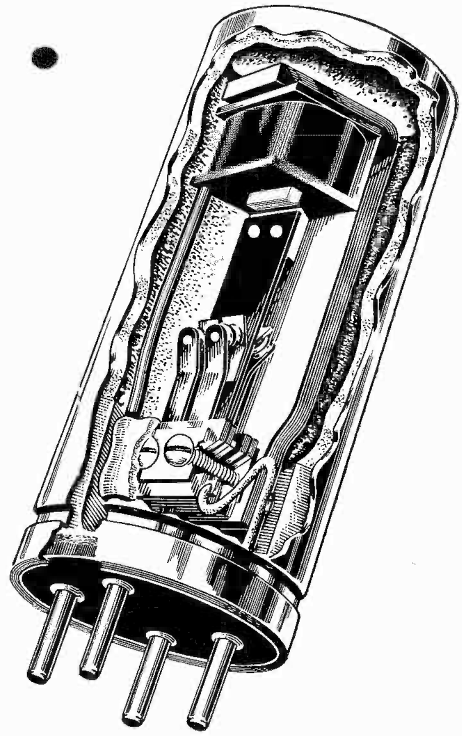
The southerntier chapter of the Radio Servicemen of America has installed a new set of officers as follows:

Wayne Shaw, Pres.
Herb Snyder, Vice-Pres.
Park Higgs, Treas.
Clint Wolfe, Secy.

Two delegates were sent to the Philadelphia town meeting and returned with valuable information and suggestions for local discussion. The last meeting featured a guest speaker, Mr. Cecil Masten of station WNBF, who spoke about a television station which WNBF is planning to construct. Spot announcements on one of the local broadcasting stations and a series of ads in the local morning paper have been producing good results.

Quiet . . . . . .

Reputation is built alone through continued supremacy. Of the many points that help to make Radiart VIBRATORS the leader in the field, the factor of quiet, noiseless operation has reached a new point of perfection because of recent engineering developments. Here is vibrator operation at its best! Servicemen everywhere depend on the engineering skill of Radiart to serve their customers interests best. They know Radiart is always correct, electrically and mechanically for each recommended application.



It Costs No More To Get A Red Seal VIBRATOR, Radiart Includes
This Important Feature . . . At Regular Low Prices

STANDARD OF COMPARISON
RADIART

The Radiart Corp.
CLEVELAND 2, OHIO

Volume Control

→ From Page 16

a human ear, be proportional to the rotation of the volume control knob. There is not room here to go into the subject of tapers, but I refer you to the excellent article "Volume Control Tapers," by Bernard Grob, appearing in the June-July, '46 issue of RADIO MAINTENANCE.

In looking back, we can see that volume controls have been tried in practically every circuit of radio receivers. Every new circuit discovery and practically every new tube developed has been reflected in changes in methods of controlling volume. Little by little, though, the control of the volume of radio receivers has become smoother and more complete. Part of this improvement has come from improved circuits; much of it has come from refinements in the mechanical construction of the controls themselves.

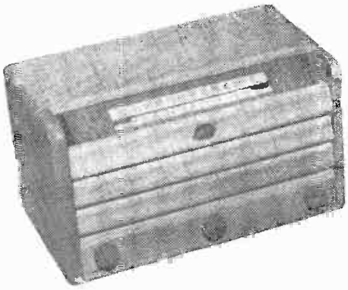
While the trend is toward the conventional A.V.C. and audio voltage-divider type of control, there is still a wide variety of volume control circuits to be found in radio servicing, and a good serviceman should be familiar with the functioning of each. Probably no single part of the radio receives more attention from the average radio listener than does the functioning of the volume control. Ordinarily, he uses it to turn the set on, to turn it off, and to adjust the volume exactly to his taste. No pains should be spared, therefore, to see that the volume control of every set that leaves your shop is functioning perfectly, for any improvement you make here is certain to be noticed! ✓ ✓ ✓

AFC in FM

→ From Page 13

lator tank circuit, and an increase of frequency to normal. Thus, by controlling the potential at the grid of the reactance tube in the correct manner, the frequency of the local oscillator may be stabilized at the correct value.

THIS MONTH'S BEST BUYS IN RADIO!



Minerva's sparkling new Model 725 6 tube superhet AC/DC has slide-rule dial, built-in antenna with 6½ Alnico V speaker. Comes in hand-rubbed walnut satin finish cabinet. Drop in and see this beauty. Your cost is $18.95.

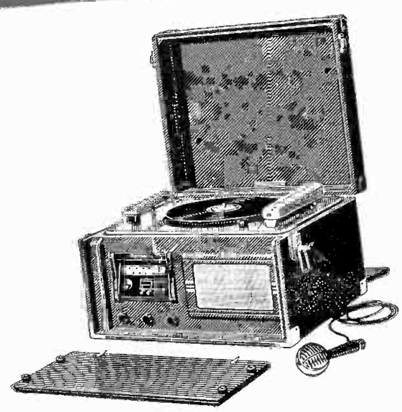
APRIL SPECIALS

Standard 4 prong non-sync. vibrators	$ .95
Cable-type distributor suppressor	.07
4" PM Speakers	1.45
5" PM Speakers	1.65
5" 6V Auto Speakers	2.25
Clarostat 8 ohm "L" Pads	1.25
Conant type "M" full wave rectifiers	1.25
Federal 75 ma. rectifier	.75
Sprague & Aerovox fluorescent light filters	.90
2 cell metal or plastic flashlights	.49
Portable single record player case	4.95
Radio 2 band coil kits and diagrams	2.95

TV ACCESSORIES & TUBES

RG8U 52 ohm co-ax cable, per ft.	$ .08
RG59U 72 ohm co-ax cable, per ft.	.08
300 ohm Twin-x cable, per ft. .03, per M	20.00
50 ft. galvanized guy wire	.30
7/24 90 ft. coils antenna wire	.49
All wave doublet lightning arrestor	.30
300 ohm stand-off insulator	.09
RG59U three inch stand-off insulator	.09
Phillips 7 inch type 7EP4	17.95

6AC7	$ .79	6BG6G	4.80
6AG5	.79	6J6	.79
6AG7	.79	6AK5	.54
6C4	.45	6SN7GT	.66
2x2/879	.96	6SL7GT	.66
6AS7G	5.75	6H6GT	.45
		8016	2.75



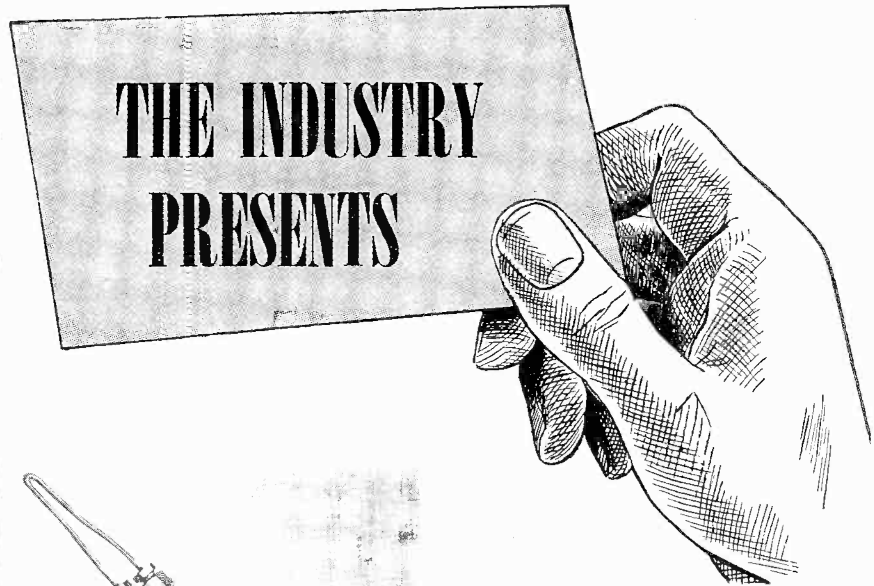
Wilcox Model 6 B 20 radio and recorder combination is a compact table model set. Comes complete with microphone, your cost, $95.00.

PHONE WRITE OR WIRE TODAY TO:

Phone LO 3-9225

Almo RADIO CO.
509 ARCH STREET
PHILADELPHIA, PENNA.

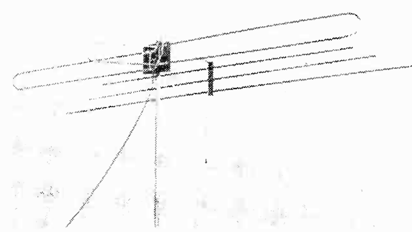
SAY YOU SAW IT IN RADIO MAINTENANCE!



SPOTLITE SOLDERING GUN

A new soldering gun with a spotlight tip has just been announced by the Weller Manufacturing Company. The spotlight, placed between the terminals of the loop tip, keeps the work illuminated even when the tip is flexed to suit the job. The spotlight goes on automatically when the trigger switch is closed to heat the gun. Heating takes place in 5 seconds and power is on only while the tool is in use. Operates on standard AC only, 100 watts, 110 volts, 60 cycle current. Two models are available: one with a single heat of 100 watts; the other has a dual heat control, with 100 watts normal heat and a 35 per cent instantaneous reserve.

For further information, write to Weller Manufacturing Co., 805 Packer St., Easton, Pa.



TELEVISION ANTENNA

Interstate Manufacturing Corporation's new antenna, code FMTV44216, is designed for fast, easy installation. Factory pretuned for high gain at all frequencies from 44 to 216 megacycles, it requires no adjustments in the field. The antenna is light in weight and built to resist all normal climatic conditions. It is normally broadband and nondirectional. Reflectors are available for the elimination of "ghosts" and for special directional effects. Further information may be obtained from Interstate Manufacturing Corporation, 138 Sussex Ave., Newark 4, N. J.

Are you Building a Business ...or Burning your Bridges?

Would you patronize a dentist who filled your teeth with plaster of Paris?

Would you trust your children's lives to a doctor who prescribed cut-rate pills?

Your business, too, is built on *customer confidence!* And your reputation is too valuable to risk with inferior or unknown products. The cost of the parts you use in the average repair job is insignificant compared with your investment in *your reputation.*

That's why we say—YOUR CUSTOMERS AND *YOUR REPUTATION CAN AFFORD ONLY THE BEST!* ... SPRAGUE.

CAPACITORS **SPRAGUE** *KOOLOHM RESISTORS

* T.M. Reg. U. S. Pat. Off.

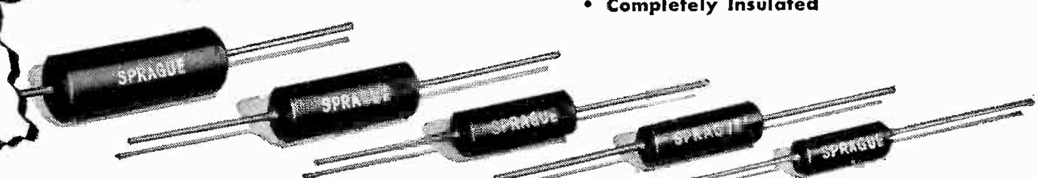
SPRAGUE PRODUCTS COMPANY, North Adams, Mass.

JOBBING DISTRIBUTING ORGANIZATION FOR PRODUCTS OF SPRAGUE ELECTRIC CO.

Reach for a SPRAGUE and Know You're Right!

The superiority of the new Sprague type TM High-Temperature Molded Paper Capacitors didn't happen by chance. You can use this better unit in your work today only because of more than four years of intensive research and one of the largest retooling programs in Sprague's history. That's why we can say *"The First Truly Practical Molded Paper Tubulars are Sprague TM's"*—and it is also the reason you can *use them on any job* with confidence and pride.

- **Highly Heat Resistant**
- **Moisture Resistant**
- **Non-inflammable**
- **Conservatively Rated**
- **Small in Size**
- **Mechanically Rugged**
- **Completely Insulated**



The Notebook

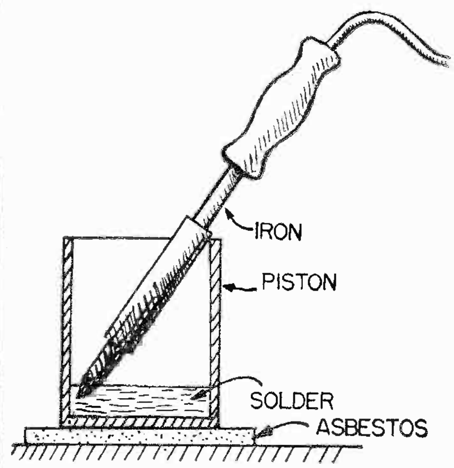
→ From Page 22

current needed for a receiver will flow from the charger.

Joseph Fiederer
Worcester, N. Y.

Tinning Iron Stand

A useful soldering iron stand can be made from a worn out automobile motor piston. The piston is placed on a heavy piece of asbestos as shown in the diagram. It is then filled to a depth of about ½ inch



with bar solder. Pistons and irons vary in size so the piston should be chosen to suit the iron. The iron may be left on indefinitely without overheating or becoming "untinned."

J. F. Liston
Toronto, Ontario

Iron Heat Control

To keep that soldering iron ready for instant use, insert a lamp socket and switch in series with the solder-

→ To Page 36

Model VH-15 Speech Master, a new *completely weatherproof* 15-inch Hypex, is the latest addition to the JENSEN Hypex family, thus expanding this line of projectors to cover a wide range of sizes and prices. Designed only for speech reproduction, without compromise to music requirements, it affords greater naturalness in the low frequencies than do other Speech Masters. Model VH-15 is recommended for sound reinforcement, indoors and out, where distinct natural speech reproduction is required to carry through high noise levels.

Developed acoustic length, 36 inches. Useful response, 190 to 6,000 cps. Voice coil impedance, 8 ohms. Polar coverage angle, 90 degrees. Power rating 15 watts maximum speech signal input. Mouth diameter 15⅝"; overall length 15".

Model VH-15 Speech Master (ST-757) . . . . **List Price $47.00**

Model*VH-91 Speech Master List Price $32.50

**Hypex and Speech Master are Registered Jensen Trade Marks.*

Jensen SPEAKERS WITH ALNICO 5

NOTE THESE FEATURES

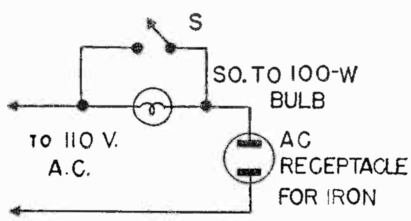
- *Horn designed to JENSEN Hypex formula (Pat. 2,338,262) for improved acoustical performance.*
- *Alnico V driver unit completely enclosed, yet replaceable without special tools.*
- *Trunnions adjustable through 180 degrees, lock projector in position simply by tightening two nuts with small wrench.*
- *Non-ferrous and stainless steel rustproof fittings. Phenolic diaphragm.*
- *Rustproof, weatherproof terminal box; no exposed terminals. No soldering needed to connect.*
- *Improved weatherproof finish on all metal parts. Horn finished in two-tone baked enamel.*
- *Power rating 15 watts maximum speech signal input.*

JENSEN MANUFACTURING COMPANY
6637 S. LARAMIE AVE., CHICAGO 38
In Canada: Copper Wire Products, Ltd., 11 King St. W., Toronto

Designers and Manufacturers of Fine Acoustic Equipment

Note Book

→ From Page 34



ing iron receptacle as shown in Fig. 1. A 50- to 100-watt lamp bulb placed in the socket will keep the iron at "stand-by" temperature; throwing the switch applies full heat.

John B. Ledbetter
Cincinntai, Ohio

Applying Speaker Cement

One of the most common faults of car radio loudspeakers is the spider coming unglued around the outside edge of its mounting. In attempting to glue this back, we evolved the following tool which does the job in a few seconds without getting cement over everything in sight.

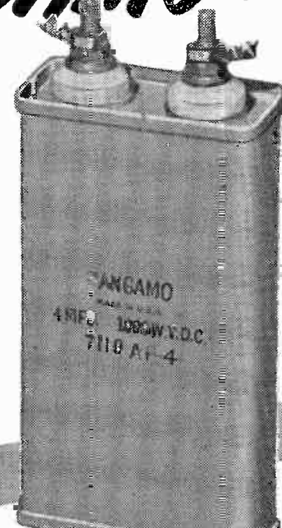
Purchase a standard size eyedropper and by heating the end bend the tip to an angle of about 45 degrees. Use a fairly thin service cement. When not in use, keep dropper in a small bottle of acetone and it is clean for the next job. I believe these droppers may be purchased correctly bent, but in either case the job is very easy.

Independence, Kansas
Kenneth C. Bates
Bates Radio Service

Buy Quality - Buy SANGAMO

Since 1923 Sangamo Capacitors have had a reputation for high inherent quality. Discriminating users have learned to rely on Sangamo for excellent design and construction, honest characteristics and conservative ratings. There is a Sangamo Mica or Paper Capacitor to fill your every need.

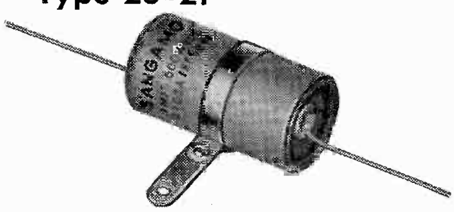
Type 71



DIACLOR IMPREGNATED CAPACITORS

Designed for use on broadcast and aircraft transmitters, and in many varied high voltage circuits. These small-sized, light-weight, long-lived capacitors have high insulation resistance, high dielectric strength, and low power factor. Available within a range of 600 to 6000 V. D. C. W. or higher.

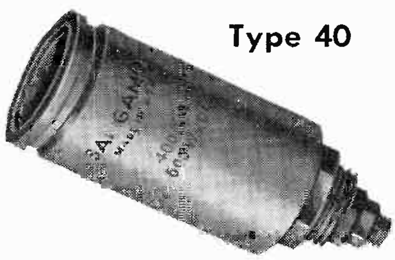
Type 20-21



METAL-CASED MINERAL OIL PAPER CAPACITORS

Extremely popular because of their excellent bypass and coupling qualities. They offer unusually stable performance from 55° C below zero to 85° C above zero. These "Jack-of-all-Trades" Capacitors are available within a range of 200 to 2000 V. D. C. W.

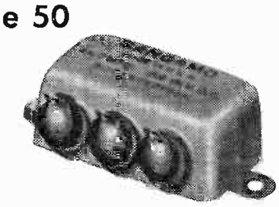
Type 40



DIACLOR FILLED FILTER CAPACITORS

Particularly suitable for use in communications equipment, industrial electronic, and other high voltage filter applications. They are enclosed in aluminum containers designed to facilitate mounting, and have an insulating washer and spade lug for insulating from the chassis.

Type 50



MINERAL OIL BYPASS CAPACITORS

Primarily intended for bypass applications. Their characteristics are excellent for R. F. and A. F. bypass, audio frequency coupling, and A. C. circuits, under all humidity conditions and at temperatures up to 85° C, subject to RMA standard temperature/voltage adjustment.

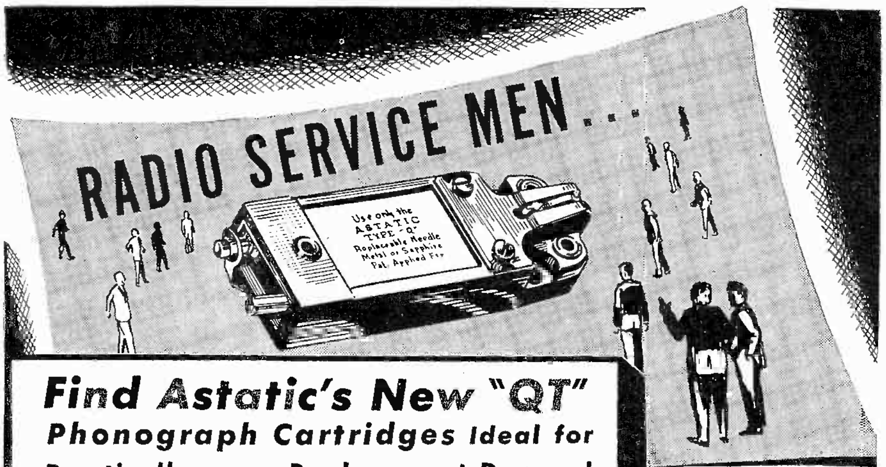
SANGAMO

Sangamo manufactures a complete line of paper, mica and silver capacitors. Write for Catalog No. 76B for full information.

PAPER • MICA • SILVER • CAPACITORS

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD • ILLINOIS

SC483-A



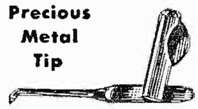
Find Astatic's New "QT"
Phonograph Cartridges Ideal for Practically every Replacement Demand

● For quiet, faithful reproduction, freedom from needle talk, relatively high output, and excellent tone range, the "QT" Cartridge is a modern replacement favorite. In addition, this new Cartridge is reasonably priced, simple to mount and connect, and designed for long life and record protection. Special literature is available.

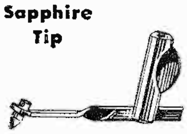
THE Astatic CORPORATION
ASTATIC
CONNEAUT, OHIO
IN CANADA CANADIAN ASTATIC LTD. TORONTO ONTARIO
Astatic Crystal Devices Manufactured under Brush Development Co. patents.

Type "Q" Matched Replaceable Needles used with Model "QT" Cartridges

Precious Metal Tip



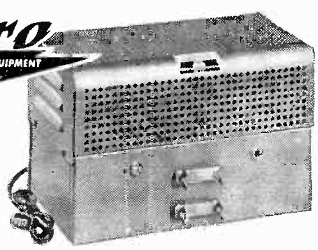
Sapphire Tip



The ONLY POWER SUPPLY
that gives these ratings without overheating*

Electro
ELECTRICAL AND RADIO EQUIPMENT

MODEL "A"



*** 6V at 15 amps. in parallel**
*** 12V at 7½ amps. in series**
*** 6V at 7½ amps. separately**
115 volts 60 cycles input

Height: 7¾" Length: 11¾"
Width: 7¾" Ship. wt. 31 lbs.

DC OUTPUT

Operates auto radios with solenoid tuning and tone controls — also 12 volt marine and aircraft radios.

Oversize transformers, chokes and rectifiers insure against overheating. Large capacity condensers for wide-range voltage regulation. Instantaneous power for solenoid operation. Two separately filtered DC output sources.

Compact. Sturdy. 18-gauge steel construction. Handsome blue Hammerloid finish. Comes completely equipped including 6' rubber cord and plug. Vastly superior and costs no more than batteries for equal service.

Send for complete description of this up-to-the-minute power supply.

ELECTRO PRODUCTS LABORATORIES
Pioneer Manufacturers of Battery Eliminators
549 West Randolph Street **Chicago 6, Illinois**

TECHNICAL MANUALS

Custom designed to your specifications

Planned, written and illustrated by a select staff . . . . experts in creating radio and electronic manuals for civilian & military use.

When you call upon Boland & Boyce to create your manuals you are relieved of every detail in their preparation. The entire operation is taken over and completed by a specialized staff with years of experience in publishing books & manuals.

First the requirements for your manual are completely surveyed. The working conditions to which they will be put are studied and the operations or equipment described in the manual are thoroughly analyzed. A complete outline is then prepared and submitted for your approval, along with a dummy of the manual as it will appear when finished. Upon your approval the job is completed and delivered with your satisfaction guaranteed.

Boland & Boyce manuals incorporate only the most modern editorial and illustrative style. Each project is treated with individual attention in technique of presentation and editorial approach. The Boland & Boyce military and civilian manuals now in use throughout the world are our best recommendations.

U. S. Navy
U. S. Signal Corps
Sylvania Electric Products, Inc.
The National Company
Western Electric Co.
Bell Telephone Laboratories
Maguire Industries, Inc.
Allen B. Du Mont Laboratories, Inc.
General Electric Co.
Mine Safety Appliances Co.

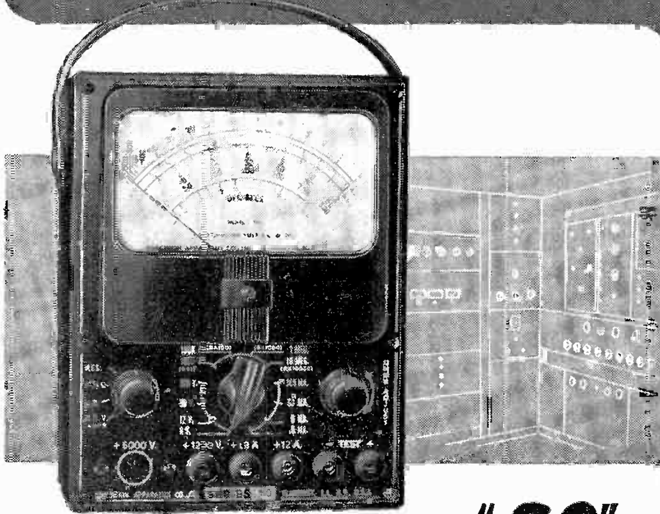
Write or Wire Boland & Boyce today for more information.

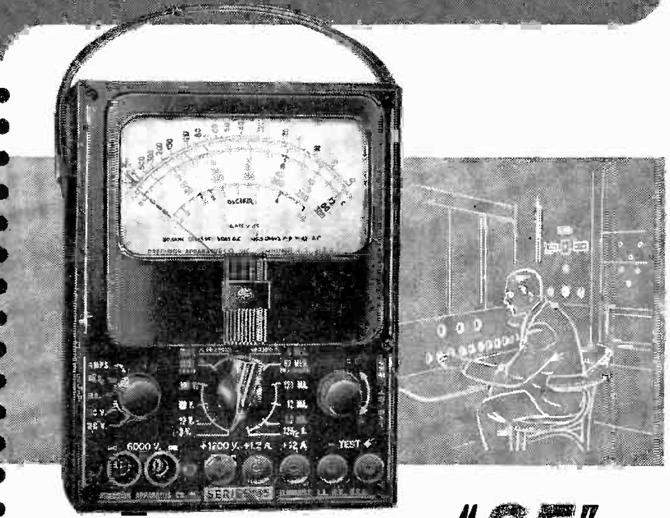
BOLAND & BOYCE INC., PUBLISHERS

Publishers of: Radio Data Book, Radio Maintenance, Video Handbook, Technical Manuals

Manual Division M-1
Montclair, N. J.

Yes APPLICATION ENGINEERED
Circuit Testers by "PRECISION"
To meet your individual instrument needs





THE NEW SERIES "80"

1000 OHMS PER VOLT D.C.
1000 OHMS PER VOLT A.C.

34 Ranges to 6000 volts A.C. and D.C.... 12 Amperes D.C.... + 70 DB... 10 Megohms (all self-contained).

Designed to meet the same high calibre performance standards as the Series 85 (at right) but is specifically intended for use wherein greater resistance to electrical and physical overload is of more importance than extremely high sensitivity.

"Application Engineered" for general purpose industrial and radio service-maintenance-test requirements.

VOLTAGE RANGES:	0-6-12-60-300-1200-6000 volts
CURRENT RANGES:	0-.6-6-60-300 MA. 0-1.2-12 Amps.
RESISTANCE RANGES:	0-1000 ohms (8 Ω at center scale) 0-100K—1 Meg — 10 Megohms
DECIBEL RANGES:	From −20 to +70 DB

Complete with batteries and test leads **$32.70**

THE NEW SERIES "85"

20,000 OHMS PER VOLT D.C.
1000 OHMS PER VOLT A.C.

34 Ranges to 6000 volts A.C. and D.C.... 120 microamperes D.C.... 12 Amperes D.C.... + 70 DB... 60 Megohms (all self-contained).

Physically and electrically engineered as a *compact, yet full-bodied*, laboratory styled *high sensitivity* test set.

Ideally "Application Engineered" for production, test, laboratory, school and service-maintenance phases of modern *radio-electronics-communications:* A.M., F.M., T.V.

VOLTAGE RANGES:	0-3-12-60-300-1200-6000 volts
CURRENT RANGES:	0-120 microamps. 0-1.2-12-120 MA. 0-1.2-12 Amperes.
RESISTANCE RANGES:	0-6000 ohms (35 Ω at center scale) 0-600K—6 Meg — 60 Megohms.
DECIBEL RANGES:	From −26 to +70 DB

Complete with batteries and test leads **$38.75**

PLUS **these superior physical features common to *both* the new Series 80 and 85:**

- ★ 4⅝" rectangular, wide angle, bakelite cased meters.
- ★ Heavy duty molded bakelite instrument case size 5½ x 7⅛ x 3".
- ★ Sweatproof plastic carrying handle.
- ★ Heavy gauge, anodized aluminum panel, resistant to moisture and abrasion.
- ★ Full Rotary Range and Function Selectors.
- ★ Recessed 6000 volt safety jacks.
- ★ Only two pin jacks for all standard ranges and functions.
- ★ Price includes ohmmeter batteries, test leads and operating instructions manual.

Ask *to see these and other "Precision" Application Engineered instruments, now on display at all leading radio parts distributors. Write to factory for new, complete 1948 catalog, including full details of the Precision* ***Electronamic*** *tube performance testing circuit.*

PRECISION TEST EQUIPMENT
Standard of Accuracy

PRECISION
APPARATUS COMPANY INC.
92-27 HORACE HARDING BOULEVARD
ELMHURST 5, NEW YORK

FOR QUICKER SALES AND PROFITS

Show... Suggest... Sell

Webster-Chicago RECORD CHANGERS

The Choice of Music Lovers

$42.50 LIST

Slightly higher West of Rockies

MODEL 156 with Automatic Stop

Model 156 embodies the most advanced features of record changer design—a vastly improved pick-up arm that accommodates a cartridge of low needle pressure—automatic shut-off—simpler, faster, more positive changer action.

Model 156-27 supplied with G.E. variable reluctance pickup, $44.50

$33.75 LIST

Slightly higher West of Rockies

MODEL 50 for Small Radio-Phonograph Combinations

Compactly designed for use with smaller radio-phonograph combinations. Precision-built for trouble-free operation. Base dimensions: 12 x 12⅛ in. Vertical space requirements: 6½ in. above, 2½ in. below top of mounting board.

Made by the Makers of WEBSTER-CHICAGO

Wire Recorders and Nylon Phonograph Needles

WEBSTER-CHICAGO

5610 BLOOMINGDALE AVENUE • CHICAGO 39, ILLINOIS

BINDERS

TO PRESERVE YOUR RADIO MAINTENANCE MAGAZINES

Keep your back numbers of RADIO MAINTENANCE in these handsome green and gold binders. Each binder will hold up to 18 copies of the magazines without puncturing holes or mutilating them in any way. They are held securely but are easily removed if desired. With the index printed at the end of each year, your magazines will be a constant reference for . . . a valuable service library. Send for your binders now!

RADIO MAINTENANCE
460 Bloomfield Avenue
Montclair, N. J.

Please send me......binders at $3.00 each.

Total amount enclosed..............

Name ....

Address ....

City ....Zone........

State ....

by John T. Frye

DO YOU know what the word "reactionary" means? I'll confess that I was not sure of it until I looked it up in the dictionary. According to that authority, a reactionary is a person who favors return to an older order, one who is a lover of "the good old days." As such, he is a natural enemy of new ideas, new developments, or innovations of any nature.

There are, doubtless, some businesses in which a reactionary disposition would be an asset. For example, a historian or an antique dealer should have a deep and sympathetic interest in "the dear, dead days, gone beyond recall." His perspective might well be that of an aged person who can recall clearly and fondly events that happened in his youth, but who takes little notice of and has little interest in the everyday life about him.

Yes, a reactionary might do quite well in some businesses, but radio servicing is not one of them. Radio itself is too young, too lusty, to fast-moving to offer any comfort to a person who likes to stop the hands of the clock or even turn them backward. Radio is like a powerful car that has several speeds ahead but no reverse. If you do not want to go ahead with this vehicle, your only alternative is to get out of it, for you cannot run it backward.

Do not be concerned, though, if you feel that there is just a wee bit of the reactionary spirit within you. There is that in all of us. A human being is a comfort-loving creature, and progress is the enemy of comfort. It is much easier to keep things as they are, to maintain the *status quo,* so to speak, than it is to bring about changes and improvements. The laws of inertia are all in favor of maintaining the old order.

What is more, we all have an instinctive fear and dislike of the unknown. The old and the familiar, whose mysteries we have entirely mastered, give us a feeling of confidence and easy proficiency. Change, on the other hand, takes away these props to our ego. It plunges us into new and untried situations in which we have no experience to guide us. We are forced to be constantly pulling against the current instead of resting comfortably on the oars.

Unfortunately for our peace of mind, "progress" and "change" are practically synonyms. Static electricity is of little practical value in our field, and a "static" serviceman is soon left hopelessly behind by the swift-moving advances in the science of radio.

In view of all this, what is your attitude toward Frequency Modulation and Television? Are you really actively interested in these advances, interested to the extent of reading everything you can about them and grasping every opportunity to learn more about the theory and practice of these new media? Do you encourage your customers to investigate the possibilities of these new forms of broadcasting, or do you discourage such interest because of a secret dread of having to service sets of this nature? Are you really hoping that it will be a long time before your particular area will be in a position to receive FM and Television broadcasts.

It is to be hoped that you display none of these outward evidences of being a reactionary, for your attitude in this matter is a pretty reliable index of your future success as a serviceman. You may discourage your customers from buying FM or Television receivers for a few weeks or months, but you cannot stop them from doing so for long. Sooner or later—and probably sooner than you think—you will either be servicing these and other radically different

→ To Following Page

Over the Bench

→ From preceding page

electronic devices that the future has in store, or you be out of the servicing business. As we said before, you have but two choices: you can either go ahead, keeping abreast of the rapid advance of radio, or you can get into some other business in which the demand for an alert and progressive mind is not so essential. There is no other option.

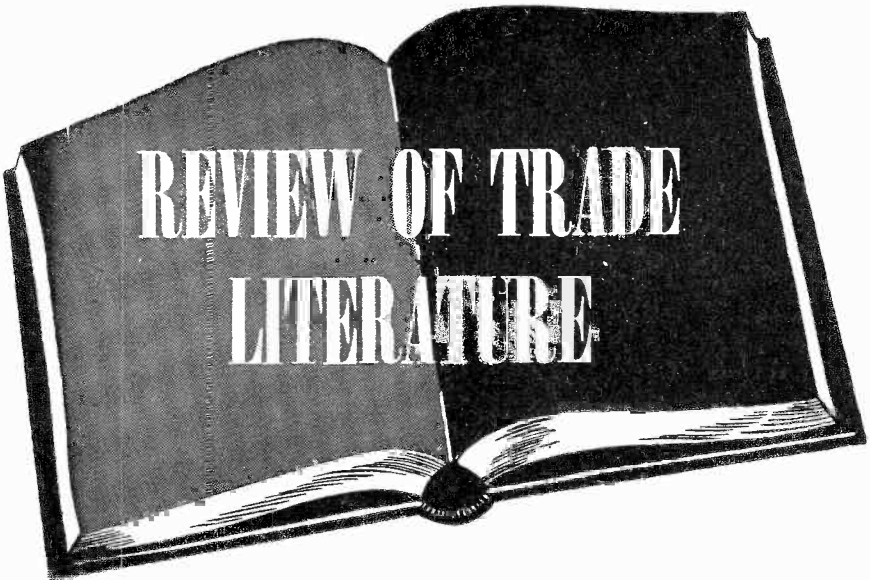
This is not so harsh as it sounds, for the radio service man is naturally progressive. Were this not so, he would not have been attracted to the field in the first place. Radio itself is still so young that only the youthful in spirit, and the mentally progressive have felt an affinity for the science.

The war, unfortunately, arrested this natural progressive bent of the serviceman. For five years he had very little new ideas upon which to whet his mind. He was busy, certainly; and his ingenuity was sorely tried by the demands of war-time servicing; but the work he did added few bits of technical knowledge to his store. Instead, he was forced to call forth and to use what he already know. He established himself as never before on terms of easy familiarity with the servicing of AM receivers; and in this field, he became vastly more proficient than he had ever been before.

Unfortunately, while he was becoming an AM service expert, he was losing his natural appetite for new ideas. He was like a machinist who has been too long on a job requiring a single operation performed over and over. What he gained in technical expertness, he lost in intellectual curiosity.

Please do not think that I am arguing that radio service is purely a young man's game. Certainly I do not want to say that. Chronological age has nothing to do with it, but mental age is what I am speaking of when I say that you have to keep youthfully alert and open to new ideas if you are to stay in radio servicing. That kind of age was what the man had in mind when he wrote:

"A man's age is directly proportional to the amount of pain he feels in coming in contact with a new idea."



To avoid delay when writing to the manufacturer give issue and page number.

ALLIED Radio Corporation has released its new 1948 catalog. Designated as No. 115, the new booklet contains 172 pages and describes more than 10,000 items. Included in these items are test equipment, batteries, public address systems, radios, radio phonographs, recording equipment and accessories (including wire, disc, and tape types), amateur equipment and builders' kits and supplies. A complete public address section includes sound systems from 7 to 60 watts as well as intercom units, microphones, pickups, etc.

This new 1948 radio catalog can be obtained free of charge by writing to Allied Radio Corporation, 833 West Jackson Boulevard, Chicago 7, Illinois.

A twelve-page FM and television brochure containing information about the new JFD line of antennas is now available. Among the featured types are polystyrene "Roto-Lock" insulator and a fringe area antenna with broad band and high gain characteristics. These and other new developments are included in the brochure which may be had free upon request to Department A8, JFD Manufacturing Company, 4117 Ft. Hamilton Parkway, Brooklyn, New York.

Volume 17 of the "Rider Perpetual Troubleshooter's Manuals" will soon be issued. This new volume will include the "clarified schematics" and other special Rider features and is to contain more than 1600 pages.

The new Du Mont Inputuner is the subject of a pamphlet now available. This pamphlet describes the operation, gives exact dimensions, and other pertinent information about this tuning unit which covers all FM and television channels as well as two amateur bands. The coverage is accomplished with continuous tuning. Copies may be had free of charge by written request on a business letterhead. These requests should be addressed to Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

Mallory's has just announced the sixth edition of the Mallory Radio Service Encyclopedia. Similar to the previous issues, the new encyclopedia includes helpful service information on pre-war and post-war receivers and contains 25% more listings than the fifth edition. Included in the information are data on volume and tone controls, capacitors, vibrators, and circuit information. The sixth edition will be available at a net price of $2.00 on April 1 and will be obtainable through Mallory distributors.

The Howard B. Jones Company is offernig a new catalog #16. This catalog describes the Jones line of electrical connecting devices. These connecting devices include multipolar plugs and terminal strips and binding posts. Information on fuse mountings and other materials is also included. Complete physical dimensions are given for all types, and the booklet is well illustrated with photographic views. To obtain this catalog (#16)), write to Howard B. Jones

→ To following page

Trade Literature

→ From Preceding Page

Division, Cinch Manufacturing Corporation, 2460 West George Street, Chicago 18, Ill.

The Radio Corporation of America Tube Department has released a new folder containing data about phonograph crystal replacements. This booklet shows the proper replacement crystal to use in the different models of RCA Victor phonographs. Outline diagrams showing the shape, the mounting holes, and other necessary information for installation are included.

Signal Generator

→ From Page 7

provisions for those are made. The linearity control varies the relative amount of deviation of the carries from center frequency for FM operation. The schematic diagram shows this control, located in the cathode circuit of the 6AG5 balanced reactance modulators.

Dial calibration can also be accomplished. The IF oscillator has a trimmer for this purpose. The RF oscillator has a trimmer, a padder, and a tuning slug. These components enable very close calibration of the main dial. This calibration has a specified accuracy of 2%.

Tests show that the WR53A performs very well in the production of visual alignment patterns. The unit is quite compact, measuring 9¾" high, 7½" deep and 13½" wide. It weighs 15 pounds and is easily transportable during radio service customer calls.

Your VTVM

→ From Page 18

audio voltages should be measurable across any bypass condenser in the set. As a precaution, connect a large condenser in series with the VTVM to protect the meter from DC voltages.

Sometimes the heterodyne oscillator of a receiver fails on the low frequency end of the dial. The oscillator circuit can be tested easily with the use of a vacuum tube voltmeter. See Fig. 6. Connect the meter to the stator of the oscillator section of the tuning condenser. A mica condenser should be used in series with the meter connection, .006 mfd or larger. The RF output of the oscillator will vary as the set is tuned from one end of the frequency range to the other. If the oscillator fails to function at all or "cuts out" at some frequencies, it will be immediately apparent using the VTVM.

The VTVM may be used to aid the alignment of a wave trap such as sometimes used in the antenna circuits of receivers. Connect the meter to the grid of the mixer tube and apply a signal at the frequency of the wave trap to the antenna input of the set. Tune the wavetrap for a *minimum* indication on the VTVM. It is important that the signal generator be connected through the dummy antenna recommended by the set manufacturer for this tuning to be accurate.

The entire receiver can be aligned using the VTVM as an output indicator. For most accurate results, the alignment should be stage by stage. Connect the unmodulated signal generator to the grid of the mixer tube. Connect the VTVM to the grid of

→ To Page 47

Your VTVM

→ From Page 45

the 2nd IF tube. Align the first RF transformer for maximum indication on the VTVM at the recommended IF frequency. Shift the VTVM to the grid of the following IF amplifier if there is one. Otherwise, connect it to the signal diode of the 2nd detector. Align the second IF transformer for maximum indication on the meter. The tuned circuits in the 2nd detector circuit may be similarly aligned by connecting the VTVM as a DC meter on the AVC bus and adjusting the alignment trimmers or slugs for maximum developed DC. A better way is to use a modulated signal input to the mixer of converter and connect the AC VTVM to the grid of the first audio tube.

Having aligned the IF stages in this manner, leave the VTVM connected in any of the stages just mentioned and connect the signal generator to the antenna input through the recommended "dummy" antenna. Proceed to align the antenna, oscillator and mixer stages as recommend by the manufacturer but utilizing the VTVM as an output indicator. It will be found that the VTVM is a very sensitive indicator when used in this way.

In the alignment of communications receivers, it is sometimes desirable to know the bandpass characteristics of the set. After complete alignment of the set, connect the VTVM to the grid of the first audio tube and a signal generator to the input. It is necessary to have a signal generator with a calibrated output attenuator and a very accurately calibrated frequency dial. Tune the signal generator for maximum indication on the VTVM at the frequency at which the test is being made. Write down the signal generator output value and the VTVM reading. Increase the signal generator output to exactly twice the value first used as indicated by the calibrated output attenuator, *not as shown on the VTVM*. Carefully detune the signal generator slightly on one side of the previous setting until the VTVM reads the same value as it did originally. Write down the frequency to which the signal generator is tuned. Then detune the signal to the other side of the original setting until the VTVM again reads the same value. Write down the frequency shown on the signal generator. Subtract the smaller of the two frequencies just obtained from the larger. The answer is the "selectivity at 2 time down" of the receiver at that frequency. The selectivity will be different at different basic frequencies. To get a more complete picture of the selectivity curve, repeat the above procedure at 100 times and 1000 times the original signal generator value.

The "Q" of a tuned circuit may be easily approximated as indicated in Fig. 7. Assuming that the internal impedance of the signal generator is small, the value of Q will be equal to the ratio of the voltage measured across the tuning condenser at resonance and at some point removed from resonance. This may be shown in a simple mathematical relationship:

$$Q = \frac{E_1}{E_2}$$

where E_1 = the voltage at resonance, and E_2 is the voltage removed from resonance. For example, if the voltage at the resonant frequency is 5 volts and the voltage at other than the resonant frequency is .1 volt, the Q of the circuit is 5 divided by .1, or 50.

Many other uses of the Vacuum Tube Voltmeter will undoubtedly suggest themselves to the enterprising serviceman. Among them will be methods of measuring the inductance, capacity or resistance of components, plotting AVC response curves, measuring hum, measuring distortion, and others. It will easily be conceded that the VTVM is indeed the most useful and versatile tool in the radio service business.

BACK NUMBERS
Get Them While They Last

JANUARY 1946
THE PROBLEMS OF ORGANIZATION
TELEVISION RECEIVER INSTALLATION
RADIO MAINTENANCE IN AVIATION
USING THE OSCILLOGRAPH FOR DISTORTION MEASUREMENTS

APRIL 1946
A MIDGET AUDIO FREQUENCY OSCILLATOR
IF I WERE A SERVICEMAN
AN EQUALIZED AMPLIFIER FOR MAGNETIC PICKUPS

MAY 1946
PA SYSTEMS
TEST PANEL FOR THE MODERN BENCH
RINGING THE BELL

JUNE-JULY 1946
FUNDAMENTALS OF TELEVISION
VOLUME CONTROL TAPERS
THE ELECTRONIC OHMMETER
VECTOR ANALYSIS

AUGUST 1946
AVC CIRCUITS
FM TROUBLESHOOTING
TELEVISION RECEIVER FUNDAMENTALS
RECORD CHANGERS

DECEMBER 1946
TELEVISION RECEIVERS . . . THE RF SECTION
TUNING THE INDICATORS
PART II—THE OSCILLOGRAPH . . . HOW TO USE IT
REPLACING AUTO CABLES

JANUARY 1947
SERVICING BY EAR
TELEVISING RECEIVERS . . . VIDEO CHANNEL
PART III THE OSCILLOGRAPH . . . HOW TO USE IT
MINIATURE TUBE CHART

FEBRUARY 1947
THE OSCILLOGRAPH . . . HOW TO USE IT PART IV
TELEVISION RECEIVERS . . . THE SOUND CHANNEL
THE AUDIO OSCILLATOR
SELENIUM RECTIFIERS

MARCH 1947
ANTENNAS . . . FM AND TELEVISION PART I
SERVICING AUTOMATIC RECORD CHANGERS
OSCILLATORS AND CONVERTERS
TELEVISION RECEIVERS . . . THE VERTICAL SWEEP

APRIL 1947
ANTENNAS . . . FM AND TELEVISION, PART II
PHASE INVERTER CIRCUITS
A UNIVERSAL SPEAKER
TELEVISION RECEIVERS . . . THE HORIZONTAL SWEEP

MAY 1947
THE OPEN AND CLOSE CASES
VOLTAGE DOUBLERS
SIGNAL TRACER
TELEVISION RECEIVERS . . . THE CATHODE RAY TUBE

JUNE 1947
WHEN THE CUSTOMER ISN'T RIGHT
TEST EQUIPMENT MAINTENANCE
CRYSTAL CONTROLLED SIGNAL GENERATOR
TELEVISION RECEIVERS . . . THE POWER SUPPLY

JULY 1947
SERVICING FM RECEIVERS
TEST EQUIPMENT MAINTENANCE, PART II
TELEVISION RECEIVERS . . . FLYWHEEL SYNC

AUGUST 1947
SPEAKER MATCHING
TEST EQUIPMENT MAINTENANCE, PART III
SERVICING FM RECEIVERS
TELEVISION . . . HF POWER SUPPLIES

RADIO MAINTENANCE MAGAZINE
460 BLOOMFIELD AVE., MONTCLAIR, N. J.

Please send me the back numbers checked here . . . I am enclosing 35c for each copy, or $2 for any 8 copies, or $3.25 for all 14.

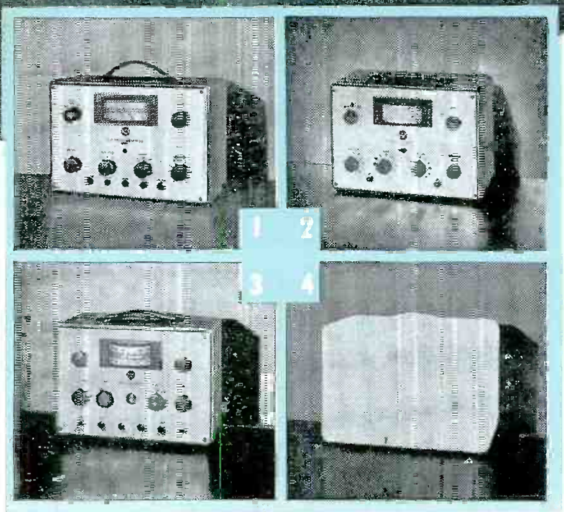
☐ January 1946 ☐ April 1946 ☐ May 1946 ☐ June-July 1946 ☐ August 1946
☐ December 1946 ☐ January 1947 ☐ February 1947 ☐ March 1947 ☐ April 1947
☐ June 1947 ☐ May 1947 ☐ July 1947 ☐ August 1947

☐ Have selected 8 copies . . . enclosing $2.00
☐ Send me all 14 . . . enclosing $3.25

NAME ....
ADDRESS ....
CITY ....
ZONE .... STATE ....

RADIO MAINTENANCE
460 Bloomfield Ave.,
Montclair I, N. J.
Please send me RADIO MAINTENANCE for:
☐ 2 years at $5.00
☐ I year at $3.00
☐ Check enclosed
☐ Bill me later
Name ....
Occupation ....
Address ....
City .... Zone ....
State ....

HUGHES PRINTING CO.
EAST STROUDSBURG, PA.



ON THE WAY—a superior line of test equipment that puts time-consuming service jobs on a profitable, production-line basis . . . that anticipates all FM and television needs. Matched styling of all instruments permits attractive, convenient grouping. Watch for announcements of the other units in this new line.

Provides every signal you need for fast, accurate FM alignment

THE WR-53A removes the last element of doubt from FM receiver alignment . . . regardless of band-width requirements. You bring the recognized advantages of the sweep method of alignment to every FM job—speed, accuracy, and reliability that add up to a perfect job every time, in less time.

It's packed with features to make your work easier. Here's a quick check list:

. . . i-f center frequency, 8.3 to 10.7 mc . . . adjustable i-f sweep width . . . internal and external frequency modulation . . . r-f range continuously variable from 85 to 110 mc . . . provides AM or c-w signals . . . includes step and fine attenuators . . . a scope phase control permits centering of sweep patterns.

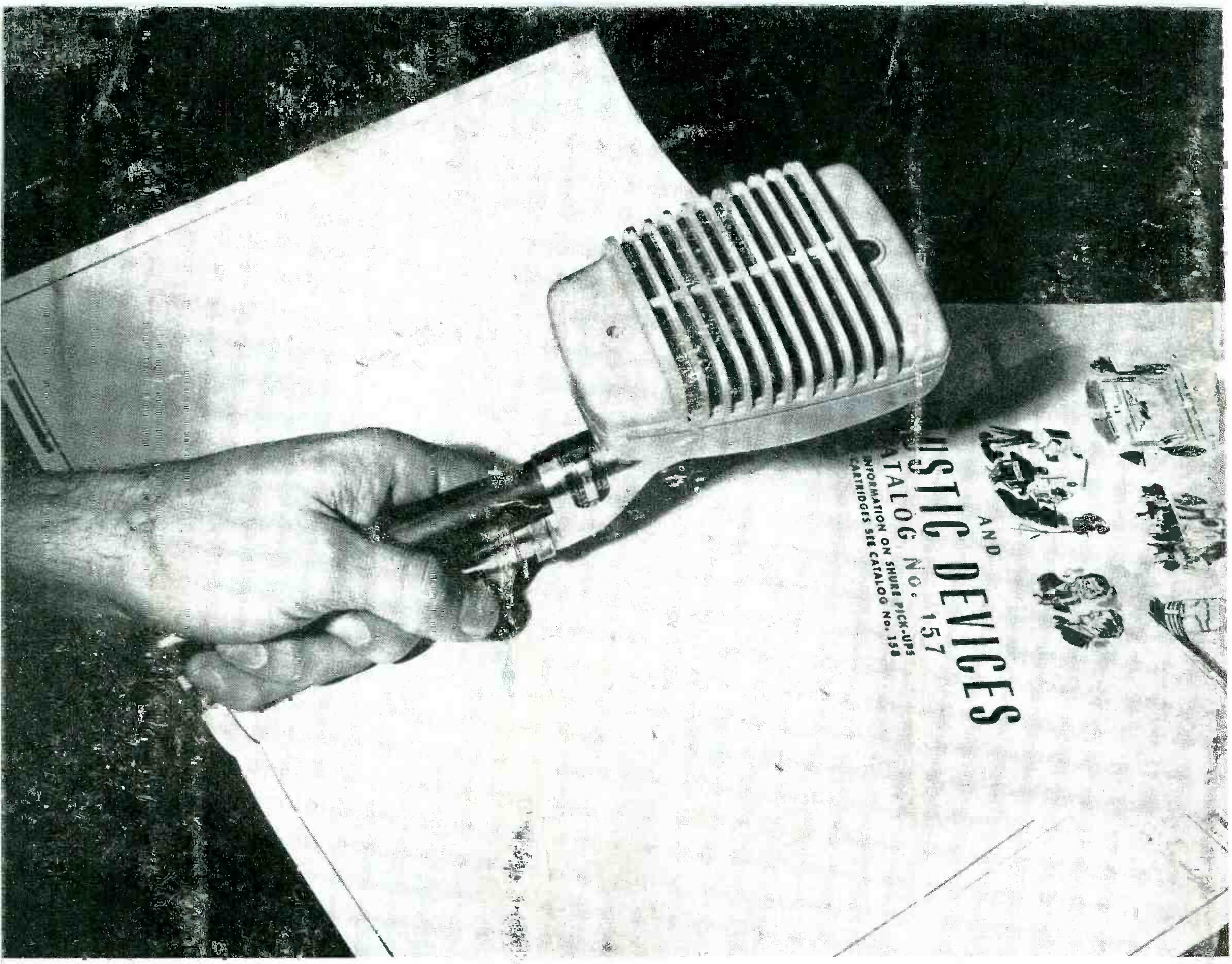
With the i-f sweep section, you can align i-f stages by the variable-frequency or visual method. When used with an oscilloscope or VoltOhmyst, you can quickly adjust an FM discriminator circuit by either the visual or single-frequency method. Alignment of r-f, local-oscillator, ratio-detector, and mixer circuits all become simple, routine jobs.

Here's an instrument that's comparable in performance yet half the price of similar laboratory-type equipment. It's a "natural" for the receiver manufacturer's laboratory as well as the radio service shop.

A new bulletin is yours for the asking. *Keep in touch* with your RCA Test Equipment Distributor.

RADIO CORPORATION of AMERICA

TEST AND MEASURING EQUIPMENT **HARRISON, N.J.**



EXTRA! Coming up: one of the biggest series on sound equipment ever published—get in on the big money in sound!

30,000

Successful Servicemen use

RADIO MAINTENANCE

every day

RADIO MAINTENANCE is one of the most valuable items among radio servicing tools. Using the proper tools speeds up work—increases profits. In every issue, RADIO MAINTENANCE presents articles and departments full of money-making ideas. Add it to your previous issues and form a complete service library. All your RADIO MAINTENANCE magazines are designed to form a reference library in themselves. Binders holding up to 18 copies each are now available for preserving your RADIO MAINTENANCE library—don't miss a single issue!

RADIO MAINTENANCE MAGAZINE

460 BLOOMFIELD AVE. MONTCLAIR 1, N. J.