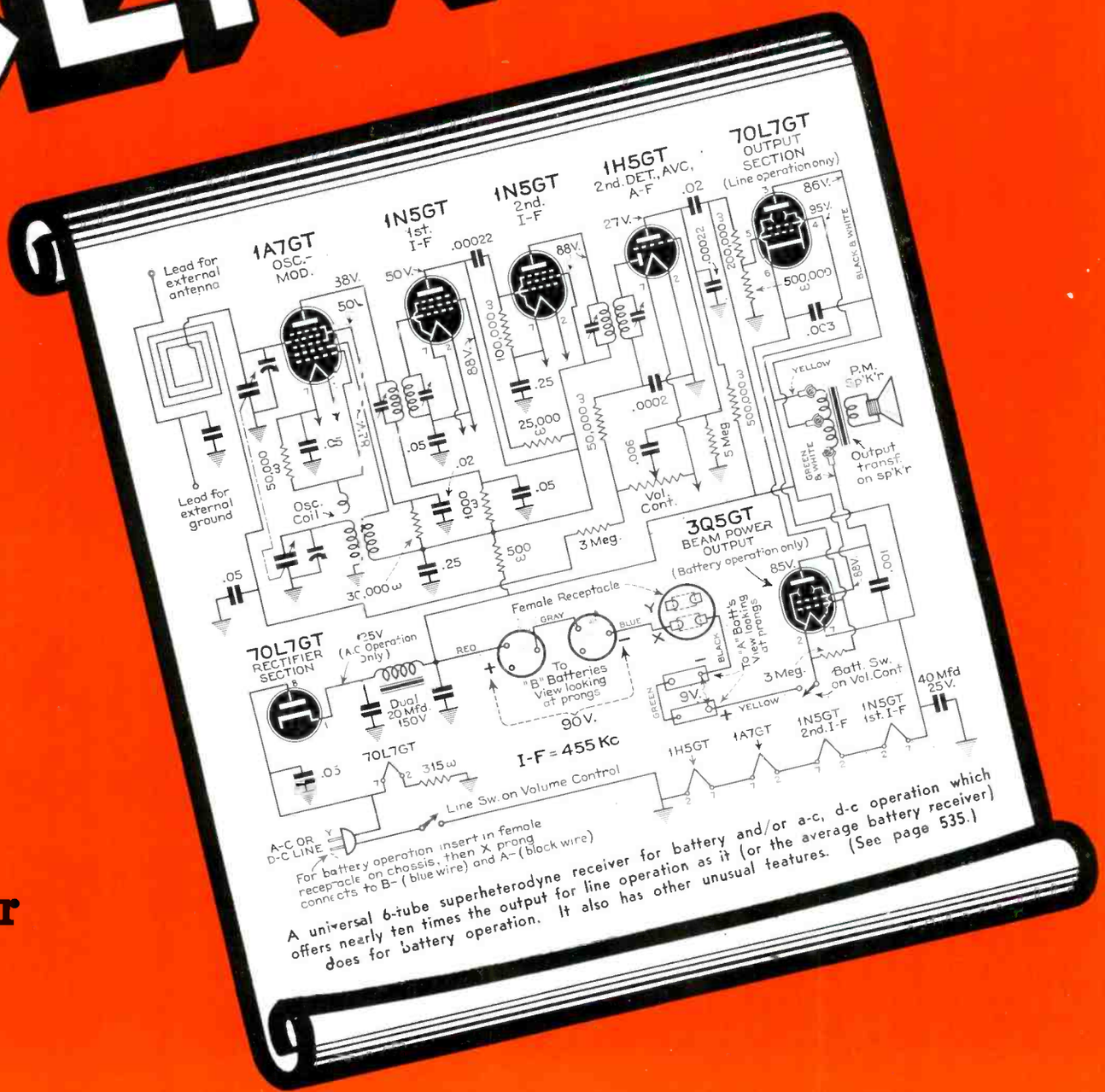
A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

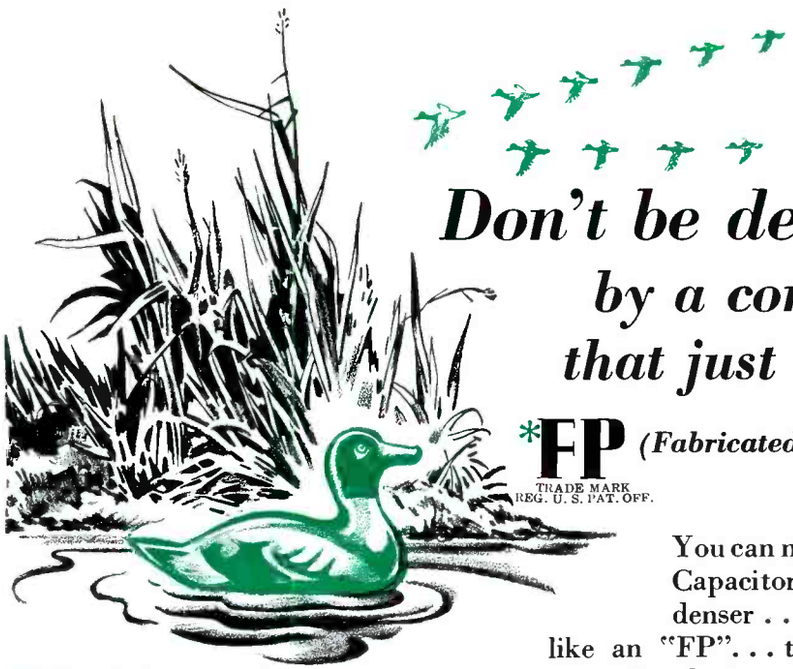
SERVICE



A universal 6-tube superheterodyne receiver for battery and/or a-c, d-c operation which offers nearly ten times the output for line operation as it (or the average battery receiver) does for battery operation. It also has other unusual features. (See page 535.)

November 1939

RADIO — TELEVISION



Don't be decoyed by a condenser that just looks like an

*FP (Fabricated Plate) CAPACITOR

TRADE MARK REG. U. S. PAT. OFF.

*NOT etched construction

You can no more expect FP (Fabricated Plate) Capacitor performance out of any other condenser . . . no matter how much it may look like an "FP"... than you could expect flight from a wooden duck.

It was only natural that the success of FP (Fabricated Plate) Capacitors would invite imitation in appearance. But the *real* difference *cannot* be imitated. FP (Fabricated Plate) Capacitors are constructed by a patented process that involved great investments of time and money to develop. The result is a capacitor that sets a new high in characteristics and performance.

Low R. F. Impedance . . . better filtering efficiency . . . surge proof construction . . . smaller sizes without a sacrifice of safety or efficiency . . . freedom from corrosion . . . these are just a few of the revolutionary features of FP (Fabricated Plate) Capacitors.

Over a Million Now in Use As Original Equipment

Best evidence of the superiority of FP Capacitors has been their prompt adoption by leading set manufacturers. In addition to the million already in use, future schedules call for the use of millions more. You'll be seeing them in all leading sets . . . and although they are being imitated in appearance, you can identify them by the number (1) or (3) in a circle, stamped on every genuine Fabricated Plate Capacitor.

Every Desired FP Characteristic In MALLORY Fabricated Plate Tubular Condensers.

Mallory Type BB Condensers are Fabricated Plate construction in a one piece drawn aluminum can. Each is insulated with an attractive cardboard tube well marked for easy rating identification. Strong internal construction eliminates troublesome open circuits.

Remember only Mallory makes Fabricated Plate construction for replacement capacitors. The sooner you call your Mallory-Yaxley distributor and place your order . . . the sooner you'll shake hands with better profits.

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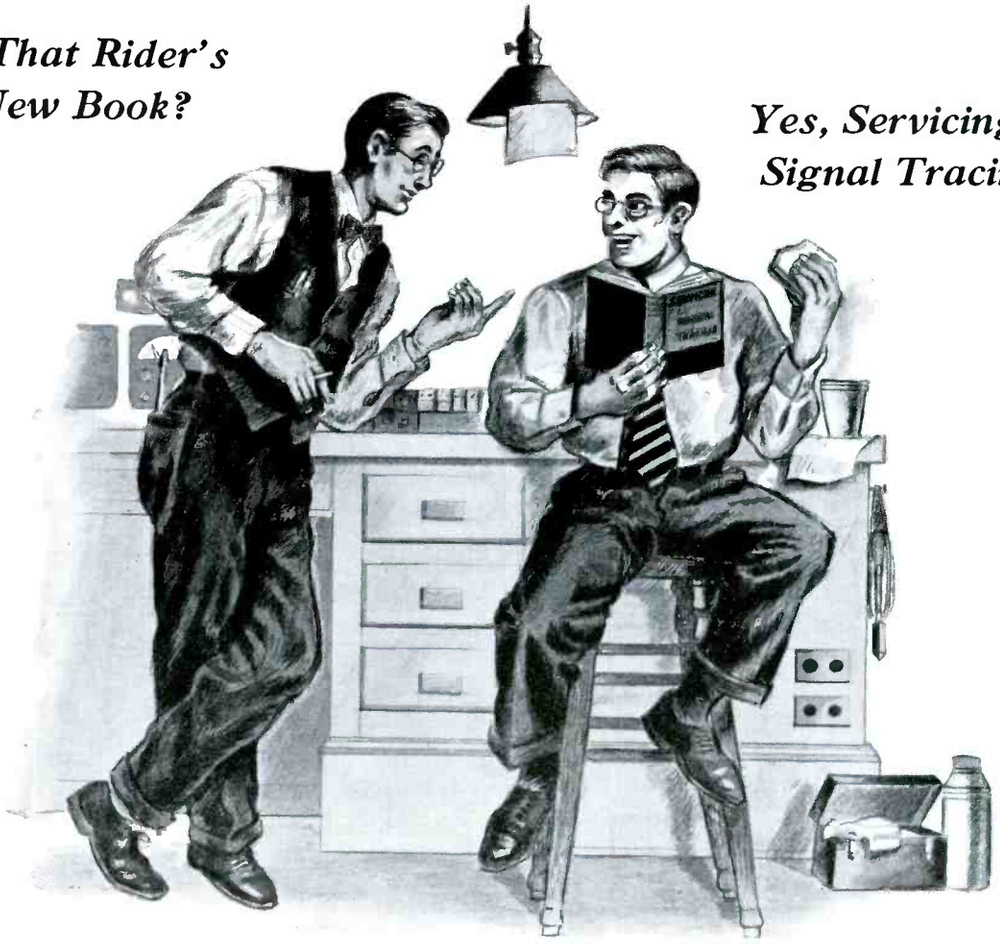
Is That Rider's New Book?



Yes, Servicing by Signal Tracing.

What d'ya think of it?
I think it's swell.

I don't mean the book, I mean do you think this new System of Rider's is any good?

Any good? Say, where have you been for the past two years! Don't tell me you don't know about servicing by signal tracing —it's the only true method of dynamic testing!

So what? I can find out what's wrong with a receiver by the same method I've used for ten years.

Sure you can, and you can deliver your jobs on horseback, but it's quicker and cheaper to use a car. Receiver designs aren't as simple as they were ten years ago. The sets we're getting in here right now are so complicated that this new system of Rider's is a Godsend.

Yea, for Rider.

OK, get smart about it. But just take my word, you better read up on it today, because you're going to be using it tomorrow. If you're gonna keep up with competition you've gotta shoot troubles a lot faster than you have been because every year it gets tougher and tougher to "outguess" the new sets when they go bad.

So, how's what you call servicing by signal tracing going to make it easier?

By tracing the signal!—the one thing that's fundamental in any make receiver.—Find out where that departs from normal and you have found the trouble.

Then that method could be applied to servicing P. A. systems, Television or most anything.

Sure, any type of electrical equipment through which a signal passes. It doesn't make any difference whether it's a new or old receiver or one they bring out next year—tuned r-f or super-het—three tubes or thirty—they all are diagnosed by the same procedure if you use the signal tracing method.

It seems too good to be true, it sounds so simple.

It's like a lot of things. You feel like saying, 'it's a wonder nobody thought of that before,' but when you understand it you can't quarrel with it—it's good.

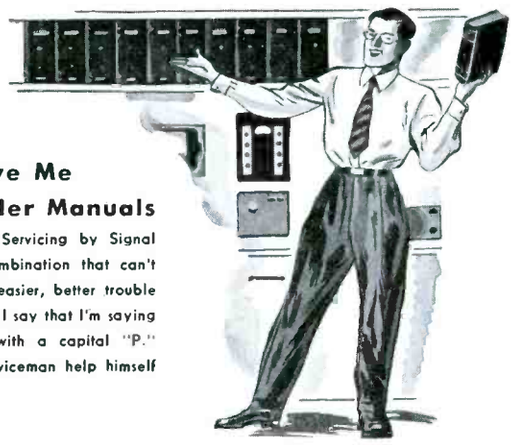
What's the book tell you?

In the first seven chapters Rider tells, in his easy to understand style, about the behavior of a normal signal from the antenna post to the loudspeaker, and signal characteristics at the points between. The rest of the book explains the signal tracing method step by step.

Let's see that book!

Sure, but you can't borrow it. It only costs $2.00 and besides it's about time you spent some time and money getting ready for tomorrow's business.

Is that all that book costs? Why it's got 360 pages. I'm going to the jobbers this afternoon. I'll pick up my own copy.—And I hate to admit it to you, but thanks a lot for a darn good tip.



Believe Me

The Ten Rider Manuals

and the system of Servicing by Signal Tracing make a combination that can't be beat for faster, easier, better trouble shooting—and when I say that I'm saying they mean profits with a capital "P." They help every serviceman help himself to bigger money.

JOHN F. RIDER, Publisher

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Vol. 8, No. 11 - November, 1939

SERVICE

A Monthly Digest of Radio and Allied Maintenance

ROBERT G. HERZOG, Editor

MEMBER AUDIT BUREAU OF CIRCULATIONS

Reg. U. S. Patent Office

ANTENNA

HARD on the heels of other innovations, frequency modulation is rapidly coming into the limelight. Without making any predictions we feel that you should endeavor to learn all you can about *every* new possibility just as early in the game as you can. We suggest that you read Mr. Yocum's article on the subject, which starts on page 507 of this issue, and make sure that you will receive a copy of the December issue so that you can follow his interpretations to their conclusion.

CHRISTMAS approaches and with it your customers go gifty. Why not take advantage of the season and wrap up your principal product in Christmas finery for added profits.

A "Gift Certificate" or "Servit-icate" that means service of a set for a beloved listener-in, or friend or member of the family, presents an attractive and practical gift. There are so many things that may be secured for Santa's sack that you can come to his aid by capitalizing on Christmas. Parts, novelties, accessories, or orders for special services, small sets, especially battery portables, and popular items in allied lines—records, appliances, Christmas tree lighting effects, electric train accessories, and repairs, etc.—can all be decked out as "Last minute gift suggestions". The homeliest gadget when covered with gift glamour makes a charming and (especially when needed) a most welcome gift.

The holiday season may be used to bring other sources for added income. Many companies and organizations give Christmas parties a day or two before Christmas or New Year's Day. The enterprising Service Man can rent radio tuners, record players and amplifiers for such events. No large selection of records is needed; a few old standbys such as "Auld Lang Syne" and "Silent Night" plus several popular numbers should be quite sufficient.

Now is the time to prepare for the increase in business which the holidays should bring. Stock up on tubes and replacement parts so that you will be able to devote your full time to profitable ends when the rush comes.

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SPRAGUE TEL-OHMIKE

CONDENSER and RESISTOR ANALYZER

It Shows Up Intermittent Opens!

By using the milliammeter and voltmeter you already own with Tel-Ohmike, you have a modern, obsolescence-proof instrument worth $50 for a net price of only **$29.70**

TEL-OHMIKE saves ycu money, not only by providing you with a basic instrument which allows you to use the meters you already own, but it saves you valuable working time. It enables ycu to make more complete and more accurate tests of *ALL* the characteristics of condensers and resistors in less time than ever before at any price! TEL-OHMIKE measures capacity from .00001 mfd. to 2000 mfd. It measures leakage current and power factor of electrolytic condensers; it measures insulation resistance up to *10,000 megohms.* It analyzes air, paper, mica, oil, dry and wet electrolytic condensers *under their exact working voltages*!

It measures resistance from 0.5 ohms to 5 megohms. All balance indications are given by a 'magic eye" tube and all measurements are taken from large, direct reading scales. TEL-OHMIKE indicates open and short circuited condensers, and *shows up intermittent open condensers and resistors.* TEL-OHMIKE establishes new standards in economy and efficiency in test equipment design. See it at Sprague jobbers, or write directly for free bulletin.

TWO NEW SPRAGUE LEADERS

SPRAGUE

KOOLOHM RESISTORS

The biggest improvement in 20 years—with more practical useful features than any other resistor—for no more money

Here are the wire wound resistors you have been waiting for—resistors you can use anywhere at full wattage ratings, even for the highest resistance values—resistors that are completely insulated and operate cooler—resistors that are different in construction and outstandingly superior in performance. All wire in KOOLOHMS is coated *before* winding with Rubencote, a new heat-proof, moisture-proof insulating material. This permits tightly interleaved windings, larger wire sizes, higher resistance values in less space, and perfect insulation throughout. No fine resistance wires! No cements or enamels! Moisture-proof ceramic jackets provide rugged mechanical protection and high voltage insulation.

WIRES TOUCH . . . BUT THEY DON'T SHORT!

Note the interleaved winding pattern of Sprague Koolohms made possible by perfect insulation of the wire itself. Note also (cutaway view) how units are protected mechanically, and insulated electrically, by a hard ceramic outer shell. No danger of chipping or breakage.

Resistance values guaranteed to plus or minus 5% accuracy. Non-inductive KOOLOHMS with zero inductance, even at 50 MC, and distributed capacitance of only 2.5 mmfd., are available at unheard of low prices! All units have Teledot indicators.

Your jobber now has Sprague KOOLOHMS in 5-watt fixed types; 10-watt fixed, 10-watt Non-inductive and 10-watt adjustable.

TELEDOT INDICATOR

Koolohms take overloads better than any other resistors—yet, for double safety, the red dot (Teledot) on the ends of units automatically changes color and warns you when 25% overload occurs. No guesswork. Teledot tells you!

BY THE MAKERS OF FAMOUS SPRAGUE CONDENSERS

SPRAGUE PRODUCTS CO.
North Adams, Mass.

TRUE DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

Model 1510
DEALER NET
49.67

HERE IS THE PROOF

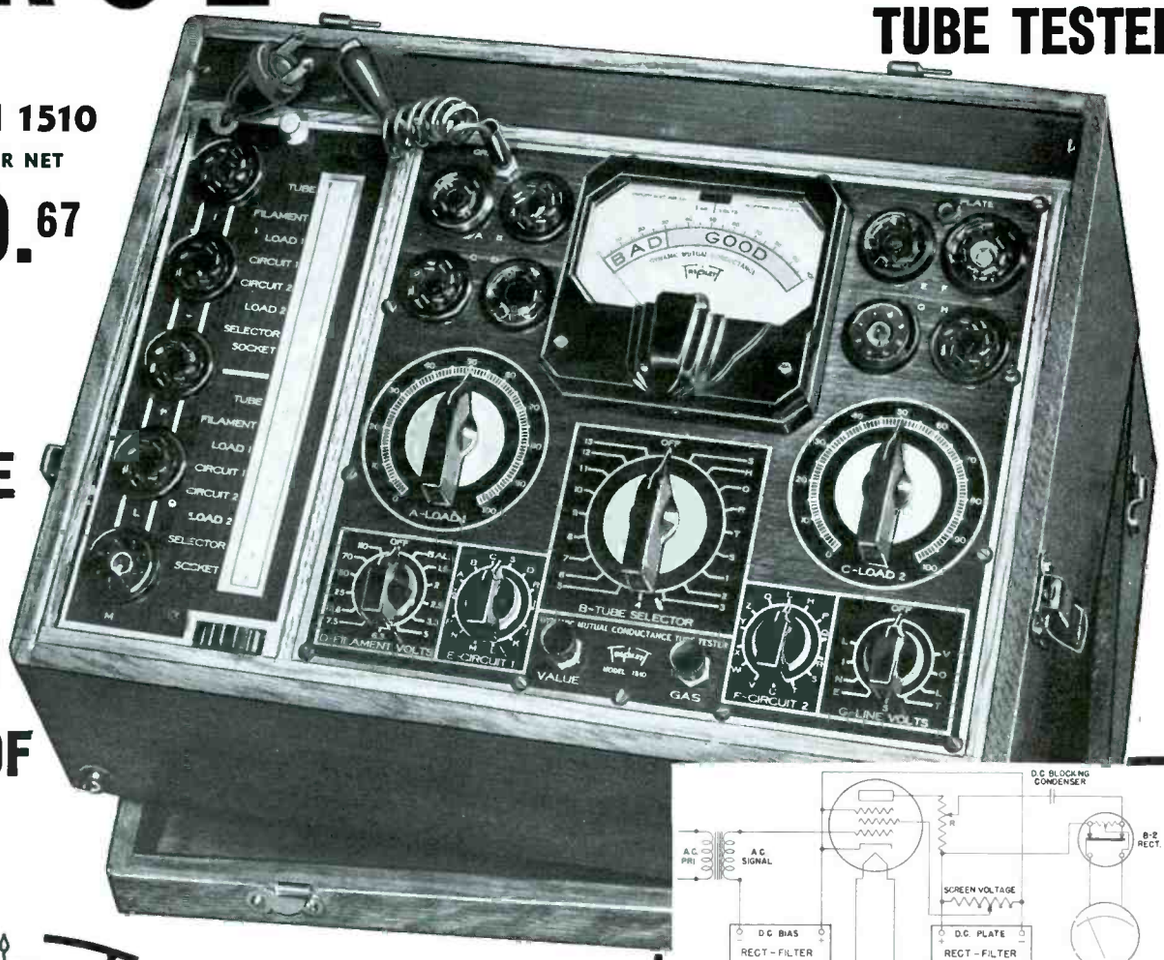


FIG. 1—DYNAMIC MUTUAL CONDUCTANCE CIRCUIT

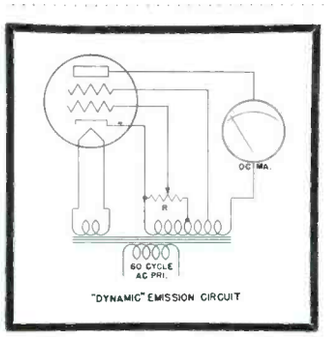
TRIPLETT Models 1510-11

You can see from a glance at the diagram that Models 1510 and 1511 are actually—not simulated—Dynamic Mutual Conductance Testers, an important point when considered along with Triplett precision manufacturing, at the attractive price of these models.

Model 1510 Dynamic Mutual Conductance Tube Tester shows GOOD and BAD on the illuminated dial. Gas and Ballast tube continuity test included. Checks all receiving tubes, including the new high-voltage series. Filament voltages in 20 steps from 1.4 up to and including tests for 117-volt tubes. Rotating chart enables quick selection of instructions. Separate line voltage meter. Tester positively will not deactivate 1.4-volt tubes. For absolutely conclusive tube testing use a Triplett TRUE Dynamic Mutual Conductance Tube Tester. Has RED DOT Lifetime Guaranteed instrument.

Model 1510 Tube Tester in attractive quartered oak case; sloping etched panel. ..... Dealer Net Price **$49.67**

Model 1511—same as above but with Volt-Ohm-Milliammeter ..... Dealer Net Price ... **$59.67**



"DYNAMIC" EMISSION CIRCUIT

DYNAMIC EMISSION

All elements have A.C. connections. Control grid voltage is varied to change output reading. Connected as shown, the plate current is pulsating D.C. and must be brought to same value for all tubes, regardless of their capacity, in order to read in "Good" section of scale. This is NOT Dynamic Mutual conductance, and rated D.C. voltages are not applied to the elements. Tube readings vary with grid voltage, spacing of elements and cathode emission.

TRIPLETT TRUE DYNAMIC MUTUAL CONDUCTANCE (Gm) CIRCUIT

Each element, except heaters, is connected to rated D.C. voltage, including bias on the control grid. A standard A.C. signal is then applied to the control grid, causing change in plate current. This change in plate current is called the A.C. component and represents mutual conductance.

The A.C. component only is taken off through a condenser at resistor R and then goes through a copper oxide rectifier which in turn operates the D.C. milliammeter.

Reading depends on number of electrons emitted by cathode, spacing of, as well as size and shape of elements. All D.C. voltages are constant as well as the signal. Mutual conductance readings at other than rated voltages are meaningless.

WRITE *for* CATALOG!

Section 1711 Harmon Ave.

THE TRIPLETT ELECTRICAL INSTRUMENT CO.
Bluffton, Ohio

FREQUENCY MODULATION

An up-to-the-minute summary on frequency modulation. This is the first of a series of two articles on this interesting subject

By CHARLES H. YOCUM

SOMETHING new and vital has come to radio. Wide-band frequency modulation offers the set manufacturer, the seller, and the user of radio the possibility for a new era in which performance will be paramount. The industry welcomed the recent upward trend in prices, small as it was. F-m is a proven system, standing ready to free it from "price" standards, give it instead a "quality" standard.

Fortune magazine, in its October issue, insists that 40,000,000 home receivers and 750 or 800 transmitters became obsolete on the day the f-m system was perfected. Engineers within the industry are more conservative. They know that years may be needed to change two-billion dollars worth of equipment to another system, no matter how superior that system might be.

Those who have not followed the progress of f-m will be amazed at its advancement. Look at the list of stations in Table I. They are on the air or actually under construction. All will be on the air before next spring.

The scientist and engineer has presented this development to us all. Will the public demand the refinements and greater enjoyment promised by f-m? A tremendous replacement volume hangs on the answer.

From the standpoint of the consumer, f-m transmission has two major advantages. First, is its amazing fidelity. Music and speech have a natural sound, you hear a truer duplication of the original program in the studio. High fidelity is commercial, not experimental.

OPERATOR	LOCATION	POWER Kw.
Major Armstrong	Alpine, N.J.	50
WDRC, Inc.	Meriden, Conn.	1
Yankee Network	Paxton, Mass.	2
Yankee Network	Paxton, Mass.	50
Jansky & Bailey	Washington, D.C.	1
Interstate Broad.Co.	New York City	1
Stromberg-Carlson	Rochester, N.Y.	1
Mutual Broad.Co.	New York City	1
Milwaukee Journal	Milwaukee, Wis.	2
WHEC, Inc.	Rochester, N.Y.	2
Worcester Telegram	Worcester, Mass.	1
Travelers Ins.Co.	Hartford, Conn.	1
General Electric	Heidelburg Mt., N.Y.	10

Table I. A list of f-m stations either on the air or under construction.

noise reduction

The freedom from atmospheric disturbances and local noise, which the buying public group together as static, is equally noteworthy. No longer will it be necessary to turn off your favorite program because a thunder storm is brewing. A bolt of lightning may strike the transmitter and cause only a mild click in your receiver. All interference is reduced. Faults associated with radio since its earliest days are wiped out or reduced far below what is considered acceptable today.

Many technical factors combine to give this vastly improved reception. One advantage of the f-m system is that radio-frequency noise which may occur between the transmitter and receiver is not evenly distributed throughout the audible range when it is reproduced in the speaker. It is a peculiarity of f-m that these noises, due to what we normally call static, are minimized at the lower audio frequencies. They increase steadily as we approach the limit of human hearing at about 15 kc. The noise and interference continue to increase still further up to 75 or 100 kc, and some part of this disturbance may pass through the receiver.

No human ear, however, can detect the part of this distortion which occurs above about 15 kc. The human ear also is much more sensitive to distortion at low pitch. Thus this peculiar distribution, of what we may call the disturbance energy, occurs in such a way that the human ear rejects by far the greatest part of it entirely, and is most sensitive in the region where the f-m system most completely wipes out the disturbing sounds. The amount of advantage accruing to f-m depends, of course, upon the keenness of hearing of each individual. A number of tests, however, show that at least 50% more actual audible distortion may be present in an f-m program than in an a-m program, yet the human ear would rank them both equally acceptable and free from objectionable disturbances. This means that an f-m program may be received with enjoyment in an area where local electrical disturbances, whether natural or man-made, would normally make pleas-

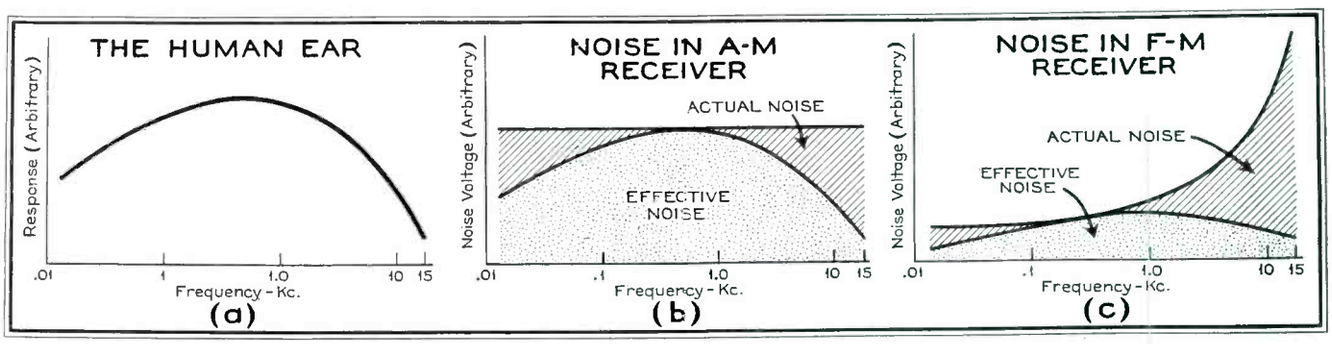


Fig. 1. The reduction in effective noise voltage in f-m reception due to response of human ear.

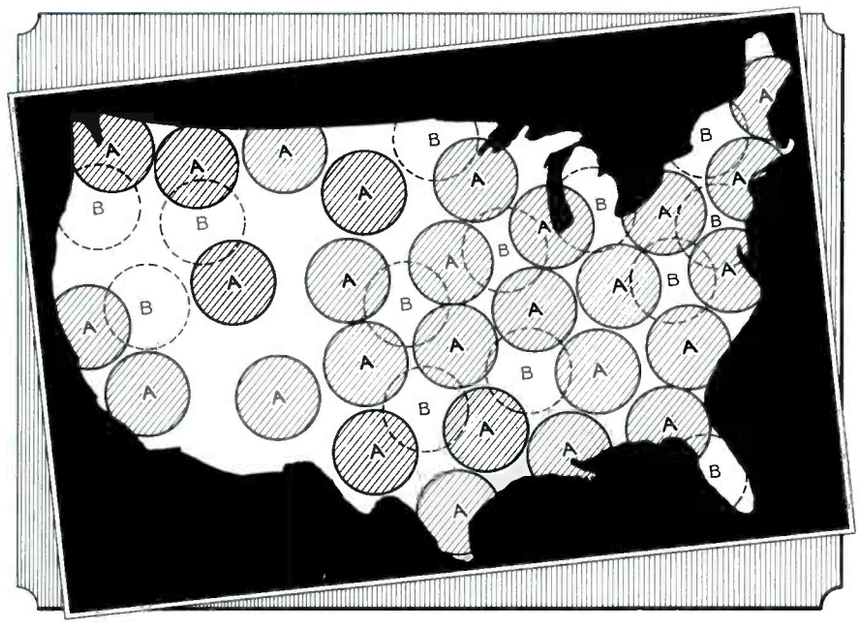


Fig. 3. A possible two-frequency arrangement of f-m stations covering practically the whole country. A frequency, 27 stations —B frequency, 13 stations.

ant listening an impossibility. See Fig. 1.

In addition, some disturbances are themselves of definite band width, or affect only a certain band of frequencies in the transmitted signal. If the program we hear in our receiver is carried to us through a system which is only 10 kc wide, then a disturbance affecting a band 1 kc wide will cause a certain amount of distortion. If, on the other hand, our receiver brings us a program by means of an energy band 100 kc wide, then this 1 kc disturbance will cause less distortion than occurred in the first case. If one f-m system operates with a swing of 50 kc each side of its carrier, and another with a swing of 5 kc each side of its carrier, the first transmitter should show an improvement of at least 10 to 1 as compared to the second in its ability to suppress noise.

The actual figures are astounding. When the peak value of the disturbance is less than 10% of the signal (both measured in the limiter stage of the f-m receiver) then the energy of this disturbance after rectification will be reduced by almost 1100 to 1. For noise voltage upwards of 25% of the signal voltage, the noise reduction in the rectified signal will be about 700 to 1. When the noise is one-half the signal it appears in the output reduced by a factor of about 400 to 1. If the noise and signal become approximately equal, the actual improvement drops to some very low value of 2 or 3 to 1. Although the primary service area would be considerably enlarged if the suppression could be kept up to 400 or 500 to 1 when noise and signal were about equal, let us not forget that high-fidelity a-m reception requires signal to noise ratio of about 100 to 1. This is the region where the f-m system's ability to suppress unwanted noise is a maximum.

inter-station interference

Reference has been made to the efforts of early experimenters who tried to use f-m in order to pack more transmitters in the broadcast band. A big advantage of modern f-m transmitters is that a number of them may be assigned to the same frequency, provided they are several hundred miles or more apart. There will be no cross-modulation or interference. This is due to the fact that the f-m receiver will reproduce only the stronger of two signals, suppressing the weaker one, provided the ratio of the signal voltages in the receiver is 2 to 1 or more. F-m is at present limited by the FCC to frequencies of 40 mc or higher. The limit of satisfactory signal strength for such transmission is somewhere between 100 and 150 miles. We can visualize a large number of transmitters, all on the same wavelength, scattered across the country at distances of approximately 300 miles from each other. Each one covers its own primary service area without being affected by, or interfering with, the other transmitters on the same band. Present experiments indicate that even better results could be had if the assigned frequencies of the stations were separated by amounts as small as 10 or 15 kc. Due to the action of the detecting device in the f-m receiver, the suppression of unwanted signals would be still further increased. It is often possible, however, to pick up the weaker signal with a directive antenna which would increase the amount of desired signal available to the receiver. Map, Fig. 3.

The ability of the f-m transmitter to minimize natural and man-made interference and to magnify the wanted signal gives the system a cumulative advantage over present types. If we calculate the performance of an f-m transmitter and an a-m transmitter, both drawing about the same number of kw from the lines of the local utility, the f-m system with a band width of 150 kc and the a-m system with a band width of 10 kc, we find that a theoretical overall improvement of more than 1000 to 1 may be secured. This improvement is measured by the accepted method: comparing the ratios of signal to signal-plus-noise permissible for high-fidelity reproduction.

Actual comparisons have shown the possibility of approaching this ratio in practical, every-day operations. Some allowance should be made for the circumstances attending the test, since u-h-f transmission of any type has advantages over the same system operated in the broadcast band. The tests would have been more acceptable had they compared a-m and f-m, both at the same high frequency. Sufficient additional improvement exists, however, to convince many investigators.

phase shift

Another operating advantage of f-m rests upon the fact that high audio frequencies are transmitted with the minimum phase shift in output, and low frequencies with the maximum. In a typical case cited by Major Armstrong, 30 cycles per second would be represented by a phase shift of 30 degrees; 10,000 cycles by a shift of but .09 degrees. Even after the series of multiplications required to change this shift to an f-m wave, the highest audio frequencies lie

Table II. Roder's calculations for frequency-modulated amplitude variations. Phase modulation (last column) should be restricted to less than 30° to avoid serious distortion. Note that in phase modulation the phase shift varies inversely as audio frequency; in true frequency modulation the frequency deviation varies directly as the audio frequency.

AUDIO SIGNAL FREQUENCY (Cycles per Sec.)	CARRIER AMPLITUDE	SIDE FREQUENCY AMPLITUDES								CORRESPONDING PHASE SHIFT.
		1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	
10,000	100	2.5	-	-	-	-	-	-	-	2.9°
5000	100	5.0	-	-	-	-	-	-	-	5.7°
2500	99	9.9	-	-	-	-	-	-	-	11.5°
1000	93.8	24.2	3.1	-	-	-	-	-	-	28.6°
500	76.5	44	11.5	1.9	-	-	-	-	-	57.3°
250	22.4	57.7	35.3	12.9	3.4	-	-	-	-	114.6°
100	17.7	32.7	4.6	36.5	39.1	26.1	13.1	5.3	1.8	286°

Amplitudes are expressed as percent of unmodulated carrier.

closest to the assigned carrier in phase relationship. Thus, a considerable amount of additional amplification may be given to all the higher audio frequencies without causing interference with adjacent programs. Pronounced amplification of the highs in an a-m transmitter is limited in order to prevent cross-modulation of adjacent channels.

cost factors

Another advantage of the f-m system is that the modulation of even the largest transmitter can be accomplished using the same type of tubes and components found in radio receivers, except for the final stages. A 50-kw modulator bay (Fig. 2—pictures) is reduced to the approximate size of an 8 or 10-tube receiver chassis, although it includes its own power pack.

The maximum voltage (plate supply) applied to any component part of the modulator is only 180 volts. Such voltages are easily handled and filtered and represent an economical design which is reflected in the initial and lower maintenance cost of the complete transmitter. Voltages over 200 are found only in the power stages.

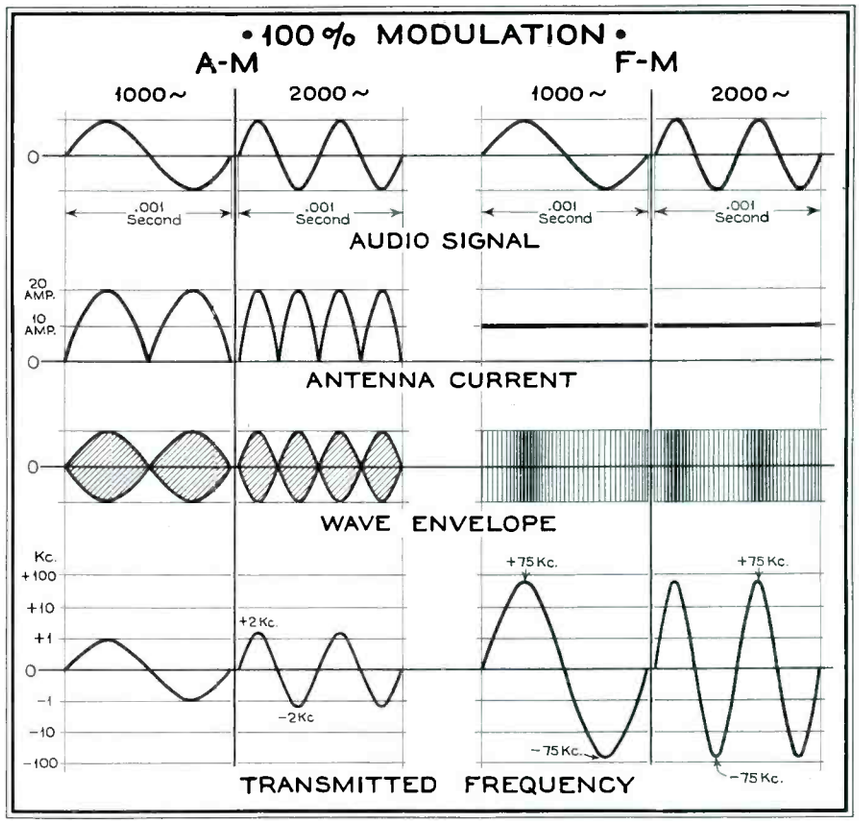
Further economy results from the fact that for equal transmitter power rating only about half the electrical energy is required from the power lines by an f-m system as compared to a-m. This economy is partly due to the fact that f-m lends itself admirably to the use of Class C output stages and also because the antenna current does not vary (during program transmission) from the carrier level.

Some criticism of f-m is voiced because, in its modulating system, a small phase shift of not over 30° must be multiplied, with strict linearity, several thousand times. The answer to this is that the modulator is relatively inexpensive. The carrier is modulated at a low energy level and the majority of the parts used in its construction, both tubes and components, are identical with those used in home receivers. This complexity of parts is merely that of numbers, since the actual circuits are doublers and triplers of a conventional type.

economic status

Reference has been made earlier to an article in *Fortune* which strongly criticizes the FCC and the broadcast industry for their apparent failure to enable the public to enjoy f-m programs. Granting every advantage claimed by the strongest advocates of f-m, how can the industry begin to replace any major part of the a-m transmitters and receivers now in use? Their replacement value runs into billions of dollars. No program has yet been evolved which offers the industry an economically sound way to change to f-m, overnight.

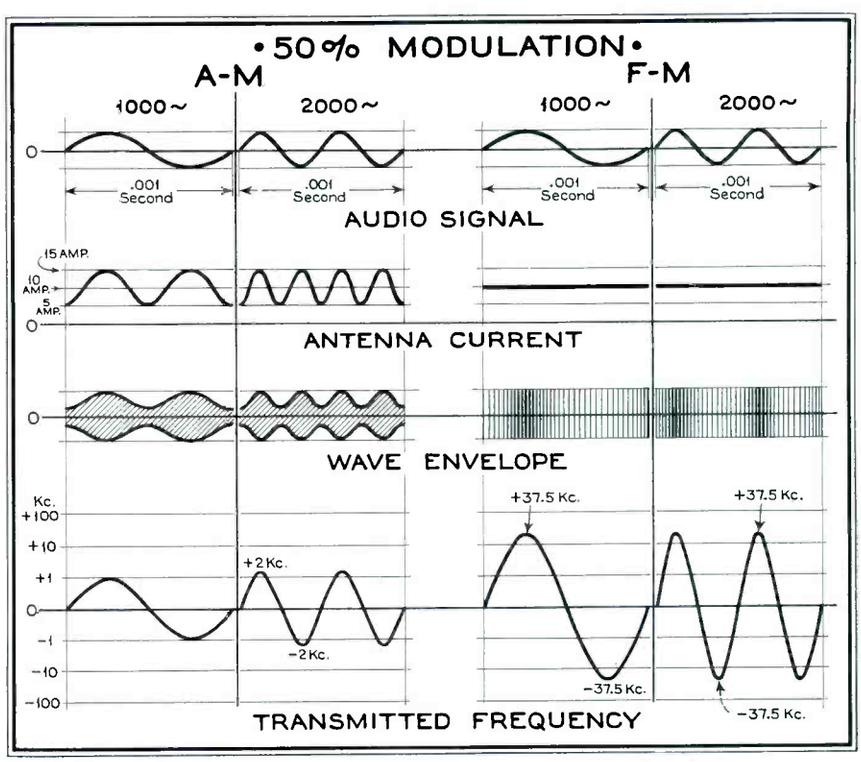
Perhaps an answer is developing at this very moment. Station WABC, for example, is now piping some of its programs to Major Armstrong's transmitter at Alpine (Fig. 4.) The potential buyer of an f-m receiver may compare the quality of the two methods of transmission in the area served by the



Above: Fig. 5-A. 100% modulated signals.

Fig. 5. A comparison of the transmission variables in f-m and a-m.

Below: Fig. 5-B. 50% modulated signals.



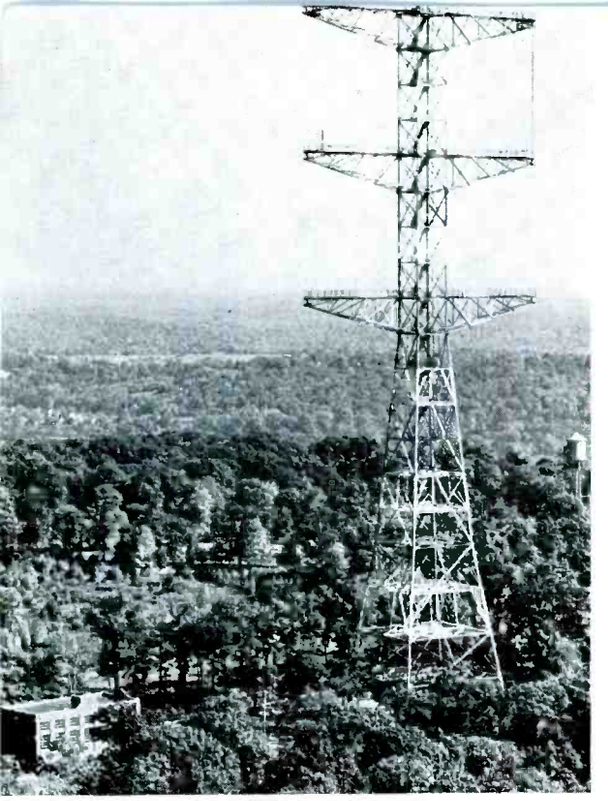


Fig. 4. First 50-kw u-h-f f-m transmitter—W2XMN, Alpine, N. J. (near N. Y. C.). Designed, constructed, operated by Major Armstrong.

Alpine transmitter. If f-m continues to advance in public acceptance, a double system may be needed, until the public makes a final choice.

The variety and quality of American radio entertainment is admittedly the best in the world. It is paid for by advertisers, who buy time on the radio only because they can thus reach more people for a given expenditure than they can by competitive media. The individual broadcaster or chain cannot change to f-m unless enough f-m receivers are in operation in his primary service area to permit him to charge the sponsor an adequate fee. The maker of receivers can offer f-m sets at attractive prices only if he is assured of a volume of sales. The public cannot be expected to buy an f-m receiver if it means that he must sacrifice the reception of his favorite programs, or if the price is too high.

Since radio broadcasting in this country is a private undertaking, many factors must be weighed before a change can be authorized. Existing contracts with sponsors, competition, stockholders, patents, licenses, are but a few. The remarkable point, in the opinion of many, is that a new and radical departure from the established system can have made the rapid progress which f-m has, in spite of these factors, all nominally opposed to sudden change.

transmission fundamentals

In order to compare the f-m and a-m systems in operation, we must first return to the fundamental problem of transmitting intelligence by radio. There are two variables which must be sent from the transmitter to the receiver, if we are faithfully to reproduce in the latter the program originating in the studio. Each of these variables suffers wide changes independently of the other. They are the pitch or frequency of the program material, and its volume.

In a conventional a-m transmitter the change in pitch is indicated by a change (in cycles per second) from the fixed carrier frequency. Thus, if an a-m transmitter, operating with double sidebands, were assigned a frequency of 42.8 mc, a 1000-cycle note would be broadcast when this transmitter was sending out a wave, the side frequencies of which would be 42.799 and 42.801 mc. Change in volume is signalled by a variation in the amount of current fed into the antenna of the transmitter. For example, if the antenna current is 10 amperes when no signal is being broadcast, this current would be increased to 20 amperes for 100% modulation, or the loudest sound which this system could transmit. An antenna current of 15 amperes would represent a sound about one-half as loud as the first, etc.

The first point of difference between the above system and f-m transmission is that the f-m station broadcasts a signal of constant amplitude whether modulated or not. Zero, 50 or 100% modulation would call for a 10-ampere antenna current in all cases, if we use the carrier power assumed for the a-m transmitter. The loudness of the sound presented to the microphone of the f-m system would be indicated by the frequency deviation of the side frequencies. If this station likewise operated on a carrier of 42.8 mc, 100% modulation would be indicated when the emitted frequency contained side frequencies of 42.725 to 42.875 mc. If 50% modulation was to be indicated, the frequency would vary between the limits of 42.7625 and 42.8375 mc. If no modulation was present, the transmitter would emit a single continuous frequency of 42.8 mc. If a 1000-cycle note is being fed into the microphone at an f-m station, the frequency swing will take place 1000 times in every second. Note that under no circumstances will the antenna current deviate from 10 amperes. We may summarize the comparison by stating that a-m indicates pitch by changing the frequency of the radiated energy; f-m by the *time rate of change* of frequency. The a-m system indicates percentage modulation by proportionate changes in the antenna current; f-m by varying the amount of frequency swing above and below its assigned carrier. See Fig. 5.

Experimenters have tried to apply frequency modulation to solve radio problems since the earliest days. It was tried on both spark transmitters and the early phone sets without success in either case. We can see now that one probable reason for these failures was that the experimenters were trying to compress the normal audio band of 10 kc into one only 2- or 3-kc wide. This, if successful, would have permitted many more transmitters to operate in the broadcast band. As we have seen, f-m has a solution to that problem today. It has achieved its success, however, by an exactly opposite method of attack. Today's f-m transmitter transmits a band 100 or 150 kc wide to reproduce in the home receiver an audio band of 15 kc with fidelity. But there were many other problems which had to be overcome, however, before f-m could reach its present state of development.

(To be concluded)

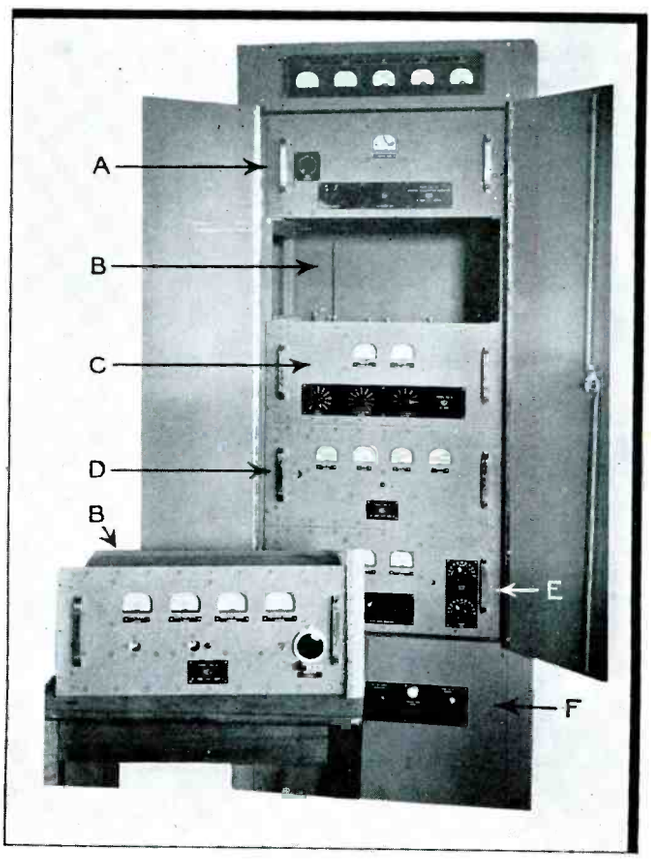


Fig. 2. The standard Radio Engineering Laboratories modulator for all f-m transmitters from 1-50 kw. Between 1 and 5 kw, this unit followed by 2 power stages; between 5-50 kw, one additional, or 3, power stages required. (A) Zero-level input predistorter and corrector; (B) modulator and crystal oscillator; (C) frequency doublers; (D) crystal control and doublers; (E) output stages; (F) power supply.

VOLTAGE MEASUREMENT

By JACK AVINS

LET'S say that you're working on Mr. Jones' set. It seems to operate well on most stations but the output is distorted on strong locals. Sounds like overloading. One of the first things therefore, is to check the avc circuit. It is possible, with a modern voltmeter, to measure the avc voltage directly at the grids of each of the controlled tubes without disturbing the operation of the receiver. If a tube is not receiving the proper control bias the defect will be indicated immediately.

On the other hand, if your measuring equipment is behind the times, instead of the simple and rapid measurement, you'll have to break into the circuit and indirectly determine grid bias by inserting a suitably by-passed milliammeter in the plate circuit of each of the controlled tubes. From the value of the plate current, you'll be able to estimate the control voltage. Even then you'll have to assume that other conditions in the tube circuit are correct before you can depend on your estimate of the voltage.

simplified measurements

Simpler, more direct, and more positive, the new way gives you your answer by indicating the true voltage directly on the meter scale without any necessity for breaking into the set or in any way disturbing its operation. Fig. 1 shows the contrast between the old and the new methods.

Let's take another illustration. Suppose you've localized trouble to the first a-f stage of a receiver so that naturally you want to see whether the grid bias and the plate voltage are normal. With a modern voltmeter you can measure these voltages—even in a high-gain resistance-coupled stage—under actual operating conditions and with no reaction on the circuit. With a lower impedance voltmeter, however, the circuit conditions are so greatly disturbed that the voltages you read differ widely from the actual voltages when the voltmeter is removed. Fig. 2 shows a typical example of how loading of a circuit by a low-resistance voltmeter causes large errors in the measurements. In the case of the plate-voltage measurement, the error is about 50%, while for the grid-bias measurement the error is about 90%. Had a modern voltmeter been used the true voltages would have been indicated in each case because of the absence of loading of the circuit.

Every Service Man has encountered leaky coupling condensers. Often these coupling condensers are intermittently leaky, a condition which makes the trouble more difficult to detect. In cases of this sort where there is reason to suspect the coupling condenser, it is helpful to be able to monitor the actual voltage while the receiver is operating. If the receiver should cut out and the output becomes distorted as a result of the leaky condenser (or a gassy tube), then the voltmeter reading will change accordingly. Thus with a modern voltmeter you can keep a constant check on the actual voltage at any point while a signal is passing through the receiver. As we shall see later, the fact that an r-f or a-f signal may be present at the point of measurement does not interfere with the accuracy of the measurement.

We could go on indefinitely citing examples to show you how a modern voltmeter simplifies servicing. But more illustrations are not necessary because undoubtedly you can recall any number of examples where a modern voltmeter would have saved time—examples taken from your own practical servicing experience. What it all amounts to is this: When you make a voltage measurement you want to read the *actual* voltage present in the circuit. You'll agree that servicing is interesting enough without using an instrument that indicates voltages different from the actual voltages you're trying to measure. Why figure out what the voltage *would be* if the voltmeter *didn't* load the circuit, when instruments are available which will give you the true voltage directly?

ELECTRONIC, "umpty" ohms-per-volt, dynamic, zero-current, infinite impedance, etc.—no doubt you've seen all these terms used to describe recently introduced voltmeters. This article discusses the latest developments in the field of voltage measuring instruments.

voltmeter development

To see modern voltage-measuring instruments in the proper perspective, it is helpful to trace briefly the development of voltmeters. The first voltmeters used in radio work consisted essentially of a current measuring instrument in series with a standard resistance of known value. As Fig. 3 shows, Ohm's law was used to determine the value of voltage across the terminals of the current meter and the resistance. Since the current through the combination was proportional to the voltage across the terminals, it was possible to calibrate the scale in terms of this voltage rather than in terms of the current.

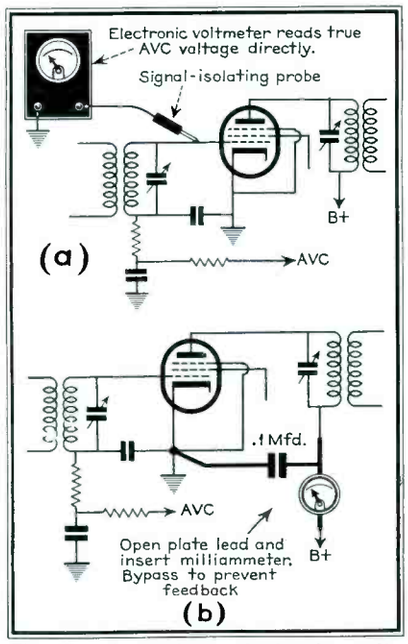


Fig. 1. A modern electronic voltmeter (a) measures the actual control voltage at the grid. Without it the measurement must be made by indirect methods (b).

These early voltmeters were entirely satisfactory for a considerable number of years, but then gradually conditions arose more and more frequently where the voltmeter gave an incorrect reading. This is not to say that the voltmeters did not indicate the voltage across its terminals. What happened however is that the voltmeters drew too much current from the radio circuit and altered the voltage conditions in the circuit.

The first voltmeters required about ten milliamperes for a full scale deflection. These voltmeters were said to have a resistance of 100 ohms-per-volt because the resistance of the voltmeter for any range could be computed by multiplying the full-scale voltage reading of the range by the ohms-per-volt value of the meter. For example, using this rule the resistance of a 100 ohms-per-volt meter on the 250-volt range would thus be equal to 250 × 100 or 25,000 ohms.

Later the resistance of voltmeters was increased from 100-ohms-per-volt to 1000 ohms-per-volt. Thus the current meter part of the voltmeter was reduced from ten milliamperes full scale to one milliampere full scale and at the same

time all the resistance or multiplier values were multiplied by a factor of ten.

For many years the 1000 ohms-per-volt meter was able to meet the needs of Service Men. So widely was this true that up until recently many receiver manufacturers specified all voltage data in terms of readings taken with a 1000 ohms-per-volt meter. In an increasing number of instances, however, we find statements like this appearing in voltage data: "This is the actual operating voltage; cannot be measured with a 1000 ohms-per-volt meter." "Measured with the 500-volt range of a 1000 ohm-per-volt meter."

Now what did all this mean? While receiver circuits had been advancing steadily, the Service Man's testing instruments had apparently been standing still. New automatic control circuits, new high gain a-f circuits, decoupling circuits, etc., had been developed for receivers—circuits which used high values of resistance and in which currents of only a few microamperes flowed. Yet voltage measurements were still being made by means of a meter which required 1000 microamperes for full scale deflection: Unfortunately the 1000 microamperes required for the deflection of the voltmeter could not be supplied from a circuit in which only a few microamperes were flowing.

The first step to cut down the current taken by the voltmeter was an obvious one: a more sensitive meter was used to replace the one-milliampere movement. Thus we find, for example, 5000 ohms-per-volt meters using a 200-microampere meter, and 20,000 ohms-per-volt meters using a 50-microampere meter. These higher-resistance voltmeters constituted a real step forward over the earlier 1000 ohms-per-volt meters. A 20,000 ohms-per-volt meter, for example, requires only one-twentieth the current from the circuit for a given deflection. Thus, it loads the circuit less and its reading is considerably closer to the actual voltage than that of lower resistance voltmeters. However, even these voltmeters which use a more sensitive current meter often disturb the conditions in the radio receiver circuits. When the voltage distribution of the circuit is affected an incorrect reading is obtained.

For a number of reasons it is not practical to increase the sensitivity of the meter movement used in voltmeters and at the present time a 50-microampere movement, corresponding to a sensitivity of 20,000 ohms-per-volt, represents about the extreme practical value. The use of a more sensitive movement is undesirable because the meter becomes less rugged and because the cost of the unit increases as the sensitivity is raised.

potentiometer types

One of the earliest methods known to engineers for the measurement of d-c voltages without drawing current was the potentiometer method. Like many laboratory methods, this method makes use of a balancing or null action. No attempt is made to measure the voltage directly, but instead the unknown voltage is matched against a known value of voltage which is provided from a separate source.

As Fig. 4 shows, a galvanometer is used to indicate when the variable voltage V_s is equal to the unknown voltage being measured. When no current flows through the galvanometer with the switch closed, the unknown voltage is equal to the bucking voltage V_s.

The voltmeter which is used in a potentiometer-type voltmeter need not be a high-resistance voltmeter because the current required for its indication is drawn from the internal voltage source and not from the circuit being measured. However, the galvanometer should be sensitive enough so that the minimum current required for an indication will not be sufficient to load the circuit.

This brings us to an important point in connection with potentiometer-type voltmeters, which have also been called "zero-current" or "infinite-impedance" voltmeters. Actually of course the galvanometers used in commercial service instruments of this type do require a certain value of current to provide a noticeable deflection, so that some current is drawn from the source. In one commercial instrument a 350 microampere meter is used so that the least detectable current would be about one microampere. If this instrument is used on say the 10-volt range its effective resistance will be about 10 megohms.

As is evident from Fig. 4, the potentiometer-type voltmeter must have a self-contained voltage source which is equal to the highest voltage intended to be measured. If a voltage multiplier is used, then a power supply having a smaller range can be used. In any event, the power supply must be carefully isolated from ground in order to avoid errors due to leakage between either side of the internal power supply and ground.

Although the input resistance of potentiometer-type voltmeters is sufficiently high, this type of voltmeter is not direct reading because a balance adjustment must be made each time a voltage reading is taken.

slide-back types

A modification of the potentiometer-type voltmeter is the so-called slide-back voltmeter. Shown in Fig. 5, this instrument also uses the same bucking principle, but the galvanometer is replaced by a vacuum-tube indicator. In operation, the slide-back v-t voltmeter is adjusted so that the plate current meter (I) indicates a conveniently small value of current, when no voltage is applied or with the test leads shorted. With the unknown voltage applied, V_s is varied until I again indicates the same small value of plate current. The voltage indicated by V_s is then equal to the unknown voltage V_x.

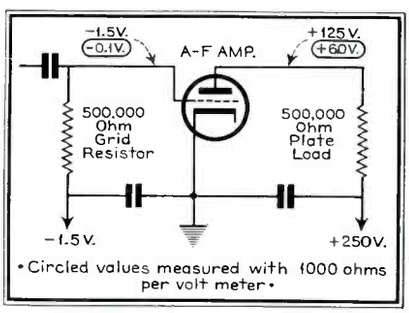
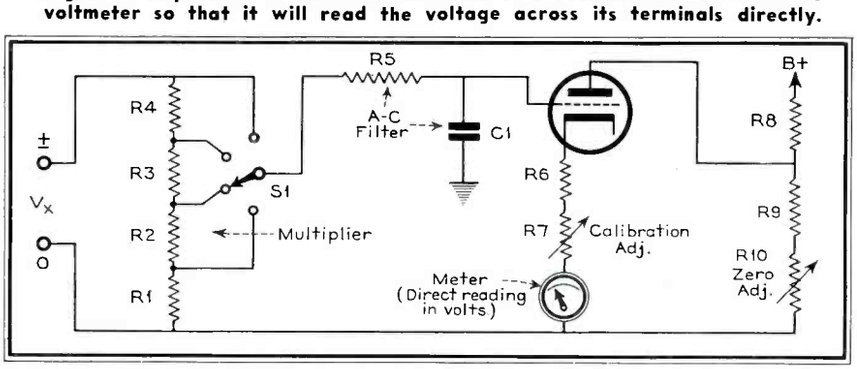


Fig. 2. Older type voltmeters load the circuit heavily and incorrect readings are obtained. With a modern instrument the actual voltages are indicated.

electronic types

Up to the present point, we have seen that the voltmeter consisting of a current meter in series with a resistor suffered from the disadvantage that it drew an appreciable current from the circuit. Although this disadvantage was re-

Fig. 6. It is possible to calibrate the scale of a vacuum-tube or electronic voltmeter so that it will read the voltage across its terminals directly.



moved by the potentiometer and slide-back types, these did not solve the problem completely because of the excessive time required to take a measurement.

So far none of the instruments which we have considered has made full use of the amplifying property of the vacuum tube. Why not use the fact that a vacuum tube has a very high input resistance and that any change in the d-c voltage applied to its grid will result in a relatively large change in plate current? In other words, why not use a vacuum-tube voltmeter for d-c voltage measurements? The obvious advantages of course are the high input resistance, the high sensitivity, and the fact that a milliammeter rather than a microammeter can be used as the indicator. Furthermore with proper circuit design it is possible to introduce enough degeneration to make the cali-

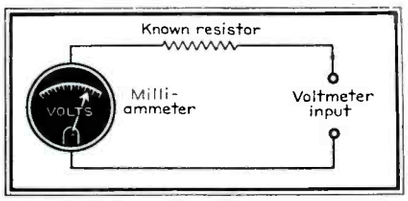


Fig. 3. Early voltmeters were made by connecting a milliammeter in series with a resistor of known value. The scale was calibrated directly in volts.

bration essentially independent of the variations in tube characteristics. Another point, by no means unimportant in service work where the instrument must be shifted from range to range, is the fact that the circuit can be arranged so that it is impossible to damage the meter.

Let us examine a simple electronic or v-t voltmeter circuit such as the one in Fig. 6. A triode is used which is self-biased by means of the resistors R_8 and R_7. In combination with the low value of plate voltage that is used, the total cathode resistance is such that the plate current produces a center-scale reading on the meter. When a negative voltage is applied to the input circuit, the plate current decreases so that the deflection is to the left of the center zero. Similarly when a positive voltage is applied to the grid, the meter deflects to the right of the zero. It is thus possible to calibrate the scale directly in terms of the voltage at the grid, and hence the instrument can be used as a direct-reading voltmeter.

The use of a large value of cathode resistance brings about a degenerative action which makes this voltage calibration essentially independent of tube characteristics and at the same time straightens the tube characteristic so that the calibration is practically linear. When tubes are changed in the voltmeter circuit, it is always possible to correct the calibration by readjusting the calibration control R_7. The plate voltage control R_{10} provides a zero adjustment which makes it possible to set the meter pointer to exactly center scale.

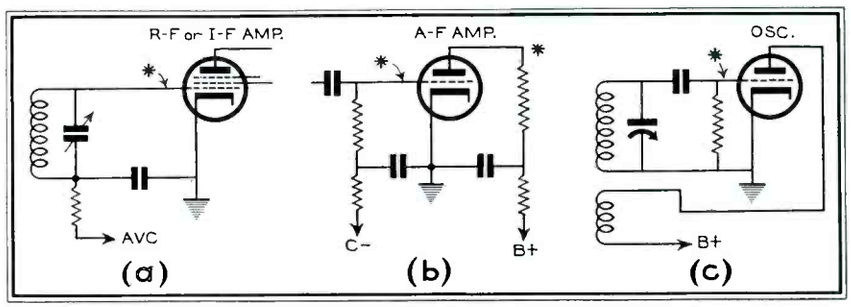


Fig. 7. With the probe shown in Fig. 8 it is possible to measure the operating voltages in the (typical) circuits shown.

Because of the center-zero arrangement, both positive and negative voltages can be measured directly without switching leads and without the necessity for a polarity switch. It is also possible to arrange the circuit so that the zero is at the left as in the conventional voltmeter. However, this requires the use of a highly linear circuit and the incorporation of a special polarity-reversing switch which is located directly in the meter circuit rather than in the test lead circuit.

With reference to the range covered by the voltmeter (Fig. 6) we note that this is dependent on the setting of the range switch. Maximum sensitivity is obtained with the switch in the number 1 position. As the switch position is changed to number 2, 3, and 4 positions, the scale of the voltmeter is multiplied in accordance with the values of the resistors in this voltage divider. The range of the voltmeter can be extended indefinitely without the necessity for using excessively high values of resistance in the multiplier. The only limitation is that the resistors must be capable of handling the applied voltage.

An interesting feature of the circuit is the filter formed by R_5-C_3. Primarily the purpose of the filter is to attenuate any a-c or signal voltages which may be present at the points where d-c voltages are being measured. Thus these a-c voltages are prevented from reaching the grid of the tube and interfering with the reading of the d-c voltage. Actually a reasonable value of a-c voltage at the grid will cause no error because the linearity of the circuit prevents rectification from taking place.

accuracy

With proper circuit design and adjustment, the d-c vacuum tube voltmeter or electronic voltmeter has an accuracy which is more than adequate for service needs. In the first place, the amplification obtained from the circuit permits a rugged meter to be used which tends to hold its calibration more permanently than would a more sensitive meter. Secondly, the calibration control which we have already described can eliminate the initial $\mp 2\%$ error which is inherent in the meter movement itself. In production this control can be set at the factory so that the voltmeter is "on the nose" regardless of deviations from the rated value of meter sensitivity. An important consideration affecting the accuracy is the proper design of the voltmeter multiplier resistors. These should be precision resistors which are accurate to $\mp 1\%$. In production a further improvement in accuracy is often made by grouping these resistors so that all "plus" or all "minus" resistors are used in a given voltage divider or multiplier network. This effectively reduces the error due to the multiplier resistances to less than 1%.

signal circuit probe

We all have had the experience of applying an ordinary voltmeter test probe to the grid or plate of an r-f or i-f tube only to find that the receiver ceased operating. Even with high-resistance voltmeters it is often not possible to make these measurements under actual operating conditions because of the detuning, loading, and feedback caused by the stray capacitance of the voltmeter test leads.

In service work, it is often desirable and convenient to be able to measure or monitor d-c voltage under actual operating conditions while a signal is passing through the receiver. Typical examples where this would be helpful are shown in Fig. 7: (a) the avc voltage directly at the grid of a controlled tube while an r-f or i-f signal is present at this point; (b) the grid bias directly at the control grid, or the plate voltage directly at the plate in a resistance coupled a-f stage with an a-f signal present at each of these tube electrodes; (c) the rectified grid voltage at the grid of an oscillator tube while the oscillator signal is (necessarily) present at the grid. In each case the point at which the measurement is made is indicated in the figure by an asterisk (*). We could

continue and cite other illustrations but this is unnecessary; the important point in all of these cases is that to make

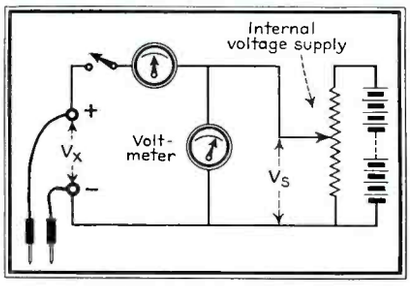


Fig. 4. The internal voltage of the potentiometer type voltmeter is varied until zero deflection on the galvanometer indicates that it is equal to the external voltage V_x.

voltage measurements that are truly dynamic, it must be possible to determine d-c voltages while an r-f or a-f signal is present. And in order not to disturb the circuit conditions the voltmeter must not interfere with the signal by detuning or loading the circuit in any way.

This detuning can be eliminated by means of a special test lead probe which contains an isolating resistor. A cutaway view of a probe of this type, used in an instrument which was introduced to Service Men last year, is shown in Fig. 8. Because of the isolating action of the resistor, the capacitance shunted across the point of measurement is approximately the shunt capacitance of the isolating resistor R. This capacitance, including the stray capacitance to ground of the test prod, is of the order of 1 mmfd, so that effectively the circuit is detuned by about 1 mmfd. As far as the loading effect is concerned, the isolating resistor reduces the r-f loading of the circuit to a value greater than 1 megohm. The d-c input resistance is of course sufficiently high since it is equal to the 1-megohm isolating resistance plus the input resistance of the voltmeter.

center zero

Aside from the convenience and ease of use made possible by the center-zero arrangement there is another more important reason for the use of this type of scale. We have seen that with the center-zero arrangement, the ground side of the voltmeter is clipped to the ground or low side of the voltage being measured. As a general rule in receiver servicing this means that the ground side of the voltmeter is clipped to the chassis of the receiver on which the measurements are being made. The "high" voltmeter lead is then connected to the point of measurement and whether this point is plus or minus with respect to ground, the voltage will be indicated directly; the voltage is plus if the deflection is to the right of the zero and minus if to the left of the zero.

Would it not be possible to use the full scale for either plus or minus voltages and then reverse the test leads as we do in the case of an ordinary voltmeter? Such a reversal of the test leads ordinarily ignores the fact that this connects the high side of the voltmeter input to the chassis of the receiver. As a result of this connection stray voltages are impressed on the grid of the vacuum-tube voltmeter and erratic readings are obtained. The results that are obtained are not unlike the effect produced by reversing the normal connections of a phono pickup to an audio amplifier.

The center-zero arrangement completely eliminates possibility of error from this source by invariably keeping the low side of the voltmeter at chassis or ground potential. Thus we see that in addition to the convenience of not having to change test leads, the center-zero arrangement eliminates errors due

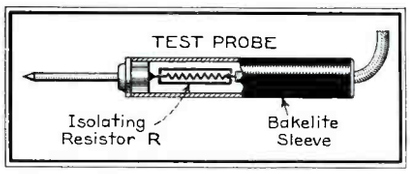


Fig. 8. The isolating resistor placed close to the probe point prevents the capacitance of the test leads and voltmeter input circuit from reacting on the circuit under test.

to faulty grounding and stray pickup.

Where a special circuit is used, it is possible to use the full scale of the voltmeter for either positive or negative voltages with the zero at the left of the scale. However, the polarity switch which must be used in instruments of this type is connected in the meter circuit rather than in series with the test leads. As we explained above, the instrument must be maintained at ground potential in all cases. Instruments which use the left-zero arrangement usually employ a balanced circuit so that equal changes in current through the meter are obtained for equal input voltages whether positive or negative.

conventional voltmeters

Although the lower-resistance voltmeters do not have the advantages of the d-c vacuum tube voltmeter—accuracy in high resistance circuits and the ability to measure control and operating voltages with the signal present—the error in making measurements in high-resistance circuits can be reduced somewhat if proper care is taken. For example, although it is general policy in using meters to choose the range which gives a reading well up on the scale, the error will be reduced by violating this principle. The reason for using a high range is that this increases the resistance of the voltmeter so that the loading on the circuit is decreased. The closer approach to the true voltage obtained as a result of the decreased loading more than compensates for the fact that only a very small deflection is obtained.

To minimize the loading effect of the lower-resistance voltmeters, a combined voltage and resistance measurement can often be made. Thus, for example, in checking the bias on an output tube, it can be measured at the voltage divider rather than at the grid. If a supplementary resistance measurement shows that there is no leakage to ground at the grid, and that the grid resistor has the proper value, then it follows that the bias at the grid has the same value which is measured at the voltage divider. This procedure, of course, assumes that the tube is not drawing grid current.

Alternatively it is possible to compute the voltage at a point in a high resistance circuit by measuring the voltage at some low-resistance point in the circuit and measuring the drop to the point at which the voltage is desired. The following example will make this clear: You wish to measure the actual voltage at the plate of a 6Q7 audio tube. First the plate supply voltage is measured and it turns out to be 250 volts. The next step is to measure the resistance between the plate and the 250-volt point in the power supply; this turns out to be 500,000 ohms, let us say. The plate current is next measured, and this turns out to be one-quarter milliampere or 250 microamperes. Thus by Ohm's

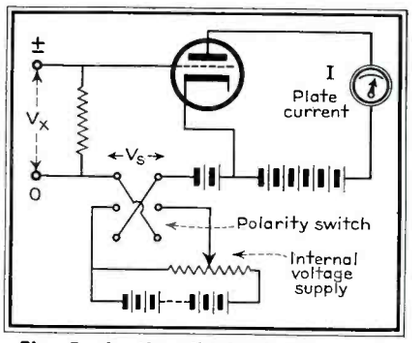


Fig. 5. In the slideback type voltmeter the plate current meter indicates when the internal and external voltages are equal.

Law this voltage drop across the load resistor is 500,000 ohms times 0.000250 amperes=125 volts, and the actual voltage at the plate is 125 volts.

With an electronic type voltmeter, time consuming measurements and computations such as those just discussed are avoided. The true voltage is measured directly at the point in question under true dynamic conditions.

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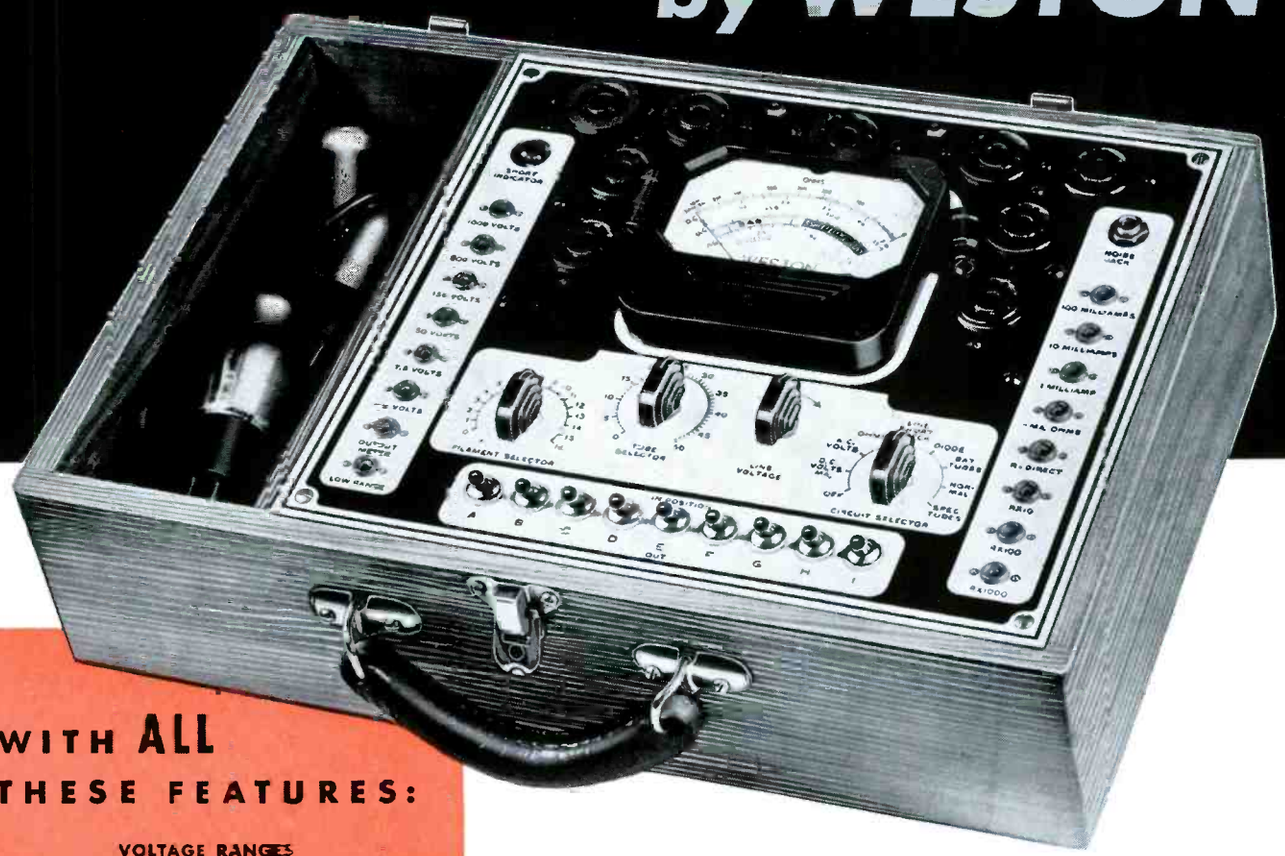

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*Approximate full scale value.

CURRENT, D-C
1 10-100 Milliamperes.

RESISTANCE
0-10,000; 0-100,000; 0-1 Meg.; 0-10 Meg.

TUBE TESTING FEATURES
Tests Loktal, single ended, gas filled, ballast and normal diode and battery tubes.
Filament tests on 117 volt tubes.
Noise, short and leakage tests.
Individual electrode tests.
Open element test.
Spare socket.
Spare tube compartment.
Equipped for use with Model 666-1B.
Socket Selectors.

PRICE ONLY $69.75
(net to dealers in U.S.A.)

All WESTON service units are *standardized* for rack or panel mounting.

With 23 circuit testing ranges... plus more than a dozen essential tube checking features... the new CHECKMASTER provides *everything* you need for years of dependable trouble shooting and estimating. And it's been made extremely compact, and light in weight... the panel measuring only 14" x 17". Thus it's ideal for field work, as well as for checking tubes and servicing in the shop. Best of all, the CHECKMASTER is WESTON *designed and* WESTON *built*. This means quicker, better servicing... for you'll have no doubts about your measurements. You'll *know* they're correct. It means you'll save money, too; for WESTON design forestalls obsolescence... gives many *extra* years of dependable service. Let us send you all the facts. Return the coupon, now!

WESTON ELECTRICAL INSTRUMENT CORPORATION
604 Frelinghuysen Avenue, Newark, New Jersey
Send literature on the new Model 774 CHECKMASTER.

Name.....

Address.....

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

AUTOMATIC ANNOUNCING

By LEWIS WINNER
MARKET RESEARCH ENGINEER

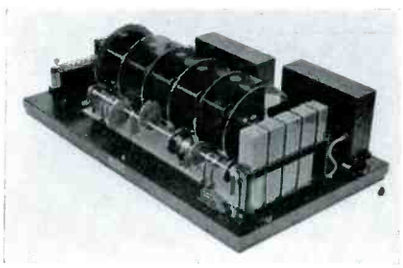
THE creation of the new automatic time and weather announcing units are paving the way for an interesting and profitable business for Service Men everywhere. The flexible design of these unusual instruments affords an extremely wide application to many industries where duplicate message announcements are essential. In the department stores, for instance, it will not be long before you will be hearing sales announcements in the elevators as you pass each floor. This will be made possible by the use of a group of units with the messages recorded photo-electrically or mechanically on film drums or plates, operated by specially synchronized motors, eccentric cams and gearing mechanisms, as described recently in COMMUNICATIONS[1].

Since these automatic announcers employ components so familiar to every Service Man, plus popular sound system circuits, operators of these devices will feel inclined to call on the Service Man more than anyone else. This fact has already been established in many towns where the new automatic time devices are now in use. In Hartford, a large service organization is maintaining the time-service device there on a 24 hour service basis. In New Haven, the boys at station WELI are taking care of the unit. In Montclair, a Service Man is entrusted with the unit used by the Montclair Trust Company. In a majority of the other cities where these devices have been adopted, the Service Man has been named as the guardian, in complete charge.

Of course, it will not be possible for Service Men to just walk in and offer complete assistance, until they have thoroughly learned the design, operation and applications of these instruments. Thus it is suggested that Service Men be extremely alert to the development of this new business; not only by reading and studying all available material, but by conducting their own surveys where the devices are already in operation and where they may be put into operation soon.

[1]Automatic Time and Weather Systems. by Lewis Winner, COMMUNICATIONS, October, 1939, p. 7.

Fig. 1. An excellent automatic announcing device developed by Ericsson of Sweden.



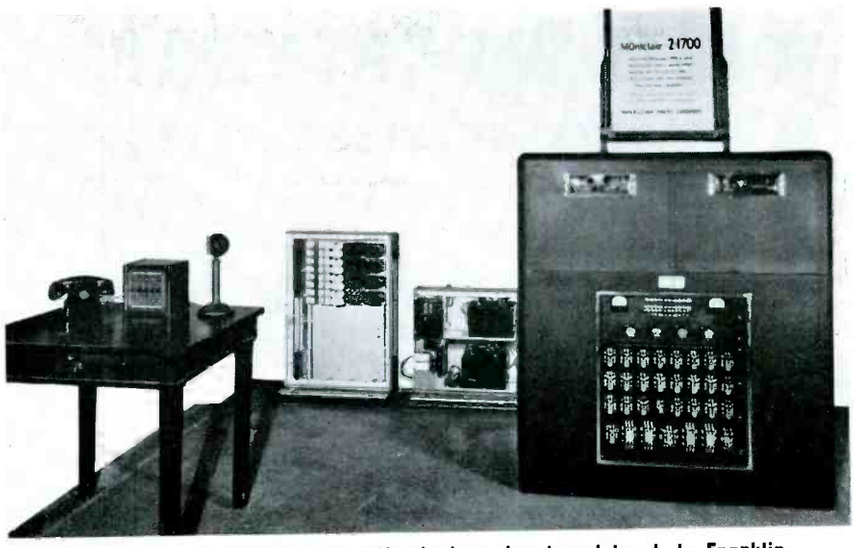


Fig. 2. The Audichron automatic devices developed by J. L. Franklin.

Department stores were mentioned as a possible source of automatic announcing installation, to further sales. But automatic units can be used for time-weather announcements, in the same manner as they are used in the telephone circuits. Offering this unusual service will certainly stimulate good will. The department stores can install phones in strategic points to enable customers to learn the required information. Many stores now employ a personal service with a series of standard phones, offering, buying assistance. Thus they are somewhat familiar with the advantages of such trunk line phone systems. It is suggested, therefore, that Service Men study department store house telephones . . . methods of running lines . . . volume levels . . . resistance line problems . . . balancing of circuits . . . motor synchrony . . . voice diffusion . . . relays . . . amplifiers . . . etc.

Airports and railroad stations are another source of installation. Here the instruments can transmit automatically to passengers such valued information as the time planes or trains will leave . . . where they will go . . . what platform, etc. Since most of these announcements are stock, repeated during the day and week, they can be recorded and transcribed automatically as the occasion demands. Of unusual interest is such an installation in the planes and trains too, offering such pertinent information as . . . the time . . . present position, etc. With the aid of the well designed audio systems we have today, this information will be heard by everyone clearly and accurately, so unlike the present method of microphone and personal announcing where the messages may be garbled.

Hotels offer another point where automatic announcing will be successful, for weather and time, as well as other pertinent repeat information that should be heard by the guests. This plan will be particularly valuable to the chain hotels where it will be possible to create a systematic network of announcements that couldn't be handled by a human system with any degree of success. Imagine, if you will, 150 persons all calling at the same time for . . . let us say . . . the weather information. It would resemble quite a problem for a standard corps of telephone operators. As a matter of fact . . . it would be well nigh impossible for them to handle the situation. Yet with the automatic system, this can be handled with utmost simplicity, with no wear and tear of nerves and with a delivery of speech that is pleasant and strident.

With a careful design of sound distribution, sign makers will also find this automatic system of great value. Take, for instance, the famous cartoon signs. Imagine the intense interest that would result when the actions of these little figures were allied with significant spoken messages . . . or just an

(*Continued on page 532*)

F-M RECEIVERS

STROMBERG-CARLSON 425, 480

THE Stromberg-Carlson Models 425 and 480 receivers are designed for the reception of the five frequency-modulated station channels (42.6, 42.8, 43, 43.2, and 43.4 mc) assigned by the FCC. The Model 480 provides, in addition, for reception of standard amplitude-modulated broadcast and short-wave programs.

model 480 circuit

The Model 480 is essentially two receivers with a common audio amplifier. In the upper section of the accompanying diagram the circuit of the r-f amplifier, converter, i-f amplifier, limiter and demodulator for the f-m portion is shown. The lower portion of the diagram is that of a conventional high-fidelity superheterodyne. Twenty tubes are used in all to provide three ranges, two for standard a-m reception and one f-m band. The ranges of the former are from 540 to 1700 kc and from 5.8 to 18 mc. The f-m range covers the five channels mentioned above from 40 to 44 mc. An electric tuning circuit is arranged so that seven favorite stations located in the standard a-m broadcast range may be set up for selection by means of the push buttons located on the front of the receiver, and eight stations may be set up for selection by means of the push buttons located on the remote control box which is furnished with the receiver. Two additional push buttons are also provided on the remote control box for controlling the volume.

The balanced transmission line from the u-h-f antenna is connected to the posts marked FM on the rear of the receiver. The signal from the antenna (upper left portion of circuit) is fed to a 6SK7 r-f amplifier which in turn feeds a 6SA7 combination oscillator-modulator stage. This stage produces the i-f signal by heterodyne action. Three i-f stages are required to drive the 6SJ7 limiter tube as indicated in the schematic. The i-f transformers are of special design, inductively tuned and suitably damped and overcoupled to provide the proper band pass without appreciable attenuation. No avc is provided in the r-f or i-f stages of the f-m portion of the Model 480 receiver. The carrier limiter is essentially a fourth i-f stage with a sharp cut-off tube. Under suitable limiter operation all amplitude components of noise and modulation are effectively attenuated.

The detector is essentially a diode discriminator circuit similar to that used in receivers for providing automatic frequency control. This detector produces a d-c voltage which varies at an audio rate and depends for its magnitude on the deviation of the intermediate-frequency signal from the mid-frequency and has a polarity depending upon the direction of this deviation. The detector circuit shown comprises two series-connected diode loads.

A six-gang variable condenser is used to tune the receiver. Three sections of the gang (C_1, C_2 and C_3) are used for the f-m portion and the remaining three (C_4, C_5 and C_6) for the standard a-m broadcast and short-wave bands. The switches labeled A and B are used to switch between the bands or to switch to f-m reception.

The Stromberg-Carlson Model 425 is an eight-tube superheterodyne receiver designed for the reception of frequency-modulated signals only. The circuit is similar to that of a conventional a-m receiver except for the limiter and second detector circuits.

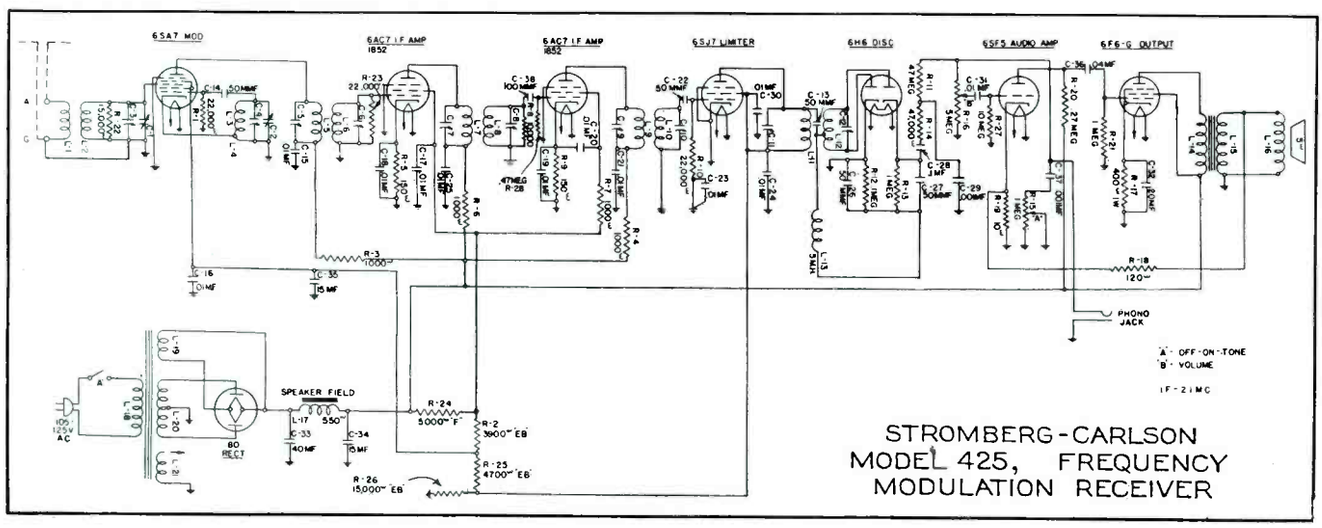
As mentioned above, the standard broadcast and short-wave portions of the receiver are conventional. Separate antenna posts are provided and an r-f stage is used on both bands. A single i-f stage, with variable selectivity, feeds a half-wave diode detector. The audio amplifier which follows is common to both portions of the receiver.

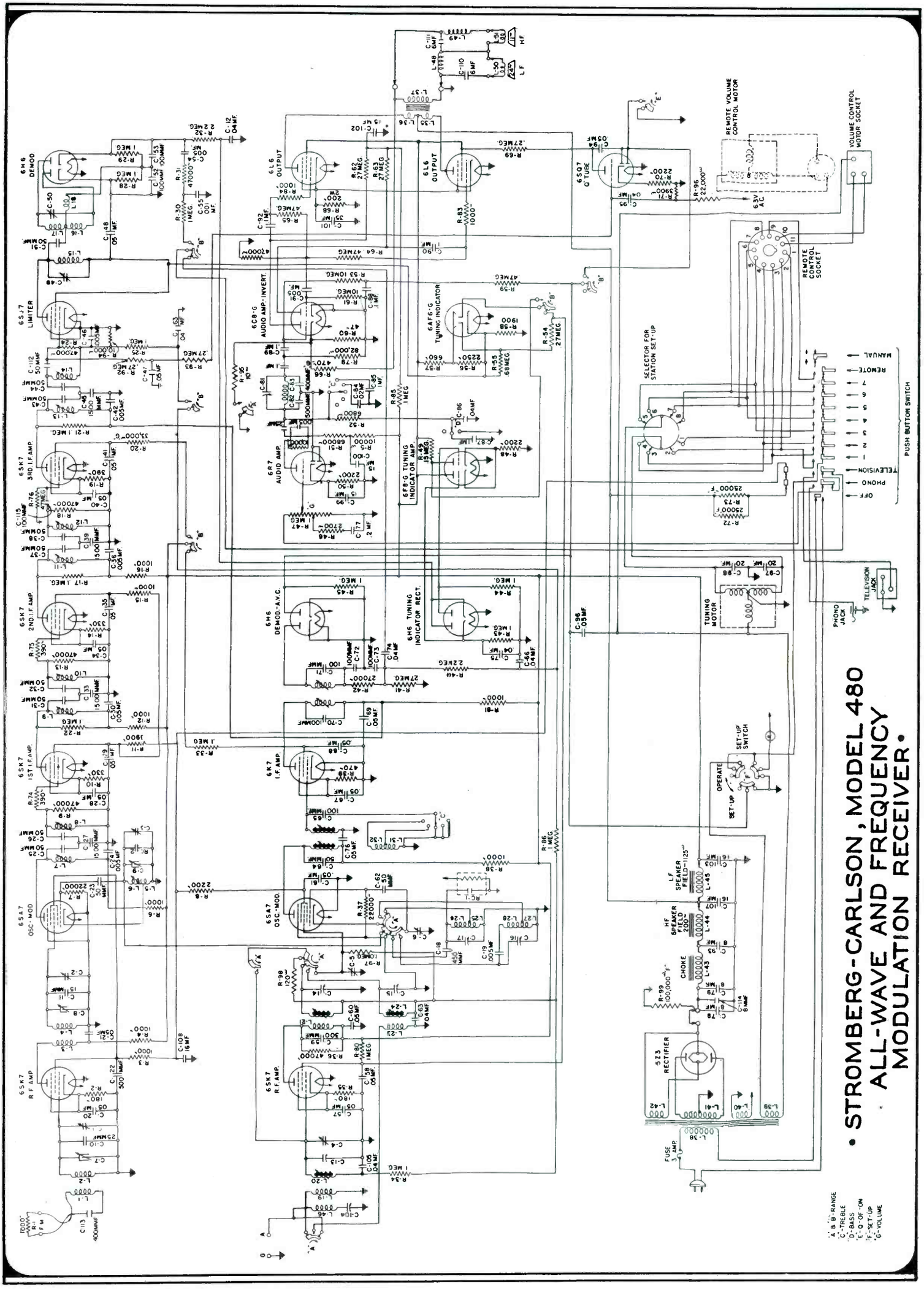
In the lower right corner of the accompanying circuit a 6SQ7 Q tube circuit is shown. This operates only on the f-m range of the receiver and is used to reduce interstation noise while tuning.

The tuning indicator in this receiver will operate differently when tuning stations in the f-m range from its operation in the a-m ranges. In the latter case one aperture will operate better on weak signals and the other will operate better on strong signals. Resonance is indicated by the maximum reduction in size of the apertures. When tuning stations in the f-m range the aperture will act as follows: when the receiver is first turned on, and no signal is received, one aperture will be nearly closed while the other one will be open. As a signal is tuned in, the aperture which was nearly closed will start opening and the other which was open will start to close; continuing tuning, resonance will be indicated by the maximum closing of both apertures.

The audio amplifier employs a 6R7 in its first stage which feeds a 6C8G dual-triode. One section of the latter tube is used as another audio amplifier stage and the second section is used as a phase inverter. A pair of 6L6s are used in a push-pull output stage. Two

(*Continued on page* 532)





BULLETIN

FROM TUNG-SOL LAMP WORKS INC.
SALES DEPARTMENT

NEWARK, N. J. October 19, 1939 NUMBER T-535-3

LIST: T-3

SUBJECT: REVISION OF LIST PRICES AND COMPENSATION
TUNG-SOL RADIO TUBES

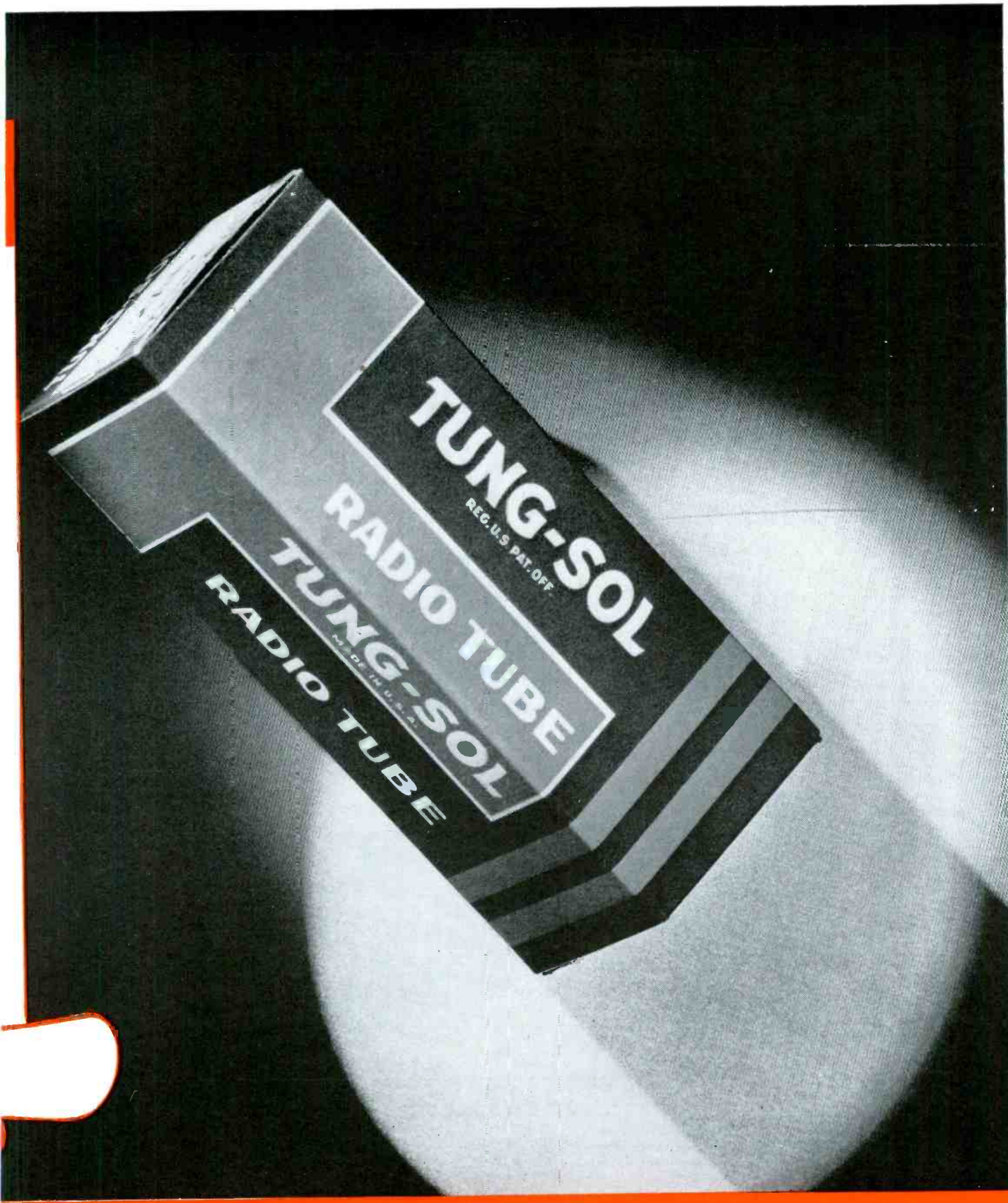
When list prices were lowered May 1st we took an opposite course to competitors who were promoting high list prices and extraordinary discounts to dealers.

It had often been stated that no one manufacturer could reform the tube industry but it has been demonstrated that one manufacturer, with the help and complete cooperation of its wholesalers could take a constructive position and maintain it.

The industry trend toward constructive merchandising is one that we would naturally endorse and it is logical, therefore, that we should do so by revising Tung-Sol schedules of list prices and compensation to conform with those already announced by our major competitors.

List prices which will be effective beginning with November business are shown on the attached price card, Form T-11. Using per cent of sales by type, indicates that the reduction will amount to only approximately 3% of old list prices.

TUNG-SOL Vibration Tested



RADIO TUBES

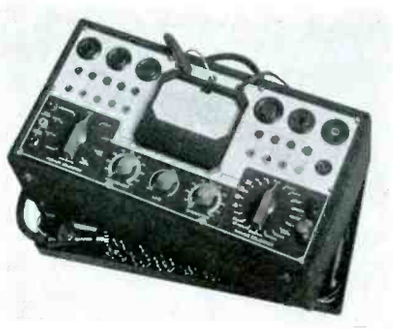
PREVIEW OF TEST

Weston • • •

Model 774 Checkmaster. Provides complete tube checking facilities as well as voltage measurements to 1,000 volts, in both a-c and d-c, in 5 ranges; output measurements to 1,000 volts, a-c, in 6 ranges; direct current measurements to 100 ma in 3 ranges; and resistance measurements to 10 meg in 4 ranges. Equipped for use with Weston 666-1B socket selectors and test leads. Weston Electrical Instrument Corp., Newark, N. J.

Triplett • • •

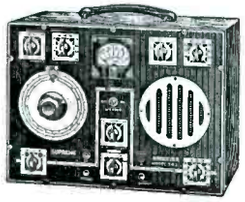
Model 1604 set tester. D-c volts to 2,500, at 25,000-ohms-per-volt, in 6 ranges; a-c volts to 2,500, at 1,000-ohms-per-volt, in 6 ranges; d-c from 50 microamperes (full scale) to 20 amp in 9 ranges; resistance to 20 meg in 5 ranges; capacity and db ranges. Complete tube testing facilities. Lifetime guarantee. Triplett Electrical Instrument Co., Bluffton, Ohio.



Supreme • • •

Model 560 Vedolyzer. Designed for visual dynamic testing. Includes a self-powered 3-in c-r oscilloscope with linear sweep. Three-band variable tuner from 65 kc to 2,050 kc for r-f amplification and testing. A vacuum-tube volt-ohmmeter with 29 ranges in r-f, d-c and a-c volts and ohms is also provided.

Model 562 Audolyzer. Designed for audible dynamic testing. Provides for audible monitoring of any portion of a receiver. 7-range v-t-v-m, with 15-meg input, also provided. Calibrated tuned circuit for frequency checks similar to that in the Vedolyzer is also included in this instrument. Supreme Instruments Corp., Greenwood, Miss.



Webber • • •

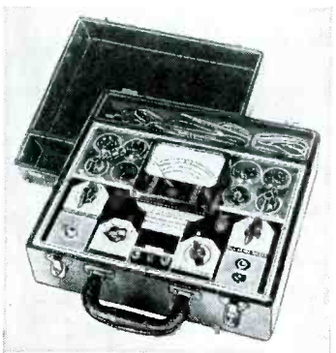
Model 210LP Imperial service estimator. Combination tube tester and volt-ohm-milliammeter. 29 ranges in d-c and a-c volts, at 1,000-ohms-per-volt; d-c ma; output volts; ohms and db. Spare sockets provided for future tubes.

Model 200MP Imperial tube tester. Dynamic tube tester for all types including loktals, gas rectifiers, bantam juniors and 117-volt types. Two spare sockets and also a ¾-volt filament tap are provided for future use. Earl Webber Co., 1313 W. Raldolph St., Chicago.

Precision • • •

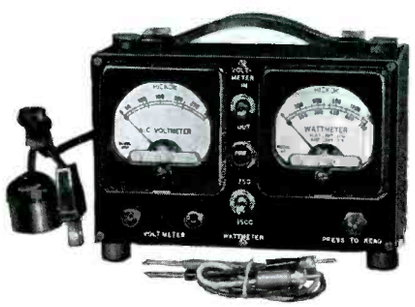
Model 920P set analyzer. Provides complete tube checking facilities as well as 33 set analyzing features. Has 6 a-c and d-c voltage ranges to 3,000 volts, at 1,000-ohms-per-volt; 5 direct current ranges to 12 amp; 4 resistance ranges to 10 meg; 6 db ranges to + 64 db; and 6 output ranges. Resistance ranges have self-contained power supply. Precision Apparatus Co., 647 Kent Ave., Brooklyn, N. Y.

Radio City Products • • •



Model 801 combination tube and set tester. Has complete tube testing facilities. Provides, in addition, 26 ranges for set testing. These are: 4 ranges, to 1,000 volts, in a-c and d-c volts at 1,000-ohms-per-volt; 5 direct-current ranges to 10 amp; 4 ohmmeter ranges to 10 meg, plus 5-ohm center-scale range; db and output ranges. Radio City Products Co., 88 Park Place, New York City.

Hickok • • •



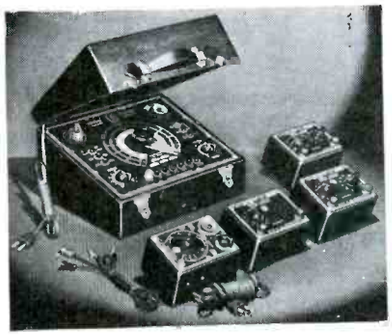
Model 145 a-c and d-c appliance tester. Dual-meter instrument checks line voltage and power consumption of electrical appliances. Has two ranges, 0 to 750 and 0 to 1,500 watts, and one range, 0 to 300 volts. Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, Ohio.

Simpson • • •

Model 260 set tester. A high-sensitivity, high-voltage tester for the Service Bench. Provides 6 voltage ranges, to 5,000 volts, at 20,000-ohms-per-volt on d-c and at 5,000-ohms-per-volt on a-c; direct current readings as low as 1 microampere and up to 0.5 amp; resistance readings from ½ ohm to 10 meg; and 5 db ranges, from — 10 to + 52 db. A 4½-in square meter is used. The Simpson Model 215 offers similar ranges at 5,000-ohms-per-volt, d-c and 1,000-ohms-per-volt, a-c. Simpson Electric Co., 5214 Kinzie St., Chicago.

EQUIPMENT FOR 1940

Cornell-Dubilier • • •



The Cornell-Dubilier capacitor test equipment line includes the Model BF50 capacitor analyzer, the Model BN midget capacitor bridge, and a series of three direct reading capacitor decades, the types CDA, CDB and CDC. The latter are standards of ± 5% and 3% tolerances. Cornell-Dubilier Electric Corp., S. Plainfield, N. J.

Clough-Brengle • • •

Model 230 a-c bridge. The instrument provides for capacity measurement in 3 ranges from 2 mmfd to 200 mfd; resistance, in 2 ranges, to 20 meg; inductance with external standards as desired; power factor; transformer turns ratios from 0.01 to 100 and leakage and insulation resistance tests to 2,500 meg. Clough-Brengle Co., 5501 Broadway, Chicago.

Solar • • •

Model EX 1-60 Exam-eter. In addition to the usual condenser and resistor tests, this instrument can be used as a peak reading vacuum-tube voltmeter. A 6E5 visual indicator tube is used. Capacity ranges from 0.00001 mfd to 1,600 mfd; resistance from 50 ohms to .5 meg. Solar Manufacturing Corp., Bayonne, N. J.

RCA • • •

Three new pieces of television test equipment by RCA. A 5-in wide-range c-r oscilloscope; a piezo-electric calibrator for use in all high frequency work; and a television alignment oscillator designed specifically for the visual alignment of the r-f and i-f circuits in television receivers. RCA Manufacturing Co., Camden, N. J.

Meissner • • •

Model 9-1006 signal calibrator. A precision secondary frequency standard employing a special silver-plated 100-kc quartz crystal. Multivibrators and amplifiers provide frequencies at 10 kc, 50 kc and continuous from 100 kc to 60 mc in 100 kc steps, modulated or unmodulated. Meissner Manufacturing Co., Mt. Carmel, Ill.

Readrite • • •

Model 423A742 combination tube tester and volt-ohm-milliammeter. Separate panels provided for tube and set tests. 5 ranges in a-c and d-c volts, to 2,500 volts; 3 d-c ranges to 100 ma and 2 resistance ranges to 1½ meg plus 0.5 to 500 ohm range. Readite Meter Works, Bluffton, Ohio.

Sprague • • •

Tel-Ohmike, a condenser and resistor analyzer which permits the Service Man to use his own milliammeter and voltmeter. Capacity measurements from 0.00001 mfd to 2,000 mfd; resistance measurements from 0.5 ohms to 5 meg; insulation and breakdown at 1,000 volts up to 10,000 meg and also power factor indication up to 50% are provided. Sprague Products Co., North Adams, Mass.

Triumph • • •

Model 330 multi-range meter. Provides 32 ranges as follows: A-c and d-c volts to 3,000 in 5 ranges; d-c to 15 amp in 5 ranges; output volts to 600 volts in 4 ranges; resistance from 0.2 ohms to 10 meg in 4 ranges; and 2 sets of db ranges. A 400-microampere 4⅝-in meter is used. Push-button range switches are used. Triumph Mfg. Co., 4017 W. Lake St., Chicago.

(*Continued on page* 526)

MERRY CHRISTMAS
and Happy New Year

To Beautiful

Boys' or Girls' Model
Retail Value, $34.50
Immediate Delivery on Dealer Deposit of $16.00

ELGIN WATCHES

Men's or Ladies' Styles
Retail Value, $37.50
Immediate Delivery on Dealer Deposit of $11.00

● Ladies' Elgin DeLuxe Wrist Watch, semi-baguette, 17 jewels, 10 K gold filled case, silk cord with ratchet center. Raised figure dial OR man's CRUSADER 8/0 size, 17 jewels, 10 K natural gold filled case, raised blue figure dial and leather wrist strap.

COLSON BICYCLES

● Boys' model: double bar streamlined 18-in. frame, chrome truss rods, light tank with horn, luggage carrier, chain guard, Texas steer handle bar, fine saddle, new departure coaster brake, balloon tires. Also available in girls' model with similar features.

STEELART BRIDGE TABLE AND CHAIRS

Retail Value, $22.50
Immediate Delivery on Dealer Deposit of $8.00

● Steelart Style "F" sets offer folding bridge furniture that the most exacting hostess will be proud to use. Rigid steel table and folding chairs with pinchproof hinges and no sharp corners to snag garments.

ROGERS SILVERWARE

Retail Value, $60.00
Immediate Delivery on Dealer Deposit of $12.00

● 87-piece service for 8 persons in Good Housekeeping approved tarnish-proof, fine wood chest. Encore design X/tra quality silver plate, double plated at points of greatest wear. Made and guaranteed by Simeon L. & George H. Rogers Company, famous Oneida silversmiths.

. . . and many other items

NATIONAL UNION

PREVIEW OF TEST EQUIPMENT

(*Continued from page 523*)

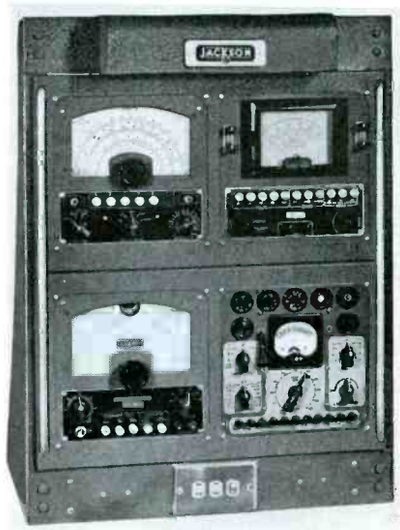
Televiso • • •

Model VG6 vacuum-tube voltmeter. Has

6 ranges in a-c and d-c volts providing for measurements from 3 to 600 volts. Uses co-axial cable input. *Televiso Co., 343 N. Pulaski Rd., Chicago.*

Jackson • • •

Model 700 Service Lab. Contains 4 standard Jackson units designed for rack



and panel mounting. These units are: Model 640 all-wave oscillator, provides modulated or unmodulated signal from 100 kc to 30 mc in 6 ranges; Model 642 20,000-ohm-per-volt multimeter, with 21 ranges and 7 functions; Model 650 condenser tester for determining the characteristics of all types of condensers from 0.00001 mfd to 100 mfd; and the Model 634 tube tester, which provides means for testing all types of tubes. *Jackson Electrical Instrument Co., Dayton, Ohio.*

Aerovox • • •

Aerovox Model 95 L-C checker may be used for determining the characteristics of all types of condensers without disconnecting them from the receiver circuits. This unit is illustrated and described in full on page 539 of this issue.

(*Continued on page 530*)

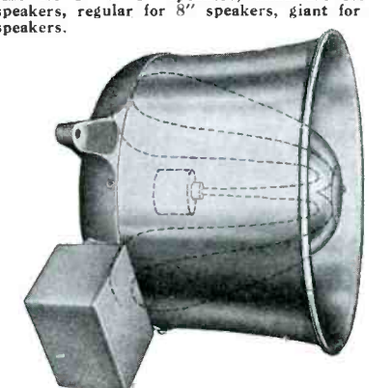
speaking of PROFITS

RACON'S are MONEY-MAKERS

for all P-A and Sound Men

PERMANENT MAGNET UNITS—Available in all sizes—from the "baby unit" having an operating capacity of 5 watts to the "bull unit" with an operating capacity of 50 watts.

MARINE CONE TYPE SPEAKERS—Re-entrant type speakers using cone type driving units for indoor and outdoor applications, Baby size for 2" or 3" speakers, miniature for 5" speakers, regular for 8" speakers, giant for 12" speakers.



MARINE HORN UNIT SPEAKERS—Re-entrant type speakers using horn type units for marine and general P-A applications—may be used as loud speaker or as a microphone. In all sizes, miniature, midget, marine and bull handling from 5 to 50 watts.

ARMORED CONE PROJECTORS—For high concentration of sound within short or long areas—various size models in all steel or aluminum bell with steel backs to take 6"-8"-10"-12" speakers.

The buyers of bigger and better sound installations ***specify*** Racon Horns and Speakers as they will not compromise with quality.

Racon's sometimes cost more than other units that look quite similar though inferior in performance. Expensive research and developmental engineering must be paid for—but experience proves the extra investment is justified because

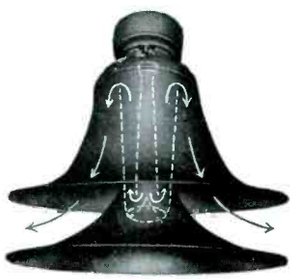
1. The sound system buyer gets more value and trouble-free use from his installation.
2. The seller of the sound systems meets with less sales resistance and can "deliver more than he promises" when he uses Racons.

A well sold and completely satisfied customer is the only kind that is profitable as he will throw more business your way.

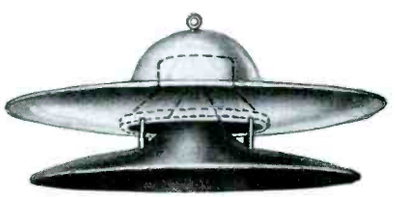
RACON HORNS, SPEAKERS AND UNITS are available for every sound distribution application. Models not illustrated here are described in our general bulletin S10. Send for your free copy today.

RACON ELECTRIC CO.

52 East 19th Street
New York City



RADIAL 3½′ TRUMPET—In either the radial projective type for 360° distribution or the uni-directional type for forward projection. Occupies space 16" deep, bell opening 19" diameter.



RADIAL CONE SPEAKERS—Types for high fidelity, giving even intensity sound projection over a circumference of 360° radially. Best adapted for permanent auditorium installations. Will handle 5"-6"-10"-12" speakers.

RADIAL CONE PROJECTORS—Adjustable from 360° radial projection to uni-directional. Models available for 10" cone speakers only.

TRUMPETS—Available in all sizes from 3½′ to 6′ Made of RACON acoustic material for indoor and outdoor types. Also made of all metal. Single unit or multiple unit types in all sizes.

AUTO-RADIO DATA

(Continued from August)

Pierce-Arrow
Philco Transitone Corp.

Model	Tubes	Year	Gear Ratio	Dial Direction[1]	I-F
E	6	1934	*	*	260
T2	6	1935	*	*	260
T3	6	1935	16/1	CW	260
T14	6	1936	16/1	CW	260

Pilot
Pilot Radio Corp.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
A6	6	*	*	*	456

Pontiac
Pontiac Motor Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
544268	6	*	*	*	456
544290	5	*	*	*	172
544291	5	*	*	*	172
544267	4	*	*	*	262
544289	4	*	*	*	172
544289	4	*	*	*	262
983507	6	*	*	*	262
983526	7	*	*	*	*
983534	6	*	*	*	262
983569	7	*	*	*	262
983570	6	*	*	*	262
983667	7	1939	[2]	—	260

Portomatic
Lehman Radio Salon, Inc.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
10	5	*	*	*	175
12	6	*	*	*	175
12A	6	*	*	*	175

RCA Auto Radio
RCA Manufacturing Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
M30	9	1932	10/1	CW	175
M32	6	1932	21/1	CCW	175
M34	4	1933	10/1	CW	175
M101	5	1935	10/1	CW	175
M104	5	1935	10/1	CW	175
M105	4	1934	10/1	CW	175
M107	6	1934	7/1	CW	175
M108	5	1935	10/1	CW	175
M109	7	1935	10/1	CW	175
M116	5	1934	2/1	CW	175
M123	6	1934	7/1	CW	175
5M	5	1936	16/1-12/1[4]	CW	260
6M	6	1936	16/1-12/1[4]	CW	260
6M2	6	1936	16/1-12/1[4]	CW	260
8M	5	1938	9/1	CW	260
8M1	6	1938	16/1	CW	260
8M2	6	1938	16/1	CW	260
8M3	6	1938	16/1	CW	260
8M4	6	1938	16/1	CW	260
9M1	5	1939	2/1	CW	455
9M2	6	1939	2/1	CW	455
67M	6	1937	16/1	CW	260
67M1	6	1937	16/1	CW	260
67M2	6	1937	16/1	CW	260
67M3	6	1937	16/1	CW	260

RCI
Radio Chassis Mfg. Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
V6	6	*	*	*	175

Radolek
Radolek Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
U6	6	*	*	*	456
10M	5	*	*	*	370
66	6	*	*	*	*
450	4	*	*	*	456
511	5	*	*	*	456
626	6	*	*	*	456

Remler
Remler Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
35	6	1934	6/1	CW	450
36	6	1935	8/1	CW	250
37	6	1936	6/1	CW	250

Setchell-Carlson
Setchell-Carlson Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
66	6	*	6/1	CCW	456

Silver Marshall
Silver Marshall Mfg.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
J	5	*	*	*	175
K	6	*	*	*	175

SilverTone
Sears Roebuck

Model	Tubes	Year	Gear Ratio	Dial Direction[1]	I-F
1730	5	*	*	*	175
1855	5	*	*	*	480
1858	5	*	*	*	175
1859A	4	*	*	*	370
1864	5	*	*	*	175
1949, 1949A	5	1936	16/1	CW	456
4400	6	1936	16/1	CW	465
4600	6	1936	16/1	CW	262
4601	7	1936	16/1	CW	262
4700	5	1938	16/1	CW	456
6000	*	1938	16/1	CW	262
6100	*	1938	16/1	CW	*
6101	7	1938	16/1	CW	262
7117	4	*	*	*	370
7128	6	*	*	*	175
7149	6	*	*	*	175
7157	5	*	*	*	456
7167	5	*	*	*	456
60001	*	1938	16/1	CW	*

Simplex
Simplex Radio Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
TA	5	1935	8/1	CW	456
Q	6	1935	8/1	CW	456

Sparton
Sparks Withington Company

Model	Tubes	Year	Gear Ratio	Dial Direction[1]	I-F
AR19	5	*	[2]	CW	TRF
AR19A	5	*	[2]	CW	TRF
AR40	6	*	8/1	CCW	TRF
AR40A	6	*	8/1	CCW	TRF
33A, -B	5	1934	6/1	CCW	172.5
34	7	*	8/1	CW	172.5
36	7	1934	6/1	CW	172.5
333	5	1934	6/1	CW	456
676, 686	6	1936	16/1	CCW	172.5

Stewart
Stewart Radio & Television Co.

Model	Tubes	Year	Gear Ratio	Dial Direction	I-F
50	5	*	*	*	262
60	5	*	*	*	262

[1]CW denotes clockwise rotation. CCW, counterclockwise. By clockwise rotation is meant that receiver is being tuned to a higher frequency when the dial scale or pointer rotates in a clockwise direction when viewed from the front of the control head.
[2]No remote control is used.
*Information not readily available.
[4]Serial numbers below 200,000.

(To be continued)

The PRECISION line of quality test equipment offers a range of 40 different models for your selection . . . Dynamic Mutual Conductance Tube Testers from $29.95 . . . Combination Tube Testers and Set Testers from $49.95 . . . Multi-Range Testers from $10.95 . . . Signal Generators from $24.95 . . . See them on display at all leading radio parts distributors or write for our 1940 Catalog.

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Standard of Accuracy **SEE THEM AT YOUR JOBBER**

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Export Division: 458 BROADWAY, NEW YORK CITY, U. S. A. Cable Address: MORHANEX

PREVIEW OF TEST EQUIPMENT

(*Continued from page 526*)

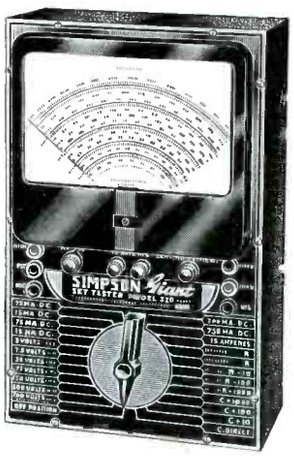
Consolidated • • •

Model 9000 dynamic conductance tube tester. The instrument provides complete

tube testing facilities. In addition, Christmas tree bulbs, pilot lights and plug-in resistors may be checked. *Consolidated Wire & Associated Corps.*, 518 *S. Peoria St., Chicago.*

Philco • • •

At least 3 new instruments are featured in the 1940 Philco line. Model 013 is a device for checking vibrators that functions without controls, meters or visual indicator tubes. Model 077 is an all-wave signal generator which provides r-f, modulated or unmodulated, from 115 kc to 37 mc in 5 ranges. The Model 026 is a 21-range, 6-function circuit tester of compact portable design. *Philco Radio & Television Co., Tioga & C Sts., Philadelphia, Pa.*



Simpson Model 320 giant set tester. Provides 50 ranges for 7 functions on a 9-in. meter. Instrument dial is illuminated and wings can be provided for rack and panel mounting.

Precision Series 844 volt-ohm-milliammeter. Provides 34 ranges for six functions.

Hickok low-range ohmeter. Has 2 ranges: 0 to 6 ohms and 6 to 200 ohms. Since resistance of leads must be considered on these low ranges readings are specified as at the meter terminals.

Radio City Products Model 456P general utility meter. An a-c, d-c multi-meter with a 1-ma D'Arsonval movement. Sixteen ranges provided for 5 functions.

Webber Model 220 Imperial multimeter. Uses 6½-in. meter and has 38 ranges for 7 functions. Mirrored scale. Push-button range selectors.

Precision Series 870 push-button multi-range tester. Provides 29 ranges for 6 functions.

(*Continued on page* 544)

F-M RECEIVERS

(*Continued from page* 518)

speakers are used (with acoustic labyrinth), one for high and one for low audio frequencies. A portion of the signal from the voice coil circuit is fed to the cathode of the 6C8G audio amplifier stage to provide degeneration.

model 425 circuit

The Model 425 receiver is an 8-tube superheterodyne designed for the reception of f-m signals only. (See accompanying diagram.) The antenna circuit of this receiver feeds a 6SA7 oscillator-modulator stage directly. Two i-f stages using 1852s are employed to drive the 6SJ7 limiter. As in the f-m section of the Model 480, no avc is provided in the Model 425. The 6H6 discriminator feeds a 6SF5 audio amplifier stage which in turn drives a single 6F6G output tube. A portion of the signal from the voice coil is fed back to the cathode of the 6SF5 audio amplifier stage to provide audio degeneration.

When a receiver designed only for the reception of amplitude modulated stations (standard broadcast and short-wave stations) is available, and it has a high quality audio system, the Model 425 receiver may be connected to it so that frequency modulated transmissions may be reproduced through the high quality audio system. A single pin jack with plug (labeled phono jack in accompanying diagram) is located on the rear of the Model 425 to enable it to be connected for this purpose to the phono jack on the amplitude modulation receiver.

If the Model 425 is operated in this manner its speaker will act as the treble speaker and the desired amount of treble response can be controlled by means of the volume control on the Model 425. The off-on-tone control should remain set for maximum treble response.

AUTOMATIC ANNOUNCING

(*Continued from page* 517)

announcement of time, instead of the electric ticker tape announcement. I said . . . careful design of sound distribution . . . a problem with which all Service Men are undoubtedly familiar. The sound must be concentrated to cover a restricted area to avoid infraction of noise and nuisance laws. But, already, such systems have been made available, offering a variation of sound distribution to within any degree desired.

The automatic systems that will undoubtedly prove themselves most popular with the merchants will be those permitting a rapid and simple change of recordings.

Your "Bread and Butter" INSTRUMENTS

SUPREME 504

It is desirable to have a completely equipped service shop, but your "Bread and Butter" instruments deserve your first consideration. Look around your own shop and see if your "Bread and Butter" instruments are satisfying your needs. (1) Will your tube tester accurately test all the new tubes being announced; (2) is your set-tester complete, fast, and reliable; (3) is your condenser tester accurate; (4) does your test-oscillator cover all the ranges needed; is it accurate and stable? The Supreme 504 and 571 meet all these basic requirements, and make a strong foundation upon which to build your business.

SUPREME 571

The Supreme 504 in a single unit answers your first 3 requirements without unnecessary bulk and at low initial cost. Correctly tests all present or future tubes regardless of tube base terminations or filament voltages. Patented filament return automatically re-connects all sockets for any possible tube base arrangement. New vari-volt selector provides 23 filament taps for testing all tubes from 1.5 volts to full line voltage. Fast tube test—just "follow the arrows" from roller chart.

The set testing functions of the Supreme 504 cover all ranges encountered in general service work. Seven D.C. voltage ranges from 0.1 to 2500 volts. Five A.C. voltage ranges from 0.1 to 1000 volts. Seven Direct Current ranges from 10 microamperes to 10 amperes. Five output ranges from 0.1 volt to 1,000 volts. Five Ohmmeter and Megohmmeter ranges from 0.1 ohm to 20 megohms. Guaranteed over-all accuracy of 2% on D.C. and 3% on A.C.

All paper condensers checked for leakage up to 20 megohms. All electrolytic condensers checked for leakage at their rated voltage on an English reading scale. Settings on roller chart for every capacity and working voltage.

The Supreme Model 571 oscillator guarantees you (1) Accuracy, (2) Stability, and (3) Range.

By the use of variable iron core coils, calibration can be held well within ½ of 1%. To eliminate error in reading, a hair line illuminated shadow indication is used. A dual drive mechanism provides fast and easy setting of the precision cut tuning condenser. Use of air dielectric trimmers in a special circuit has eliminated frequency drift with change in line voltage and temperature to a point where it can be disregarded.

The Model 571 has five fundamental ranges which cover the following frequencies: 65 to 205 KC, 205 to 650 KC, 650 to 2050 KC, 2050 to 6500 KC, 6.5 to 20.5 MC. Harmonics of these ranges extend these frequencies to 82 megacycles. All these are read on two scales so that there is no confusion as to which is the proper band.

Besides these features, the Model 571 provides signals with two different levels of modulation: 30% and 75%. Double shielding throughout minimizes leakage.

FOR COMPLETE DYNAMIC TESTING

Choose either the 562 Audolyzer or 560 Vedolyzer

MODEL 562—The need of a fast, simple, inexpensive, but complete dynamic testing instrument prompted the design of the Model 562. With it one probe can be used to localize trouble in any receiver. A built-in voltmeter with an input impedance of 15 megohms allows measurements in grid, A.V.C., A.F.C., or any other circuit without affecting the operation of the set. A built-in speaker offers an audible system of testing which is the simplest and fastest yet devised. Servicemen are now acclaiming the Audolyzer to be the instrument of the year. Write for descriptive literature.

MODEL 560—In selecting a Model 560 Vedolyzer you are providing yourself with the most modern up-to-date dynamic testing instrument available. Signals of all types, A.C., D.C., R.F., I.F., A.F., are measured on a vacuum tube voltmeter and at the same time all the alternating signals are studied for waveform on a 3" cathode-ray tube. A three-stage video amplifier makes possible the study of R.F. and A.F. whose level is only .01 volt. By using this instrument, you are looking ahead, for its video amplifier has many television applications. Write for descriptive literature

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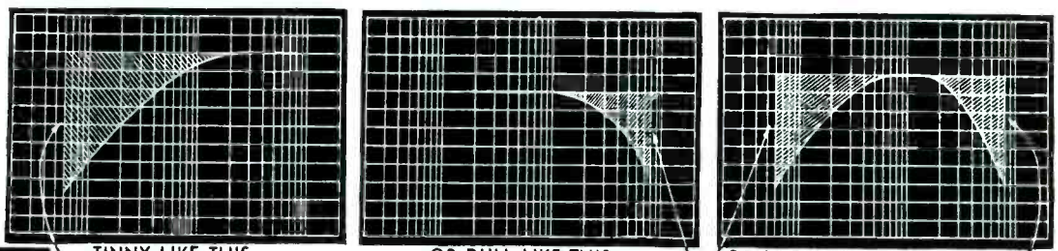
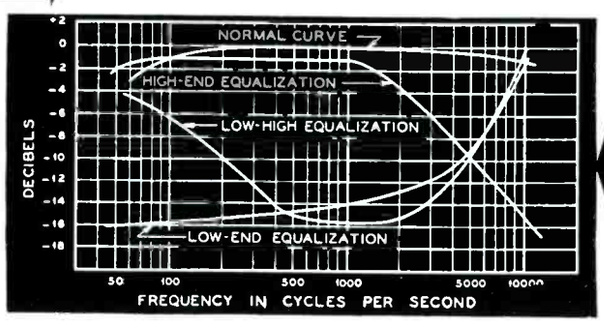
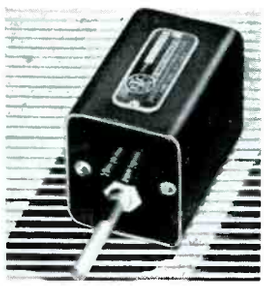


TINNY LIKE THIS — OR DULL LIKE THIS — OR LACKING HIGHS AND LOWS LIKE THIS

WHETHER YOUR AMPLIFIER OR SET SOUNDS



UTC VARITONE CAN BRING BACK THESE LOST NOTES LIKE THIS . . .



The Varitone Audio Unit is the Only Transformer of its Kind Giving Continuously Variable Low End, High End, or Low and High End Equalization.

The UTC Varitone is a revolutionary audio device which permits full control of the frequency response of any audio amplifier or receiver. Using this device, tone correction can be affected for defects in acoustic conditions or overall audio response. It is also possible to produce new tonal effects from phonograph recordings or radio reception and to bring back notes which would otherwise be lost completely.

VT-1—This Varitone is incorporated with a universal audio transformer. Two primaries are provided. One is suitable for working from a single or double button microphone a low impedance pickup, or a line; the other primary is designed to work out of the plate of a tube or from a high impedance pickup. The secondary winding is centertapped and is equally suitable for working into one or two grids. Net price..... **$5.10**

VT-2—The VT-2 is a Varitone control unit, incorporated with an impedance matching device so that it can be connected directly across a 200 or 500 ohm line, or low impedance pickup or mike, or in shunt with the plate circuit of any triode or a high impedance pickup. The circuit is not changed in any other way. The VT-2 is solely an addition for tone correction. The original audio circuits are not disturbed. Net price..... **$3.60**

VT-4—The VT-4 is a complete self contained wired unit including a variable control so arranged that with the control at one end high fidelity performance is effected by the increase of low and high frequencies, and with the control at the other end the high response is reduced to diminish static, line noises, and heterodyne whistles. The unit is connected directly from plate to B plus of first audio triode. This unit is designed to work in the plate circuit of low impedance tubes such as 01A, 12A, 30, 31, 26, 27, 37, 55, 56, 85, 262A, 864, 57 triode, 6C6 triode, 77 triode, etc. Net Price..... **$3.60**

VT-10—Band pass filter for amateur service removes unnecessary low and high frequencies, reducing QRM, increasing efficiency and intelligibility. Connects in plate circuit of triode. Net Price..... **$6.00**

UNITED TRANSFORMER CORP.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

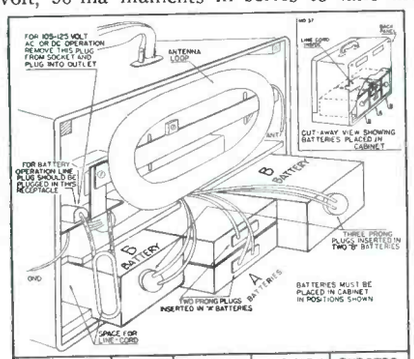
EMERSON DF302, DF306

(See Front Cover)

THE Emerson Models DF302 and DF306 utilize the new 70L7GT combination rectifier and beam-power output tube for line operation. The rectifier section supplies the direct current necessary for both plates and filaments while the beam-power section handles about 1½ watts of audio power.

filament current

A novel method of supplying the filament current for line operation is used. Since the 70L7GT requires 50-ma cathode current, it is feasible to connect the four 1.4 volt, 50-ma filaments in series to take the



TYPE BATTERY	No. Req'd	RAYOVAC	EVEREADY	BURGESS
4½ V. "A"	2	P83A or EM-83	746	3G
45 V. "B"	2	P5303	762	B30-P1

In this receiver the loop does not cover the battery compartment.

place of the usual cathode bias resistor for that tube. Besides the economy involved there are two definite advantages for this connection. Less filtering is required for a given percentage of hum and a substantial amount of voltage regulation is secured. With 10% change in the power line voltage, for instance, the filament voltage will vary only about 3 to 5%. The compensation is obtained through the plate current characteristic of the tube.

When battery operation is contemplated, the line cord is coiled up in a separate compartment reserved for it at the rear of the set. The line plug is inserted in the special receptacle provided for it at the rear. This closes the battery circuit. The receiver will not operate on batteries unless this plug is in place. For a-c or d-c operation (105 to 125 volts), the small door containing the line cord is opened and the plug removed, disconnecting the batteries. The plug may then be inserted in the wall outlet. In this mode of operation the receiver consumes 30 watts.

The tube complement is as follows: 1A7GT oscillator-modulator, 1N5GT i-f amplifier, 1N5GT second i-f, 1H5GT second-detector-avc-audio amplifier, 3Q5GT beam-power output for battery operation only and the 70L7GT beam-power output and half-wave rectifier for line operation only.

The four 1.4-volt filaments discussed above, together with the 3Q5GT filament, remain in series for battery operation. An A battery of 9 volts is required to deliver 50 ma. A 90-volt B battery is also required. The B drain is 11 ma.

loop

Another feature of this receiver is the positioning of the loop. In most battery portables the loop must be moved or removed in order to change or test the batteries, or even to check tubes. It is not always possible to replace the loop in the identical position which it occupied before being disturbed; that is, the position in which the set was tuned or aligned. Thus, it might disturb the alignment of the set when it is replaced. In this receiver the loop does not cover the battery compartment. It is on the receiver chassis and need not be disturbed when the batteries are removed.

This self-contained loop antenna operates at maximum efficiency when its position is at right angles to the transmitting station. It is important, therefore, once the station is tuned in, to rotate the cabinet back and forth through at least a quarter of a circle (90 degrees), leaving it at the position where the station is received at maximum intensity. While the loop will provide sufficient volume in most locations, it may be necessary to use an external antenna and ground in remote areas or dead zones. Connections are made to the two leads at the rear of the cabinet.

This set has tuning range from 540 to 1600 kc. Two 455 kc i-f stages are used; resistance coupling is used between them. Avc is used only on the first tube, the 1A7GT oscillator-mixer.

speaker

In order to accommodate the high power output on line operation, a 6½-inch permanent magnet dynamic speaker is used. The output transformer is tapped for the 70L7GT, the full primary winding being used only for the 3Q5GT battery output tube. (The latter tube is left idle in line operation.) This changing of primary impedance is necessary to obtain normal power and optimum quality from each output tube.

Henry Howard.

BOOK REVIEWS

MALLORY YAXLEY RADIO SERVICE ENCYCLOPEDIA, third edition, published by P. R. Mallory and Co., Inc., Indianapolis, Ind., 1939, 264 *pages,* 8½ *by* 11 *in, paper covers, price* $1.25.

Just as Rider's Manuals have been called the Service Man's Bible, so, with equal justice, the Mallory Yaxley Radio Service Encyclopedia might be named the Service Man's Koran. No single Service Man, no matter how wide his experience, could ever hope to have at his fingertips the information made available on the 22,000 radio receivers given in this third edition of the Mallory Yaxley Encyclopedia.

The data is tabulated in such a manner as to give instant information on the manufacture and model, controls, condensers, vibrators, number and type of all tubes, the i-f peak, and reference to pages in Rider's manuals. The data on controls is further broken down to include the function of the particular unit, such as volume, tone, etc., a schematic of the circuit, the Mallory Yaxley replacement of both control and switch, the bias and notes. The compilation under condenser is likewise subdivided and lists the original part number, a schematic of the circuit, the Mallory Yaxley replacement, and notes. The foregoing as well as the complete tube complements and i-f peaks are probably the most exhaustive compilation ever made. The Service Man will readily appreciate the reference to Rider's manuals for he is thereby instantly enabled to consult these for additional circuit information where such may be necessary.

Following this remarkable compilation are three sections devoted to a discussion of controls, condensers and vibrators, respectively. A careful reading of these sections will well repay the Service Man, not only because of the brief and well written explanations but also because some of the information given is available from no other source.

Purchasers of the Mallory Yaxley Encyclopedia can obtain the Mallory Supplemental MYE Monthly Technical Service for one dollar. The first of these, supplement No. 1, has just been issued. This tabulates the characteristics of receiving type tubes and it is this reviewer's belief that it is the most exhaustive compilation available.

The usefulness of both the Mallory Yaxley Radio Service Encyclopedia and the Monthly Supplemental Service (to judge from the excellence of the first issue) will be quickly recognized by the Service Man. Both are highly recommended. R. L.

ENGINEERING ELECTRONICS, by D. G. Fink, published by McGraw-Hill Book Co., 330 *W.* 42 *St., New York City,* 1938, 358 *pages, price* $3.50.

This volume offers a survey of the theory and applications of electron tubes. The book is divided into three distinct but related parts: (1) Physical Electronics, in which the production and control of electrons in a vacuum and in gases and vapors is discussed; (2) Electron Tubes, which is comprised of an explanation of thermionic vacuum tubes, gas-filled thermionic tubes, photosensitive tubes and cells, electronic sources of light, and specialized electron tubes including cathode-ray tubes, the electron camera, electron multipliers, and the strobotron; and (3) Electron-Tube Applications, which discusses power trans-

formation circuits, communication circuits, and industrial control and measurement circuits.

The treatment is mainly of a descriptive nature, but where mathematics is employed there is required of the reader only a knowledge of algebra and trigonometry. The two exceptions to this have been relegated to footnotes.

Engineering Electronics is undoubtedly the finest treatment of the subject that this reviewer has encountered. Whether or not your library already has a text on this subject, this book is of such excellence as to constitute an imperative addition.

R. L.

SYLVANIA RADIO TUBE COMPLEMENT BOOK, first edition revised to include 1938-39 *supplement, prepared by Sylvania Radio Tube Division, published by Hygrade Sylvania Corp., Emporium, Pa.,* 1939, 168 *pages plus* 56-*page supplement,* 4½ *by* 9 *in, paper covers, price complete,* 25c, *supplement alone,* 10c.

The 1939 edition of the Sylvania radio tube complement book has a special supplement which contains the tube complements of hundreds of new receivers released during the past year. This supplement is bound as an integral part of the parent book and is also issued separately for those who already have the first edition.

The 56-page supplement contains only the listings of the many receivers together with their tube complements and i-f peaks. Because of the completeness of the compilation, this reviewer believes that the supplement should prove a very valuable aid to the Service Man. It is certainly worth more than the 10c asked.

The parent book, in addition to the listings of tube complements and i-f peaks for practically all sets from far back into the early days of radio, contains material on alignment, tube type substitution, tube testers, panel lamps, interchangeable tube types, etc. A complete listing of the names and addresses of receiver manufacturers together with a comprehensive compilation of trade names and their respective owners should also prove of special value to every Service Man.

The Sylvania Radio Tube Complement Book should be on every Service Man's must list.

R. H.

RCA VICTOR SERVICE NOTES FOR 1938, *published by the Service Division, RCA Manufacuring Co., Inc., Camden, N. J.,* 1939, 448 *pages,* 8½ *by* 11 *in,* $1.25.

The new book is one of an annual series compiled by the RCA Service Division. Service data and wiring diagrams on 1938 RCA Victor radio and Victrola models with complete information on their automatic record changers, as well as data, diagrams and schematic circuits for RCA test equipment and television receivers are included in the new edition.

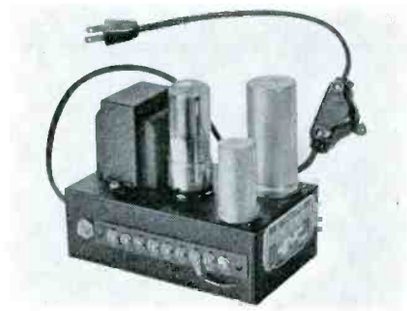
A new feature of this volume is a tabulated replacement parts guide which lists the principal parts used in the RCA Victor receivers from and including 1934, to date. Complete supplementary data on 1938 instruments is also included.

The edition includes 650 illustrations and covers 70% more models than the 1937 service notes. The latest RCA test equipment catalog is also bound in the volume.

R. H.

GTC L PORTA POWER

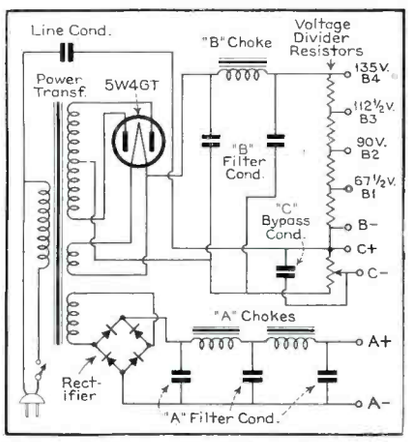
THE General Transformer Corporation Model L Porta Power is designed to convert the average two-volt receiver to line power operation. It will supply A, B and C power for from four to eight two-volt tubes. The B supply is tapped at 67½, 90, 112½ and 135 volts. Adaptation may be made for 45 volts. Any



The GTC Model L Porta Power supplies power for 2-volt sets from the 60-cycle a-c power lines.

of the taps may be used separately or they may be used together in any combination. The C supply is variable from 4½ to 22½ volts. Two C voltages can be obtained where necessary.

A 5W4GT is used in a full wave rectifier circuit with brute-force filters to provide the B and C current. A copper sulfide rectifier is used in a full wave bridge



Taps are provided on the Porta Power for various A, B and C voltages.

circuit for the A power. The brute-force filter in the A circuit uses a double choke and three condensers. The A and B circuits are isolated both electrically and magnetically.

IRC APPOINTS BURLINGAME

The October issue of SERVICE announced the appointment of Bruce O. Burlingame, 69 Murray St., New York City, by the International Resistance Co., Philadelphia, to handle the IRC fixed and variable resistance products to the jobber and industrial trade in this territory. His territory will specifically be parts of Eastern Pennsylvania, Maryland, Delaware, New Jersey and the District of Columbia.

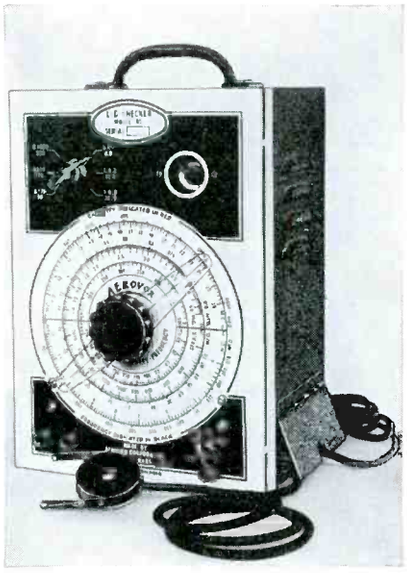
Mr. Burlingame takes over the territory which has previously been handled directly from the IRC general office. This appointment entails no changes in the sales organization, and Perry Saftler will continue to represent IRC in the New York metropolitan area.

AEROVOX 95L-C CHECKER

THE Aerovox Model 95L-C checker is designed to measure the capacity of condensers at radio frequencies without the necessity of disconnecting them from the set. It is also designed to permit the determination of the resonant frequencies of circuits and the measurement of inductance.

capacity measurement

The frequency at which a circuit becomes resonant is a function of the inductance of the coil and the capacity of the condenser



The line cord and loop of the Aerovox 95L-C checker can be housed in a neat compartment on the side of the instrument.

connected in series with the coil. The capacity of the condenser used with the coil can be determined from the frequency necessary to produce resonance.

To use this method two conditions must be obtained: first, the variable frequency supply must cover an extremely wide range and be accurately calibrated. Moreover, the oscillator must be inherently stable as to variations in line voltage and load. Second, the coil used for comparison should be very stable and of low resistance.

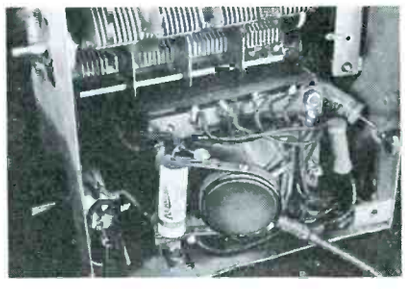
This is accomplished by the design of a compensated oscillator using a voltage-regulator tube to eliminate line-voltage variations.

The coil used is one-half turn of phosphor-bronze strip of small diameter (C prod), which has a very low resistance and inductance.

The condenser to be measured is connected across the clips of the C prod making certain that the C prod is connected as close to the condenser as possible. The loop of the output lead is then snapped into the groove of the C prod. After the line cord has been plugged into a 110 volt outlet, the eye control knob is turned to the right, turning on the checker. When the tubes warm up, the control is adjusted until the eye just closes.

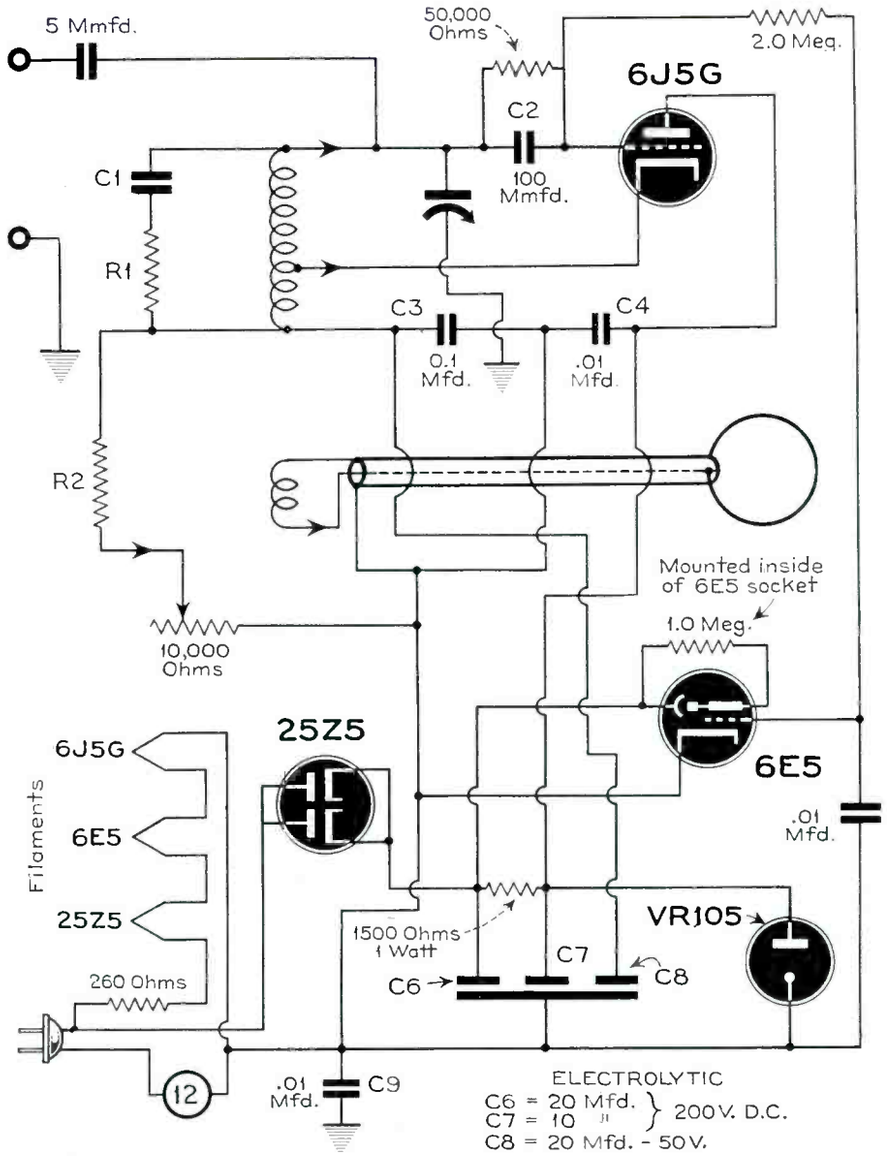
The main dial is then tuned, using various ranges while the eye is watched. A sharp opening of the eye indicates that a resonant point has been reached, and the capacity of the condenser is read from the proper scale. Care should be taken not to confuse the gradual opening of the eye at the ends of the scale with the sharp widening when resonance is reached. The degree of opening is a measure of the quality of the capacitator. A good condenser will cause the eye to open wide while a slight opening indicates a poor condenser. An internal short circuit will not allow the eye to open at all, although external short circuits will allow the eye to open to almost normal width. Thus the checker can be used to measure condensers in the circuit without their removal from the circuit.

The characteristics of a condenser can be determined without disconnecting it from the receiver circuits.



An open condenser is indicated by the opening of the eye at a frequency much higher than normal for a condenser of that size. Thus an open 1-mfd condenser might measure 0.0004 mfd. In addition to the false indication, the opening of the eye is sluggish and very small.

To measure capacities less than 0.0004 mfd use a capacitor slightly larger than 0.0004 mfd and measure its capacity. The condenser to be measured is then connected in parallel with the first condenser and the total capacity of the two condensers found. The required capacity is the difference in



A type 6E5 visual indicator tube is used as a grid-dip indicator in the L-C checker.

the two readings. Great care must be used in connecting these condensers in parallel, making certain that all connections are made as close to the condenser as possible.

frequency determination

The L-C checker can be used to measure the resonant frequency of a tuned circuit. This is done by coupling to the tuned circuit by means of the loop and varying the frequency of the oscillator. At the resonant frequency the eye will open sharply. The amount of opening is determined by the resistance in the tuned circuit and the degree of coupling. Low resistance circuits tightly coupled will cause a large opening, while high resistance circuits will not cause as large an opening. For more accurate determination of the frequency the coupling is decreased until a barely noticeable flicker is noted as the checker is tuned.

Wherever the coil is enclosed in a metallic case which may prevent magnetic coupling, capacity coupling can be used. The two binding posts at the lower left hand corner of the panel are for this purpose. The black post is grounded to the case; the red binding post is coupled to the oscillator through a 5-mmfd capacitor. The grounded terminal of the circuit to be measured is connected to the black binding post, and the high potential terminal to the red binding post. The L-C checker is then turned as before for the opening of the eye.

Capacity coupling may produce some shift in frequency calibration. The maximum shift will be less than 5%.

The method used to determine the frequency of i-f transformers is as follows:

The black lead is connected to the ground or chassis of the receiver. The red lead is then connected to the grid cap or plate lead of the transformer to be tested and the

The cathode resistor (R2), shunt capacitor (C1) and compensating resistor (R1) are changed for each range as indicated below.

RANGE	FREQ.	CATHODE RES. (R2)	CAP. (C1)	COMPEN. (R1)
A	50-175 Kc.	2000	125	60,000
B	175-500 Kc.	2000	100	35,000
C	500-1750 Kc.	2000	250	35,000
D	1.4-4 Mc.	400	150	10,000
E	4-12 Mc.	0	5	4000
F	9-26 Mc.	0	0	0

checker tuned as before. It may be necessary to short the unused winding to eliminate dead-end effects.

inductance measurement

To measure inductance with the L-C checker connect a condenser of known value

The L-C checker can be used to determine the resonance point of tuned circuits.

across the coil to be measured and find the resonant frequency of the circuit by using the loop, magnetic coupling, or a test prod, capacity coupling.

The loop is held near the coil to be measured and the checker is tuned. The opening of the eye indicates the resonant frequency of the coil and condenser. To obtain the most accurate results the loop is removed as far as possible while still causing a visible opening of the eye.

The inductance of the coil is then given by the equation:

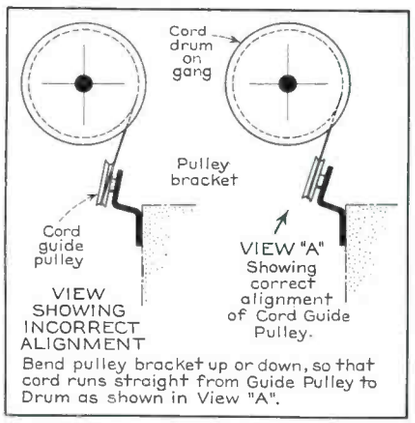
$$L = \frac{1}{4\pi^2 f^2 C} \text{ henries}$$

when C is in farads.

Engineering Dept., Aerovox Corp.

DIAL STRINGS

A FEW of the new receivers with rather complicated stringdrives on the dial system are causing trouble because the string keeps slipping off the guide pulleys. If the string is to stay on the pulleys, it is necessary that the string be tight and the pulleys in line. Some receivers have several positions to which the tension spring on the dial cord may be connected to give the proper tension. The various pulleys may be aligned by bending their



Correct alignment of the dial-string guide pulley is important for trouble-free operation of the dial drive.

supports so that the string runs straight from the guide pulley, with no tendency to climb up one side. The accompanying sketch will make this clear.

RCA Wheel Static.

ASSOCIATIONS

RADIO SERVICEMEN OF AMERICA

RSA is proud to announce a co-operative agreement between the members of the National Association of Broadcasters and the RSA, whereby local station members of NAB will continuously urge their listeners to keep their radios in repair at all times. NAB will sponsor RSA for this work in each broadcast.

With this NAB-RSA promotional campaign barely under way, 10 of the nearly 70 chapters of RSA are already participating.

Chapters located in Boston, Cleveland, Chicago, and Danville (Ill.) had made enough progress to take part in the Curtain Raiser program that launched the campaign. The Peoria, Davenport, St. Paul, Green Bay, Johnstown and Pittsburgh chapters have completed the preliminary arrangements to be ready to cooperate with local stations in their respective communities in the carrying on of the program.

Twenty-five chapters will act as pioneers, in order to learn experimentally the best way to make this campaign most effective nationally in the quickest time.

• • • allentown

The Lehigh Valley chapter in Allentown, Pa., has enrolled in the RSA television course. Business seems very good and we are looking forward to a successful season.

• • • boston

RCA sponsored John F. Rider, publisher, at a joint meeting held in the Crystal Ballroom of the Hotel Kenmore on Sept. 20. The enthusiastic response needs no comment.

• • • chicago

A regular meeting was held on Wednesday, Sept. 13. Robert Thompson of Meissner discussed and demonstrated the Meissner television kit. The "Standing Room Only" sign was hung out early in the evening and late comers were forced into the hall. Leon Podolsky of Sprague Products Co. was sponsor of our meeting of Sept. 21. On Sept. 28, RCA sponsored John F. Rider, publisher, who spoke at length on test equipment.

• • • dallas

At last Dan Cupid and his soldering iron got busy on Dee Sponsel and connected him to a running mate and loudspeaker. Which goes to prove that Service Men are human after all, even if they do yell about their disgust with most women Best wishes Dee, don't let the r-f get shorted out.

The Texas Broadcaster.

• • • duluth

The new benefits of RSA membership were discussed at our first meeting of the season early in September. We have scheduled, for the coming meetings, a continuation of credit lists and also Chanalyst applications by Endresen, Lukkonen and Elmgren. Regular meetings will be held on the first and third Mondays of each month.

• • • jersey city

William Fuller was elected chairman of the Jersey City chapter; L. Coon was elected vice-chairman; Frank Johnson was retained as secretary; George Kuhn, Sr., was nominated treasurer; William Iannuzzi was elected sergeant-at-arms. These officers will remain until December, 1940. The scheduled speaker for the next meeting will be Mr. Studeman, service supervisor of Philco Radio and Television Co.

• • • ohio valley

At the meeting held Sept. 19 correspondence from the national office was read and reviewed. The members voted to join the television course. Ways and means for the collection of delinquent dues were also discussed.

• • • washington, d. c.

Washington chapter met at the Knights of Pythias Temple, Tuesday, Oct. 3. The discussion was "Know Your Own Testing Equipment," and the master of ceremonies was W. Frank Cook of N.R.I. The Washington chapter is cooperating with the headquarters office of the National Association of Broadcasters in furthering the NAB-RSA tie-up.

OTHER GROUPS

• • • california

The annual picnic for the friends, families and members of the Radio Service Association of California was held Sunday, Sept. 10, at Tildon Park in Berkeley. The event featured a shooting gallery, an archery range and other concessions (the program committee did not forget anyone)—kiddie races, baseball, volley ball and rolling pin throwing contests were listed among the activities. Prizes were awarded for each event with special gate prizes. The affair was the biggest in the history of the organization.

• • • prsma

At the Oct. 3 meeting Westinghouse presented their Festival of Light. The lecturer demonstrated numerous curious effects with luminescent and flourescent tubing and materials. As an added feature the program committee arranged with SERVICE magazine to have Robert G. Herzog, Editor, discuss Television Picture Tubes. Mr. Herzog also demonstrated his famous "Impact Excitation Generator" which was described by Alfred E. Teachman in the September 1936 issue of SERVICE.

• • • the representatives

The 1939-40 season of the Representatives was well under way with their first fall meeting, held Sept. 12. Officers for the coming year were elected.

C. B. Cooper, publicity

PRSMA Television Class, 1939

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of SERVICE—A Monthly Digest of Radio and Allied Maintenance published monthly at New York, N. Y., for October 1, 1939.

County of New York, } ss.:
State of New York, }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of SERVICE—A Monthly Digest of Radio and Allied Maintenance, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York, N. Y.; Editor, Robert G. Herzog, New York, N. Y.; Managing Editor, None; Business Manager, B. S. Davis, Ghent, N. Y.

2. That the owners are: Bryan Davis Publishing Co., Inc., 19 E. 47th St., New York, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; J. A. Walker, St. Albans, L. I., N. Y.; A. B. Goodenough, New Rochelle, N. Y.; S. R. Cowan, Brooklyn, N. Y.; P. S. Weil, Brooklyn, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock, and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) BRYAN S. DAVIS, Business Manager.

Sworn to and subscribed before me, this 29th day of September, 1939. (Seal) J. A. WALKER, Notary Public.

Queens Co. Clk's No. 1991; Reg. No. 5650. New York Co. Clk's No. 199; Reg. No. 1-W-176. Commission expires March 30, 1941.

CROSLEY 158

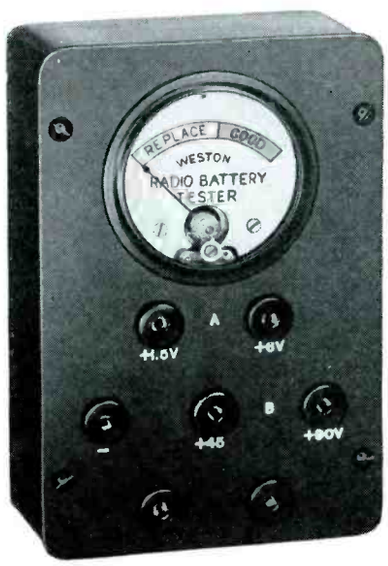
Intermittent change in tone: Cause defective tone control condenser. Replace with 0.005-mfd across primary of output transformer and 0.05-mfd in series with tone control across primary of output transformer.

Noisy volume controls, audio instability: Replace 3-meg control with 1-meg unit. Replace 0.5-meg resistor (No. 52 on schematic) with 0.1-meg, ¼-watt unit. This change entirely eliminates audio instability.

D. C. Sprong

PREVIEW OF TEST EQUIPMENT

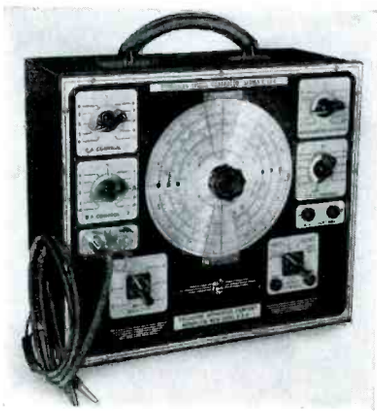
(*Continued from page* 531)



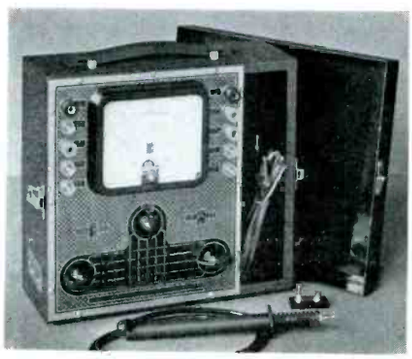
Weston Model 777 pocket size battery tester. Gives readings on a "Replace-Good" scale for popular battery voltage ratings.

Readrite Model 739 pocket volt-ohm-milliammeter. Has 13 ranges for 4 functions.

Clough Brengle Model 220 Unimeter. A 20,000-ohm-per-volt volt-ohm-milliammeter with ranges to 10,000 volts. 39 ranges for 6 functions. (At right.)



Precision Series E200 signal generator. Incorporates avc substitution method for mc in 6 bands, modulated or unmc in 6 bands, r-f or modulated.



Index to Advertisers

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Output indicator; peak voltmeter ranges 0-35, 0-350 and 0-3500 volts; r.f. alignment indicator; measures capacities to 2000 mfd., resistance to 7½ megs; indicates power factor; spots leaky condensers and intermittents; continuity checker.

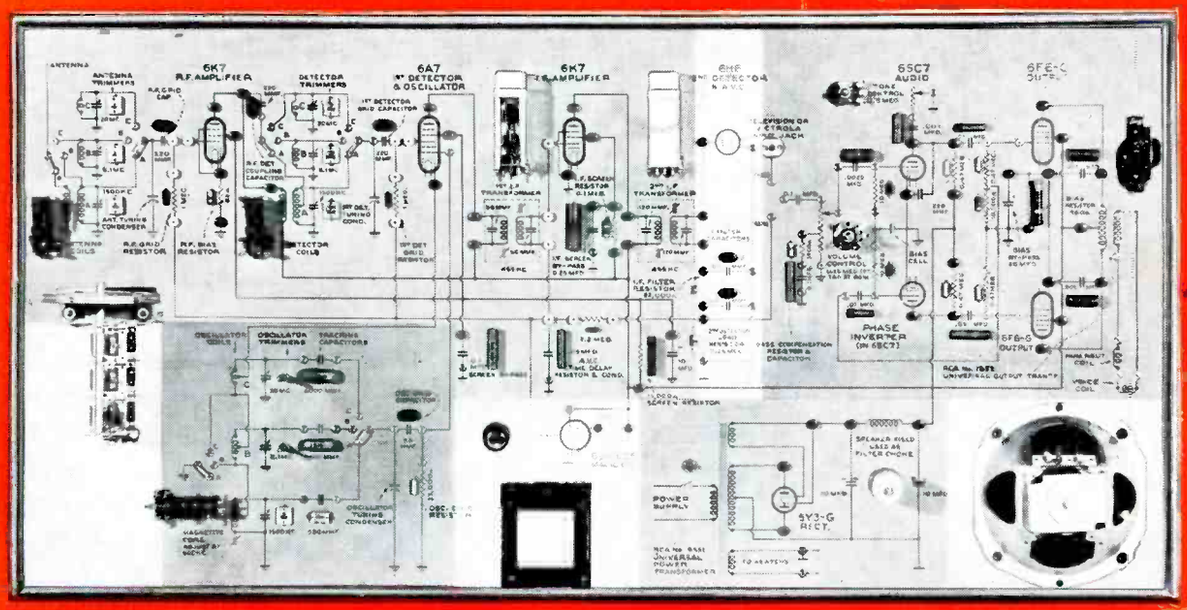
DEALER COST $39.00

SOLAR ANALYZER CB

Measures capacity to 70 mfd., resistance to 2 megs; indicates power factor; spots leaky condensers and intermittents; continuity meter. Most popular condenser tester on the market.

DEALER COST $19.20

SOLAR MFG. CORP., Bayonne, New Jersey



This is the Dynamic Demonstrator which will be used at the RCA Service Equipment Demonstrations. With it any radio trouble may be created. So "pack all your troubles in your old kit bag" and bring them to this demonstration. With the Dynamic Demonstrator and modern service equipment we will show you how the troubles of a radio set may be easily, quickly, and efficiently traced and corrected.

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Test Equipment

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