DEVOTED ENTIRELY TO THE

25 CENTS

RADIO SERVICEMAN

RADIO MAINTENANCE

William E. Hagaro
P.O. Box 224
Slickville, Perna

BILL HAGARA
BOX 224, SLICKVILLE, P
RADIO SERVICE

NOVEMBER 1946

PART II TESTING AND ALIGNING TELEVISION RECEIVERS

DON'T FORGET THE DIAL LAMP

THE OSCILLOGRAPH... HOW TO USE IT

CRYSTAL PICK-UPS

A BOLAND AND BOYCE PUBLICATION

SILVER

"VOMAX" Top Ranking Choice

Thousands upon thousands of "VOMAX", the truly universal vacuum-tube volt-ohm-milliammeter . . . . in service today in ranking laboratories ranging from the U. S. Bureau of Standards on through the roster of radio's elect . . . . bought by Veterans Administration and other school training programs . . . . consistently selected by America's top-profit service organizations . . . . conclusively prove it is the best.

"VOMAX" is also the cheapest . . . . not only because the best is always cheapest in the long run . . . . but in first cost, too! Increasing production in response to increasing demand enables us . . . . despite continually increasing material costs . . . . to hold its price down.

"VOMAX" alone gives you the profit-priceless ability to measure every voltage in radio servicing . . . . at meter resistance so astronomically high it does not upset measured circuits . . . . 24 d.c. voltage ranges 0 through 3000 volts at 51 and 126 megohms input resistance . . . . 6 ranges 0-1200 volts a.c., a.f., i.f., r.f. to over 100 megacycles at 6.6 megohms honest input resistance . . . . decibels from —10 through +50 . . . . resistance from .2 ohms through 2,000 megohms . . . direct current from 50 microamperes through 12 amperes. No other instrument at any price gives you all that "VOMAX" does. Its value is unequalled . . . . it's the standard of comparison . . . . the overwhelming choice of those "in the know" . . . . is radio's outstanding buy . . . . at only $59.85.

"SPARX" DYNAMIC SIGNAL TRACER

Next to the universal volt-ohm-milliammeter . . . . "VOMAX" is the ideal universal d.c. through u.h.f. meter . . . . what the radio service profession most needs is a good dynamic signal tracer. Ability to trace the signal through every successive receiver circuit reduces "trouble-shooting" to basic fundamentals . . . . banishes forever the hard-to-service "toughies" . . . . turns loss jobs into quick profits.

Designed by radio's only International Grand Prize winner, "SPARX" is the aural-visual signal tracer you have been clamoring for. Not only does "SPARX" trace r.f., i.f., a.f. signals from 20 cycles to over 200 megacycles . . . . it is your shop test-speaker as well. It also tests microphones, phono pickups, P.A. amplifiers, speakers . . . . registers presence or absence of d.c. and a.c. operating voltages, too.

With new radar crystal diode probe, 3-stage 65 db. gain a.f. amplifier, ground-insulating transformer power supply and PM dynamic speaker, it's the instrument you've dreamed of . . . . like all SILVER instruments will earn its cost in no time at all. Yet "SPARX" costs you only $39.90.

"904" LABORATORY CAPACITANCE RESISTANCE BRIDGE

Not only does Model 904 C-R Bridge cover the tremendous range of ¼ mmfd./ohm up through 1000 mfd./megohms . . . . give you truly laboratory accuracy in measurement of capacitors and resistors . . . . provide 0-500 volts continuously variable built-in d.c. polarizing voltage for electrolytic and other capacitors . . . . give power factors measurement 0-50% . . . . but it brings something quite new to radio measurements.

With Model 904 C-R Bridge you can at last measure capacitance of any type of condenser . . . . air, paper, oil, electrolytic, ceramic . . . . **with d.c. operating voltage applied during measurement!** Think what this means in increasing your efficiency . . . . in finding those "intermittents" which cause so much trouble . . . . in speeding your work and increasing your profits.

Measuring capacitors and resistors to ±3% **laboratory accuracy** . . . . matching "VOMAX" and "SPARX" in size, post-war style, top quality components and construction . . . . it's the same amazing bargain at only $49.90 net as "VOMAX" . . . . value which has forced 500% expansion in our plant facilities in less than one year.

And

See these "must" instruments . . . . and new SILVER amateur transmitters, receivers, kits, parts which were sensations at the 1946 Trade Show at your favorite jobber. Act fast . . . demand continues far in excess of supply . . . . for SILVER products are the profit tools used by your smart competitors. Send postcard for new post-war catalog.

OVER 35 YEARS OF RADIO ENGINEERING ACHIEVEMENT

McMurdo Silver Co., Inc.

1249 MAIN STREET • HARTFORD 3 • CONNECTICUT

RADIO MAINTENANCE

INCLUDING
ELECTRONIC MAINTENANCE

Volume 2 | NOVEMBER 1946 | Number 10

Contents

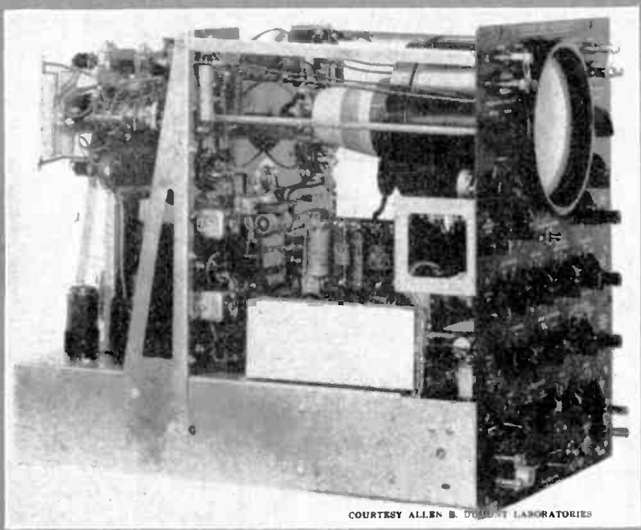
Radio Maintenance is published monthly by Boland & Boyce, Inc., at 34 No. Crystal St., East Stroudsburg, Pa., U.S.A.; Executive and Editorial Office, 460 Bloomfield Ave., Montclair, N. J. Subscription Rates: In U.S., Mexico, South and Central America, and U. S. possessions, $2.50 for 1 year, $4.00 for two years, single copies 25 cents; in Canada, $3.00 for 1 year, $5.00 for 2 years, single copies 30 cents; in British Empire, $3.50 for 1 year, $6.00 for 2 years, single copies 40 cents; all other foreign countries, $4.00 for 1 year. Application for entry as second class matter is pending at the Post Office, East Stroudsburg, Pa.

Subscribers should allow at least three weeks for change of address.

Do you know a better way to do it?

Each month RADIO MAINTENANCE will pay a crisp new ten dollar bill for the best serviceshop suggestion and five dollars for all others printed.

All radio servicemen have their own slants on solving particular problems. Send in *your* tips and tricks and profit by them!


COURTESY ALLEN B. DUMONT LABORATORIES

Karl R. Alberts

the Oscillograph . . . how to use it

The theory and construction of the oscillograph has been discussed in two previous articles. This article begins a series on the use of the instrument.

IN THE preceding sections of this series, Parts I and II, the theory of the cathode-ray tube was described and general types of cathode-ray oscilloscope circuits examined, with particular reference to a simple, rugged type, the DuMont 208. In this section, we will go into some of the uses to which the radio repair- and maintenance-man can put the oscilloscope to good practical advantage.

Refer to Part I of this series for a tabulated list of functions to which the oscilloscope is usually put.

One of the simplest yet most useful functions in which the cathode-ray oscilloscope excels is its use as a voltmeter. Of course its accuracy is not so great as that of the very sensitive instruments specifically designed for that purpose. It has the following great advantages over conventional voltmeters:

1. It has extremely high input impedance;
2. It enables the operator to view the voltage wave under examination while he is measuring it;
3. Every point of a complex voltage wave-form can be examined and measured individually.

It has the disadvantage that it does not have the extreme range capabilities of some voltmeters. With some auxiliary apparatus, described later on, even this disadvantage can be overcome.

Of course, it is not very economical to buy a cathode-ray oscilloscope merely to use it as a voltmeter alone, but when an oscilloscope is used as a general testing instrument for some of the functions outlined in Part I, as well as others, then its use as a voltmeter will be found of great value.

Set-up

For cathode-ray oscilloscopes which have a deflection factor (See Part I of this series) in the order of 25, a DC voltage of 25 volts applied directly to the deflecting plates will deflect the spot or trace one inch above or below its zero voltage position. Since the operation of the oscilloscope is approximately linear, a voltage of 50 volts will cause a 2-inch deflection, 62.5 volts will cause a 2½-inch deflection, and so on. For convenience in later testing, the screen of the oscilloscope should be calibrated in terms of voltage applied to the vertical deflecting plates.

Connect the oscilloscope in the following manner: Right and left horizontal deflecting plates tied to their horizontal amplifier terminals, bottom vertical plate grounded, top vertical plate connected to external signal. For oscilloscopes which, like the DuMont 208, have a rear terminal block, connect as shown in Fig. 1. For other oscilloscopes where no terminal block is provided, usually two switches, one for the horizontal channel, the other for the vertical channel, are provided with positions marked AMPLIFIER and EXTERNAL, or similar markings; switch horizontal to AMPLIFIER, vertical to EXTERNAL. The latter operation automatically grounds the bottom plate and connects the top plate to a probe on which the external signal is to be impressed.

Connect D4 (top plate) to ground temporarily. Turn on the oscilloscope, switch sweep frequency to some arbitrary value (say 1000 cycles per second), adjust FOCUS and INTENSITY controls so a clear, sharp line is obtained. Adjust horizontal gain for a line about 3 inches wide. The line should be somewhere in the vertical center of the screen. Now lift D4 off ground and connect it to an external variable DC voltage source, as in Fig. 1. (It might seem strange to have to use a voltmeter in order to calibrate the oscilloscope screen so that the oscilloscope itself may be used as a voltmeter; it must be remembered that the voltmeter is being used only for the initial calibration of the oscilloscope and will not be used thenceforth. Once the oscilloscope has been calibrated, it will be capable of doing many more things than an ordinary voltmeter.)

The voltmeter, incidentally, should have a high impedance compared with the resistance of the potentiometer across the battery, although the shunting effect of the voltmeter's internal resistance across the potentiometer is unimportant if the voltmeter is left connected in the circuit when the voltage is applied to the top vertical plate.

Increase the voltage by turning up the potentiometer, until the sweep line just disappears off the top of the screen. Note the voltage value indicated on the external voltmeter. With this voltage figure in mind, estimate the best voltage increments by which to divide the screen. If, for example, the voltage is about 50 volts, then a total screen deflection (top to bottom) will be produced with about 100 volts; main divisions of 20 volts with sub-divisions of 10 volts will then be most practical. Fig. 2 shows a screen calibrated in this fashion. Make the markings with a soft red or blue china marking pencil directly on the glass. The screen is now calibrated and ready for use as a DC or AC voltmeter.

Suppose it is necessary to check the B— and bias voltages in a radio set quickly, in an approximate manner, merely to determine some gross error in the set and without too much regard for precision. Connect the oscilloscope ground to the chassis ground of the radio. Connect the top vertical plate D4 to a probe which can conveniently be hooked to any point to be observed. Then with the probe in hand, move from one DC point to another on the radio chassis, observing the deflections on the oscilloscope screen and checking whether the voltages corresponding to the deflections are correct for the points being observed.

For DC voltages which are greater than full-screen deflection, it will be necessary to build a simple attenuator, such as that shown in Fig. 3. The resistors are made high-valued in order not to constitute much of a shunt on most networks in a radio set. It will prove to be a good idea to construct a small box or chassis consisting of the attenuator shown in Fig. 3, or a similar one, and two plug-and-jack connections for the probe lead, one labeled "direct" and the other "attenuator." The direct lead will connect directly to the top deflecting plate, and can be used on circuits of very high impedance where no shunting resistance can be tolerated.

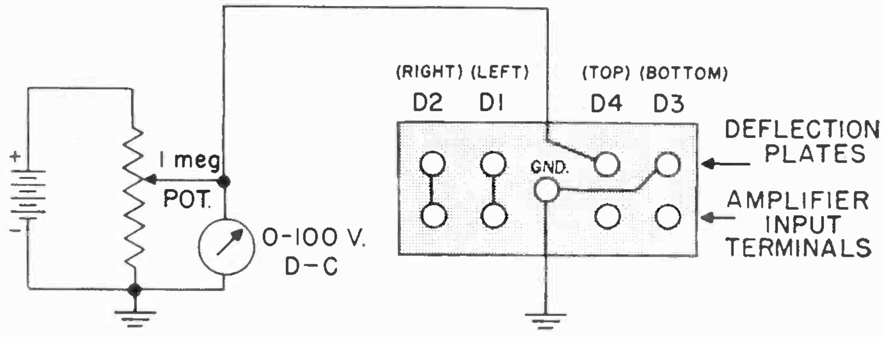


Fig. 1 Connections used when calibrating the oscilloscope. The terminal block shown is that used on the DuMont 208B but the same method can be used with other oscilloscopes.

It must be remembered that the accuracy of a cathode-ray oscilloscope is less than that of most commercial DC voltmeters. For this reason, and also the fact that the range of measurement is limited (even with an attenuator the upper range is limited because the greater the voltage division, the less the accuracy of measurement; and the lower range is limited to a minimum in the order of 2-3 volts), the oscilloscope can only be considered a handy, quick-test voltmeter, not a substitute for a conventional precision meter.

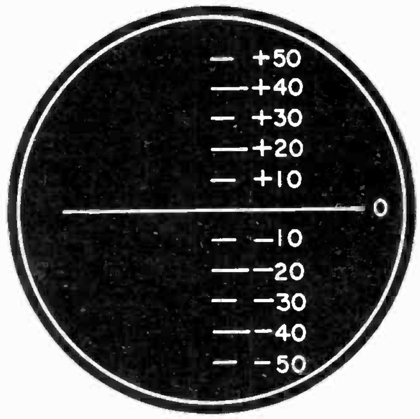


Fig. 2 An Oscilloscope screen calibrated by the method explained in the text. The markings are made with a soft red or blue china marking pencil.

AC Voltages

Where the oscilloscope as a DC voltmeter proved to be inferior to the commercial DC voltmeter except in its convenience (particularly when the oscilloscope is set up for rapid checking and testing of many kinds, with DC voltage measurements only one of many tests), as an AC voltmeter, the oscilloscope has several points of superiority over the conventional type of AC voltmeter:

1. It has an extremely high input impedance, when signals are applied directly to the vertical deflecting plates. The plates, being arranged like the two opposing plates of a condenser, have a certain amount of capacitance, which constitutes the input impedance. This capacitance is usually in the order of 10 to 50 micro-

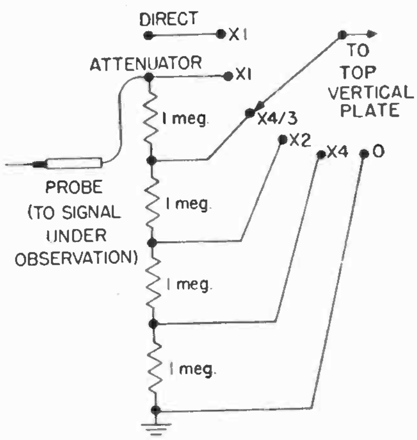


Fig. 3 A simple attenuator used to extend the measuring range of the oscilloscope. The attenuator should be mounted on a small box or chassis.

microfarads (.00001 to .00005 microfarad). A capacitance of 20 uuf has an impedance of 8 megohms at 1000 cycles; at 100 kc, it is 80,000 ohms. Thus at low or moderately high frequencies, connection directly to the vertical deflecting plates constitutes a negligible loading effect on an AC voltage.

2. Its accuracy compares well with

→ To Following Page

The Oscillograph...How to Use it

→ From Preceding Page

that of most commercial peak-reading or RMS AC voltmeters.

3. It has equal sensitivity over a very wide range of frequencies.

4. It can indicate magnitude of a voltage wave even when it is not a pure sine wave. Every point of a complicated wave-form can be measured, whereas a conventional voltmeter would give a measure either of the peak value or the RMS value of the wave, which for a complex wave would be worthless. (The RMS value of a pure sine wave, it will be remembered, is .707 times the peak value.)

If the voltage to be measured is anywhere in the range of a few volts to several hundred volts, it can be measured by connecting directly to the top vertical plate, just as was done for a DC voltage. The minimum of a few volts is determined by that voltage which can just produce an observable deflection. For an oscilloscope having a deflection factor of 25 volts/inch, one volt would deflect the sweep line by an amount no more than the thickness of the sweep line and hence would not be measurable. Four or five volts could easily be measured. It will be necessary for AC to connect the voltage being measured, or some voltage which varies directly with it, to the EXTERNAL SYNC. terminal on the oscilloscope, and adjust coarse and fine frequency controls and sync amplitude control to obtain a steady pattern on the screen. Or, connect nothing to the EXTERNAL SYNC. terminal and use INTERNAL SYNC. See Part I of this series which includes a brief note on synchronization of sweep with signal.

For voltages having values in excess of full-screen deflection value, the attenuator arrangement shown in Fig. 3 can be used.

The calibration marks on the screen of the oscilloscope should be checked from time to time to insure that slight changes in the oscilloscope's deflection factor, which may be due to drifts in anode voltages or any other cause, will be taken into account.

An alternate arrangement for large or small voltages, DC or AC, consists of employing a "continuous calibrator" or "volt box." With this arrangement, only one line need be marked on the screen. Also, voltages considerably in excess of full-scale deflection voltage can be accurately measured without the use of an attenuator. For this method, the circuit of Fig. 4 must be built up. It is really worthwhile doing this because the "calibrator" will be found of tremendous usefulness in all future testing with the oscilloscope where signals are connected directly to the vertical plates. The main battery shown consists of seven or more 45-volt "B" batteries, which will last a very long time because of the negligible drain in the circuit. The small 1.5-volt battery is used merely to light the 1.5-volt lamp to indicate that the switch is *on*. The voltmeter is a 0-300 or 0-500 volt DC voltmeter.

With the bottom vertical plate D3 grounded and the horizontal plates D1 and D2 connected to their amplifier terminals and synchronization of sweep and signal obtained as per the directions given above, connect the top vertical plate D4 to ground and note where the sweep line occurs. Mark this position on the screen with a china-marking pencil. Make the line

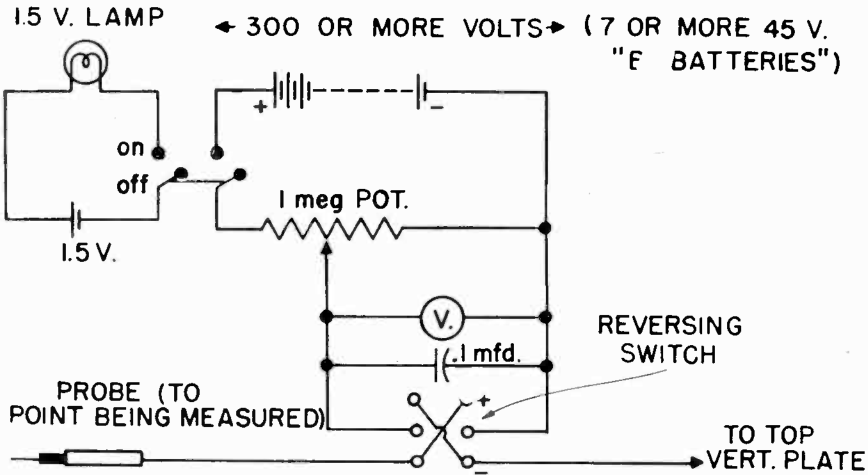
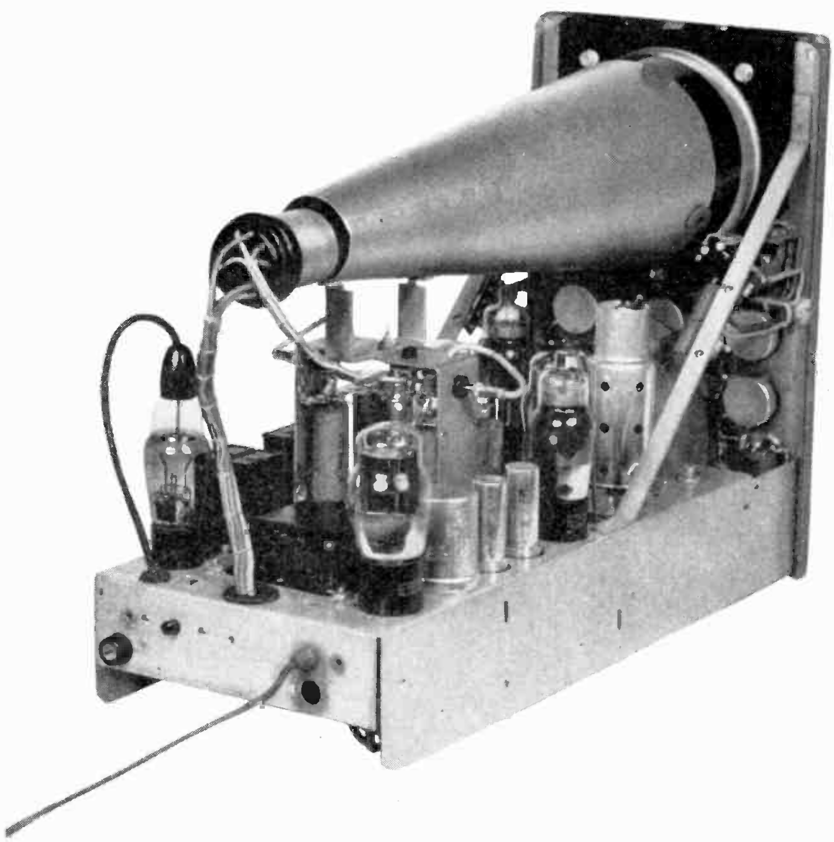


Fig. 4 The above arrangement is used as a calibrator. It is particularly useful when studying complex waveforms.



The RCA Model 160 Cathode Ray Oscilloscope. Note the shield covering the Cathode ray tube. The tube with the large cap on top is the high voltage half-wave rectifier.

Fig. 5 The DC Voltage is indicated on calibrator voltmeter. The RMS value of the hum is equal to V2 minus VI divided by 2.828.

3 or 4 inches. This is the *only* mark to be made on the screen. Now, connect in the "calibrator" circuit and then touch the probe to some known DC voltage (say +10 volts). With the switch *off*, the sweep line will jump up to a position corresponding to a +10-volt deflection. Turn the "calibrator" switch *on* and turn up the potentiometer until the line returns to the marked line on the screen. If the sweep goes in the opposite direction, throw the reversing switch. Mark the correct position of the reversing switch plus, and the other position minus. The voltmeter on the "calibrator" will read very nearly 10 volts.

This, then, is the technique for measuring DC voltages by this new means. Connect the probe to the unknown voltage, turn on the switch, turn up the potentiometer until the sweep line returns to its zero position line (throw reversing switch if necessary) and then read the voltage directly on the voltmeter. What the "calibrator" does is interpose a counter or bucking voltage between the signal voltage and the deflecting plate, making the net voltage on the deflecting plate zero; the voltage necessary to do this is then indicated on the voltmeter. Although the voltage from the "calibrator" must necessarily be of opposite sign to that of the voltage being measured, the plus and minus markings on the reversing switch take this into account; and hence for any unknown voltage, the magnitude and polarity can be read off directly from the "calibrator."

Note also that voltages up to the limit of the battery voltage or the meter's full-scale (whichever is the limiting factor) can be measured by this means; even if we are measuring 250 volts (which would deflect the sweep line far off the screen), by bucking it out with 250 volts of opposite polarity from the "calibrator," we make the net voltage to the top deflecting plate zero. This is the technique in all cases.

The method will be particularly useful in looking at DC points where excessive hum or pick-up is suspected. (Small amplitudes of hum may not be detected because of limitations on oscilloscope sensitivity.) If the point is "clean," a clear, straight line will show on the screen (representing only DC on the top vertical plate); if there is some 60-cycle hum or high-frequency pick-up on the point being observed, it will show as a wave of long or small ripples (depending on the frequency of the extraneous signal) whose amplitude peak-to-peak can easily be measured. The DC voltage at the point will be the "calibrator" voltage necessary to bring the pattern to a position where the marked line on the screen cuts through its center.

To measure any point on an AC voltage wave, connect the probe from the "calibrator" to the voltage point

→ To Page 30

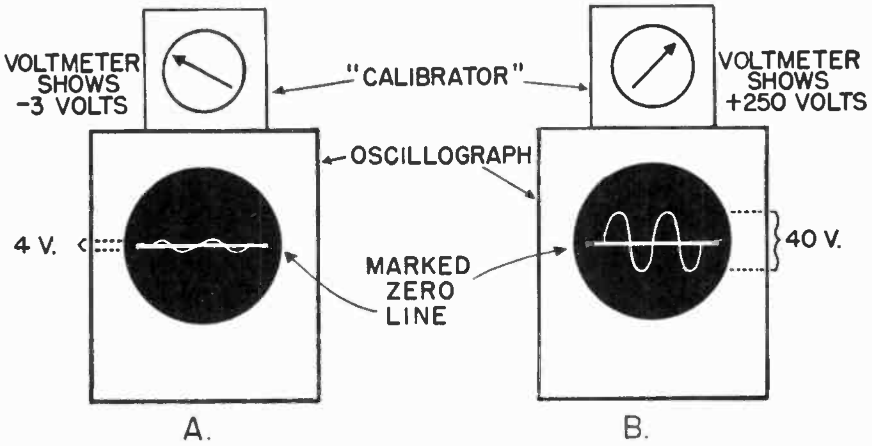


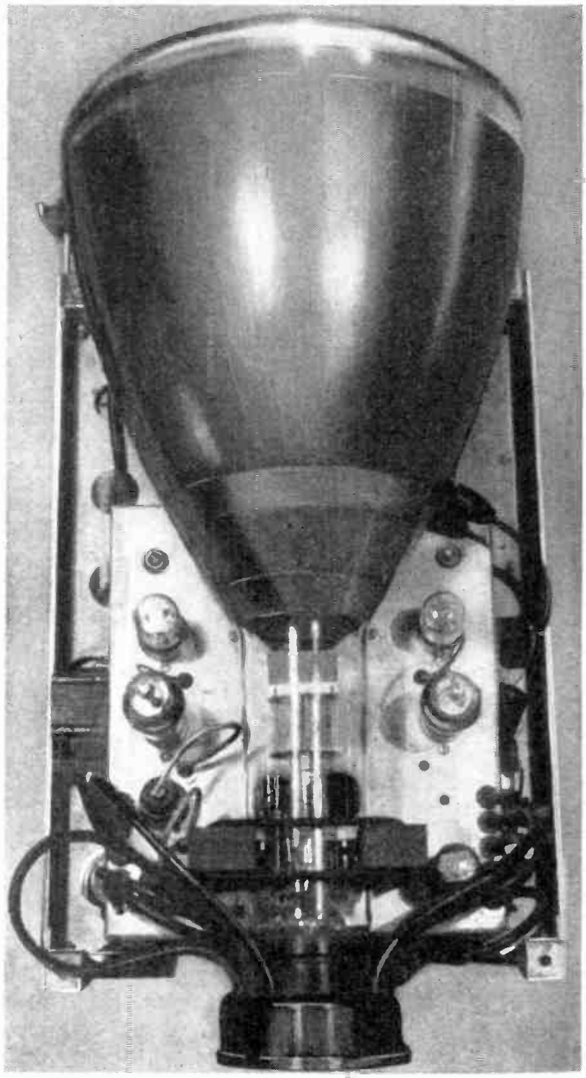
Fig. 6 A shows the pattern obtained at the input of the stage while B shows the pattern obtained at the output. This makes possible measurement of the gain of the stage.

The General Electric CRO 5-A Cathode Ray Oscilloscope. This is an excellent instrument for general servicing work. It uses a 5-inch tube.

TESTING AND ALIGNING TELEVISION RECEIVERS

Morton Scheraga

DuMont Laboratories



This is is the second article explaining the adjustment of the television receiver.

LAST MONTH, we covered the alignment of the sections of a television receiver that control the operation of the cathode ray tube and the scanning motion of the electron beam. It remains to discuss the video circuits that bring the picture information up to the grid of the television tube.

It is well to consider first the type of circuit design of the video section that the serviceman will encounter when he delves into the repair of different receivers. The basic factors in the circuit design are the required sensitivity, selectivity, and width of frequency response. These items are subject to wide variation and will be governed in the main by the cost of the receiver.

There is at present no standard for the sensitivity of a receiver. However, a peak-to-peak signal of about 25 volts is required at the grid of the cathode ray tube for optimum contrast of picture, and the receiver should be able to amplify an input signal to this level. Cheaper television receivers, in which the gain is limited by cost, have sensitivities of 1000 microvolts input, or even in extreme cases 5000 microvolts, to be able to produce about 25 volts at the kinescope. Of course, this will mean that the set will have to be located in an area where a strong signal can be received. Receivers located on the fringes of the operating areas of a television transmitter will probably have difficulty in receiving a picture of good quality. Thus the serviceman, in installing a receiver in a customer's home, should take into account the signal strength at the particular location and the sensitivity of the receiver. The effect of a weak signal with too low a receiver sensitivity is shown in Fig. 1.

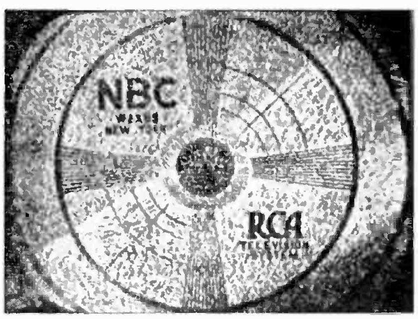


Fig. 1 A test pattern showing noise in the picture due to too weak a signal.

The selectivity problem involves mainly the attenuation of the two audio carriers adjacent to the video carrier. The sound carrier nearest the picture carrier is, as shown in Fig. 2, that of the adjacent television channel, and this signal accordingly must be sharply attenuated. An attenuation value of 60 db (a voltage ratio of 1000 to 1) is recommended design practice. The other sound carrier, that which accompanies the picture in the same channel, is more remote from the picture carrier, and consequently 40 db (100 to 1) is usually considered sufficient attenuation. If the audio carriers are not properly attenuated when the alignment is made, sound modulation will get into the picture. This interference effect is shown in Fig. 3. There are also adjacent picture signals to be considered, but the pass band of the IF amplifier is sufficiently narrow to overcome the effects of adjacent picture components.

The band width is a compromise between desired detail in the image, on one hand, and cost on the other. Fig. 4 shows the standard television channel as defined by the RMA Television Committee. It indicates that the maximum band width for picture information is 4 megacycles. The selectivity problem, however, for 4 mc band width is acute and entails filter or trap structures of greater complexity to attenuate the adjacent signals. Furthermore, the greater the band width, the lower the gain per stage through the receiver, and the more tubes required for a given sensitivity.

For the less expensive receivers, therefore, which employ small cathode ray tubes, the band width is purposely limited to a value not greater than 3 mc and often lower than 2.5 mc. This means that cheaper circuits can be used, though the picture detail will be less. Also, there is little advantage in using a wide band with the smaller tubes since the spot size of the electron beam prevents the reproduction of any more detail. On the other hand, the large and more expensive receivers with large cathode ray tubes permit greater detail and use of band widths of 3.75 to 4 mc.

The serviceman should take into consideration the above problems involved in the circuits of a receiver when aligning the video systems. Since the band width and selectivity of a receiver determine the quality and contrast of the picture, it is important that the alignment be carried out with care to obtain the maximum band width and selectivity for which the particular receiver is designed. The ability of the serviceman to do this alignment properly will mean a satisfied or unsatisfied customer, whose eye can readily detect noise in a picture or poor detail, both of which are due to poor alignment. The serviceman should, therefore, consult the service manual supplied by the manufacturer of a receiver before starting the alignment. The service manual will indicate the sensitivity, band width and response characteristics of the amplifiers for the particular receiver. With these limits in mind, the serviceman is ready to attack the two-fold alignment job, that of maximum gain (in other words, greatest sensitivity) and that of maximum band width.

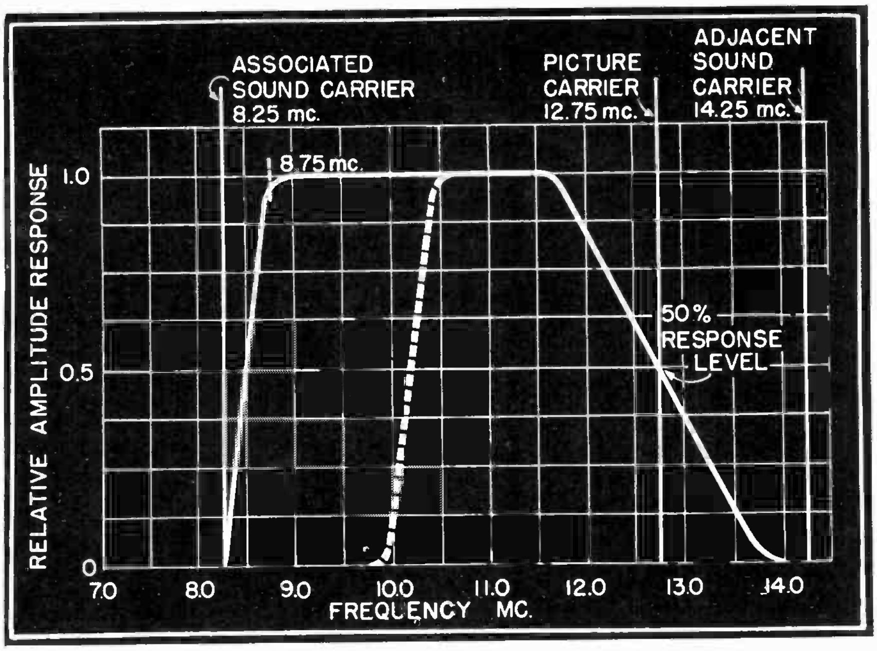


Fig. 2 Ideal picture intermediate frequency response.

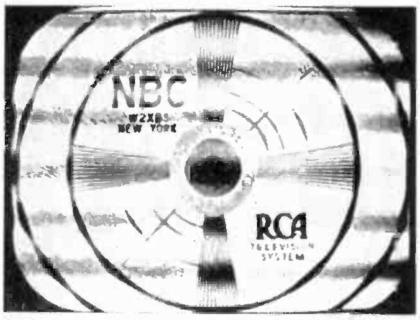


Fig. 3 A test pattern showing sound modulation in the picture caused by improper alignment of the sound traps.

Aligning the Video Amplifier

The video amplifier receives the detected IF picture signal and must bring it up to the level required to modulate the grid of the cathode ray tube. An unofficial standard for television receivers is to feed at least one volt of detected signal so the video amplifier. If this requirement is met, one stage of video amplification will generally be required. If a lower signal is produced by the IF amplifiers, some receivers may have two

→ To Following Page

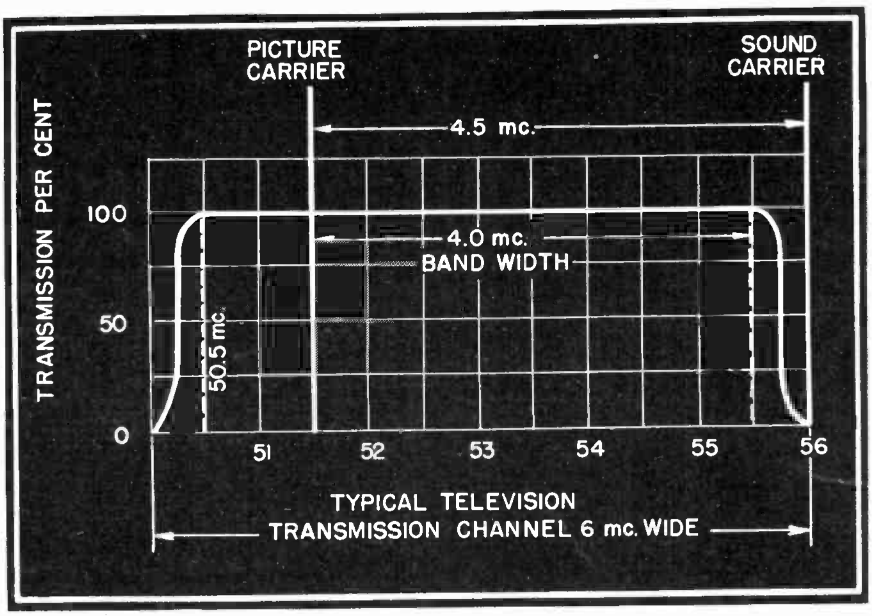


Fig. 4 A typical 6 Mc television channel.

→ From Preceding Page

stages of video amplification. To obtain the wide band width of 4 mc or less in the cheaper receiver, compensating networks are employed to maintain good low- and high-frequency response. Some receivers will use fixed components in the video amplifier, in which case the serviceman can realign the stage only with difficulty by changing a fixed component in the compensating circuits. Other receivers will have peaking coils whose inductance can be varied to obtain the correct response.

Two methods will be described for the alignment of the video amplifier: (1) The use of the variable frequency oscillator and (2) the sweep generator. Most servicemen will have signal generators with frequency ranges from, say, 20 cps to 100 mc (two signal generators are required in practice to cover this wide range—one for low frequencies and the other for the high frequencies) when they become engaged in television work and will be able to use them in conjunction with a cathode ray oscilloscope or vacuum-tube voltmeter to do the alignment. The sweep generator, also known as a wobbulator, is a piece of equipment that will be new to most service shops and these will be on the market in the near future. The sweep generator makes alignment a much more rapid process.

The connections for the video oscillator method are shown in Fig. 5. A simple substitution method is employed to measure the gain of the video amplifier. First, the vacuum-tube voltmeter (or oscilloscope) is connected across the signal source, which is set at some desired frequency, and the reading recorded. Then the voltmeter is placed across the output terminals of the amplifier and the value noted. The ratio of output to input voltages is the gain at the particular frequency. The procedure is then repeated for as many different frequencies as are required to cover the full range of the amplifier. The desired response characteristic of a 4 mc wide video is indicated in Fig. 6. If this is the band width of the receiver under test, the serviceman will measure a constant gain at all frequencies up to about 4 mc, after which the gain will fall rapidly. If this condition is not met, the gain will vary with the frequency and he must adjust the peaking coils and go through the procedure all over again, as many times as necessary to obtain the correct response. The tediousness and time consumption of this method are obvious, but it is the only means available to the serviceman if he does not own a sweep generator.

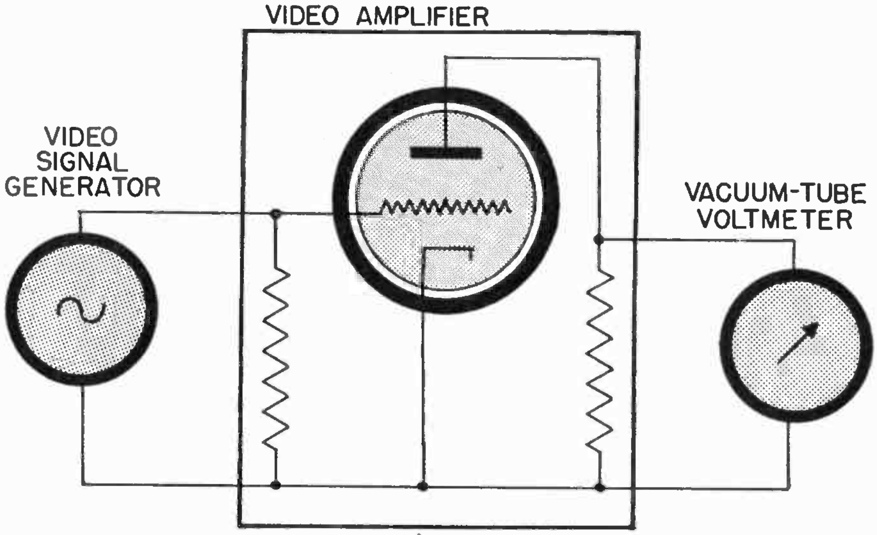


Fig. 5 Method used to measure the video amplifier response with a signal generator

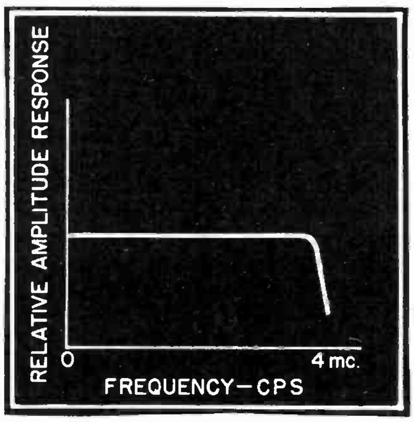


Fig. 6 Ideal video amplifier response.

Fig. 7 The oscilloscope pattern obtained when using the sweep generator.

The sweep generator makes alignment a simple and rapid task. Used with an oscilloscope, it plots an oscillogram of the amplitude response of the amplifier versus frequency, and gives the type of pattern shown in Fig. 7 for a good video amplifier. In making any adjustments of the peaking coils, the serviceman can see at a glance the effect on the amplitude response. Thus alignment becomes a matter of only a few minutes. A description of the sweep generator is given in the October 1945 issue of RADIO MAINTENANCE as applied to audio circuits, and the reader is referred to the article, "Using the Signal Generator and Oscillograph." The sweep generator described in that article is good for the audio range. For the testing of a video amplifier, the output sweep frequency should have a range ideally from zero frequency (DC) to about 6 mc to check band widths as wide as 4 mc. In actual practice, sweep generators from 100 kc to about 10 mc will be on the market. With the sweep generator, the normal procedure for alignment is as follows:

Connect the output of the generator to the input terminals of the amplifier to be tested as in Fig. 8. If the generator is not provided with a blocking condenser, a series capacitor of approximately 0.01 ufd must be used if connecting to a circuit in which DC voltage is present. Connect the video detector probe from the output of the stage to ground and connect the output of the detector to the vertical input and ground of the oscilloscope. Adjust the attenuator of the video sweep generator until sufficient signal input is obtained that will cause a pattern to appear on the oscilloscope.

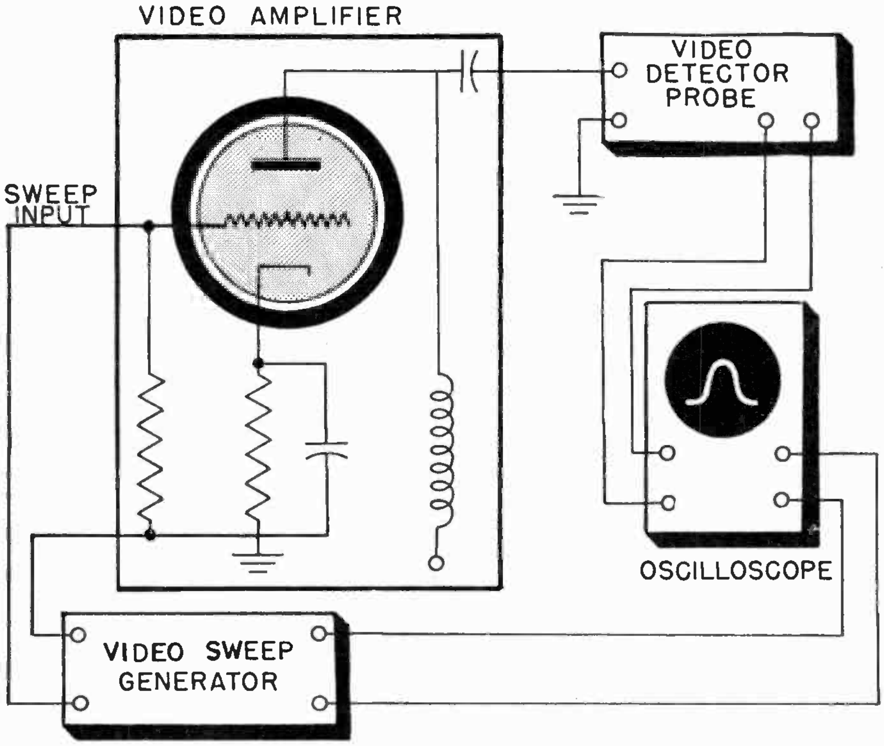


Fig. 8 A typical test set-up for testing the video amplifier response using the sweep generator method.

In order to determine whether the pattern on the oscilloscope is of proper band width, markers are provided in the sweep generator which appear as small pips on the pattern. These are shown in Fig. 7. By varying the marker frequency, the pip can be moved to any position on the pattern and with the calibrated dial, the frequency band width can be read directly. With this setup, all the serviceman has to do is check the band width of the amplifier with the markers. If it is not flat for the desired range, he simply adjusts the peaking coils while watching the pattern until the markers indicate the proper band width. With the video amplifier aligned for 4-mc band width, and if the preceding amplifiers have equally good selectivity, it will be possible to see the vertical lines in the wedge of the test pattern all the way down to the center circles (see Fig. 9). The effects of poor low- and high-frequency response are shown in Figs. 10 and 11.

Checking the DC Restorer

With the video amplifier aligned, the serviceman should then check the DC restoration. This check should be made only if some radical change has been made in the video circuits. Otherwise, the DC restorer as designed by the manufacturer should not require any changes of the fixed components when an alignment of the amplifier is made. To make this test, measure the DC residual voltage on the grid of the cathode ray tube without any signal. Then measure the DC voltage at the same point with a 15-kc sine wave fed to the video amplifier from the signal generator. Be careful not to overload the amplifier. The peak amplitude of the sine wave should be measured at the grid of the cathode ray tube using a calibrated oscilloscope. If the DC restorer is working properly, the change in DC voltage at the grid from the residual value to that when the sine wave is fed to the video amplifier should be 85 per cent of the peak sine voltage at the grid. For example, if the DC restoration is correct, a 15 kc, 2½ volt peak-to-peak sine wave fed into the video amplifier, which would result in a 50 volt amplified signal at the grid of the cathode ray tube, would cause a change in the DC bias on the grid of about 42 volts.

A value as low as 65 per cent is permissible to still maintain good DC restoration and picture contrast. If the restorer is not working properly, the constants of the circuit must be changed. Since the method of DC restoration will depend upon the design of the manufacturer, the serviceman will have to become familiar with the different techniques as they appear in future models. In the circuit shown in Fig. 2 of part I, the DC restoration is accomplished by using a diode and resistor-capacitor combination of proper time constant. It is this time constant which would be changed in this circuit, if necessary, to obtain sufficient restoration.

Aligning the IF Amplifiers and Detector

The next circuit unit in the alignment procedure includes the intermediate frequency amplifiers and detector which supply the signal to the video amplifier. Referring again to Fig. 2 of part I which is the ideal form of the response of a picture IF amplifier, note the following characteristics of the selectivity curve. In

→ To Page 22

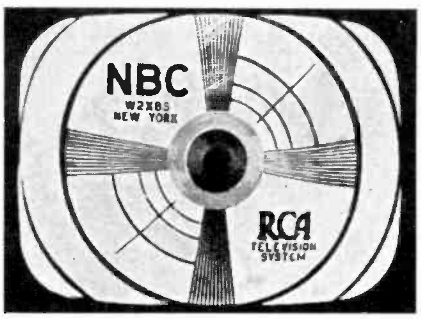


Fig. 9 A normal test pattern.

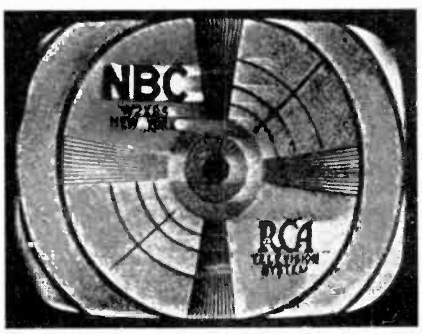


Fig. 10 A test pattern showing loss of low video frequencies due to improper alignment of the video amplifier.

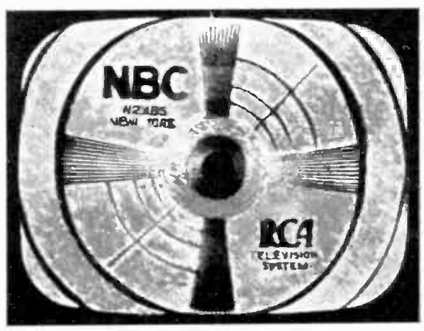
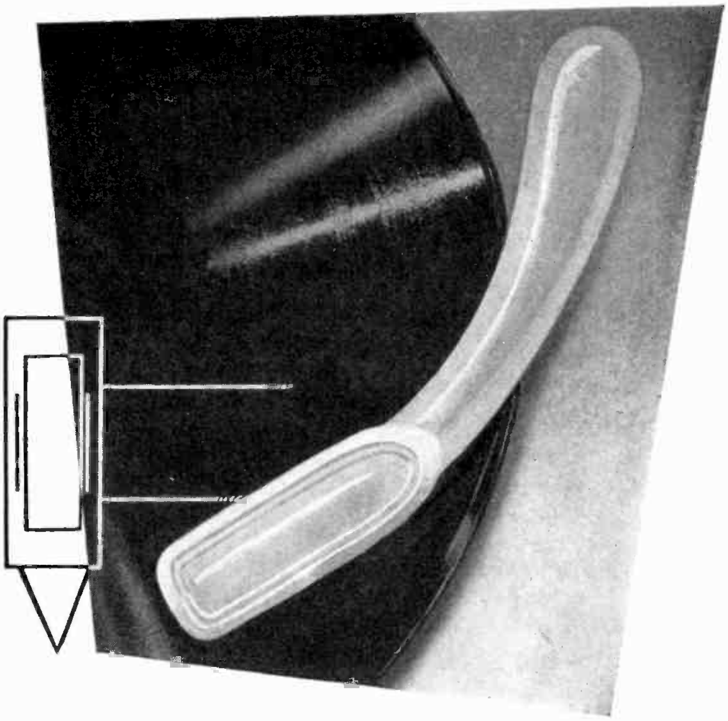


Fig. 11 A test pattern showing loss of high video frequencies due to improper response of the video amplifier.

Crystal Pick-ups

by J. K. Poff

Astatic Corp.



A discussion of crystal reproducing cartridges, their theory and application.

SINCE the early 1930's, electric phonographs and radio phonograph combinations for home use have appeared on the market in ever increasing quantities; and performance has been steadily improved through the years, to the degree that reproduction of recorded sound today is indeed pleasant.

The success of these devices is due largely to the development and improvement of pickup cartridges, using crystal elements of Rochelle Salt (Sodium Potassium Tartrate). Use of this substance has resulted in improvements such as decreased needle pressure, higher output voltage and wider frequency response. It is no longer necessary to employ an expensive pre-amplifier and complicated equalizer in conjunction with a phonograph pickup in order to obtain satisfactory reproduction of records. The voltage developed by cartridges of this type is sufficient to enable them to perform satisfactorily with ordinary low-gain types of amplifiers.

The comparatively low cost of crystal phonograph cartridges, together with their other advantages, has allowed radio and phonograph manufacturers to produce equipment for home use, priced well within the means of almost everyone. Cartridges are made with a wide variety of characteristics to suit various applications, see Fig. 1.

Maintaining this equipment has become a very profitable endeavor for many radio servicemen. There are many others, however, who have shied away from this phase of service work for various reasons, not the least of which is a feeling that they do not understand it. This is unfortunate since there is really nothing too complicated about it.

It is felt that a few facts concerning the operation, application and care of crystal cartridges presented here might be helpful.

Principle of Operation

In 1880, the famous Madame Curie, working with her husband, discovered that certain crystals would develop electrical charges on their surfaces when subjected to mechanical stresses. These electrical charges became known as piezoelectricity (electricity developed due to pressure or torsion). This is the principle upon which a crystal pickup cartridge functions.

The needle, following the groove of a record upon which sound has been recorded, is vibrated in proportion to the amplitude of the recorded sound (Fig. 2). This vibration is imparted to the crystal element through a needle chuck or torque wire assembly. The illustration below (Fig. 3) shows side by side, the construction of a low needle pressure type cartridge and of a conventional removable needle type cartridge.

In both, a torsional crystal element (twister) is used and is so mounted that the needle vibration imparts torsional forces to the crystal element. The motion of the vibration system is almost entirely absorbed by the twisting of the torque wire in the low pressure cartridges, and by the flexing of the coupling rubber in the conventional type, so that the crystal, practically speaking, does not vibrate. However, the flexing of the torque wire, or coupling rubber, applies forces to the crystal directly proportional to the needle motion and the crystal generates voltages corresponding to these forces. Various types of rubber and other damping materials such as viscoloid, etc., are used for controlling output voltage, frequency response, and other performance characteristics.

Application

Crystal cartridges are made in a great number of styles with a wide variety of electrical characteristics in order to accommodate a multitude of various applications.

The size, shape, and required needle pressure of the cartridge have a great deal to do with the styling of the pickup arm. The output voltage and frequency range of the cartridge are factors taken into consideration by equipment manufacturers when they are designing the amplifier and speaker combination with which the cartridge is to be used. Much time is spent on the circuit design of an amplifier, and a crystal cartridge used for reproduction of records becomes one of the basic components of the amplifier input circuit.

We all know that components of any circuit cannot be replaced with any but those of like characteristics without disturbing the circuit balance and changing its performance. When it becomes necessary to replace a crystal phonograph cartridge, this should be done with an exact substitute or duplicate of the original for best results.

Crystal replacement cartridges are manufactured with characteristics exactly like those of the original equipment cartridges. Cases have come to our attention where original units were replaced with others having different electrical characteristics with the object in mind of improving performance. The results in some of these cases were very unsatisfactory. Many times people have written in condemning certain types of cartridges and have gone to great lengths explaining why they do not like a particular model. When the truth was learned in many of these cases, it was found that the original cartridge had been replaced and that the one then being used was, in most cases, entirely inadequate for use with their equipment.

Take, for example, the fellow who, possessing a fairly good, late model

→ To Following Page

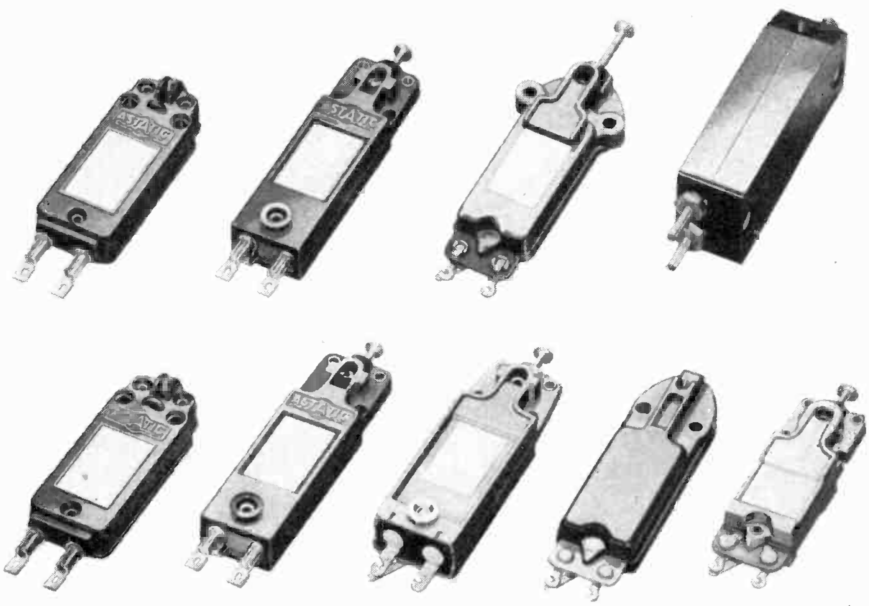


Fig. 1 The complete Astatic line of crystal cartridges designed to meet the needs of a wide variety of applications.

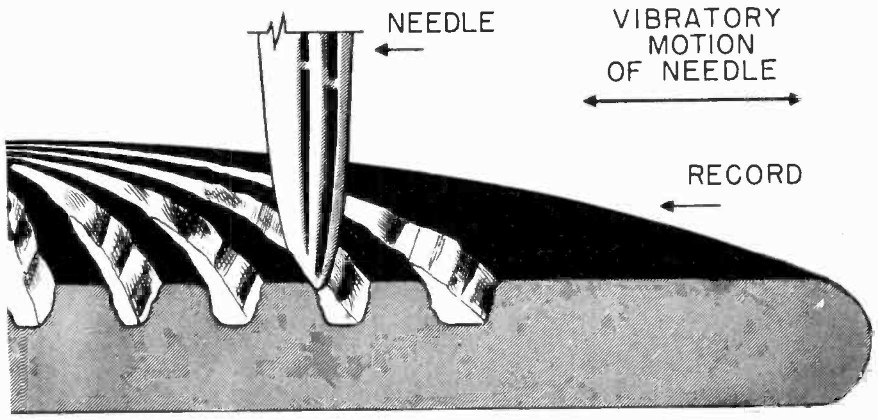
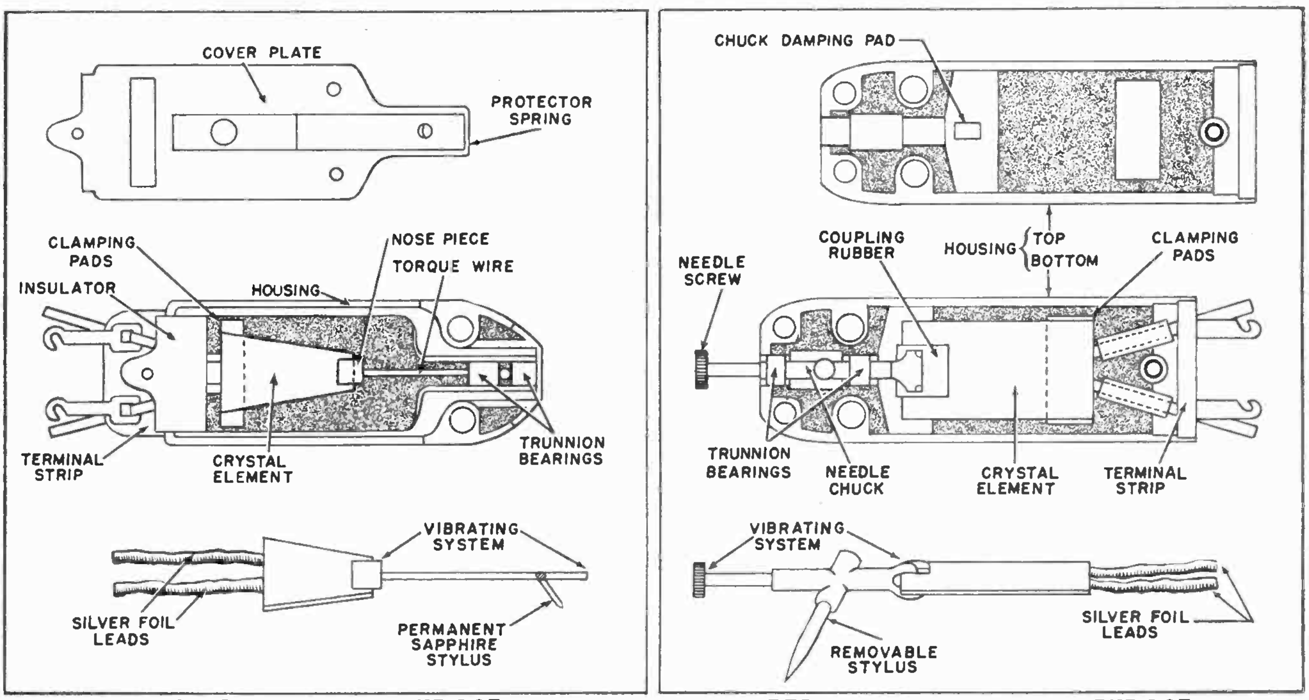


Fig. 2 A greatly enlarged view of a record and needle, showing the needle following the record grooves. The needle is vibrated in proportion to the amplitude of the recorded sound.



FIXED STYLUS CARTRIDGE REPLACEABLE NEEDLE CARTRIDGE

Fig. 3 The cartridge at the left is the low pressure type with permanent needle. The cartridge at the right is the conventional type with a replaceable needle.

→ From Preceding Page

pre-war receiver with a record-changer attachment, decided he wanted to improve the performance of his equipment by replacing the original cartridge with a more recently developed model. The output voltage of his original cartridge was approximately 2.5 volts at 1000 cps. The cutoff frequency of this cartridge was approximately 4000 cps and the needle pressure was 2¾ ounces. The cartridge which was selected to replace the original had an output voltage of 1.0 volt, a needle pressure of one ounce, and a greatly extended frequency range, cutting off at 10,000 cps. When the cartridge was installed, the pickup arm was counterbalanced for one-ounce needle pressure. This caused considerable trouble with the record changer trip mechanism since it was designed to operate at the greater needle pressure required by the original cartridge. A decided loss in output was noticed (which was due to the decreased output voltage) and because the audio-amplifier of the receiver had insufficient gain, the volume could not be adjusted satisfactorily.

In addition, the amplifier was not capable of handling the same frequency range as the new cartridge and, therefore, the results of this installation proved very unsatisfactory. Satisfactory reproduction was again obtained when a replacement cartridge exactly like the original was again installed.

There have been cases where servicemen, thinking to better the performance of a client's phonograph, have substituted a higher output, wider range cartridge for a low output, medium range cartridge. These installations likewise proved unsatisfactory, introducing such disagreeable factors as distortion, acoustical feedback and tracking difficulties. Satisfactory performance was again restored when an exact replacement cartridge was installed.

As has been previously stated, much time is spent designing the amplifier and speaker combination, and much thought given to the choice of a suitable cartridge for use with the completed equipment. It is strongly advocated, therefore, that when it becomes necessary, crystal cartridges be replaced with *exact* replacements or substitutes recommended by either the equipment manufacturer or the cartridge manufacturer.

Many people prefer to have their record reproducing systems assembled with components of their own choosing, with the idea in mind of obtaining something not quite so commercial and more suitable to their individual taste. Servicemen are often called upon to express their opinions and make recommendations regarding these components. Before recommending a pickup or cartridge for use with such a system, it should first be determined just what kind of record reproduction is desired. This is very important, since everyone has individual taste, insofar as this is concerned. Some people prefer classical music (the so-called "long-haired" type), others like "boogie-woogie." Some want a booming bass while others desire a high-pitched response. The pickup or cartridge should then be selected, taking these preferences into account, and not because the serviceman happens to prefer one type or model above another.

The technical specifications of pickups and cartridges should be consulted prior to making selections or recommendations. Information concerning output voltage, needle pressure and frequency range is of particular interest and value. Selection of the proper pickup, and accurate installation thereof, will determine to a great extent the type of reproduction which may be obtained.

Care should be exercised when installing a pickup arm to make sure that the motorboard is perfectly level and that the pickup is mounted squarely; otherwise, the needle will not properly "ride" the record grooves, causing excessive needle and record wear.

If the amplifier, with which the pickup is to be used, is of the high gain, high output type, and it is necessary that the volume be kept at a high level, it may be advisable to install the pickup and turntable mechanism in a compartment or cabinet, separate from the speaker, in order to prevent feedback.

Certain types of turntable motors may cause a considerable amount of vibration with regard to the turntable, which may produce a disagreeable rumbling noise.

Before installing a pickup on the motorboard of a turntable using such a motor, the direction of maximum vibration should first be determined. The pickup arm should then be installed so that it is parallel with the vibrating motion (Fig. 4). Observance of this precaution will do much toward preventing this rumbling.

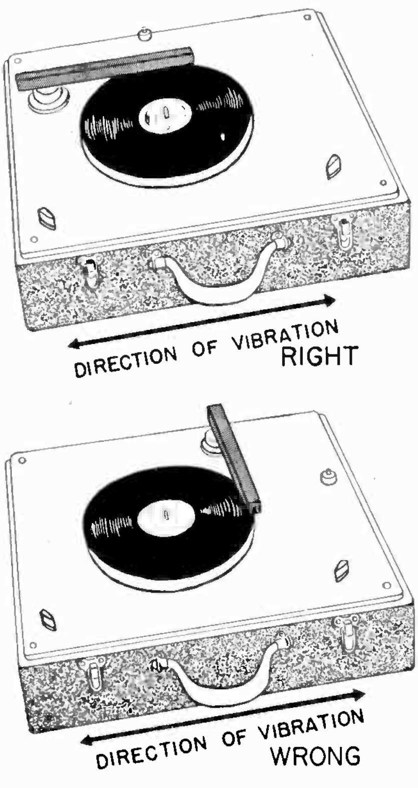


Fig. 4 Method of mounting pickup to minimize the effects of vibration. The pickup arm should be parallel to the direction of vibration.

Equalizers, Circuits, and Their Use

It is sometimes advisable and often necessary, due to the many individual tastes involved, that an equalizer be employed in the input circuit of an amplifier, in series with the phonograph pickup, in order that the response of the pickup be entirely satisfactory to the listener. This is especially true with radio receivers or amplifiers which were not originally designed for phonograph operation.

An understanding of the proper application of equalizers would be of great help to the serviceman called in for consultation and advice by the listener whose equipment does not have enough low frequency or sufficient high frequency response to suit him. As we stated before, everyone has individual taste insofar as tonal response is concerned, and the serviceman's understanding of the application of equalizers and his ability to effect changes, make necessary recommendations, or otherwise help the user to obtain the desired results, will prove invaluable.

Circuits shown here are standard circuits and are used and recommended by many engineers. It is pos-

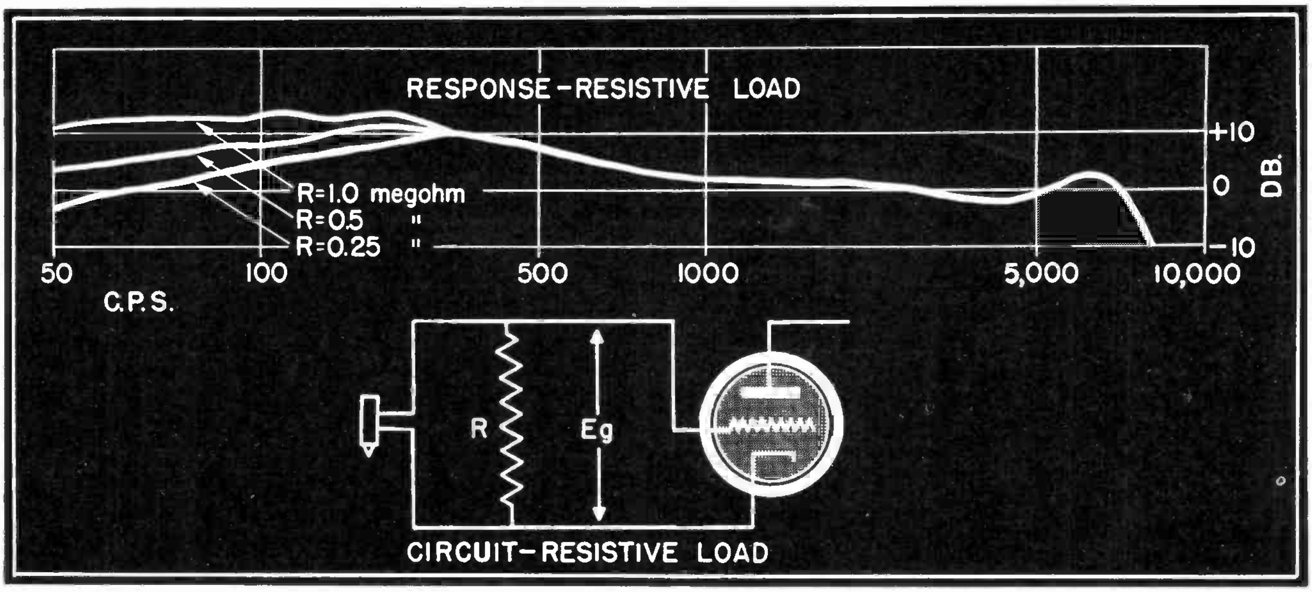


Fig. 5 Method used to connect a crystal pickup to an input stage. The curve above shows the effects upon the response of changes in the value of R. Decreasing the resistance decreases the low frequency response.

sible by properly applying these circuits to vary the frequency response of a crystal pickup in order to meet many requirements.

Crystal pickup cartridges are high impedance devices and should therefore be connected across a high resistance load, the usual value employed being 0.5 megohms. By decreasing this value, the low frequency response of a pickup cartridge may be decreased, while increasing the value will increase the low frequency response of the cartridge (Fig. 5). However, if this value is made either too high or too low, the bass and treble balance of the cartridge may be upset and the overall performance unsatisfactory. For best results with average crystal cartridges, this value must be kept between 0.25 megohm and 1.0 megohm.

With the value of load resistance being adjusted for optimum low frequency response (optimum, in this case, being that which is most satisfying to the individual listener), the pickup may be further compensated by using the equalizer circuit shown in Fig. 6. The value of capacitance to be used is usually between 50 uuf and 500 uuf, depending on the amount of high frequency response desired. R-1 may be between 1.0 megohm and 5.0 megohms. When the sum total value of R-1 and R-2 is 2.0 megohms, maximum bass response is obtained. Any further increase in the value of R-1 has no further effect on the low frequency response of most cartridges. Further increase in the value of R-1 does, however, minimize the effects of increased temperatures on the low frequency response. As the temperature increases, the low frequency response of the cartridge has a tendency to decrease slightly; and if a condition exists where the operating temperature varies between normal room temperature (approximately 70° F.) and 100° to 110° F., it may be advisable to employ a higher value of resistance for R-1.

It should be noted that as the value of R-1 is increased, the value of capacitance should be decreased proportionately. Another important fact to remember is that when a circuit is equalized, there is necessarily a re-

→ To Page 26

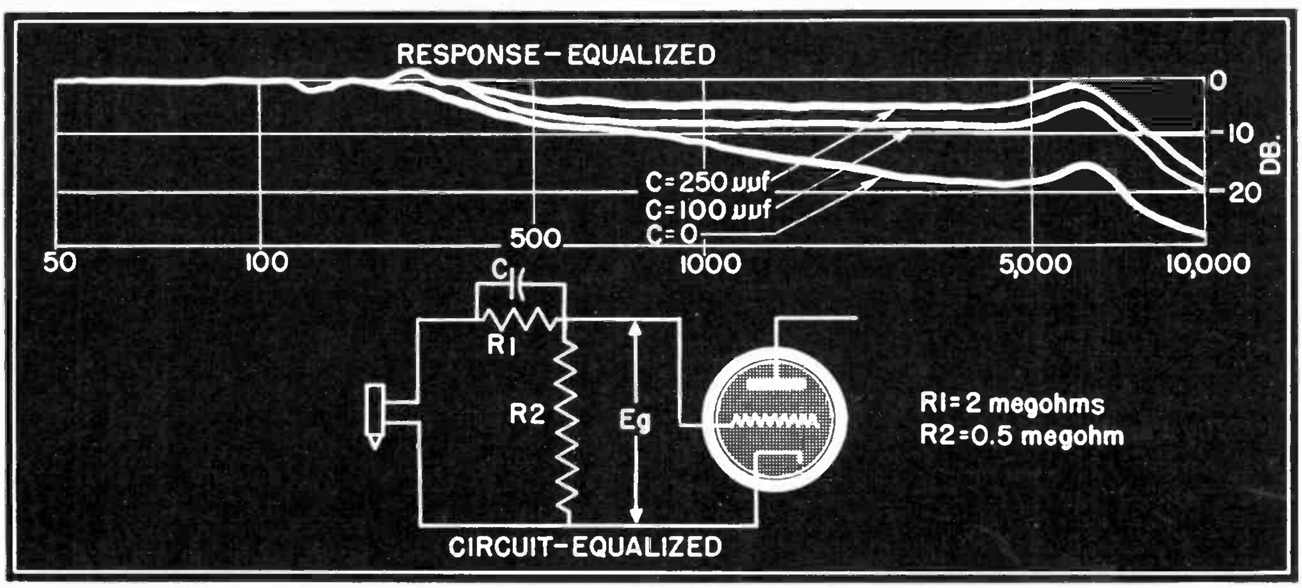
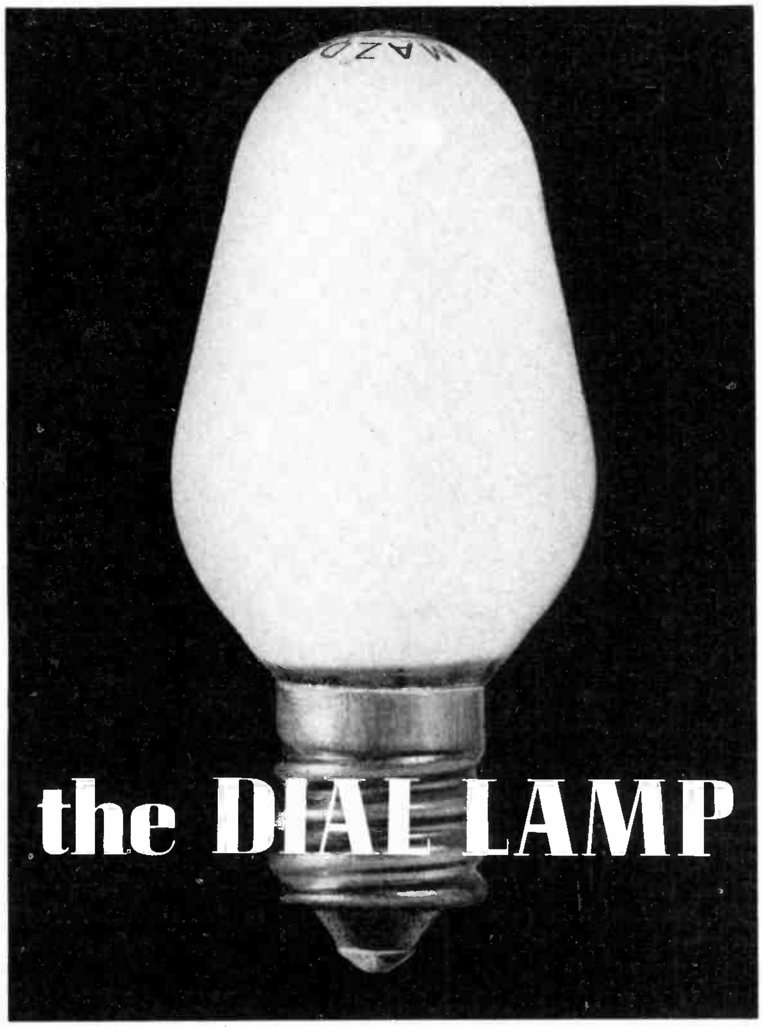


Fig. 6 In this circuit an equalizer has been added. The capacitance C affects the high frequencies while the resistances R-1 and R-2 primarily affect the bass response. The curve shows the effect of various values at C.

by G. F. Prideaux

LAMP DEPT.,
GENERAL ELECTRIC CO.

don't forget... the DIAL LAMP



When it comes to satisfied customers, dial lamps are small but important. A dial lamp is something the customer can see, so make sure it's operating when you return that set.

DIAL LIGHTS CONSTITUTE a single small component part of a radio set, but the owner of the set values highly the function they perform and he will be very unhappy if the dial light in the set you return to him does not function properly and give a good, long life. If you return a set in which the dial lamp is not operating, it will be noticed immediately and the customer will lose confidence in your work. Although it's small, it's important.

Why Panel Lamps Fail

The majority of panel lamps fail by normal burn-out of the filament after having given a life in the neighborhood of 3,000 hours. Some fail after a shorter life due to excessive line voltage, and in AC-DC sets, many lamps fail after short life due to the high surge voltage impressed on the panel lamp when the set is first turned on and the tubes are heating up. Others fail due to the effects of shock and vibration which twist and short portions of the coiled filament. In rare instances, a lamp will become inoperative due to corrosion of the base center contact solder, particularly in the case of 2 and 2½ volt lamps. Trouble has also been caused by broken or loose connections to the dial light sockets. It is always good practice to clean the base center contact solder of the lamp before installing it in the radio.

A few AC-DC sets have used the regular 7-watt C-7 bulb nightlight lamp shown in the title with either a white-coated or clear bulb. It is suggested that the 10-watt C-7 bulb lamp (10C7) be used for replacing the 7C7 lamp as the 10C7 is a slightly stronger lamp and more resistant to vibration. Fig. 1 shows a type C-7 lamp.

Lamp Identification

Lamp numbers are the surest way to identify the various radio panel lamps, but other factors are of assistance in cases where the burned-out panel lamp has been in service for a long time and the marking has been obliterated. Bulb shape and size, base, bead color, and in some cases the filament, are helpful.

For several years, the Lamp Department of the General Electric Company published a panel lamp guide which identified the proper lamp for use in all the various radio sets. This became so voluminous and so burdensome that it was discontinued.

The following is a list of the more

common lamps giving their physical and electrical characteristics. Bead colors are not fully standardized, but those given will be found correct in the majority of cases. A glance at the various lamps of different rating will show the differences in filaments.

Lamp No.	Lamp Volts	Amperes	Bulb	Base	Bead Color
40	6-8	0.15	T-3¼	Miniature Screw	Brown
41	2.5	0.50	T-3¼	Miniature Screw	White
42	3.2	0.35	T-3¼	Miniature Screw	Green
43	2.5	0.50	T-3¼	Miniature Bayonet	White
44	6-8	0.25	T-3¼	Miniature Bayonet	Blue
45	3.2	0.35	T-3¼	Miniature Bayonet	Green
46	6-8	0.25	T-3¼	Miniature Screw	Blue
47	6-8	0.15	T-3¼	Miniature Bayonet	Brown
49	2.0	0.06	T-3¼	Miniature Bayonet	Pink
51	6-8	0.25	G-3½	Miniature Bayonet	———

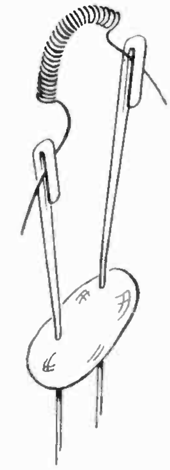


Fig. 2 Old type lamp construction which resulted in noise interference when subjected to vibration.

Radio Interference

Radio panel lamps, if improperly made, can be a source of noise interference in radio receivers. This noise is caused by vibration produced by the loudspeaker and impressed on the lamp, while the underlying trouble is usually an imperfect clamp or joint between the legs of the filament and the lead-in wire. Fig. 2 shows the type of joint which frequently gives trouble. Minute variations in resistance at this point cause a pulsating current of high frequency to flow through the lamp or, in some instances, minute sparks to radiate noise directly to the aerial connection. To eliminate this trouble a new type of joint, shown in Fig. 3, has been adopted to insure perfect connections between the filament and the lead-in wire, and eliminate noise interference.

The C-7 bulb, 120 volt lamps illustrated in the title and in Fig. 1 still may cause noise interference in AC-DC radios employing loop-type aerials. The noise is caused by vibration and emanates from the junction of the filament coil and the little anchor or support wire. The coil, when under vibration, jiggles in the anchor loops and minute sparks are formed. These sparks radiate radio frequency interference directly to the loop aerial. Interposing a grounded metal shield between the lamp bulb and the loop aerial is one method of eliminating this trouble.

Lamp No. 51 is designed primarily for automobile service and no special precautions are taken with its manufacture to insure that it will be free from radio interference.

Vibration-Resistant Radio Panel Lamps

The filament and mount structure of old style radio panel lamps was as shown in Fig. 4. While lamps so constructed gave their normal long life on life test racks, their service life in radios was frequently far short

→ **To Following Page**

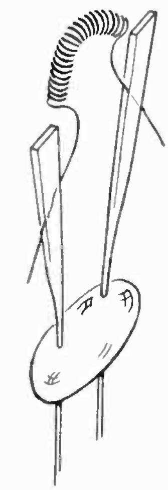


Fig. 3 New type lamp construction which eliminates noise interference.

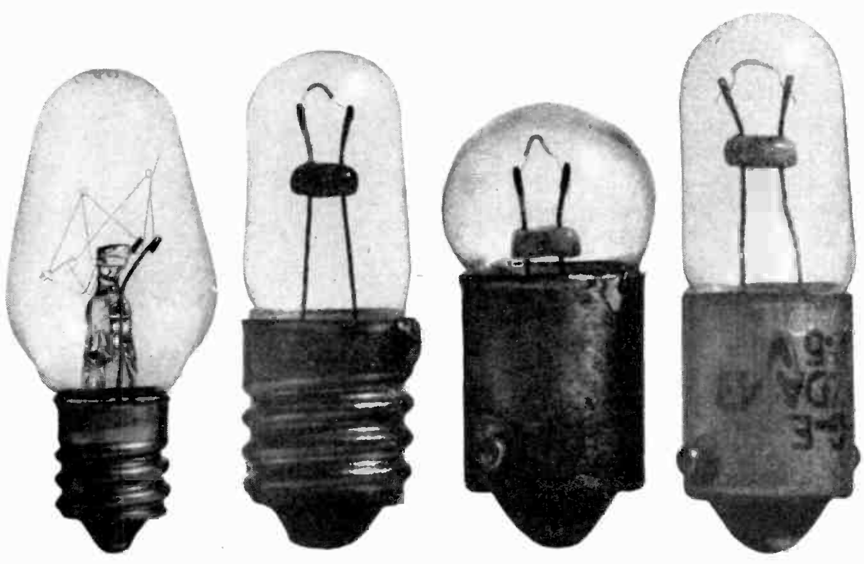


Fig. 1 The four common types of lamp construction. From left to right: The C-7 bulb with miniature screw base; the T-3 bulb with miniature screw base; the G-3 bulb with miniature bayonet base; the T-3 bulb with miniature bayonet base.

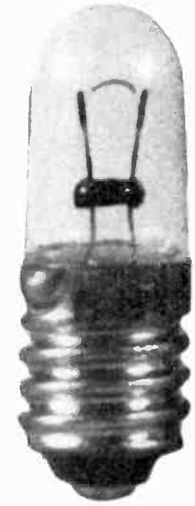


Fig. 4 Old type lamp construction. Note distance between the bead and the filament.

Don't forget the Dial Lamp

→ From Preceding Page

of this. Investigation and studies revealed that while the filament was normally stationary, as shown in Fig. 5 when certain notes or frequencies were produced by the radio, the tips of the lead-in wires and the filament would vibrate violently as shown in Fig. 6. In some cases, the natural frequency of the lead-in wires was approximately twice that of the natural frequency of the coil with the result that when the leadtips were moving in one direction, the center of the coil was going in the opposite direction. One can readily visualize that this destructive action would quickly tear the coil filament apart, causing it to tangle, twist, short circuit and burn out. Methods were found of modifying the lead and mount structure so that its natural frequency was approximately the same period as that of the coiled filament. Fig. 7 shows the new modified lamp. When the critical frequency is impressed upon this lamp, the coil moves with the lead tips and very little harm is done even though the movement is fairly large. Fig. 8 illustrates the newer lamp filament stationary and when vibrating.

At the time the lamp was made more resistant to vibration, it also was made much more resistant to shock. The shock tester, Fig. 9, is a device designed to give lamps many severe shocks with the filament lighted in many different positions. As a drum holding the lamp rotates, the entire mechanism is lifted and dropped on heavy iron anvils. Tests on this shock device have shown that the new construction lamps withstand approximately ten times as many shocks as the old construction lamps.

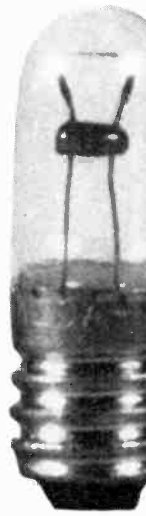


Fig. 7 The new lamp construction which eliminates the effects of vibration. Note the change in the bead position in relation to the filament.

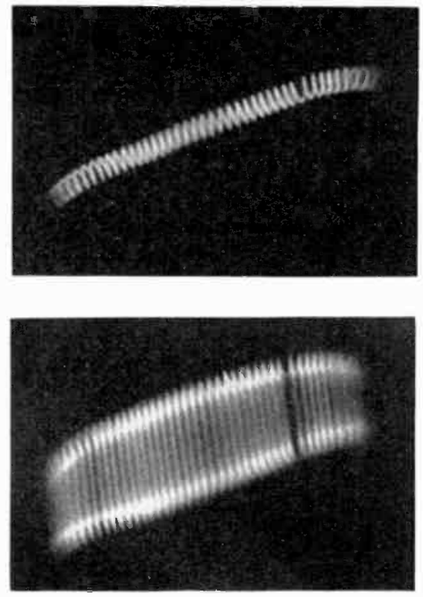


Fig. 8 When the new lamp is subject to vibration, the filament moves back and forth but it does not bend.

Dial Light Circuits in AC-DC Radios

Fig. 10 shows a common circuit for AC-DC receivers using .3 ampere tubes. Many of the earlier AC-DC sets used this type circuit. The initial current through the tube filaments when the set is turned on is

→ To Page 31

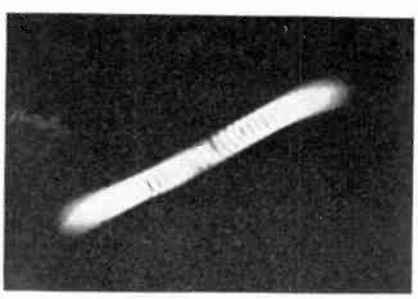


Fig. 5 This is the way the old lamp filament looked when stationary.

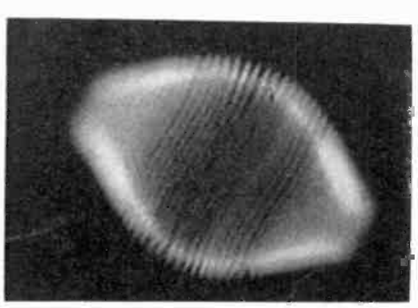


Fig. 6 Vibration caused by the speaker caused the old filament to vibrate like this. It bent in the middle and did not last long.

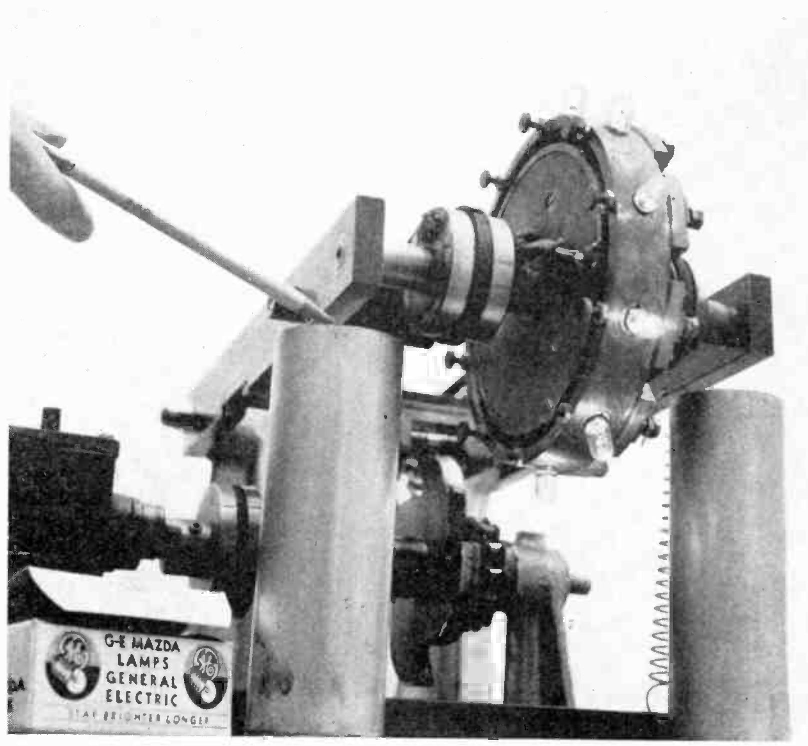
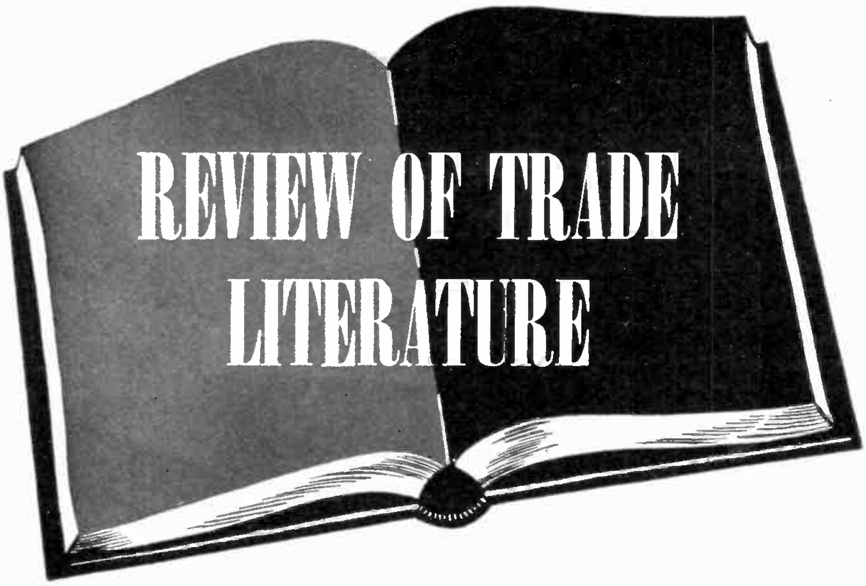


Fig. 9 This gadget is used to check the shock resisting qualities of panel lamps.



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

THE Garod Radio Corporation, of 70 Washington Street, Brooklyn 1, N. Y., has just published a new series of operation and service booklets covering the Model 6BU1 table receiver, the Model 6DPS8 combination console, and the Model 45APA portable automatic phonograph. The bulletins include circuit diagrams, tube layouts, electrical specifications, alignment procedure, changer instructions and installation notes.

The Olson Radio Warehouse, 73 East Mill Street, Akron 8, Ohio, has just announced their new catalog, "Radio Parts for Service Men." The company states that at the time of publication all items listed are in stock.

The catalog lists hundreds of items of interest to the serviceman and is available on request.

A complete new catalog and selection guide has been published by Electro-Voice, Inc. It contains complete data and information on the Electro-Voice line of microphones including Cardioid, Dynamic, Crystal, Velocity, Differential and Carbon Microphones.

A selection guide in the front of the catalog makes it easy to select the right microphone for each application.

Everyone interested in sound will find the catalog extremely useful. Write to Electro-Voice, Inc., Buchanan, Michigan, for a free copy.

The Cornell-Dubilier Electric Corporation has announced a new 24-page catalog #195A. It contains specifications on all C-D electrolytic, paper and mica capacitors in addition to C-D capacitor test instruments and Quietone interference filters.

A copy may be secured by writing to Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

The Triplett Electrical Instrument Company's catalog containing information on their Volt-Ohm-Mil-Ammeters, tube testers, signal generators, and appliance testers may be secured by writing the company at Bluffton, Ohio.

Just released by National Union Radio Corporation of Newark, New Jersey is their new 1946, 7-piece Window Display for Radio Dealer and Distributor use.

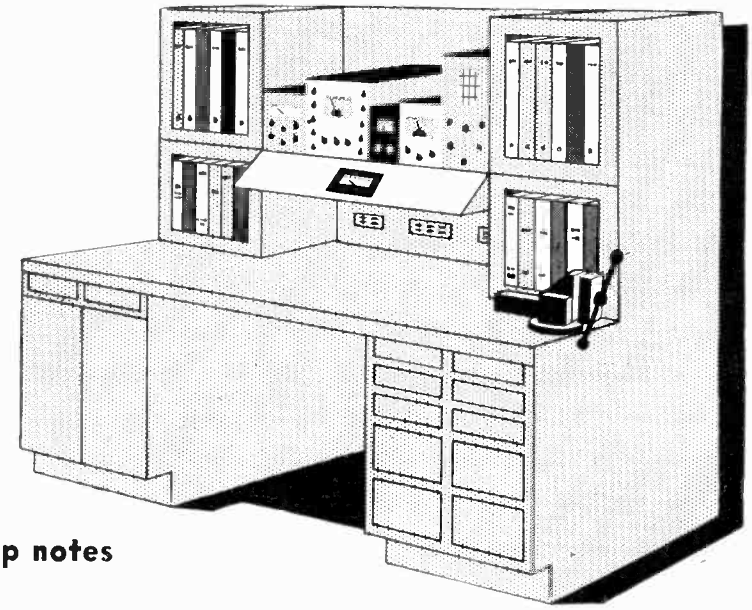
A new approach in point-of-sale radio service and product promotion is achieved by featuring a central theme of "Only Skilled Hands Touch the Radio We Repair for You." The primary objective of the display is to capture customer confidence in the professional radio service man by tying in his skill and know-how with the use of quality National Union Radio service products.

The display is varnished lithographed in 10 sparkling colors and supplied with individual ribbons to focus attention on the life size radio chassis illustrated in the large background display.

Six small side cards will be released from month to month in time for special promotion of any specific product. The initial release will comprise a 3-piece setup for immediate store display.

This display is available at National Union Distributors throughout the United States.

The Radio Service Bench



Case histories and shop notes

by Max Alth

Kadette, International

Audio oscillation at the high frequency end of the dial:

The control grid of the 36 has moved too close to the RF coil. Decouple and realign.

Distortion when tuned to high power local stations:

Change the detector bias resistor from 100,000 ohms to 50,000 ohms.

It is a good policy with this set and other similar midget sets to remove the line dropping resistor from inside the chassis and to replace it with a line cord resistor. For the Kadette International, the value is 240 ohms. This lowers the set's operating temperature and greatly increases its life.

Majestic 850

Dial light burnouts:

The twisted pair connected to the dial light carriage chaffs against the edge of the chassis hole. Replace the pair and further protect it with a piece of spaghetti.

Midwest 18-36

Fading:

The 75 uuf condenser in parallel with the trimmer across the secondary of the last IF coil is often intermittent. It opens and detunes the stage. It is located inside the IF can.

Motorola, 1941 Wireless Record Player

Repeating each cycle without playing record:

The switch which is actuated by the swinging of the tone arm as it enters the oscillating groove at the end of the record is set too close. This misadjustment can be spotted by the click of the magnetic switch which accompanies each cycle. Adjust oscillating switch.

Pawl jumping cam wheel:

This is caused by an overload condition which can be remedied by removing the spring washer from under the pawl and replacing it with a flat washer. The spring washer causes too much friction.

Motorola, Golden Voice 8-80

When the 0Z4 rectifier is bad:

Replace it with a 6X5 which will give better, more positive operation. The 0Z4 will not start with a battery voltage under 5.5 volts. Some of the rectifier sockets are wired at the factory for the change. On others, ground one filament terminal and run the other to the soldering lug on the .5 ufd condenser connected to the input side of the filter choke.

Motorola T8

Poor tone:

Replace the 6A4 tubes. They must be fairly well matched for best results. Check the first and second grid coupling condensers for leakage. Check the first audio plate resistor. It should be 100,000 ohms.

Motorola 860-88

Intermittent drop in volume, consistent with car motion:

The muting switch contacts have been set too close. Increase the spacing, being careful not to make it too great for normal operation.

Motorola 89K1

Does not switch on:

Stiff relay spring.

Intermittent button operation:

Soft or dirty relay springs.

Dead motor:

Check the 20 ohm resistor connected to the motor. On models 109K1 and 109K2, check the 60 ufd starting condenser. Check the motor winding on the power transformer. It should furnish 24 volts. Model 89K1 has a 6.3 volt tap on this winding for the dial lights.

Sears Roebuck Phono Player 5815

Excessive power hum:

Check the 400 ohm plate supply filter resistor. Aging of the electrolytic condensers overloads this resistor causing a change in value. If it is bad, replace it with a 5-watt unit or a small filter choke.

RCA 381

Sudden volume changes:

The 60,000 ohm grid resistor in the oscillating circuit of the 6A7 tube is shorting to the solder lug on the broadcast band padding condenser in the oscillator circuit.

Philco 931, 932

Excessive vibrator hash:

Check the vibrator can for proper grounding. Also the bonding of immediate shielding. Clean local tube prongs and spring socket connections. Go over all grounds with a hot iron.

RCA 330, 331

Intermittent oscillator:

Check the heater voltage at the

→ To Page 28

PLEASE PLACE YOUR ORDER WITH YOUR REGULAR RADIO PARTS JOBBER. IF YOUR LOCAL JOBBER CANNOT SUPPLY YOU, KINDLY WRITE FOR A LIST OF JOBBERS IN YOUR STATE WHO DO DISTRIBUTE OUR INSTRUMENTS OR SEND YOUR ORDER DIRECTLY TO US.

The New Model CA-11
SIGNAL TRACER

Simple to operate . . . because signal intensity readings are indicated *directly on the meter!*

Essentially "Signal Tracing" means following the signal in a radio receiver and using the signal itself as a basis of measurement and as a means of locating the cause of trouble. In the CA-11 the Detector Probe is used to follow the signal from the antenna to the speaker—with relative signal intensity readings available on the scale of the meter which is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

NOW AVAILABLE FOR IMMEDIATE DELIVERY!

The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions . . . Net Price **$18.75**

Features

- ★ **SIMPLE TO OPERATE—only 1 connecting cable—NO TUNING CONTROLS.**
- ★ **HIGHLY SENSITIVE—uses an improved Vacuum Tube Voltmeter circuit. Tube and resister-capacity network are built into the Detector Probe.**
- ★ **COMPLETELY PORTABLE—weighs 5 lbs. and measures 5" x 6" x 7".**
- ★ **Comparative Signal intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.**
- ★ **Provision is made for insertion of phones.**

SUPERIOR INSTRUMENTS CO.

Dept. RM—227 FULTON ST., NEW YORK 7, N. Y.

Testing and Aligning Television Receivers

→ **From Page 11**

the better receivers, the picture IF transformers will be able to pass the full 4-mc band, as represented by the solid line. The dotted line shows response limited to 2.5 mc to allow greater gain per stage and better signal-to-noise ratio, at the expense of picture detail. This will be the case in less expensive receivers where fewer IF stages are used. It is seen that the response at 8.25 mc and at 14.25 mc is very small so that none of the sound IF signals get into the pictures. These requirements are accomplished by the use of suitable rejection circuits. The amplifier response at the IF carrier frequency (12.75 mc) is down 50 per cent while the corners of the flat part of the curve are at about 8.75 mc and 11.75 mc. This represents the ideal shape of the overall response of the IF amplifiers and the positioning of the carrier frequencies. In practice, only the best receivers can duplicate this curve; and since the response characteristics will vary for each receiver design, manufacturers will supply response curves with their service manuals to guide the serviceman when he aligns these circuits.

The method of testing the receiver system at intermediate frequencies is most easily accomplished with the sweep generator (similar to the video sweep generator), but whose range extends from about 7.5 mc to about 15 mc, thus including both picture and sound IF carrier frequency and sidebands, as well as the positions of the adjacent carriers. Note: There is a good possibility that the television industry will switch over to a new standard intermediate frequency of about 22 mc. If this change should be made, the IF sweep oscillator range would have to be located around this higher frequency. The methods described for the 12.75 mc picture IF will, of course, hold true for 22 mc.

It is also entirely possible to test the IF amplitude frequency response on a point-by-point basis, that is, by the use of a standard signal generator that is adjusted step by step to various frequencies within the desired test range. This procedure, however, requires considerable time and is impractical in any service shop. There is at present no substitute for the ease of alignment with the sweep generator.

In using the sweep oscillator, the connections shown in Fig. 12 are set up and the pattern observed on the

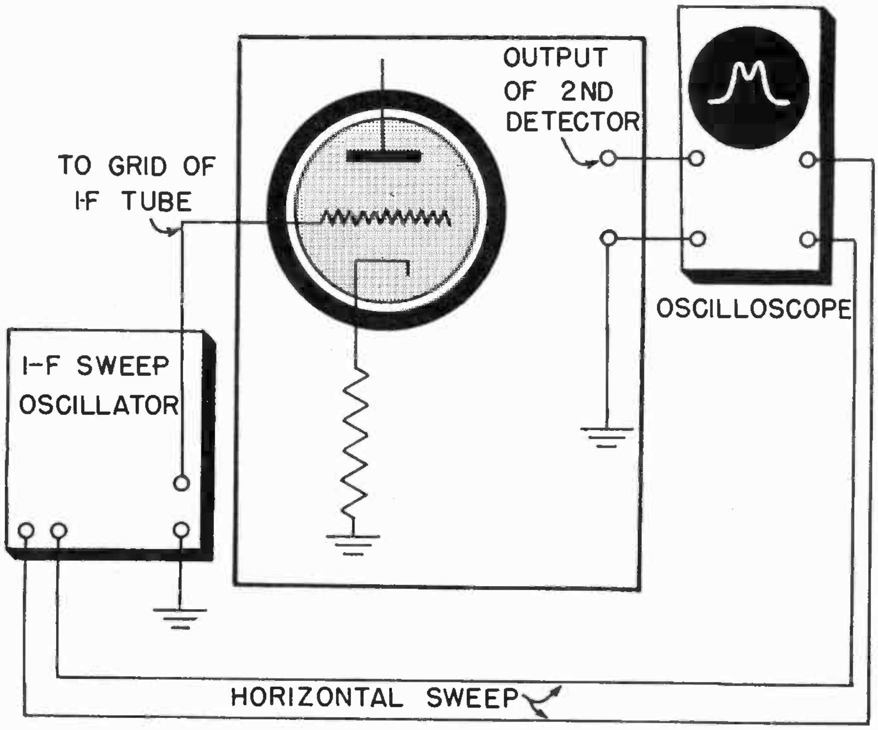


Fig. 12 The connections used when aligning the intermediate amplifiers using the sweep oscillator.

oscilloscope. The sweep generator is fed into the grid of the last IF tube and the output connected across the load of the second detector. A typical oscillogram obtained is shown in Fig. 13. Adjustments are then made on the IF coupling circuit between the last IF tube and the detector. In making these adjustments, the desired limits of the IF pass band are constantly checked by the markers. These are shown as pips on the curve in Fig. 13. If the sweep generator does not have built-in markers, they can be inserted into the IF grid from a separate signal generator with a calibrated frequency dial. By varying the frequency of this signal, the point at which the marker appears can be moved to any position on the oscillogram, thus serving to identify or mark that point on the curve. Another method of inserting markers externally which does not load the grid circuit is to feed the high side of the marker-signal generator onto the chassis at the point where the sweep generator is connected to the receiver chassis, and the ground side of the marker-signal generator to another point on the chassis. It would appear that the signal generator has a direct short across it; but actually at the high frequency of the marker, there is enough impedance in a short distance on the chassis to serve as load for the generator. In this manner, the marker is inserted into the circuit, with the advantage that no false load appears across the grid during the alignment.

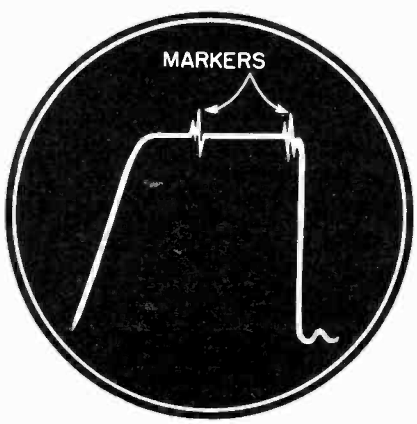


Fig. 13 An intermediate frequency response pattern showing marker pips.

When sufficient flatness of response is obtained within the desired channel limits, and when as much selectivity as possible outside these limits is obtained, the sweep oscillator is connected with reduced output in shunt with the grid of the next-to-last IF tube and the coupling circuit adjusted between the last and next-to-last IF tubes. The amount by which the sweep oscillator output voltage must be reduced, in order to obtain a given vertical deflection on the oscilloscope screen, is a direct measure of the gain of the next-to-last IF stage. Thus the serviceman can check with specifications in the service manual to see if he is making the alignment properly and getting as much gain out of a particular stage as the design calls for.

Following the same procedure, the

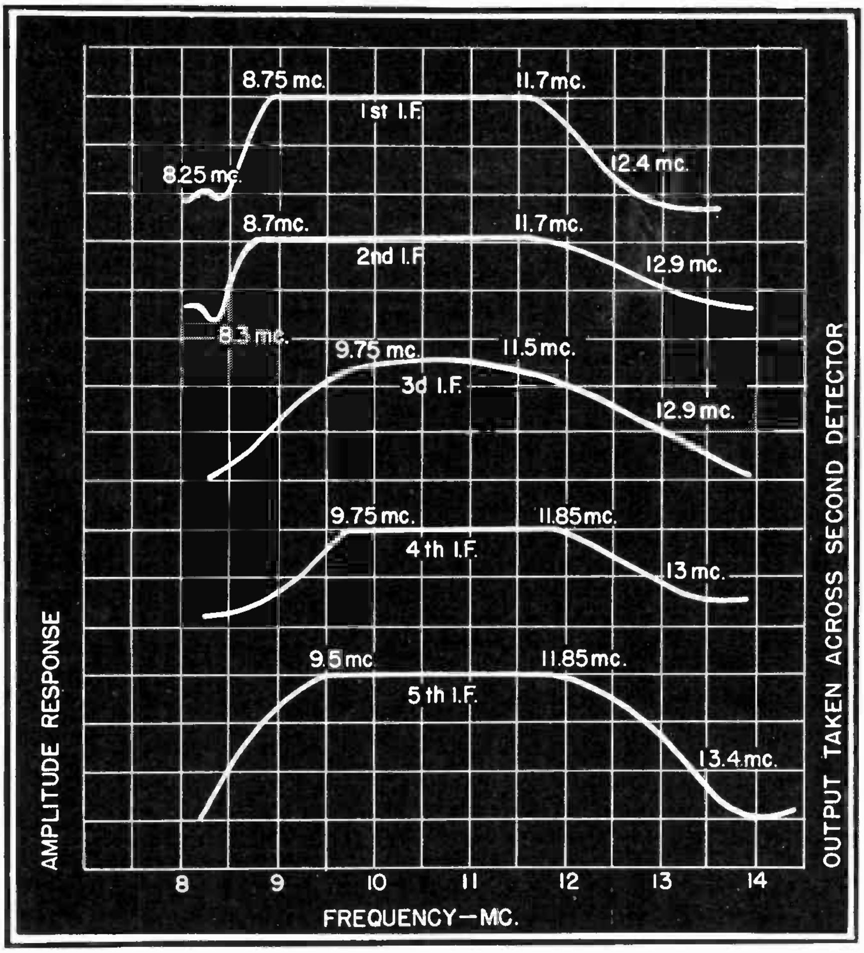


Fig. 14 The intermediate frequency response curves of a television receiver using five stages of intermediate amplification. Note the sound attenuation in the 1st and 2nd stages.

sweep oscillator is connected successively in shunt with the grid of each IF tube, working backward stage by stage until the converter tube is reached. The final test with the sweep oscillator should be with connections in shunt with the converter-tube grid (although in operation no IF appears at this point) in order to align the circuit immediately following the converter tube. In aligning each successive stage, note that the output was checked at the detector in all cases. The manufacturer will usually supply response curve for each IF stage measured in this same manner. These offer a good check during the alignment procedure.

Typical curves obtained for the receiver circuit in Fig. 2 are given in Fig. 14.

No general rules for circuit alignment, other than the above, can be given since the procedure depends almost entirely on the design of the IF coupling circuits and the manner in which selectivity against the adjacent signals is obtained.

No mention has been made of the sound IF alignment in the description of the IF circuits, because the sound carrier in television is now frequency modulated, and the subject of FM circuit alignment will be discussed in detail in a later issue of RADIO MAINTENANCE. It may be pointed out here simply that the sound IF is taken off the first detector and fed to the first sound IF stage, after which the sound channel is treated independently of the picture channel. In the circuit we are studying (Fig. 2 of the previous article) the sound IF is obtained from the "take-off" coil L-18 in the first detector. L-18 and C-19, together with a loading resistor R-10, of the first detector transformer assembly, form a parallel circuit resonant at 8.25 mc. This circuit is connected to the high signal potential end of the common coupling impedance C-23, by the capacitor C-24. Since the parallel circuit is resonant at the sound IF, 8.25 mc, a strong sound IF signal voltage will be developed across it. This voltage is coupled to the grid of the first sound IF stage. The circuit will not offer much impedance to the picture IF signal currents and, therefore, very little picture IF signal voltage will be applied to the first sound IF amplifier.

Similarly, the sound IF is rejected from the picture IF amplifiers by rejector circuits in the first detector and first and second picture IF stages which are resonated to offer rejection at the sound carriers of 14.25 mc and 8.25 mc. The rejection frequency is adjusted by varying the inductances L-19, L-23, and L-28. The effect of these rejector circuits can be seen in the selectivity curves of Fig. 14.

RF and Oscillator Testing

When the IF system of the receiver has been adjusted for satisfactory band pass and selectivity, the RF stages are tested. A sweep oscillator is of value here, but not as essential as in IF testing. The band pass characteristics may be determined simply by applying three test frequencies to the antenna input, one at the picture carrier, one at the upper edge of the channel, and the other at the lower edge of the attenuated sideband. If substantially equal response is obtained at the detector output from each of these three frequencies, the design of the IF circuit will usually take care of selectivity beyond these limits and the equality of response within them.

If the sweep oscillator is used, it must have sweep frequencies from approximately 1 mc below to approximately 1 mc above the limits of the channel to be tested. Connections for RF alignment with the sweep generator are shown in Fig. 15. Here again, the overall response can be seen at a glance while adjustments are made. Fig. 16 shows a test pattern containing transient reproduction of sections of the pattern, a con-

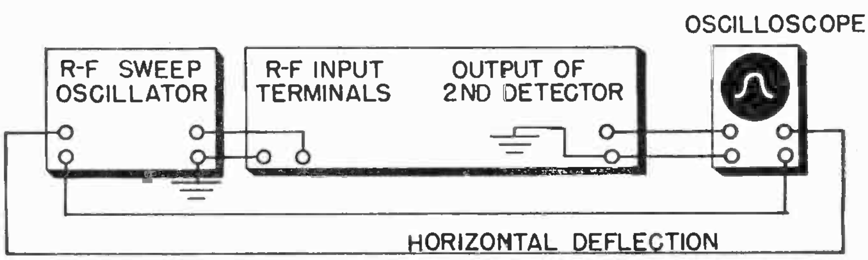


Fig. 15 Connections used when aligning the radio frequency section using a sweep oscillator and oscilloscope.

→ To Following Page

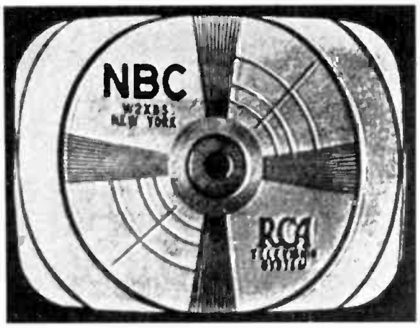


Fig. 16 Transients in a test pattern.

Fig. 17 Ghosts in a picture produced by reflections from structures in the neighborhood of the receiver.

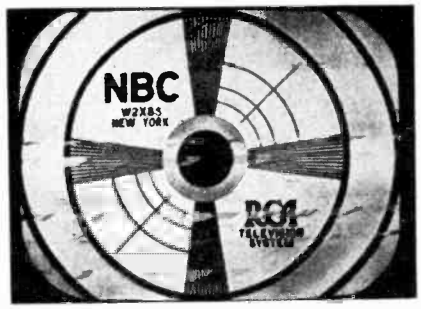


Fig. 18. A test pattern showing the effects of excessive auto ignition interference.

Testing and Aligning Television Receivers

→ **From Preceding Page**

dition which may arise by an improperly aligned RF section. The type of RF circuits used in receivers will vary, and the reader is referred to the manufacturer's service manual for information on the adjustable elements of these stages to obtain proper alignment. Pre-war receivers had only push button or rotary switching stations, providing only specific channels. To align each channel, the switch is rotated to the desired point and the alignment made as described above. This type of switching arrangement will appear in most of the new receivers; and newer developments include continuous tuning arrangements over all of the television channels with devices such as the "Inductuner." The latter device will be new to most servicemen but no information has been released yet on this type of tuning. However, this will be forthcoming when the manufacturer releases new sets containing these circuits.

Oscillator performance is checked at each band switch position by using conventional meters—a microammeter for grid current and a vacuum-tube voltmeter for output voltage. The frequency may be adjusted by heterodyning the output of the oscillator against a standard frequency source such as a good signal generator.

Conclusion

This description of the methods used in testing and aligning a television receiver has been presented in circuit units from the antenna input terminals to the cathode ray tube. General procedures have been outlined by which the serviceman should be able to attack any type of television receiver. All major adjustments in the alignment process are made with test instruments, and can be done in the service shop without resorting to over-the-air test patterns. From the methods and equipment described, the serviceman must sift ideas to apply to his particular needs and business.

After all work on the receiver is done in the shop, the serviceman's responsibility does not end, for he must return the set to the customer. A station may be tuned in at the service shop to check the reception of the set after it has been aligned. The picture obtained may be very good, whereas at the customer's locale, reception may prove to be poor. For example, reflections from buildings, and interference from auto ignition, diathermy machines, and stray frequencies which may not be in the neighborhood of the service shop, could turn up. These are illustrated in Fig. 17, 18, 19 and 20. The serviceman has no control over these. He may find, however, that the signal at the antenna is so strong as to cause overloading, in which case there may be a loss of synchronization and type of pattern shown in Fig. 21. This condition may be remedied by reducing the signal input with an H-pad attenuator inserted between the receiver input terminals and the antenna transmission line so that the received signal is below the overload value for the particular receiver. The signal input should be measured and then values for an attenuator selected in making up the required H-pad

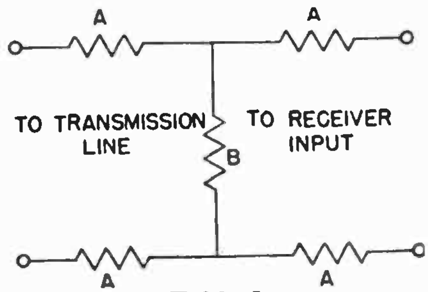


Table I

Approx. Atten.	Value A in ohms	Value B in ohms
2:1	18	82
4.5:1	27	47
9:1	33	33

(see Table 1). One-quarter watt carbon resistors only should be used.

If proper measuring equipment is not available, it is suggested that the various H-pads be tried and the one with minimum attenuation that removes the overload conditions be used. In some locations, too weak a signal will reach the receiver, as in Fig. 1, and external noise interference may

→ **To Page 29**

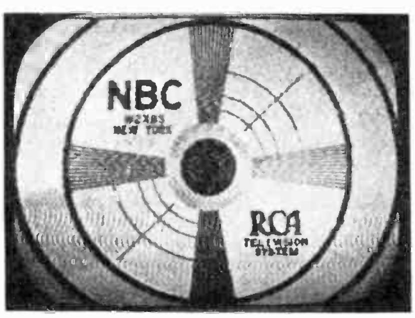


Fig. 19 A test pattern showing the effects of excessive diathermy interference.

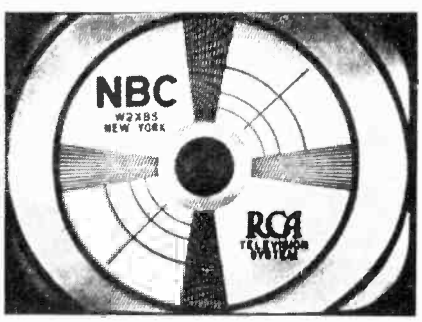


Fig. 20 Beat frequency interference produced by drifting stray carrier.

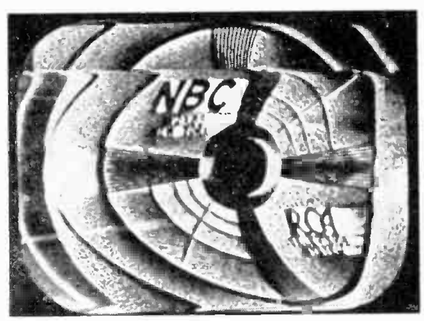
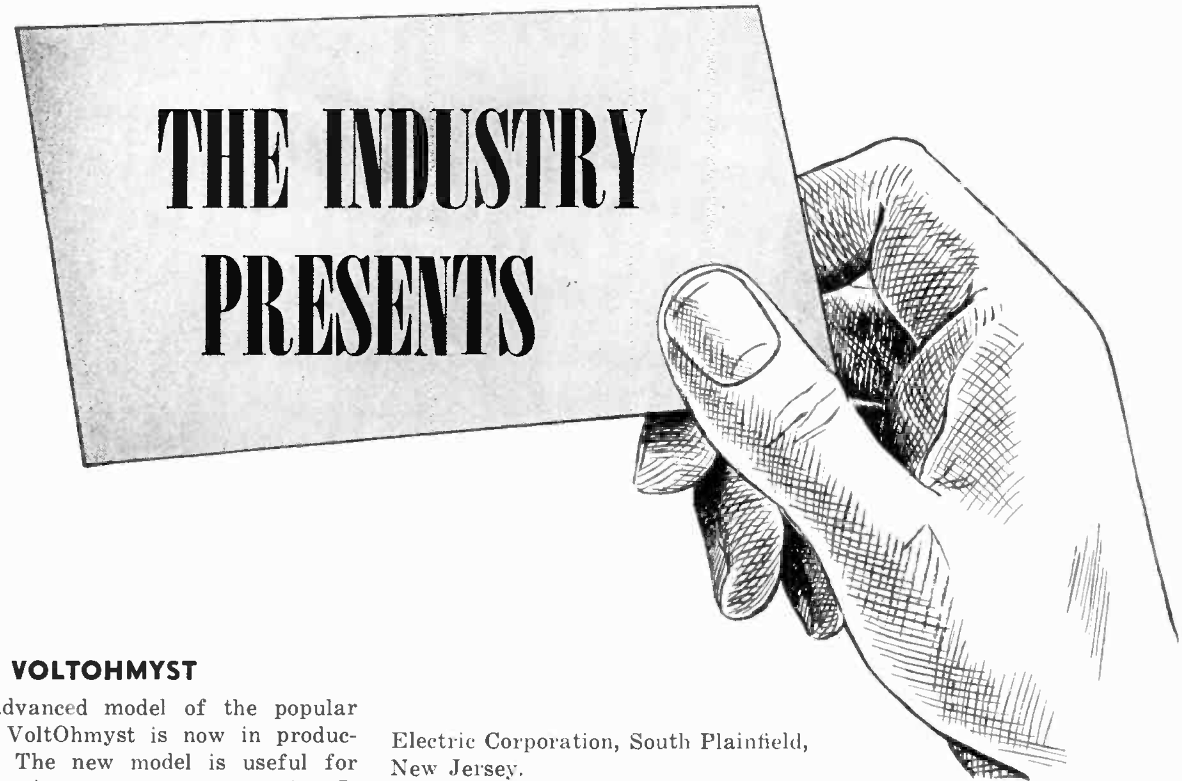


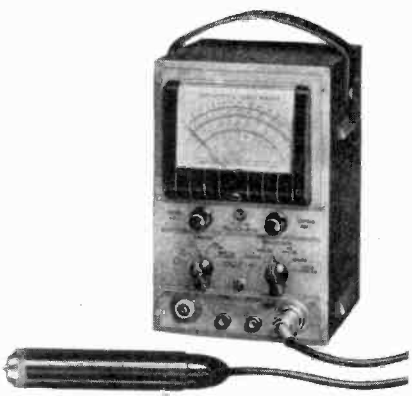
Fig. 21 The effects of too strong a signal.



THE INDUSTRY PRESENTS

NEW VOLTOHMYST

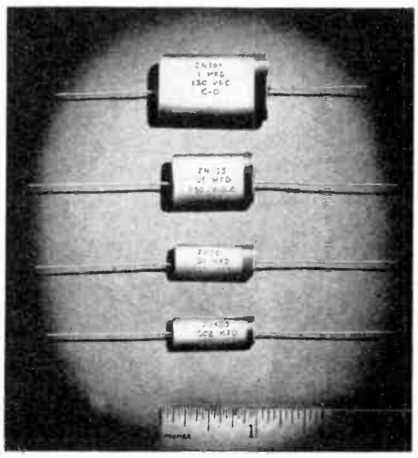
An advanced model of the popular RCA VoltOhmyst is now in production. The new model is useful for frequencies up to 250 megacycles. It thus becomes an efficient instrument for work on FM and television receivers. Important feature of the improved model is a newly developed diode probe capable of measuring peak-to-peak voltages at very high frequencies. The instrument measures voltages up to 1000 volts and resistances of from zero to 1,000 megohms.



FLAT MIDGET CAPACITORS

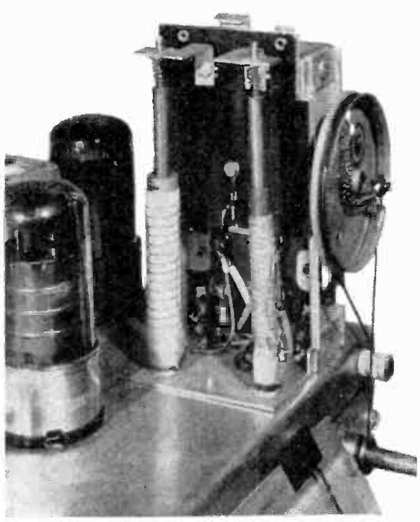
A new line of midget capacitors has been announced by the Cornell-Dubilier Electric Corporation. The new units are the smallest manufactured by the company and were designed primarily for use in hearing-aids and pocket radios. Values range from .0001 ufd to 0.1 ufd and voltage ratings from 150 volts to 600 volts. The smallest unit measures ¾" x ¼" x 3/32".

Further information may be secured by writing to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.



PERMEABILITY TUNER

Electronic Laboratories, Inc., of Indianapolis, Indiana, has announced a new permeability type tuner known as the Vario-Tuner. The unit is designed to replace the coil and condenser combinations used in conventional broadcast receiver mixer and oscillator stages. It is more efficient, smaller in size, and easier to install than the older gang tuning condenser systems.



MINIATURE SELENIUM RECTIFIER

A new selenium rectifier designed to replace the rectifier tube in all types of home and portable radios is being manufactured by the Federal Telephone and Radio Corporation of Newark, N. J.

The rectifier is a five plate, metal unit measuring 1¼" x 1-5/32" x ⅝". It is unbreakable, starts instantly,

→ To Page 29

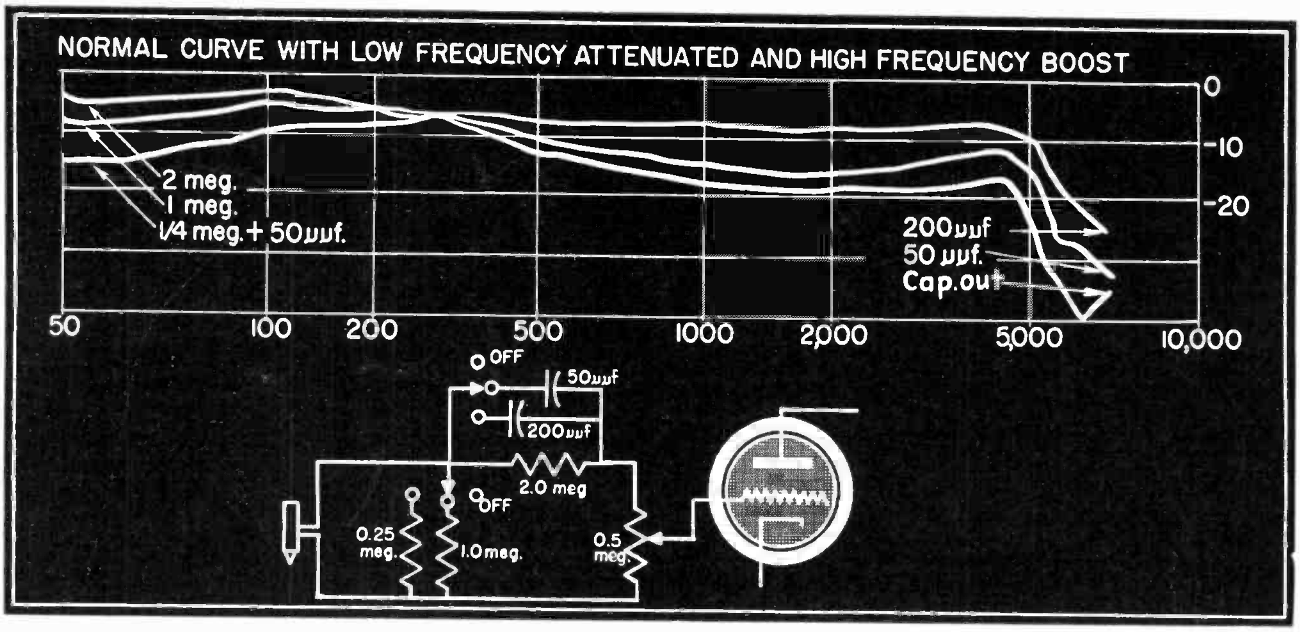


Fig. 7 This circuit permits independent variation of the high and low frequency response. The curve shows the response with various combinations of resistance and capacitance.

Crystal Pickups

→ From Page 15

duction in output of the cartridge, and, therefore, it may be that increasing the value of R-1 will not allow sufficient exitation voltage to reach the input tube grid to enable the amplifier to deliver its full rated power output. If this is the case, it is best that the sum total values of R-1 and R-2 be held to 2 megohms or less.

By using a slightly more elaborate circuit, such as is shown in Fig. 7, both high and low frequency response may be varied independently. Switch No. 1 is used to control low frequency response, and switch No. 2 is used to control the high frequency response.

Temperature and Humidity Effects

Crystal devices using Rochelle Salt crystal elements function best at temperatures between 70° and 80° F. when the relative humidity is approximately 50 per cent. They are very much like human beings in that wherever humans can live comfortably, the crystal element will function normally and have a very long life span.

The piezoelectric limitations of Rochelle Salt crystal pickup cartridges are between —40° F. and +120° F. If exposed to temperatures above 120° F., the crystal will lose its piezoelectric activity permanently.

Plenty of ventilation should be provided around the phonograph or radio cabinet in order that the temperature around the pickup be kept at the lowest possible value. Pickup cartridges and other crystal devices should not be stored near heaters or radiators, nor should they be displayed in store windows or show cases where bright sunlight is apt to shine. When leads are being soldered to the cartridge terminals during installation or service, the soldering iron should *not* be applied for a longer period of time than necessary to make a solid joint. Terminals are well tinned during manufacture; and if the leads are also well tinned before connection is made, it is only necessary that the soldering iron be applied to the joint long enough to "flow" the solder. It is important that these facts be kept in mind since the nearer to normal temperatures (70°-80° F.) the crystal can be stored or operated, the longer will be its useful life.

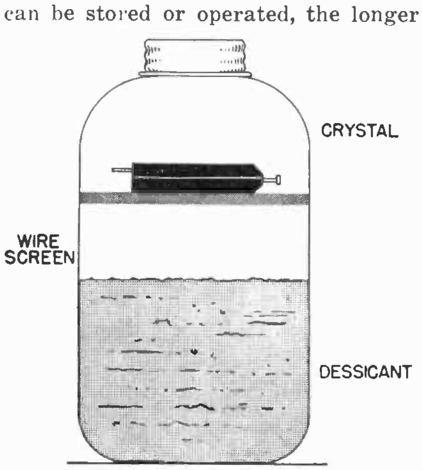


Fig. 8 A crystal cartridge may be stored in this way in humid climates to prolong its life. The desiccator consists of a jar with a piece of ordinary wire screen fitted into it to hold the cartridge above the desiccator liquid. The top should be closed tightly.

In extremely dry climates, crystal pickups have a tendency to become dehydrated (loss of natural moisture) when subjected to high temperatures. Once a crystal becomes dehydrated, nothing can be done to restore it to normalcy. In climates where the temperature and relative humidity are extremely high, crystal cartridges have a tendency to take on excess moisture. A simple desiccator, such as is shown in Fig. 8, may be used as an aid in controlling this hydration. If the crystal cartridge, when not in use, is stored in the desiccator, the excess moisture will be removed from the crystal element, thus helping to prolong the useful life of the cartridge.

Testing Pickup Cartridges

Accurate testing of all the types of pickup cartridges requires a specialized type of equipment and a special kind of skill or knowledge on the part of the operator. Interpretation of the results of the test to determine whether the unit is satisfactory calls for a knowledge of average characteristics and tolerances for that particular type of unit. Facilities such as these are not often found outside the cartridge manufacturer's plant; and it is usually impossible to conduct a thorough test anywhere except at the factory. A simple listening test may, however, be conducted by the radio serviceman or technician which will serve to determine whether the unit is operative or defective beyond question.

There is usually available a turntable and an amplifier with speaker to

→ To Page 31

BACK NUMBERS OF RADIO MAINTENANCE ARE AVAILABLE AT 25c PER COPY

Check the copies you want on the coupon below.

OCTOBER 1945

ANTENNAS FOR FM AND TELEVISION
BUSINESS MANAGEMENT FOR THE RADIO DEALER
RADIO MAINTENANCE FOR AVIATION
USING THE SIGNAL GENERATOR AND OSCILLOGRAPH

JANUARY 1946

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

FEBRUARY 1946

MODERN BENCH CONSTRUCTION
SYMPOSIUM ON TEST EQUIPMENT
FUNDAMENTALS OF VACUUM TUBE VOLTMETERS
REPAIR OR RECONDITIONING

MARCH 1946

TROUBLESHOOTING TELEVISION RECEIVERS
APPLICATIONS FOR LOW COST SIGNAL TRACER
RADIO REPAIRMEN'S ASSOCIATIONS
RADIO SERVICE ALONG THE AIRWAYS

APRIL 1946

PA SYSTEMS
A MIDGET AUDIO FREQUENCY OSCILLATOR
IF I WERE A SERVICEMAN
AN EQUALIZED AMPLIFIER FOR MAGNETIC PICKUPS

MAY 1946

PA SYSTEMS
TEST PANEL FOR THE MODERN BENCH
RINGING THE BELL

JUNE-JULY 1946

FUNDAMENTALS OF TELEVISION
VOLUME CONTROL TAPERS
THE ELECTRONIC VOLT OHMMETER
VECTOR ANALYSIS

AUGUST 1946

AVC CIRCUITS
FM TROUBLESHOOTING
TELEVISION RECEIVER FUNDAMENTALS
RECORD CHANGERS

SEPTEMBER 1946

SOUND EQUIPMENT
FM TROUBLESHOOTING
THE OSCILLOGRAPH . . . HOW IT WORKS

OCTOBER 1946

TESTING AND ALIGNING TELEVISION RECEIVERS
VIBRATOR SUPPLIES
PART II THE OSCILLOGRAPH . . . HOW IT WORKS
CABINET REPAIR

RADIO MAINTENANCE Magazine
460 Bloomfield Ave.
Montclair, N. J.

Please send me the back numbers checked here. I am enclosing 25c for each copy.

☐ October 1945
☐ January 1946
☐ February 1946
☐ March 1946
☐ April 1946
☐ May 1946
☐ June-July 1946
☐ August 1946
☐ September 1946
☐ October 1946

Total Amount Enclosed $..........

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

The Radio Service Bench

→ From Page 20

oscillator tube. Low line voltage will cause the oscillator to go out of operation while the rest of the circuits continue to function.

Philco 39-55

Weak reception:

Open antenna coil primary winding. Check IF circuits for continuity. Check them in operation. Open coils will have no peak.

• • • •

A tuning wand can easily be made from a powdered iron core removed from an old permeability tuned coil and a length of brass or copper rod. Cut the rod to a convenient length, drill and tap a hole in one end of it to receive the bolt fastened to the iron core (See Fig. 1).

• • • •

Ballast resistors can often be repaired by removing the heat shield that covers them and tightening the small nut and bolt that connect the resistance wire to the socket prong. Broken ends can be spliced successfully if the wire has not become brittle from overloading.

• • • •

Electrolytic condensers which depend upon the crimping of a lug against the chassis for a ground connection sometimes develop high resistance at this point. This is especially true in portables. Further crimping of the projecting lug is not always a permanent cure. Try drilling a small hole in the chassis near the aluminum can and running a self-tapping screw through the hole and against the can. (See Fig. 2).

• • • •

Small battery clips may be successfully used to make a connection to the ammeter post in an automobile without loosening the nut. A strip of brass with a hole drilled in each end can also be used (See Fig. 3).

• • • •

Auto radios using synchronous vibrators that need to be replaced and cannot be secured may be repaired by converting the input vibrator circuit for a single reed, double swing type, and using a selenium rectifier in the high voltage circuit.

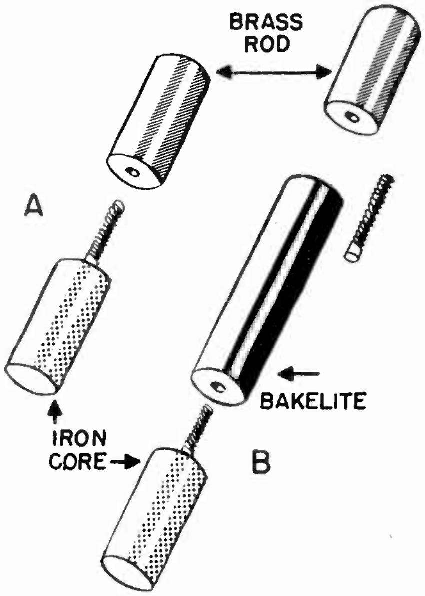


Fig. 1 Two types of wand can be made. The one with the bakelite center is more useful.

A clean, stiff paint brush used in conjunction with a nozzle type vacuum cleaner will work wonders with a dusty radio chassis. It will give the set that completely overhauled look that the customer appreciates.

• • • •

An efficient line noise filter for temporary use can be made from two ¼ pound rolls of No. 18 bell wire and two or more .05 ufd condensers.

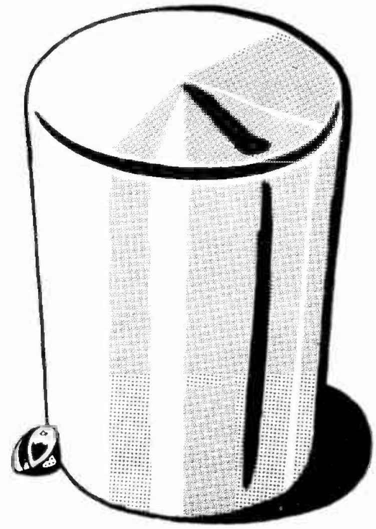


Fig. 2 Using a self-threading screw to ground an electrolytic.

Insert the coils in each leg of the line and shunt the condensers across the line before and after the coils. Or use four condensers, two in series, and run the center taps together to an outside ground. The whole affair can be enclosed in a small metal box to give it a manufactured appearance.

• • • •

A list of the day's radio programs tacked in a prominent place above the service bench is a great help in setting up push buttons. A quick check of

→ To Page 1

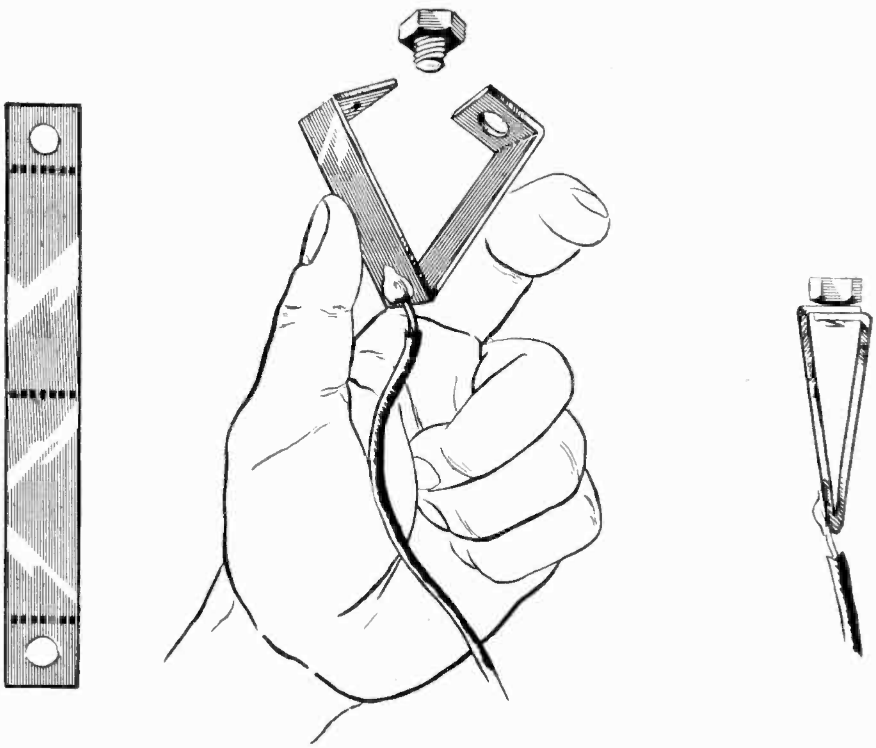


Fig. 3 This clamp is useful when making connections to automobile ammeters. It is made from a small strip of brass.

Industry Presents

→ From Page 25

runs cool, delivers greater output voltage, and will last the life of the set. It can be used to replace a total of 29 different rectifier tubes now in use.

NEW MINIATURE TUBES

Two new miniature tubes are being produced by Raytheon Manufacturing Company, Newton, Mass. Designated the 6BD6 and 12BD6, they are designed to replace such tubes as the 6D6, 6U7G, 6K7, 6SK7, etc. They are exact electrical equivalents of the 6SK7 and the 12SK7.

ELECTRONIC VOLT-OHMMETER

The Specialty Division of General Electric Company's Electronics Department has announced a new Electronic Volt-Ohmmeter. The instrument is designed for general service and laboratory work and is capable of measuring audio and R-F voltages of from 60 cycles to over 100 megacycles. The unit weighs 15 pounds and operates on 105-120 volts, 60 cycles.

Further information is available on request to the Specialty Division of the G-E Electronics Department, Wolf Street Plant, Syracuse, N. Y.

Television Receivers

→ From Page 24

appear in the picture or the synchronization of the sweep circuits may be unstable. The alternatives which may be employed to remedy this situation are: Installation of a higher antenna or a low loss transmission line, or the use of an additional RF amplifier to bring up the sensitivity of the system.

It is impossible to account for every problem that will be faced in television servicing. The many "bugs" that will seem difficult at first will be ironed out with more facility as the serviceman applies the techniques presented in this article to the repair of many receivers. Television receiver alignment is a precision job, and persons in need of repair work on their set will find their way to the service shop that knows the repair problem and can do it better

The Oscillograph

→ From Page 7

being observed. To synchronize the vertical voltage on the screen with the sweep, either use INTERNAL SYNC. or connect the signal (or a voltage which varies directly with the signal voltage; for example, if hum voltage is being measured, connect some 60-cycle line voltage to the EXTERNAL SYNC. terminal) to the EXTERNAL SYNC. terminal, and adjust coarse and fine frequency controls and sync amplitude control to obtain a steady pattern on the screen showing one or two complete cycles. Then, in the same manner as for DC voltages, turn up the calibration potentiometer until the point of the wave whose voltage is desired is exactly coincident with the zero-line marked on the face of the screen. Then the voltage of the point will be read directly on the "calibrator's" voltmeter. If the RMS voltage of a pure sine wave is desired, measure the peak-to-peak voltage and divide by 2.828. This is the same as measuring the voltage between the peak and the half-way point, and multiplying by .707. See Fig. 5.

Suppose we are checking the power amplifier tube in the audio of a radio receiver by inserting a small signal on the voltage amplifier tube ahead of the power tube. Connect the probe to the power tube's grid. Then suppose, after proper adjustment of sweep and synchronization controls, that a pattern like that of Fig. 6A is obtained: The calibrator's voltmeter shows -3 volts, with the top of the AC wave at -1 volt and the bottom at -5 volts. The AC signal then has a peak-to-peak value of $5 - 1 = 4$ volts, or an RMS value of $4/2.828 = 1.41$ volts. Now connect the probe to the plate of the power amplifier tube. Suppose a pattern like Fig. 6B is obtained, when centered by the calibrator potentiometer. The voltmeter reads $+250$ volts, the top of the wave is at $+270$ volts and the bottom at $+230$ volts. The AC voltage then has a peak-to-peak value of $270 - 230 = 40$ volts, or an RMS value of $40/2.828 = 14.1$ volts. From this knowledge we can now determine whether the audio is functioning properly or not: The power amplifier's grid bias is 13 volts, the B+ on the plate is + 250 volts, and the overall gain of the tube is $14.1/1.41 = 10$.

For complex AC voltages which are known to be less than a few volts in amplitude and which, therefore, would show little or no deflection on the screen if connected to the plates directly, the following technique is to be used. The "calibrator" cannot be used here since it is useful only for signals sufficiently strong to cause a visual deflection when connected directly to the top plate. Strap D4 and D3 to their respective amplifier terminals (or in the case of some oscilloscopes, switch vertical plates to AMPLIFIER). Connect the small signal under observation to the input terminals of the vertical amplifier. Turn up the vertical gain until the signal can be seen comfortably (about 2 or 3 inches high on the screen). Mark the extreme positions of the wave on the screen with china-marking pencil. Keep the position of the vertical gain potentiometer fixed (remember the number to which it is set). Then remove the signal and impress a variable 60-cycle voltage on the vertical amplifier, with gain set to same position as before. Increase the 60-cycle voltage until the pattern on the screen is exactly the same amplitude as that of the signal before. Measure the 60-cycle input with an ordinary AC voltmeter. Multiply this value by 2.828, and that will be the voltage between the two marked lines on the screen.

If the signal voltage is a complex wave-form, the voltages of all points on it can be estimated with reference to the two marked lines on the screen. If the signal voltage is a pure sine wave at some frequency other than 60 cycles, its voltage is exactly that measured on the voltmeter for 60 cycles. (It might be wondered why any pure sine-wave voltage could not be measured directly with a voltmeter. The answer is that most AC meters are accurate only at 60 cycles.) Care must be taken that a voltage of frequency higher than the maximum frequency in the flat pass-band of the vertical amplifier is not measured without consideration of the lower amplifier gain at that frequency than at 60 cycles.

Use as an Ammeter

The cathode-ray oscilloscope can be readily applied to the measurements of currents. Simply pass the current to be examined through a precision, non-inductive resistor and measure the voltage across the resistor by one of the means described above. The current will then be the voltage divided by the value of the resistance. Care must be taken to make the resistor as large as possible (to make the voltage across it as large as possible) without making it so large that it affects the circuit in which it is placed. ✓ ✓ ✓

More articles on the use of the Oscillograph are forthcoming . . .

Dial Lamps

→ From Page 18

quite high, resulting in a high voltage drop across the panel lamp. When the set warms up, the lamp voltage goes below normal, resulting in poor dial illumination. The more tubes used in a set, or the higher the filament rating per tube, the worse this surge condition.

In a few sets, the shunt resistor is designed to give a low resistance initially which increases as the set warms up, resulting in a somewhat better lamp performance.

Fig. 11 shows a circuit commonly employed for AC-DC receivers using 150 milliampere tubes.

This circuit was designed in an attempt to secure improved panel lamp performance. Both the rectified current and the filament current of the tubes pass through the panel lamp and its shunt resistor. When the set is turned on, the rectified current is zero, thus tending to offset the high initial filament current. As this current reaches normal, the lamp becomes dimmer until the rectified current commences to flow, making the lamp brighter. This circuit has been replaced in new sets by an improved one using a tapped rectifier. Fig. 12 shows the preferred type of circuit using tapped rectifier tubes.

This circuit also allows the rectified current and the tube filament current to flow through the lamp and its shunt resistor. The shunt resistor in this circuit is a section of the filament of a radio tube such as a No. 35Z5GT. As the filament has a relatively low resistance when cold, the

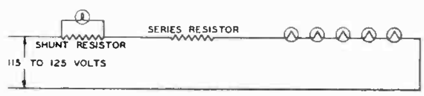


Fig. 10 Circuit used in AC-DC receivers with .3 ampere tubes.

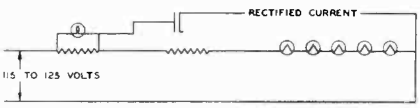


Fig. 11 Circuit used in AC-DC receivers using 150 milliampere tubes.

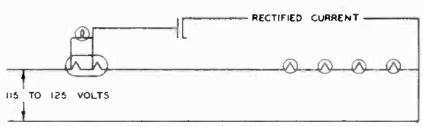


Fig. 12 This circuit results in the best panel lamp performance.

panel lamp is well protected from the surge through the filament of the tube. When the set is turned on, the panel lamp lights up momentarily to approximately its normal brilliance. It then dims until the rectified current flows, at which time the lamp again lights up to approximately normal brilliance. With this type of circuit, some variation in light output of the panel lamp may be noticed after the set is warmed up and operating. This is normal and is a result of variations in the rectified current.

Lamp Stock

Based upon the lamp manufacturers' demand for various types of radio panel lamps, and unless some local condition modifies it, we would suggest the lamp stock be made up in the following proportions:

Lamp No.	Per Cent
40	10
41	8
42	1
43	2
44	20
45	1
46	20
47	25
49	3
51	5
10C7	5
	100

A small stock of lamps should be carried in your portable kit. Lamps in your kit can be quickly renewed from the shop stock so the proportions of the various lamps in the kit need not necessarily be the same as the proportions in the shop stock.

Lamp No.	No. in Kit
47, 44, 46, 40	4 each
41	2
49, 43, 42, 45, 51	1 each
10C7	2

Crystal Pickups

→ From Page 26

which the unit may be connected. Cartridges may be coupled to the amplifier through short leads having clips to connect to the cartridge terminals. The cartridge may then be held in the fingers to play the record. A special motorboard with mounting holes drilled to accommodate each of the various types of pickup arms will simplify this test.

Although the method outlined above does not permit complete and accurate measurements, it will often establish whether or not a unit is operative, possibly saving the inconvenience of delay in returning it to the factory. If there is any doubt at all about the condition of the cartridge, it is best that it be returned to the factory for complete inspection and test. Any attempt to repair pickup cartridges outside of the factory usually results in obliteration of the cause of failure.

While the information and facts presented in this discussion are generally applicable for a majority of installations, special situations requiring individual solutions do arise from time to time. When such situations are encountered, it is best that the cartridge manufacturer be consulted since they are best qualified to render the necessary assistance. It is cheerfully given and much time and effort can be spared the serviceman confronted with such a problem.

The Radio Service Bench

→ From Page 28

program against time will identify the station.

• • • •

A group of 10-watt resistors set up behind the bench and connected through a multipoint switch to a pair of jacks so that any resistance is available at finger touch is a great time saver. The same goes for a condenser bank.

• • • •

The new midget selenium rectifiers are being used with great success in replacing rectifier tubes in portables. They stand up better under the jolts usually received by a portable.

• • • •

When installing a storage battery under the service bench for the powering of auto radios, it is good practice to lay down a layer of paraffin around each battery terminal. The wax will prevent the acid from creeping up to the lead post and corroding the connector.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933, of RADIO MAINTENANCE MAGAZINE published once per month at East Stroudsburg, Pa., for October 1, 1946.

State of New Jersey } ss.
County of Essex }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Louis N. Smith, who, having been duly sworn according to law, deposes and says that he is the Circulation Manager of the RADIO MAINTENANCE MAGAZINE 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, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Myron J. Boyce, Wayne, N. J.; Editor, William F. Boyce, 45 Hillcrest Rd., W. Caldwell, N. J.; Managing Editor, Joseph J. Roche, 45 Hillcrest Rd., W. Caldwell, N. J.; Business Manager, Alice Boyce, 45 Hillcrest Rd., W. Caldwell, N. J.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Myron J. Boyce, Treas., Wayne, N. J.; William F. Boyce, Pres., 45 Hillcrest Rd., W. Caldwell, N. J.

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: (If there are none, so state.) None.

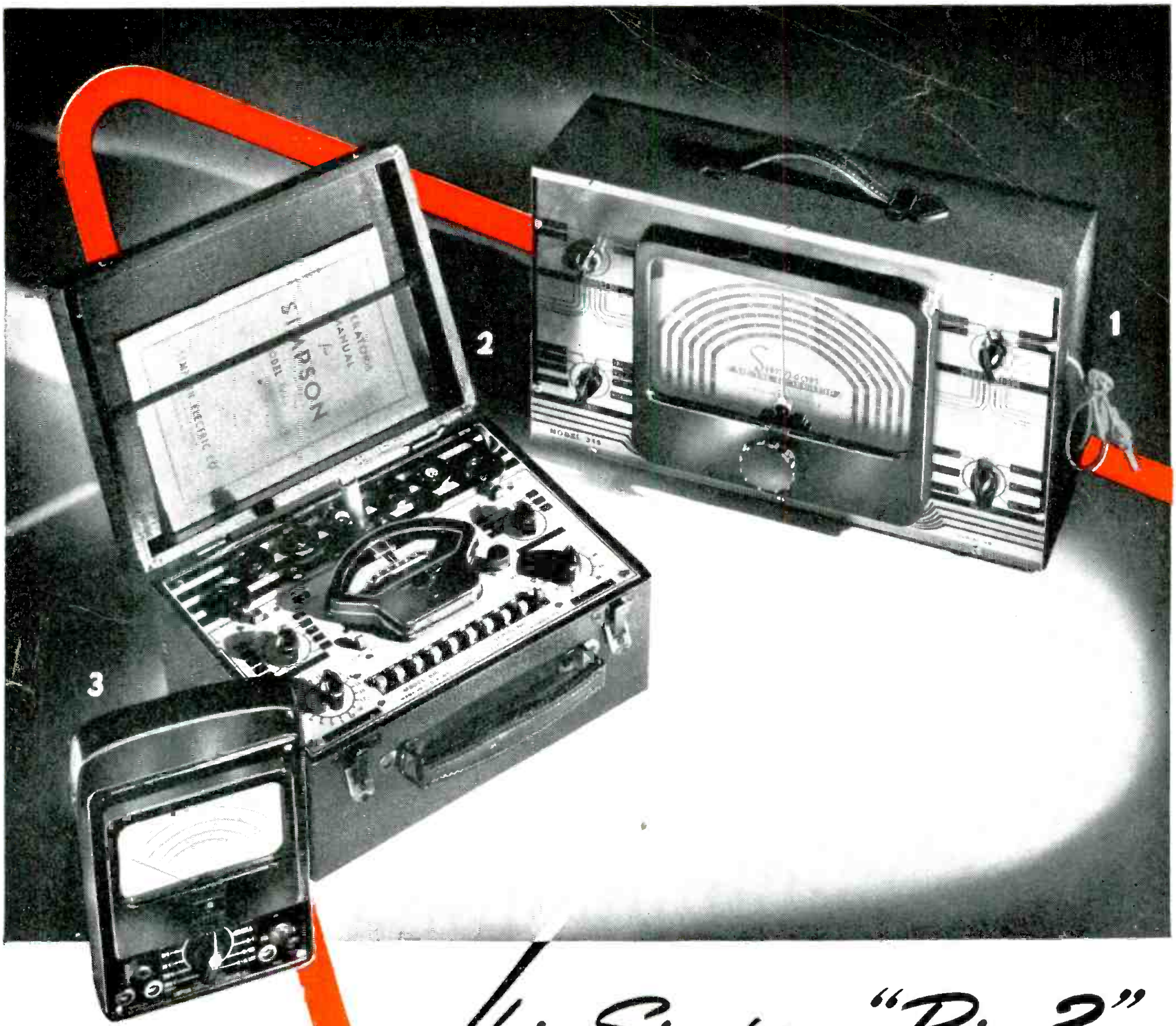
4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books 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.

LOUIS N. SMITH,
Circulation Manager

Sworn to and subscribed before me this 13th day of September, 1946.

[Seal] DAVID E. ESSIG,
Notary Public of N. J.

Advertisement



Model 315 Signal Generator. Designed down to the most minute detail for highest accuracy, greatest stability, minimum leakage, and good wave form $67.35

Model 325 Tube Tester. Tests all tubes. Provides for filament voltages from .5 volts to and including 120 volts. Spare sockets for future tube developments $46.25

Model 260 High Sensitivity Set Tester. 20,000 ohms per volt. D.C. Voltage ranges to 5,000 volts A.C. and D.C. Resistance ranges to 20 megohms Current ranges to 500 milliamperes $38.95

This Simpson "Big 3"

. . . gives servicemen a real profit-making set-up

● The successful radio serviceman today must have the finest in test instruments for a very practical reason—that's his only hope of present and continued profits. To meet the tremendous volume of business available he must be able to "trouble-shoot" fast and *accurately* every time. Only thus can he correct trouble speedily, with satisfaction to the customers.

Simpson offers you, in three basic test instruments, the accuracy and advanced electronic engineering which have given Simpson the proudest name in the industry. They are tried-and-tested examples of the kind of instruments Simpson has always built. Their use will demonstrate that from Simpson alone can you expect "instruments that stay accurate" with construction and design that lead the field.

To dealer and to serviceman alike, Simpson offers today the assurance of continued profits that only quality can give. No Simpson instrument is ever marketed, or ever will be, unless its makers feel that, of its kind, nothing finer can be produced.

Simpson

INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44

National Union Announces an

EXCLUSIVE RADIO MERCHANDISING PLAN for Service Engineers

PRESENTATION MODEL No. G619. *6 Tubes. AC-DC. Tuned R.F. Stage. Superheterodyne Circuit. Loop Aerial. Automatic Volume Control. Illuminated Slide-Rule Dial. Standard American Broadcasts. Mahogany Veneer All-Wood Table Cabinet, 13" x 8¾" x 6½".*

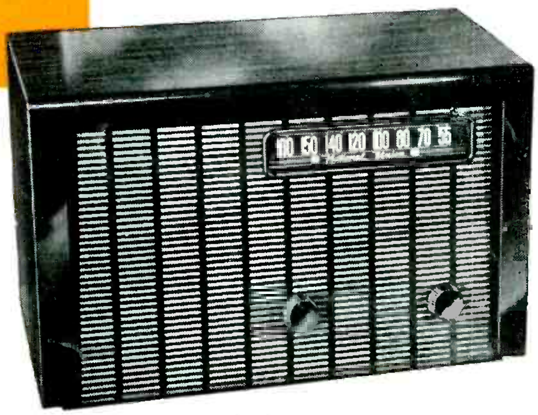
HERE IT IS AT LAST! The radio line thousands of service engineers have been waiting for—yes, the radio that has *everything* the service trade needs to cash-in on today's big pent-up new set demand.

And who else but National Union could provide a merchandising plan for radio sets—so perfectly fitted to the service engineer's special needs?

For over 15 years National Union products, plans and policies have been shaped for the exclusive benefit of service dealers.

And now N.U. RADIO SETS are here—for the same service men who have so long known and used other N.U. products—and have found the N.U. way of doing business a better, more profitable one for their special type of operations.

THE LINE—5 models, of which one 5-tube and one 6-tube model are now ready; three others available in 90 days.
THE PRODUCT—Top quality throughout; precision-built chassis; beautiful cabinets in modern designs.
PERFORMANCE—Thoroughly up-to-the-minute; N.U. sets compare with the best in their class.
PRICES—Competitive with established brands.
VOLUME REQUIREMENTS—None! N.U. sets are not sold on a franchise basis. Order whatever quantity you need.
DISTRIBUTION—Sold only through N.U. Distributors and Service Dealers.



COMPANION MODEL No. 571. *5 Tubes. AC-DC. Superheterodyne Circuit. Built-in Antenna. Automatic Volume Control. 2-Gang Air Condenser Tuning. Illuminated Slide-Rule Dial. Standard American Broadcasts. Walnut Veneer All-Wood Table Cabinet, 13 5/16" x 7⅞" x 8⅛".*

OTHER MODELS NOW BEING PLANNED

- A 3-Way (AC-DC-Battery) Portable Model.
- A Combination Table Model Radio-Phonograph with Automatic Record Changer.
- A 6-Tube Battery-Powered Farm Radio Table Model.

Here, for the first time, is a practical post-war radio line for the service engineer to handle—a group of fine modern radio sets—but *above all* a proven merchandising plan which *fits*. Ask your N.U. Distributor for the complete facts today!

NATIONAL UNION RADIO CORPORATION, NEWARK 2, N. J.

NATIONAL UNION RADIOS, TUBES AND PARTS

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Phototubes
Panel Lamps • Flashlight Bulbs • Radio Sets • Auto Vibrators • Ballasts • Batteries