# RADIO and TELEVISION maintenance

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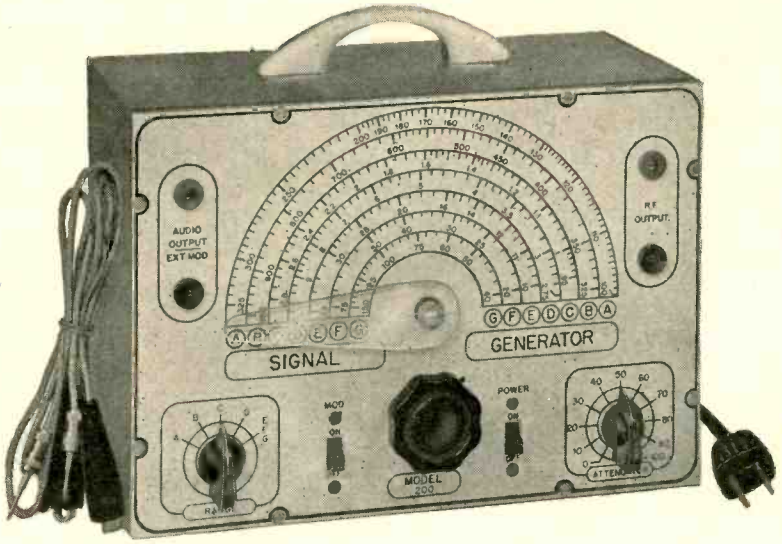


## *SPECIFICATIONS*

- ★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.
- ★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R. F. signal. Also available separately.
- ★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.
- ★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.
- ★ **ACCURACY:** Use of high-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on all ranges from 100 Kilocycles to 10 Megacycles and an accuracy of 2% on the higher frequencies.
- ★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and operating instructions.

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# RADIO and TELEVISION maintenance

## JANUARY, 1951

### FEATURES



### DEPARTMENTS



DEVOTED TO SERVICE OF RADIO-AUDIO-VIDEO

# RADIO INDUSTRY NEWSLETTER

**TV BLACK MARKET FORECAST FOR '51**

"The usual number of chiselers and black marketeers" are expected by George Trad, vice-president of Trad Television Corporation. In a recent public statement, Trad forecast that "in the next few weeks, vital materials will be almost impossible to get, and television sets will be rationed like water from the only canteen on the desert." A similar prediction, foreseeing a TV set black market by March, was made by Du Mont executives Ernest Marx and Walter A. Stickel. Stickel also declared that there is now a shortage of large cathode-ray tubes.

**INCREASE TV, ELIMINATE FM**

The 20 Mc band used for FM radio should be turned over to television, according to President Ross Siragusa of the Admiral Corporation. Citing the fact that three more 6-Mc TV channels could thus be opened, Siragusa also criticized FCC for the freeze on new TV stations. He said a lift of the freeze could nearly double the amount of operating transmitters, without any overlapping of frequencies.

**ASKS BAN ON COLOR VIDEO**

The National Production Authority was asked by a group of radio, TV, and appliance wholesalers to ban production of color television sets, as a war measure. According to some authorities, such a ban would be only academic, since materials shortages have already virtually doomed potential production in color video, and, to push the new medium back still farther, the Chicago District Court deciding on an RCA suit to halt CBS color TV, banned commercial color broadcasting until April 1. The suit will go to the Supreme Court for final decision.

**PHONEVISION GETS GOOD RECEPTION**

Zenith Radio Corp. finally got started with its much-postponed test of Phonevision, and reported high customer enthusiasm over the scheme. With 300 Chicago families able to get code signals over the telephone to unscramble the transmitted TV picture, the company said it received "hundreds" of phone calls from TV set owners asking how they could subscribe. Signal reception was described as "excellent." Motorola President Paul Galvin said he hoped the FCC would approve the system, but H. Leslie Atlass, CBS executive, pointed out that the commission had turned down subscription radio and was likely to do the same thing to subscription TV. An interesting sidelight on the test was the happy reaction of set owners who tuned to the distorted picture (sent over channel 2) and listened to the sound track, which was not scrambled.

**MUST CONCENTRATE ON REPLACEMENTS**

A call to the entire electronics industry, including service associations, to provide for scarce replacement parts during the year was made by Leonard Ashbach, of Majestic Radio and Television, who said 1951 would be critical. He said the government should allow parts producers to help keep the nation's 10,000,000 TV sets in use, by devoting "a good percentage" of their production to replacements for television.

**SEES 'AUSTERITY' IN NEW TV SETS**

A new possibility in the effort to keep up production of TV sets in the face of increasing shortages and government cutbacks is the idea of "austerity" models in receivers, brought out by Frank A. D. Andrea, of Andrea Radio. Stripped of all "gadgets," such as remote controls, enlarging devices, and other extras, receivers with only the bare essentials for operation were foreseen for this year.

**RADIO LISTENS IN ON PHONE CONVERSATIONS**

A Tennessee housewife recently picked up both long distance and local telephone calls on her AM radio. Neither telephone nor radio engineers were able to explain the phenomenon, but the set owner isn't too anxious to have the mystery figured out and eliminated. She said some of the telephone conversations are more interesting than the radio programs.

Test Equipment

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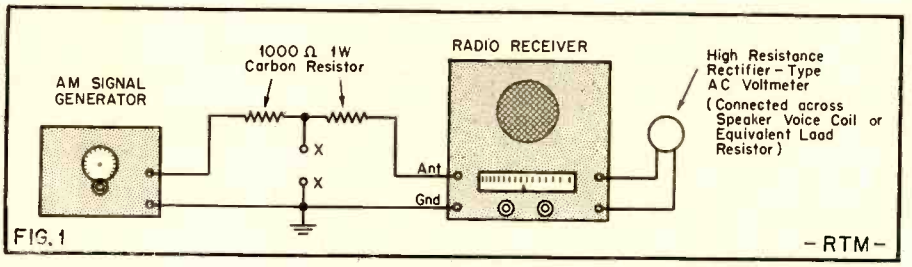
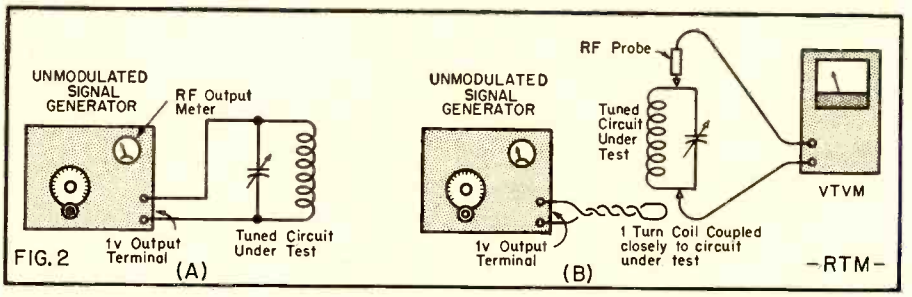


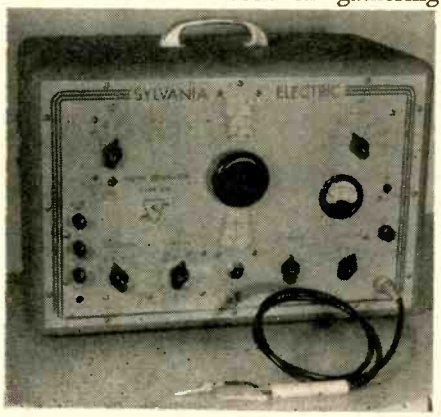




# NEW USES FOR YOUR SIGNAL GENERATOR

By RUFUS P. TURNER

IT IS wise operation to get as much service as possible from every test instrument you own. This is important equally to the independent service technician and to the operator of a small laboratory, or anyone else with a small instrument budget. To make each instrument do the largest possible number of jobs requires some knowledge of the instrument's capabilities. Here, we will outline several tests and measurements which may be performed with an RF signal generator. These tests, of course, are apart from set alignment, the basic purpose of the service signal generator.

The instrument used in gathering data for this discussion is the Sylvania Type 216 FM-AM unit. This instrument delivers cw or AM output on fundamental frequencies from 80 Kc to 60 Mc.




The author's AM-FM signal generator.

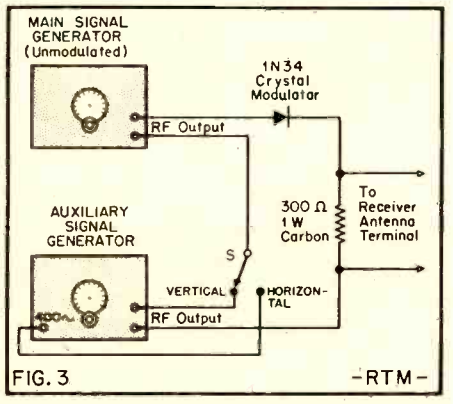
Amplitude modulation percentage is continuously variable up to 100. Frequency modulated output is available up to 120 megacycles. The FM sweeps are 0-30 Kc at 60 cycles, 0-150 Kc at 400 cycles, and 0-700 Kc at 60 cycles. The maximum output signal voltage available through the attenuator is 25,000 microvolts (0.025 v.). Output impedance is 50 ohms. An internal heterodyne detector is provided for checking unknown frequencies. A 400-cycle audio signal (1.3 volts across 5,000 ohms impedance) is available for external use.

## RF Impedance Check

*Checking RF Impedance:* The efficient operation of radio-frequency circuits depends a great deal upon the effectiveness of circuit components at the frequencies at which they are to be operated. Thus, a capacitor intended to bypass a resistor at 1000 kilocycles must have the lowest possible RF impedance at that frequency. In order to determine the suitability of the capacitor for the intended application, it accordingly must be tested at 1000 Kc. Lower-frequency checks, for example those made with a 60- or 1000-cycle bridge, are not conclusive as regards ability of the capacitor to give peak performance at 1000 Kc.

Figure 1 shows a simple apparatus employing the signal generator for checking RF impedance of capacitors, coils, resistors, or tuned circuits. This is a rudimentary T-network comprised by the two 1000-ohm 1-watt carbon resistors and the unknown component (or standard component) connected to the terminals X-X.

To make an impedance test, follow



this procedure: (1) Connect an accurately-known 10-ohm carbon or non-inductive wirewound resistor to terminals X-X.

(2) Set the signal generator to deliver an amplitude modulated signal at the desired test frequency.

(3) Switch off the AVC in the receiver.

(4) Set the receiver volume control for maximum output and tune in the signal generator signal. This receiver may be any set capable of tuning to the test frequency and having ANTENNA and GROUND input terminals.

(5) Set the AC voltmeter to one of its lowest ranges (such as 0-3 or 0-10 volts). This voltmeter is connected in parallel with the loudspeaker voice coil. (If a silent test is desired, replace the voice coil with a 25- or 50-watt resistor having the same ohmic value as the voice coil.)

(6) Increase the output of the signal generator until a strong, readable deflection of the voltmeter is obtained. Record the reading of the signal generator attenuator at this point as $E_1$.

(7) Now, remove the 10-ohm resistor from the unknown terminals X-X and connect in its place the capacitor, coil, or resistor to be tested. Use the shortest possible leads in making the connections.

(8) Readjust the signal generator output until the voltmeter reads the same voltage as before. Record the new setting of the signal generator attenuator as $E_2$.

(9) Calculate the RF impedance (in ohms) by means of the formula $Z = 10E_1/E_2$.

Use the shortest practicable connecting leads in the impedance measuring setup. Check any circuit component at its intended frequency of operation. Above about 1500 Kc, it will be necessary to shield the two 1000-ohm resistors by mounting them in a grounded metal can or box to which the signal generator and receiver also are grounded. Shielded (coaxial type) input and output terminals may be provided for signal generator and receiver connections. Short, insulated binding posts may be used for the X-X terminals. At the high frequencies employed in television, the shielding must be extended further to isolate each 1000-ohm resistor and the X-X terminals from each other to prevent "feed-through" type leakage.

### Tuned-Circuit Frequencies

*Checking the Frequency of a Tuned Circuit:* Fig. 2 shows two setups for determining the frequency of a wave-trap or any similar coil-capacitor type of tuned circuit. These setups may be used also for aligning tuned circuits.

In Fig. 2(a), the RF output meter of the signal generator is used as the indicator. When searching for the resonant frequency of the tuned circuit, begin by tuning from the highest generator frequency downward, in order to eliminate harmonic errors. The output meter will deflect sharply as the generator is tuned through the circuit frequency. Note that the high (usually one-volt) output of the signal generator is used, and that the signal does not have to be modulated. Keep all leads short between the signal generator and the tuned circuit. Stray capacitance, due to the connecting leads and the signal

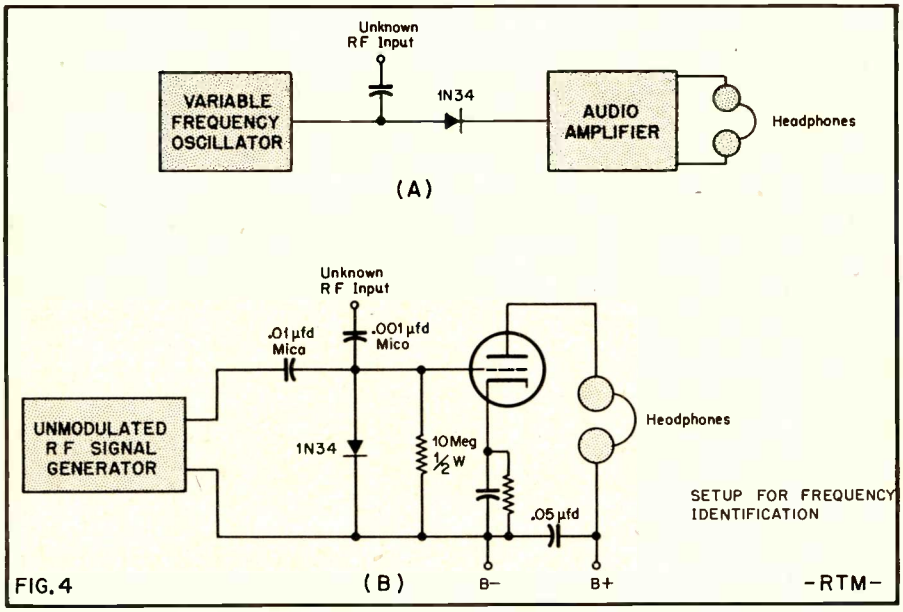


FIG. 4

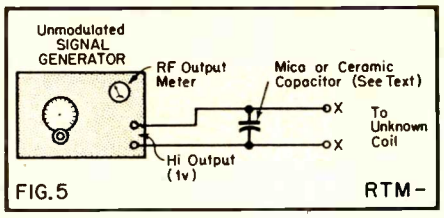


FIG. 5 RTM-

generator output circuit, effectively is in parallel with the tuned circuit under test and will influence the resonant frequency of the latter. Therefore, the measured frequency will be somewhat lower than the true resonant frequency unless care is taken to keep all stray capacitance low with respect to the circuit capacitance.

Figure 2(b) shows an alternative method in which an external RF vacuum tube voltmeter is used as the resonance indicator. Here, RF energy is coupled into the circuit under test by means of a single-turn coupling coil placed in a stationary position close to the coil of the test circuit. When the signal generator is tuned to the resonant frequency of the test circuit, the VTVM will be deflected upscale. In this instance, the input capacitance of the meter is in parallel with the tuned circuit and hence will influence the resonant frequency. However, the meter capacitance usually is very small as compared to the tuned-circuit capacitance and accordingly will have only negligible effect.

When aligning a tuned circuit, the signal generator is set to the desired frequency, and the circuit adjusted (either by means of capacitor adjustment or coil-slug tuning) to give peak deflection of the VTVM (Fig. 2-b) or slight deflection of the output meter in the signal generator (Fig. 2-a). This method permits the silent alignment of a radio or television receiver, provided the tuned circuits are not canned and are readily accessible.

### Line-Pattern for TV

*TV Line-Pattern Generation:* An auxiliary RF signal generator or test oscillator having both RF and 400-cycle audio output may be used in conjunction with a "main" signal generator to produce vertical or horizontal lines for adjustment of the linearity controls of a television receiver. Fig. 3 shows the circuit.

A 1N34 germanium crystal diode is employed as the modulator for mixing the signals from the two generators.

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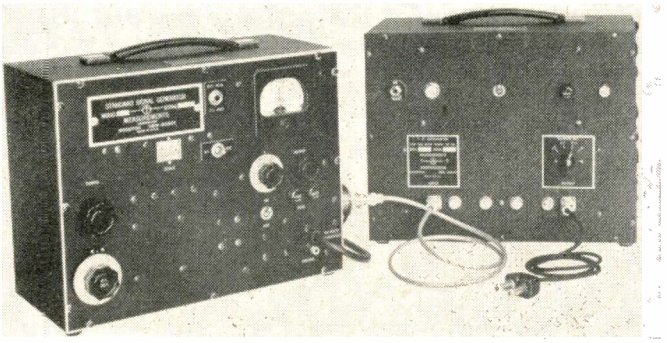
# A Critical Part--the Discriminator Needs Correct Adjustment With Proper Equipment for Best Sound in TV or FM



Measurements Corp. FM signal generator, covering 88-108 Mc band, and IF converter, which produces 4.5 Mc, 10.7 Mc, and 21.7 Mc signals.

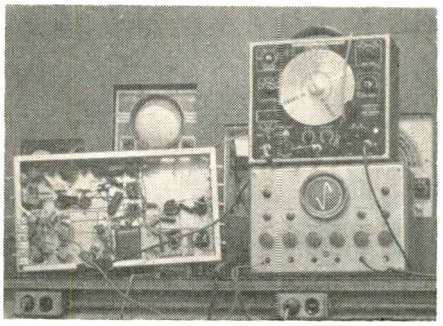
# FM ALIGNMENT AND EQUIPMENT

## PART 1

By NORMAN L. CHALFIN

ALL TV sets have FM sound IF sections, no different from those in standard FM receivers. If you learn about the alignment of an FM receiver, you will have the know-how on the sound IF section of the TV receiver. The alignment isn't tricky in itself, but some of the accompanying manifestations can provide headaches if you're not familiar with what causes them.

A technician familiar with the AM broadcast superheterodyne will find nothing really new in the IF and RF portions of the FM receiver. Trouble shooting procedures involving resistance and voltage analysis in these sections is the same for FM as it is for AM. Resistances or coils can open, and capacitors can short in both sets. Both are subject to the familiar trouble shooting with the VTVM or VOM.



Setup of scope and FM sweep generator for discriminator alignment. Correct discriminator response curve apears on the scope face.

### Limiter

The most important difference between AM and FM receivers starts at the limiter of the FM set. This circuit is not found in AM sets. The limiter is designed to maintain a constant RF signal level to feed to the discriminator (FM detector). The stronger the RF energy in the last IF amplifier, the more the limiter clamps it down. The presence of most amplitude components of modulation in the signal is in this way eliminated. The need for a constant level at the input to the discriminator is due to the fact that the discriminator, unlike the ratio detector, will be sensitive to amplitude variations in the signal.

### Reverse Limiting

One of the difficulties found in limiters is "reverse" limiting. This occurs when the IF stage preceding the limiter becomes saturated and begins to draw grid current. The result of this condition is that low-level signals will sound louder than higher level ones. The condition of reverse limiting is not prevalent in sets which employ AVC. FM sets using discriminators often derive AVC bias from the limiter grid bias voltage, which varies as the strength of the incoming signal. AVC is not in-

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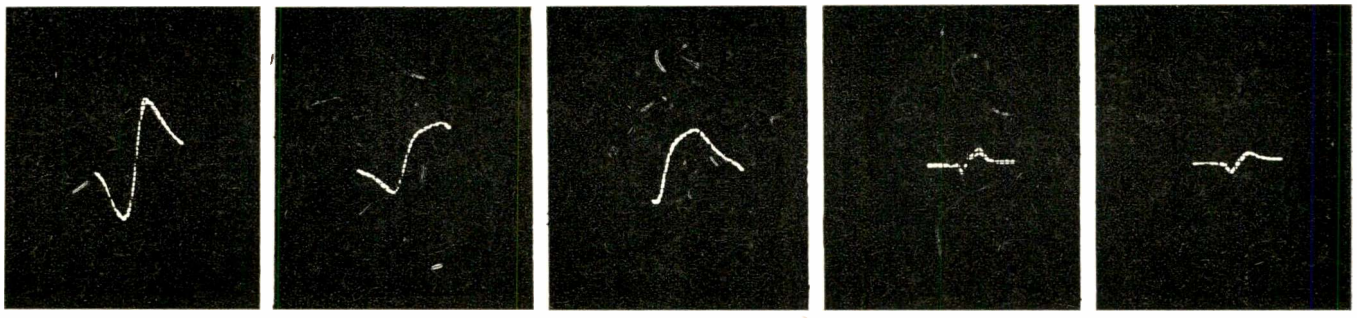

From left: 1. Normal "S" curve of properly adjusted discriminator. 2. Pattern of detuned discriminator primary. 3. Result of detuned discriminator secondary or bad oscillator tracking. 4. Reverse limiting, plus a pip on the curve resulting from oscillation in IF amplifier. 5. Low signal level. Can result from improper RF alignment, or, in a stagger-tuned IF system, detuning of one of the coils.

Test Equipment

## You can't count on true measurements unless you

# KNOW YOUR METER

By RUDOLF F. GRAF

MOST manufacturer's schematic diagrams are accompanied by voltage charts. These charts indicate the readings to be obtained at various points of the circuit with respect to a particular reference point, usually B minus or chassis. The charts generally specify whether these readings were taken with a VTVM, a 20,000 ohms per volt or a 1,000 ohms per volt meter. It is our aim here to illustrate the different and sometimes greatly misleading results that may be obtained by using the wrong meter.

### Multimeters

The "ohms-per-volt" of a meter actually refers to the resistance per range volt of the instrument. It is the statement of meter sensitivity. Let us see how this is determined. In the case of a 20,000 ohms-per-volt multimeter, examine the DC voltage ranges shown in Fig. 1. For this particular meter the full scale voltage ranges are 2.5V, 10V, 50V, 250V, 1,000V, and 5,000V.

We note that the circuit consists of a microammeter in series with a number of resistors. The microammeter requires 50 microamperes of direct current for full scale deflection. For the meter to read full scale when connected to a 2.5 volt source, we must connect a resistor in series with the meter movement which will limit the total current to 50$\mu$a. Applying Ohm's Law, we find that with application of 2.5 volts, a current of 50$\mu$a will flow in a circuit whose resistance is 50,000 ohms. Since the meter movement itself has a resistance of 2,000 ohms we have to add an additional resistor of 48,000 ohms. This resistor is the multiplier. If we now apply 2.5 volts between the positive and negative jacks of the meter we will get a full scale reading, and the circuit whose voltage we measure will see 50,000 ohms across itself.

If the applied voltage is greater than 25 volts, say 10 volts, additional resistance must be inserted in series with the meter circuit to limit the current through the movement. For a 10-volt full scale reading we need a multiplier resistance of 200,000 ohms. Since we already have 50,000 ohms in the circuit, we need to add only another 150,000 ohm resistor.

The 50 volt range requires a 1 megohm multiplier, but we only need to add an 800,000 ohm resistor, since 200,000 ohms is already in the circuit. The multiplier resistors for the other ranges are found in the same way. The 5,000 volt input is not switched, because insulation breakdown might occur in the switch. Employing a separate jack is usual practice.

If we are on the 50v range and the voltage applied is 25 volts, the total current in the meter circuit will be 25$\mu$a, and the meter will deflect only half way —to the 25v mark on the scale. In the same way, all other readings less than full scale are obtained. Examining Fig. 1, we discover that the resistance that the circuit under test sees, varies with different voltage ranges.

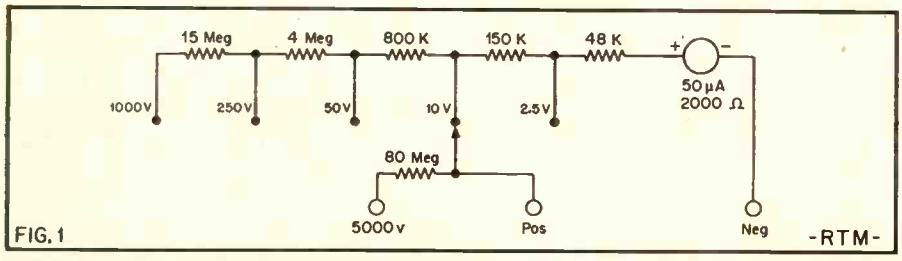

FIG. 1

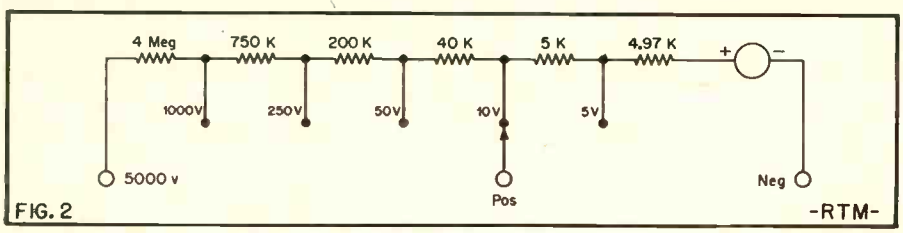

FIG. 2

### 1000 Ohms Per Volt Meters

The DC voltmeter circuit of a 1,000 ohms per volt meter is illustrated in Fig. 2. The multipliers are found in the same way as for the 50$\mu$a movement, but since we now use a one ma meter, the multipliers are all of a much lower value. The ohms per volt of a meter can be easily found by taking the reciprocal of the full scale meter current. Thus, for the 50$\mu$a meter 1/.00005a equals 20,000 ohms per volt; for the 1 ma movement 1/.001a equals 1,000 ohms per volt.

### Vacuum Tube Voltmeters

When any meter movement is connected in a circuit using one or more vacuum tubes so that a plate current

change, as caused by a change in grid voltage, is indicated on the meter, we have a Vacuum Tube Volt Meter. A typical instrument uses a two tube bridge circuit, forms of which have in recent years been used in most VTVMs. A simplified circuit of the DC voltage ranges of such an instrument is shown in Fig. 3.

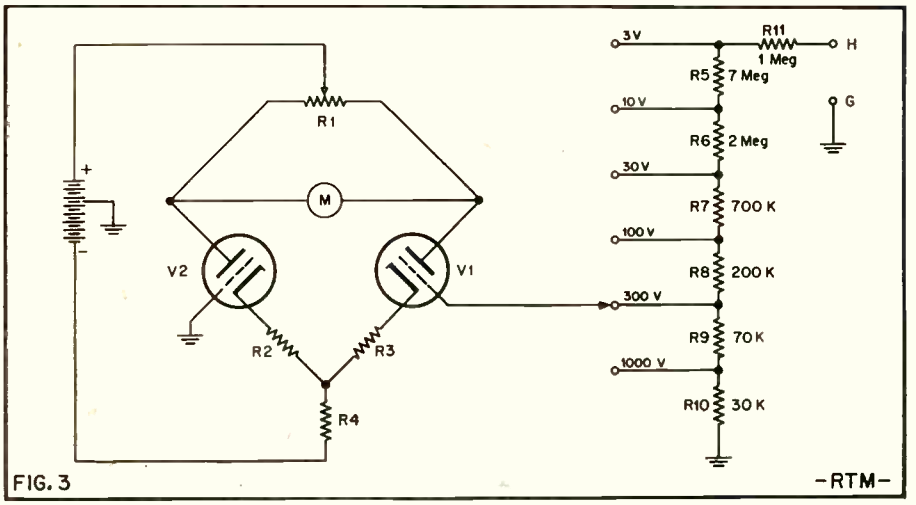

FIG. 3 -RTM-

The voltage under test is applied to the grid of $V_1$. If this voltage is positive with respect to ground, the plate current of $V_1$ will increase, causing an increased voltage drop across $R_4$. Since $R_4$ is also common to $V_2$, this increased voltage drop across this resistor will increase the bias on $V_2$ and therefore decrease its plate current. This decrease in current will cause an increase of potential at the plate of $V_2$, while at the same time, due to the increase in current, the potential at the plate of $V_1$ will decrease. The meter, connected between the two plates, measures the total potential difference. The deflection of this meter will depend, of course, on the total potential difference between the plates, which in turn depends on the potential applied to the grid of $V_1$. Since the decrease in plate current of $V_2$ is essentially equal to the increase in plate current of $V_1$, the total power drawn from the supply remains essentially unchanged.

Now let us examine the source of the voltage for the grid of $V_1$. Referring to Fig. 3, we see that this voltage is obtained from a voltage divider made up of six resistors: $R_5$, $R_6$, $R_7$, $R_8$, $R_9$, and $R_{10}$. The sum of all these is 10 megohms. The instrument is so calibrated that if we apply three volts between terminals H and G and have the Range Switch in the 3v position, the meter will read full scale. (The 1 megohm resistor $R_{11}$ is an isolation resistor in the probe. It must be taken into account when the initial calibration is made.)

Assume that thirty volts is applied at the input terminals. This is ten times as much voltage as before. In order to have the meter read full scale for this voltage, we must pick off a tenth of the voltage and apply it to the grid of $V_1$. This is accomplished by moving the range switch to the 30v position. Since the full voltage is applied across 10 megohms and we take off only the voltage across 1 megohm, $(R_7+R_8+R_9+R_{10})$ the meter now still reads full scale.

It is important to notice that the resistance which is seen by the circuit under test is the same for the 3v, for the 30v and for all the other ranges of the instrument: 11 megohms.

The ohms per range volt of this instrument is not constant for all ranges. It is highest for the lowest voltage range and lowest for the highest voltage range. As a matter of fact we now can see that on the 1000v range a 20,000 ohms-per-volt meter has greater sensitivity (higher input resistance) than the VTVM.

## Applications

Now let us see how all of the above factors affect the readings obtained in various circuits. Fig. 4(a) shows an amplified tube with a load resistor of 200,000 ohms and a B+ voltage of 300 volts. If the plate current is one ma, the voltage at the plate will be 100 volts. Now let us see what our meters will tell us.

If we first use the 1,000 ohms per volt meter on its 250 volt range, the input resistance of the meter is 250,000 ohms. Fig. 4(b) shows the equivalent circuit, with the meter connected between the plate and ground. The voltage at this point will now be *only 79 volts*. That is what the meter will read. Fig. 4(c) shows the equivalent circuit if we use the 20,000 ohms per volt meter on its 250 volt range. In this case, the meter will read 98.6 volts. The VTVM is shown connected in Fig. 4(d), and in this case the reading will be 99.5 volts. We now see that if we use a meter whose internal resistance is not very much higher than the resistance of the circuit under test, we will

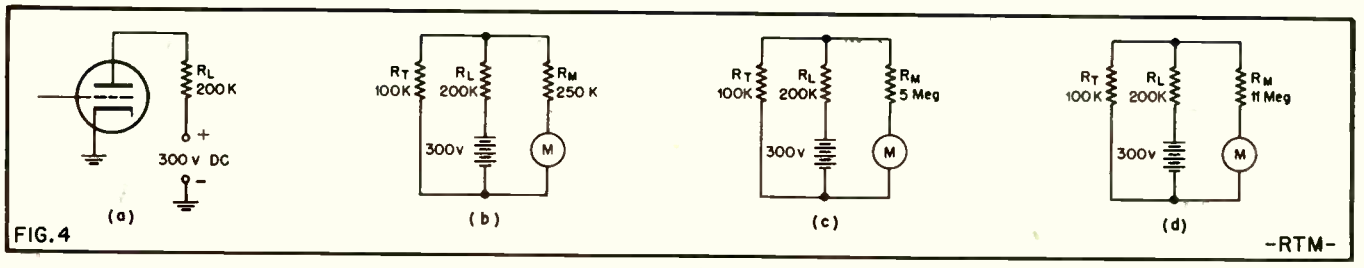

FIG. 4 -RTM-

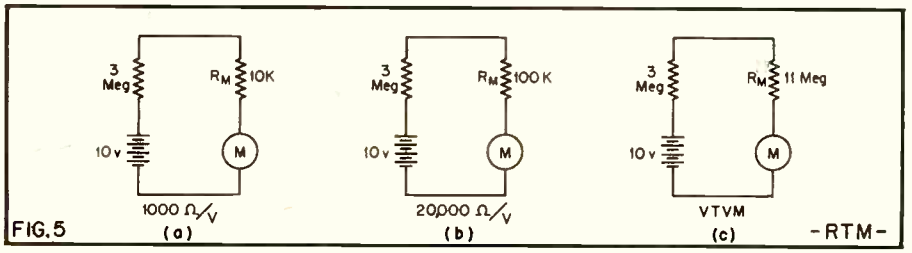

FIG. 5 -RTM-

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R&TM Survey

# TEST EQUIPMENT AND PROCEDURE IN TV WORK

By DAVID T. ARMSTRONG

TELEVISION has brought the servicing business to maturity. The tinkerer is more likely to do harm to the receiver and himself than good. Precise information is absolutely necessary, and it is assumed that this information should be of such a type as to present a minimum of theory so that the serviceman will know why he is replacing a coil, resistor, or capacitor.

Too many servicemen are still operating on the premise that spotty information here and there and random bits of theory and technique will be sufficient to get by on most servicing calls. This may be true, but unless the technichian knows precisely what is wrong, why it is wrong, and what he can do to correct the defect, he is proceeding in the dark.

## Which Servicing Method?

When a television receiver requires servicing the customer is interested in having the set made to operate normally as soon as possible. The serviceman is concerned with the choice of the best method to use to diagnose the difficulty and repair the defect in the shortest possible time and with the least expense for parts. The following methods are usual:

1. *Sense indications — seeing, smelling, and touching.* In many respects it is possible to do excellent TV servicing by means of visual indications. The smell of a burned out transformer is like no other smell. Sometimes touching a resistor or condenser will reveal a crack in a resistor, or improve the reception by the addition of body capacity when a condenser is fingered.

Sometimes finding defective condensers which cause intermittent trouble is not so easy. Tapping them with the fingers or wiggling them may be insufficient. It is better to use a small slotted tool made of plastic; insert one condenser lead at a time in the slot and twist or push the wire lead. The defect often becomes noticeable at once.

2. *Past experiences with identical set difficulties.* This, like most other methods, is not infallible. There will always be situations which the technician must think through for himself and diagnose on the basis of his overall knowledge of the receiver and its circuits. But past experience is frequently a wonderful time saver—especially when there is a consistent weak spot in every example of a particular model or type of receiver.

Here is another item which shows up to the man who has had plenty of experience and learns from it. Fluctuations in picture brightness often are caused by an intermittently open HV condenser. Cut one lead, and if the fluctuations cease, replace the capacitor. It is a most likely source of trouble.

3. *Part substitutions method.* It is to be hoped that this method of servicing will soon cease to exist. It is very time-consuming, unduly expensive, and betrays a serious lack of knowledge of the fundamentals of TV servicing. Even worse, it is usually doomed to failure when there is more than one defective component.

4. *Point to point resistance checks, and point to point voltage measurements across components.* Used in connection with a service manual, the voltages found across components will serve to locate stages giving trouble and to locate defective components. But the time required to check the voltages on a large number of points in the typical receiver should rule this out generally, except for routine voltage checks, or checks in one particular stage. There are some defects in a modern receiver, in fact, which will not reveal themselves by means of a point to point accumulation of voltage data.

5. *Signal substitution.* In the shop this is a desirable technique. Most of the time, however, servicing on a television receiver must be done in the customer's home, sometimes with the customer breathing down your neck and abusing you because the set stopped operating in the middle of the crucial round in the main bout.

The chief virtue of signal substitution is that it locates a defective stage; the finding of the defective component must be done by some other means.

6. *Dynamic signal tracing with a vacuum tube voltmeter, oscilloscope, signal and marker generator.* This involves expensive equipment, which can cost $1000 or more. These instruments indicate immediately loss of gain in stages, distortion, interference, regeneration, oscillation, noise, low signal voltage, and a number of other causes of trouble. Such instruments are used to analyse a receiver under actual working conditions and reveal true dynamic characteristics. For the most part such servicing must be reserved for those unusual cases which do not yield to ordinary methods.

The charge for this type of servicing should be proportionately greater than the charge for the routine servicing that can be performed in the home with a minimum of equipment.

## Most Efficient Procedures

No one of the above indicated serv-

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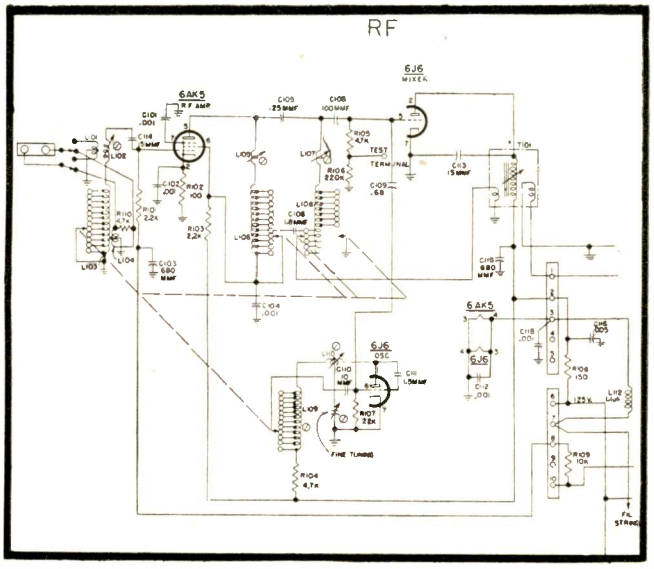
# SWEEP GENERATOR AND SCOPE IN TV VISUAL ALIGNMENT




**RF section of the Westinghouse V-2158-1A chassis—a typical intercarrier system receiver.**

By MARTIN MEYERSON

WITH the advent of special circuitry in modern TV receivers to produce the required reception, it has become mandatory for the serviceman to utilize effective visual alignment techniques for ease in alignment and maximum TV receiver operating efficiency.

Alignment is easier if the technician is familiar with the set, so a brief circuit analysis of a typical RF-IF chassis, the Westinghouse V-2158-1A, should be helpful.

This chassis utilizes a 12-channel stepped tuner and the intercarrier system for IF, with the picture and sound carriers both sent through a single IF string and separated after the second detector. The sound is taken off the plate of the second detector through a 4.5 Mc trap and fed through two stages of sound IF amplification and then through a ratio detector to the audio output circuit. The output of the second detector also supplies the sync separator with the incoming sync pulses, while the output of the video amplifier supplies the cathode ray tube with picture intelligence and blanking.

### RF Amplifier

The input signals are fed to the RF amplifier through a tuned circuit which consists of series inductances, which are shunted out as the channel selector progresses from channel 2 to channel 13. The output of this amplifier also contains a set of series inductances which tune the amplifier.

### Oscillator

The RF oscillator again has a set of series inductances which operate in the same manner as those for the RF amplifier. It has, in addition, two coils which may be adjusted for best oscillator tracking on the low and high bands respectively. The frequency of the oscillator is higher than the incoming signals, to provide a picture carrier IF of 45.75 Mc and a sound carrier IF of 41.25 Mc.

### Mixer

The input to the mixer is tuned in much the same way as the output of the RF amplifier, and is capacitatively fed by both the RF amplifier and the local oscillator, to give the resulting picture and sound IF values.

### Video IF

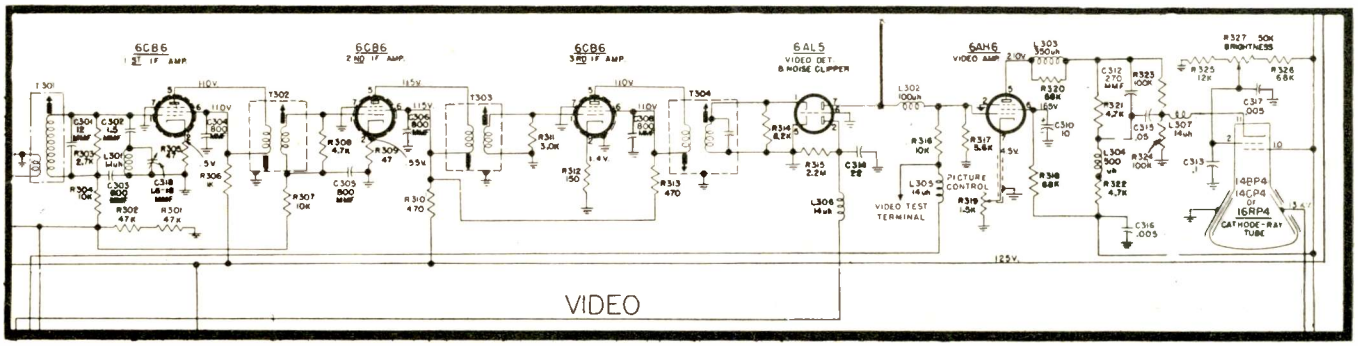
The common IF system uses overcoupling in the transformers to obtain the required bandwidth. Each transformer has two adjustments, a powdered iron slug accessible from the top of the chassis, and one accessible from the bottom of the chassis. All the transformers have a center frequency of 44 Mc, and the response curve is fairly flat-topped.

### Sound System

The sound carrier is taken off the plate of the sound detector by a 4.5 Mc trap, fed through two stages of IF amplification, and passed through a ratio detector to the audio output circuit.

### Video Amplifier

The video amplifier derives its input



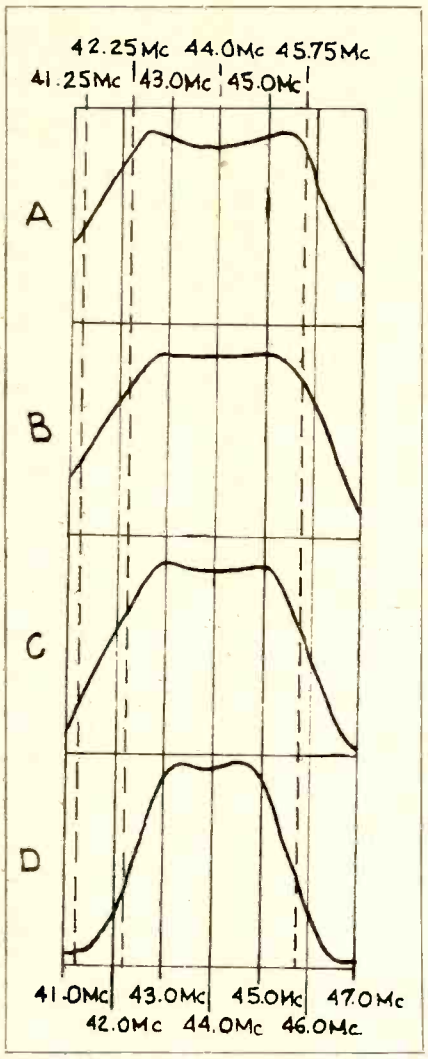



**Fig. 1. Proper curves to be obtained, working backward through the IF strip of the receiver.**

from the plate of the video detector, while its output, consisting of picture intelligence and blanking pulses, is fed to the picture tube. The 4.5 Mc trap which feeds the sound system also prevents the beat signal from being fed to the picture tube.

The receiver uses a keyed AGC circuit which operates on the RF and first two stages of IF.

## General Data

The filaments are all connected in parallel, from both sides of a grounded center-tap filament transformer. A 5U4 low voltage rectifier supplies the necessary B voltages, which are +325 and +125 volts with respect to chassis ground.

## Video IF Alignment

In the following procedure, if there is any doubt as to whether a correct transformer peak is obtained in a particular case, it is advisable to turn the tuning slug out (counter clockwise) as far as possible. Then continue the alignment by turning the slug in (clockwise) until the first peak is obtained, and use this peak for all further adjustments.

1. To avoid undesirable beat response during alignment, remove the 6AK5 amplifier tube from its socket, and rotate the channel selector switch to channel 13.

2. Connect the vertical input of the oscilloscope to the video test terminal (plate coil of the second detector) through a decoupling network consisting of a 470 mmf shunt capacitor and a 47,000 ohm series resistor. Also connect the vertical input to the pip output of the marker generator. The oscilloscope horizontal input should be connected to the sweep output of the sweeping oscillator, to establish the required time base.

3. Connect the sweeping oscillator through a 100 mmf coupling capacitor to the grid of the 6CB6 third IF amplifier, and set the oscillator to sweep approximately 10 Mc around a center frequency of 44 Mc. Use minimum sweeping oscillator output and maximum oscilloscope gain to obtain an accurate, undistorted response curve. It may be necessary to detune the previous stage to avoid absorption of the applied signal, so a clip lead should be connected to the plate of the 6BC6 second IF amplifier (there is B+ here, so care must be taken to avoid shock.) This technique should be continued throughout the alignment, if the amount of applied signal is found insufficient to produce a good response curve.

4. Set the marker generator at 44 Mc and adjust the primary (bottom slug) of the fourth video IF transformer until it is peaked at 44 Mc. Adjust the secondary (top slug) of this transformer for curve symmetry, and check the curve at 42.25 Mc, 43 Mc, 45 Mc, and 45.75 Mc as shown in Fig. 1(a).

5. Connect the sweeping oscillator to the grid of the 6CB6 second IF amplifier, and the detuning clip lead (if necessary) to the plate of the 6CB6 first IF amplifier.

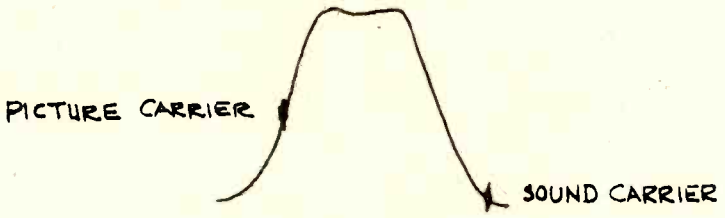



**Fig. 3. RF response curve used for alignment of local oscillator.**

6. Adjust the primary of the third IF transformer until it is peaked at 44 Mc. Adjust the secondary of this transformer for curve symmetry, and again use the check points as shown in Fig. 1(b).

7. Connect the sweeping oscillator

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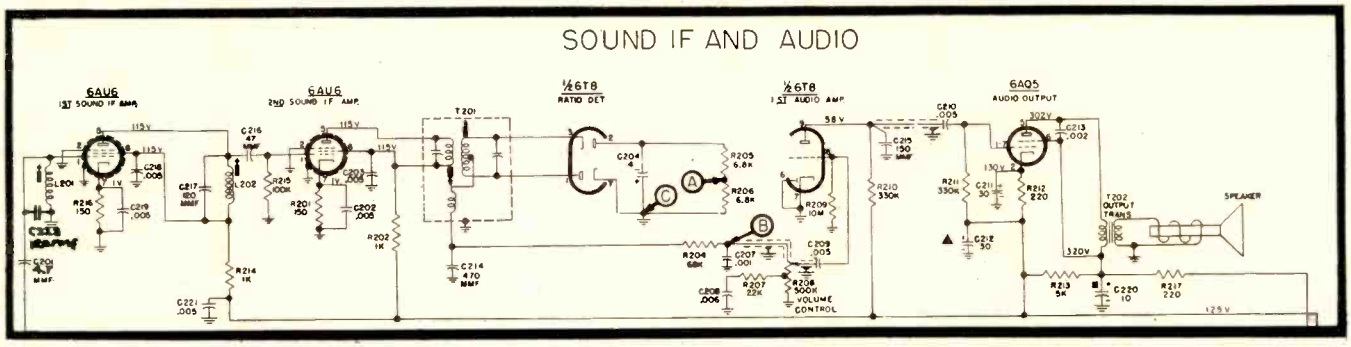


**Fig. 2. Check points for alignment of 4.5 Mc sound IF section. For this procedure, a VTVM is used with the marker generator on its 4.5 Mc crystal oscillator. For non-intercarrier sets, the same procedure would apply, but the IF value would be different.**

# THE RCA SERVICE COMPANY

## —And How It Operates

By E. C. CAHILL

*Ed. Note: The following article by E. C. Cahill presents RCA's view of the TV servicing field. In that RCA maintains a unique position in the field, readers' reactions to this article are solicited.*

IT is to the credit of the radio industry's major manufacturers that in the early days of commercial television they unanimously regarded and promoted the new medium as an industry project. It was important to *establish* television, and to prove to the public that the new medium had reached a point of development that made it practical for home entertainment.

The public was, and still is, less concerned with the perfection of television in the laboratories than with the operation of individual receivers. RCA Victor was among the first of the manufacturers to recognize this and act upon the vital importance of proper installation and efficient servicing. In 1946, not enough of the nation's radio servicemen, as efficient as they were in radio servicing, were ready for the transition to television servicing. At that time, one could not predict the efficiency of receivers in the home, under a multitude of conditions that could not be simulated in the laboratories. A service average per receiver could not be set up, nor a pattern drawn of the types of servicing that would be classified as normal.

**The Author . . .**

***Edward C. Cahill, president of the RCA Service Company since 1943, administers the activities of the largest single radio and television service organization in the country.***

E. C. CAHILL

### Good Service Essential

Nevertheless, the success of commercial television depended to a large extent on the service behind it. Someone had to assume the commercial risk of a service program placed at the beck and call of the television customer. RCA Victor decided to assume the risk.

The RCA Service Company made its manpower and facilities available for a program of installation and service by factory-trained men. We placed behind the installation and servicing of receivers in the home the know-how and experience we had gained in developing commercial TV.

### Dual Purpose

Our purpose was two-fold. We sought to assure buyers that their receivers would be properly installed, and to further the industry effort to establish television in the public mind. Every receiver operating perfectly in the home in 1946 was proof to the public television had arrived.

From the beginning, service data on all RCA Victor receivers was made available to all technicians. Through various media — pamphlets, meetings, discussions—our experience with servicing was made available to all who thought they could benefit from it.

Our factory service program provides us with an opportunity to study the operation of our receivers in customer's homes under a variety of conditions which cannot be duplicated in the testing laboratories. These field observations have resulted in improvements in tubes, circuits, and chassis, more practical engineering and design, and other advancements which mean improved performance for the consumer and fewer servicing headaches for all technicians.

### Field Observation Program

Our service company has a coordinated field-observation program involving a number of our service branches, selected to provide a complete cross-section of geographic, climatic, and other conditions. Each instrument installed by these branches becomes the subject of an operations report by the installing serviceman, and the report is forwarded to the home office in Gloucester, N. J.

Within the organization is a quality control board, representing production, engineering, sales, purchasing, and servicing departments. The board studies and correlates this flood of information, establishes operation patterns, and presents the findings to the department or

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# TV SERVICE *campaign ever launched!*

HERE'S the hardest hitting . . . and the most complete advertising campaign ever planned, to bring service business to every dealer who displays the Sylvania emblem.

All during 1951, your prospects are certain to SEE, HEAR, and READ about your expert service in magazines, on television, and through window displays.

**POPULAR WEEKLY TV SHOW**

The great Nation-wide TV show, "Beat the Clock," featuring Bud Collyer over CBS-TV, will go to bat for your service and the Sylvania products which you sell. Clever animated cartoon commercials on the CBS-TV station in your area will inform prospects of your expert workmanship and prompt service.

**DEALER TIE-IN PROGRAM**

*"Service business is booming . . . tie-in with Sylvania's national advertising and get a bigger share!"*

Tying everything together is the greatest and most colorful dealer tie-in program you have ever seen!

You get FREE giant, full-color displays of the featured stars. You get counter cards . . . bright window streamers . . . spot radio announcements . . . mailing pieces . . . all designed to identify you as the Sylvania Service Dealer advertised on television and in the national magazines.

*Ask your jobber for full information about the bigger-than-ever 1951 Service Dealer Advertising Program. If he can't give you all the facts, mail the coupon now!*

RADIO TELEVISION SERVICE
SYLVANIA RADIO TUBES
Authorized Dealer

**Be sure to display this emblem.** Put up these Sylvania decals right now! This seal is the target of the whole Sylvania Service Dealer campaign. Put them on your windows and on your trucks. Made in 8-inch and 12-inch sizes. Order a supply from your jobber TODAY! They're free!

Sylvania Electric Products Inc.
Dept. R-2001, Emporium, Pa.

*Please send me full details about the greatest Radio-Television service advertising campaign in the history of the industry.*

*Name* _____

*Street* _____

*City* _____ *Zone* ___ *State* _____

# ELECTRIC

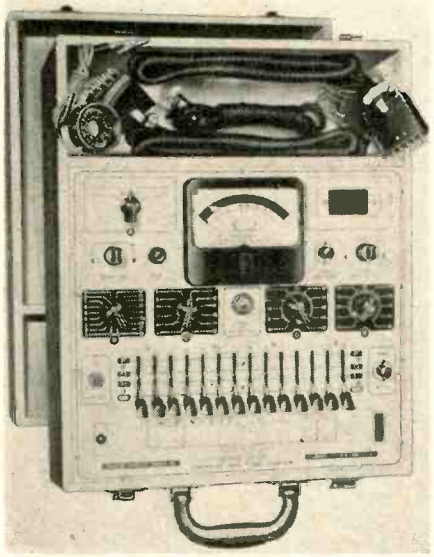
FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS


Some of the interesting new items being made available currently in the Radio and TV service field are presented in this column. For further information, write to: Products Editor, RADIO AND TELEVISION MAINTENANCE, P. O. Box 867, Atlantic City, N. J.

## CR TUBE TESTER

The new Model CR-30 Cathode Ray Tube Tester, put out by Precision Apparatus Co., is scheduled for release this month.

A self-contained instrument which will perform all tests on CR tubes without removing them from their mountings or cartons, the new unit is reported to test all elements of the tube under test,



with parameters based on beam current. A voltage-regulated VTVM will detect a beam current change of 1/10 microampere with the instrument in the high-sensitivity position. The meter is more than four inches wide, and has a special scale for CR tube characteristics.

Built into a hardwood portable case, the tester has a large tool and test cable compartment.

—RTM—

## ISOLATION TRANSFORMER

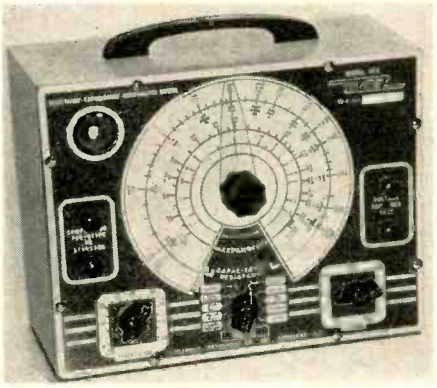
Two new products from the Philco Corporation, a vibrator test kit and a new isolation transformer, have just been made available.

The isolation transformer, which the company says will soon be of prime importance in servicing "line connected" TV sets safely, is rated at 250 volt-amperes, and is designed for direct hookup into a line outlet on the service bench. It also can be used with plugs attached to the connecting leads. According to an announcement of the equipment by the company, metal shortages will soon result in increased use of "hot chassis" TV designs, making isolation units more useful than previously.

—RTM—

## COMPARATOR BRIDGE KIT

A resistance - capacitance - inductance comparator bridge kit was recently announced by Electronic Instrument Company. The new unit, the company said, tests resistors from 0.5 ohm to 500 megohms, and condensers from 10 mmfd to 5000 mfd. A source of variable voltage



from zero to 500 is incorporated for leakage and polarization tests. Exact measurements of the power factor of electrolytic units from zero to 80 percent are also provided for.

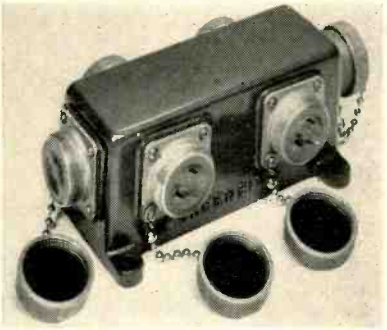
No multipliers or charts are needed to use the instrument, the manufacturer points out, as all measurement ranges are calibrated on the front panel.

—RTM—

## POWER OUTLET BOX

A new waterproof power outlet box has been made available for radio remote work and other applications where durability and protection against weather or water are necessary.

The manufacturer claims that the box, when used with the special connectors that fit it, is completely weatherproof and waterproof, and that leads to the box cannot be pulled out accidentally.



Input to the unit handles 6000 watts, while the five outputs will each handle 1500 watts. Sockets fit standard two-prong 110 v. plugs.

—RTM—

## PANEL INSTRUMENTS

Three different sizes of panel instruments have been put out by Simpson Electric Co. in a new line of meters.

The instruments, which come in 2½-, 3½-, and 4½-inch sizes, are mod-


ernistic in design, with etched faces protected by unbreakable plastic. They can be supplied in various ranges for individual applications.

To provide good looks, the instruments are made with chrome-plated strips recessed into the fluted plastic covers.

—RTM—

## MICROVOLT RF GENERATOR

A new microvolt signal generator put out by Hickok covers all AM, FM, TV, and mobile radio frequencies in seven ranges, with controlled output from 0.2 to 100,000 microvolts.

Double frequency range of 125 Kc to 110 Mc and 150 to 220 Mc, all on fundamentals, is provided in the instrument,

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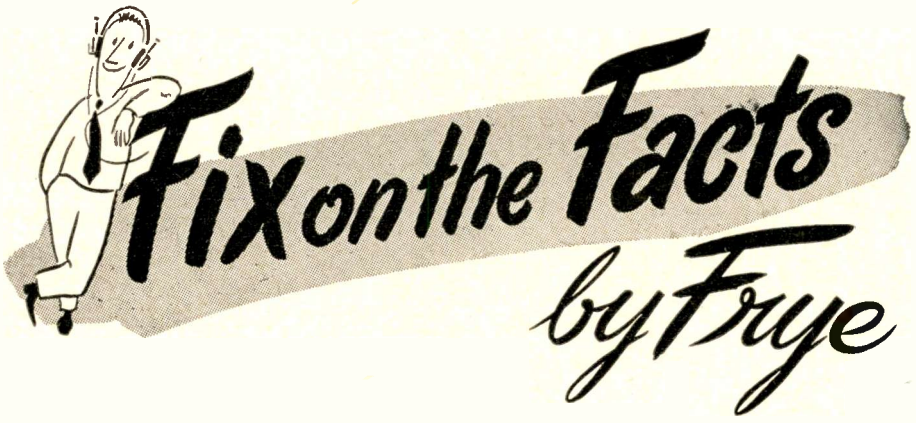



## WHAT THE VTVM CAN DO FOR YOU

IF YOU had to use one solitary instrument to do all of your service work, which one would you choose?"

When I was recently asked this question, my eyes quickly flitted over the 'scope and sweep generators, moved a little more slowly across the standard signal generator and the signal tracer, lingered affectionately on the trusty old VOM that has served me faithfully for fifteen years, and then, half-guiltily, slid on past to the vacuum tube voltmeter.

Yes, that comparative newcomer to my service bench, the VTVM, would be it; and to answer that reproachful, how-can-you-do-this-to-me? look on the face of my old volt-ohmmeter, let me hasten to give my reasons:

In the first place, the high input resistance of the VTVM—eleven megohms in the particular model pictured—allows me to take readings with it that I simply cannot make with my VOM. This resistance is so high that it exerts practically no loading on a circuit being tested. As a result, plate, screen, and grid voltages that are fed through high values of resistance can actually be measured, instead of its being necessary to estimate how much the heavy loading of a low-resistance VOM has pulled these voltages down from their true values. In the same way, the AVC voltage actually delivered to the grids of the tubes can be measured. A leaky AVC bypass condenser—a defect that often slips through a routine service check undetected—can be spotted.

JOHN T. FRYE

Then, too, the vacuum tube voltmeter will read the rectified grid voltage present on the grid of an oscillator tube. This particular voltage has very poor "voltage regulation," and any heavy loading will reduce the voltage to a fraction of its original value or stop the oscillations altogether.

### Motorboating Portable

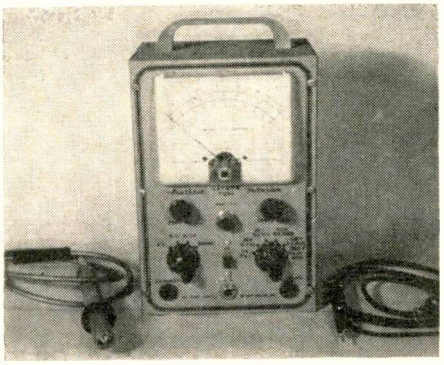
Recently I encountered a puzzling case of motorboating in a three-way portable. The condition was not caused by the usual open filter condensers, gassy tubes, etc. The VTVM revealed that the supposedly "cold" chassis was actually several volts negative with respect to the set ground; furthermore—and this was the giveaway—this negative voltage was exactly equal to the voltage on the oscillator grid. Investigation showed that a very high resistance short had developed between the grid winding of the oscillator coil and the metal supporting bracket fastened to the chassis. No sign of this leaking voltage could be detected with the volt-ohmmeter.

### Ease of Use

Another reason for my fondness for the VTVM lies in the ease with which measurements can be made with it. I like that business of clipping the common connection to the set ground and then using the probe to measure either positive or negative voltages simply by changing the switch on the meter. When the operator feels still lazier, he can use the "Zero Adjust" to bring the pointer to rest at center scale and then read these opposite polarity voltages without even having to change the switch! Positive voltage moves the pointer in one direction; negative voltage, in the opposite. With the instrument set up in this fashion, it is ideal for adjusting the discriminator of an AFC or FM detector circuit. Until the trimmer is in exact adjustment, the pointer will stand off one way or another from the zero-reference position.

### AC Readings

The VTVM is also much handier and safer to use in making AC readings. Many VOM instruments have a spring-return switch that must be held down while making an AC reading. This is insurance against burning out the delicate instrument rectifier by placing the probes across too high a voltage for the scale being used. The trouble with this arrangement is that you need at least three hands to keep the probes in place and hold this switch down all at the same time. The VTVM, on the contrary, is almost burn-out proof, and AC voltages are read just as easily and confidently as DC values.



The author's VTVM with high-voltage probe at left and crystal RF probe at right

Such ease contributes to more thorough servicing. For example, a push-pull output stage can be checked for balanced audio input and output voltages in a matter of seconds; and, during these days of critical phase-inverter circuits, you will be surprised at how many push-pull stages you find with a lot more "push" than "pull"—and vice versa. Still another consideration lies

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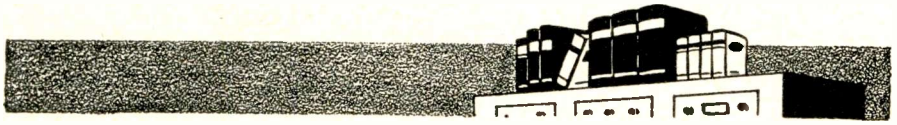
# trade LITERATURE



## SERVICE BUSINESS

THE first edition of "Making Money in Televison Servicing," by Eugene Ecklund, former manager of the Du Mont Service Department, has just been released by Howard W. Sams and Company.

The 150-page paper-bound book is based on the author's own experience in the service field, the publisher reports, with much attention paid to new problems which face the electronic technician planning to enter the television field. Considerable detail is devoted to the business techniques of operating a TV service shop. Mr. Ecklund takes into consideration the fact that, in many cases, a knowledge of business management, important to success, must be superimposed on the technician's familiarity with the technical side of television.

—RTM—

## TEST INSTRUMENT PAMPHLET

SIMPSON Electric Company, Chicago, is now publishing a small illustrated pamphlet describing six of the company's FM and TV service instruments. Covered are the Plate Conductance Tube Tester, Model 335; the Field Strength Meter, Model 488; the Mirrorscope, Model 476, the VT Volt-Ohmmeter, Model 303; the AC-DC-Ohm-Millammeter, Model 260; and the Genescope, Model 480.

The folder includes pictures and specifications of all the instruments.

—RTM—

## RIDER VOLUME 21

VOLUME 21 of the radio manual series put out by John F. Rider, Publisher, Inc., will be released this month, it was announced recently.

Covering the period December, 1949, to October, 1950, the book, more than 1,600 pages long, sells for $18.00. Nearly 600 models of AM, FM, auto receivers, record changers, tuners, disk and tape recorders are included, the announcement said. In addition, a cumulative index for Volumes 16 through 21 in the series is incorporated in the book.

Information on the various units includes schematic diagrams, alignment procedures, IF peaks, operating voltages, parts lists and values, power and voltage ratings of parts, and dial drive arrangements.

—RTM—

## RCA SERVICE DATA

RCA Victor has recently made available service data on all its models of radios, phonographs, and TV receivers produced from 1923 through 1950.

Available from the company's tube and parts distributors, the data is presented in four volumes covering the years 1923 to 1948, with a volume for 1949 in preparation, and data on 1950 models in booklets.

—RTM—

## NEW SAMS MANUALS

TWO new service aids have been published by Howard W. Sams & Co. The 600-page second edition of "The Radio and TV Industry Red Book" is a parts listing for about 20,000 TV and radio receivers.

Correct replacements, manufacturers, and installation notes are included in a ready reference form that should save much time for the busy service technician. The volume costs $3.95.

The third volume of the "Automatic Record Changer Manual" covering changers produced in 1949 and 1950, is a welcome addition to the service information on these units that the Sams organization has already issued.

Technicians familiar with the earlier volumes will find the same complete and comprehensive parts, change cycle data and adjustments. The "exploded-view" technique is carried through in this, as in preceding volumes. The record changer manual is listed at $3.00.

N. L. C.

—RTM—

## ANTENNA SYSTEMS

A NEW book from John F. Rider, Publisher, is "TV Master Antenna Systems," by Ira Kamen and Richard H. Dorf. With theory given only when it is necessary, the book covers the installation, use, and other information on commercial master antenna systems, with the practical working aspects of the systems given closest attention.

In 368 pages, the authors give detailed explanations of the major amplified and non-amplified units, with schematic diagrams, performance data, and design information. According to a recent announcement, much of the information presented in the book is not obtainable elsewhere. Price of the volume is $5.00.

—RTM—

## ALLIED CATALOG

PRODUCTS of Allied Electric Products and Sheldon Electric Cos. are shown in the new Catalog No. 161 for the Allied-Sheldon firm.

Extension cords, lamps, fluorescent lighting accessories, and TV picture tubes are included in the 24-page booklet, which is available free on request.

—RTM—

## NEW SUN BOOKLETS OUT

SUN Radio and Electronics Co., New York, has recently announced release of two booklets, one the 1951 edition of "Audio Equipment, a Handbook for Music Lovers," and the other a new, 130-page catalog of radio, TV, and other electronic components.

The audio equipment book, 100 pages long, contains a section of technical information written for the layman, which describes the principles and practice of high-fidelity work, while the balance of the book has listings, prices, and specifications on audio components and subassemblies offered by the company.

The equipment catalog gives full technical information on all items listed, with photographs and drawings of many. Both books may be obtained on request from the company, at 122-124 Duane St., New York, N. Y.

—RTM—

## TUBE SUBSTITUTION GUIDE

TO AID servicemen in finding correct substitutions for scarce receiving tubes, John F. Rider, Publisher, has just put out the "Receiving Tube Substitution Guide Book," which contains systematic listings of 2,500 radio and TV tubes, with accompanying wiring instructions. Views of sockets of the original tubes with those of the sub stitutions are included to simplify work.

In addition, much information on

→ to page 25

## Fix On the Facts

→ from page 19

in the fact that the electronic rectifier used in the AC circuits of most VTVM's is virtually flat in its response to an extremely wide range of frequencies, a virtue that is most important in testing audio amplifiers.

### Ohmmeter Circuit

Even the ohmmeter circuit of the VTVM is far superior to that of the VOM. Because of the sensitivity of the former, a very low voltage can be employed to read very high resistance values. For example, a typical VOM can read up to 200,000 ohms with a self-contained 4.5 volt battery and up to 20 megohms with a built-in power supply that delivers about 350 volts. The VTVM, on the other hand, will read up to one billion ohms with only a self-contained three-volt battery.

This ability to read very high values of resistance is very useful for checking insulating materials for leakage. As an example in point, I recently had to fix a set with a persistent hum that did not respond to any of the usual treatments. When the VTVM-ohmmeter was used on the socket connection of the rectifier socket, I found that there was a leakage between one of the plate lugs and the chassis that varied (when cold) between 50 and 100 megohms. Probably a flashover had carbonized a tiny path through the socket material, and probably this resistance grew less after the set was in operation for a while. At any rate, replacing the socket cured the hum.

### Accessories

And finally, the accessories that can be employed with a VTVM greatly enhance its value as a service instrument. For one thing, because of the very small power consumed, low-wattage, compact voltage multiplying resistors can be used inside accessory probes to extend the top voltage range. The probe pictured to the left of the VTVM in the illustration will increase its range to 10,000 volts, and other probes can be purchased that will raise this to 30,000 volts. Anyone who has noticed the higher and higher potentials being used as accelerating voltages on TV tubes does not need to ask why these high-voltage probes are required.

The probe shown on the right of the meter pictured is a crystal probe that employs a germanium crystal rectifier and permits the VTVM to measure alternating frequencies up to as high as 300 megacycles. That means the owner of a VTVM is no longer confined to measuring only the static DC voltages in the portion of a receiver ahead of the detector. Instead, he can determine the gain of an IF stage or check the actual amount of oscillator voltage delivered to a mixer. In short, a VTVM with a crystal probe becomes a signal tracer that can detect and measure the signal during all of the many forms it assumes from the time it enters the antenna until it leaves the speaker.

### Disadvantages

But, like anything else, the VTVM has its disadvantages: it must be powered by batteries or from the light line; many VTVM'S will not measure current; and since they are more complicated than VOM'S, they are probably more subject to component failure. After all, they use tubes; and you know how pessimistic a serviceman is about predicting the life of a vacuum tube!

None of these defects, however, are really serious or insurmountable. For example, almost every circuit contains a resistance, which, if we can accurately measure the voltage drop across it, will give an accurate check on the current through it.

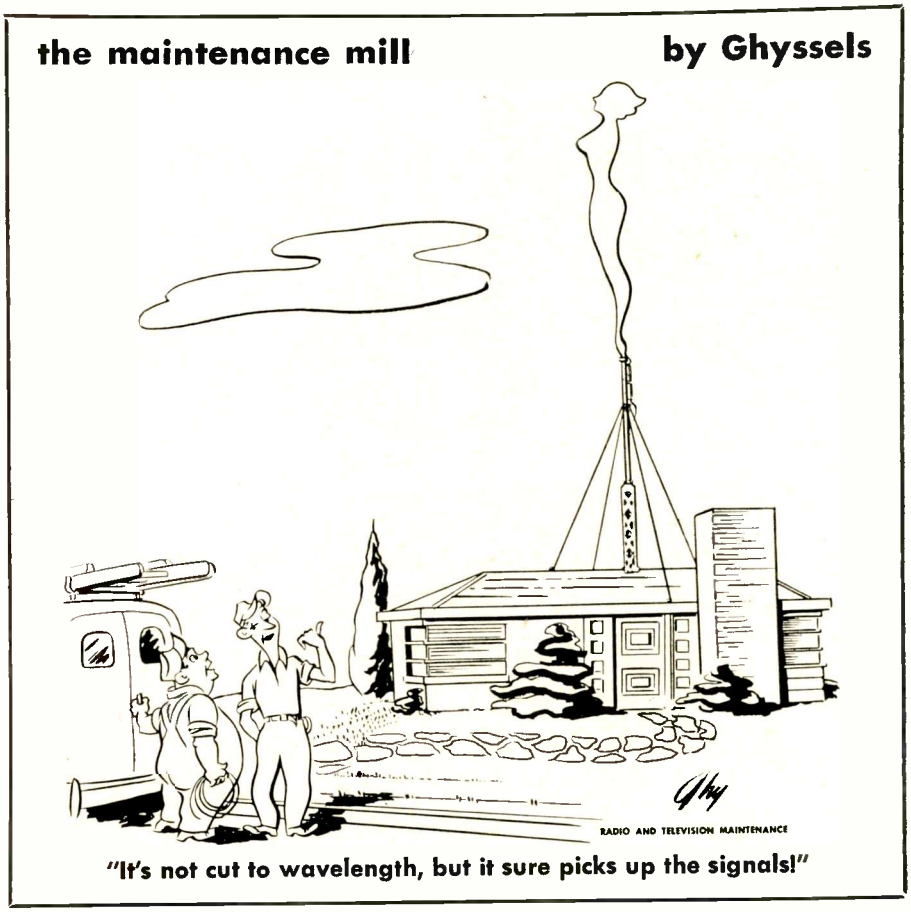
As a final bit of supporting evidence in favor of the VTVM, the manager of the RCA Service Company says that the main item of test equipment used by the RCA serviceman is the Senior Volt-Ohymst, the RCA version of a VTVM. When an organization as big as that one sends its representatives out into their customers' homes armed with VTVMs, that instrument must be good.

—RTM—

### Whiteside to Lecture on TV Service

INDIANAPOLIS—Jack Whiteside, electronic development engineer at Simpson Electric Company, began a five-month nation-wide tour here recently with an illustrated lecture on television servicing.

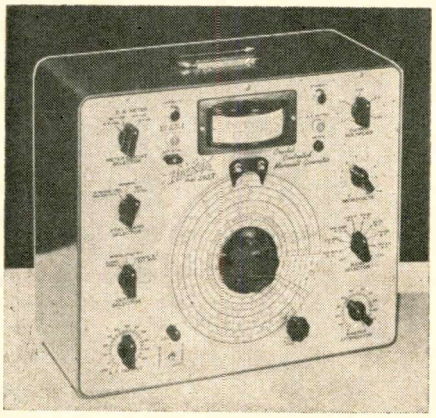
The talks, which are being sponsored by parts jobbers in key TV areas, deal with specific problems of servicing, and short cuts to their solution. Mr. Whiteside particularly accents the efficient use of test equipment which he has helped to develop.



## Products for the Trade

→ from page 18

as is crystal frequency control (to .0025 percent) on the mobile bands of 30-50 Mc and 152-162 Mc.



The signal may also be externally modulated from 15 to 10,000 cps, the maker states, with audio output variable from zero to two volts at 400 cycles. A Db meter indicates reference level.

—RTM—

### TERMINAL BOX

A portable power outlet box, with fuses, pilot light, and switch, is being distributed by Sun Radio and Electronics Co.

The metal box incorporates eight standard 110-volt outlet receptacles,

with a 12-foot rubber-insulated cord and unbreakable plug.

Two fuses with extractors provide a safety factor against overloads, while the single-throw, double pole switch cuts off both legs to all eight outlets. The neon pilot light indicates power flowing through the switch.

—RTM—

### UTILITY CABINETS

Steel cabinets with welded-in chassis for small assemblies, such as control units or minor radio and television ad-

→ to opposite page

# EDITORIAL

## GUARANTEE YOUR TV SERVICE CONTRACTS!

IN many television areas in this country, defaulting service contractors have given the service industry a black eye with its customers. This can be prevented, and here's a way to do it: *let associations insure the contracts of their members.*

*The seriousness of this bad publicity is not to be underrated. Thousands of TV set owners have complained to better business bureaus that contractors with whom they have signed have either gone bankrupt, failed to give adequate service, or have maliciously gone off with collected fees.*

The solution to the problem might well lie in the guarantee, by the local contractors' organizations, of the contracts, so that customers would no longer be left holding the bag. Look at the advantages:

1. The advertising value would be tremendous. The association seal on the contractor's door, and in his newspaper ads, would really *mean* something to the potential customer.

2. News value and free publicity for the group and for all its members would be at a high level.

3. The public, with the sure knowledge that they couldn't lose out, would be far more inclined to place their service business in the hands of contractors who belonged to the association.

4. With a properly audited system of fees and disbursements, the treasury of the organization could well be filled—large insurance companies successfully operate similar plans *at a profit,* and so could the contractors' associations.

5. More money in the treasury means increased prestige, and a corresponding increase of other activities for the association. Important in the public mind, a smooth-running, profitable association would have a real reason for being, and would also have increased value of many kinds to its members.

The central setup for the operation of the scheme would be simply to charge each member of the group a fee for each contract he signed. Even though the fee would be a small percentage indeed, the total (in any group of reasonable size) would cover the face cash value of a good many contracts. Set buyers, knowing a good thing when they saw it, would be much better prospects for contract business with independent servicemen and dealer-contractors who were affiliated with the group. The confidence inspired by the backing of an organization known to be responsible would be immeasurable.

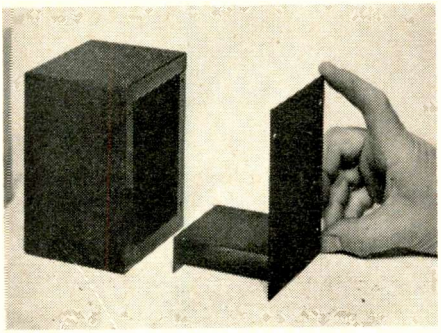
To make sure that no member companies signed contracts and promised the association's guarantee, but didn't pay the specified fee, the association could become a third party to each contract; a standard form for the agreement would be used by all the members, and the form would not be valid unless countersigned by the association secretary. A more difficult detail to be worked out would be for the executives of the association to have some check on the integrity of the members. They would have to be sure that none of the members had the intention of selling his contracts, paying his percentages, and skipping town. If a member *should* do such a thing, the association would be left with the short end of the deal.

*A strong enough organization, however, would be able to keep every member in line, and a large enough group would have the power to enforce its rules. One of the beauties of this guaranteeing plan, of course, is that it is exactly the sort of thing that makes for size and strength in the association.*

The increased business coming to all members of a group that could guarantee TV service contracts, would put many of the smaller members in a much better business position than they would otherwise occupy. In the larger companies, the plan would strengthen their sales efforts correspondingly. Insuring contracts would be only one of the functions of the servicemen's association, but it can, and should, become a major activity.—M. de A.

ditions, are now in production by Insuline Corporation.

The cabinets, which are made with

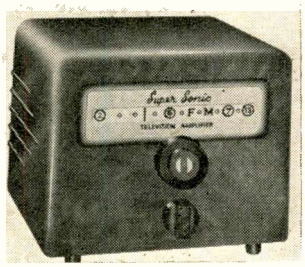


black ripple finish on the steel construction, are available in six sizes, ranging from four by two by four inches to six by six by six inches. The chassis are welded to the front of the box, which could serve as a control panel.

—RTM—

## BOOSTER

A continuously-tuned TV preamplifier designed to cover the low, FM, and



high bands without switching is the "Super Sonic" TV-FM amplifier, just

→ to following page

**The Cover . . .**

*Installation crews use the new field strength meter put out by Simpson Electric to find the best position and orientation for the TV antenna. The meter, which in its high-sensitivity setting gives full scale deflection on 50 microvolts, gives the value of the signal at the second video detector.*

*The unit is equipped with a shoulder strap for tower testing, allowing the operator full use of both hands. A standard 12-channel television tuner selects channels on which reception is possible in the area, while a phone jack provides for audible identification of the signal being measured.*

*The meter's measurement ranges are from zero to 50, 500, 5,000, and 50,000 microvolts, for use in all areas of reception.*

# What's your problem?

**This department of RADIO AND TELEVISION MAINTENANCE is devoted to helping to solve the difficult service problems of our readers. Tough ones of general interest will be printed, and readers will send in answers. The best solutions will be printed in later issues. If only one answer to a problem appears here, its originator will receive $5.00 in cash. If two or more different ways of beating the poser are of nearly equal merit in the opinion of RTM editors, the second best will be worth $3.00 to the man who submits it, and the third best will bring home $2.00. Send your question or solution to: Problem Editor, RADIO AND TELEVISION MAINTENANCE, P. O. Box 867, Atlantic City, N. J.**

### HEAVY INTERFERENCE

Gentlemen:

On one of my television installations, across the street from an automobile factory, I have a real problem. There are three channels operating in the area, and reception is very bad on all three.

I know the trouble isn't in the receiver (a Starrett model) because I've gotten nearly perfect reception on the set in other localities.

The pictures are foggy, full of ghosts, and contain as many as five horizontal dark bars, each an inch or two wide. I've tried high-low, lazy X, stacked and single arrays, and individual aerials, one for each channel, but changing or reorienting the antennas only makes the bars move, instead of eliminating them.

I've tried both twin-lead and coaxial cable, but the coax isn't much better than the twin-lead.

There are a couple of antenna locations which help a *little*. On the front lawn and in the basement of the customer's house, the aerial seems to work slightly better. Reception is also improved with a portable indoor antenna placed on the floor (any higher makes the picture worse), but none of these positions is really satisfactory. The bars and ghosts are still there. A booster, incidentally, brings the picture in stronger, but also amplifies the interference.

Can you help me?

CHARLES KARAFA,
Detroit, Mich.

### FRINGE AREA FM

Gentlemen:

One of my customers, who lives in an apartment building, wants better reception on his FM set from a station about 50 miles away.

The station puts out 20 Kilowatts, and there are hills and buildings which make line-of-sight reception impossible. To make it more difficult, the customer's landlord won't let him put up a roof-top antenna.

I installed a booster, which builds up the signal quite a bit, but there is still considerable fading and interference in the daytime and early evening. Later at night, reception is fairly good. For an antenna, he is using a strip of 300-ohm twinlead outside the living-room window facing the station.

Can anyone suggest some kind of indoor antenna, or other arrangement, that would improve the situation?

LEONARD WEAVER,
Allentown, Penna.

## Products for the Trade

→ from preceding page

announced by Sonic Industries.

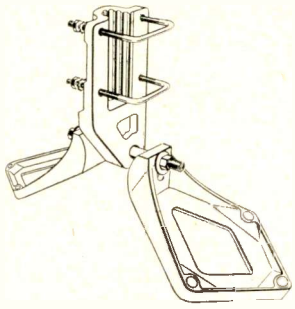
Among features claimed for the unit by the maker are pure silver inductances and RF circuit contacts, minimum shunt grid and plate circuit capacitances, copper-plated chassis and heavy power filtering.

Both 72 and 300-ohm output and input connections are provided. Two controls are built in, one a power switch and the other a tuning control.

—RTM—

### ANTENNA MOUNT

A new roof mount for antennas was announced by Channel Master Corp. recently. The mast, which is gripped by U-bolts in a serrated clamp on the



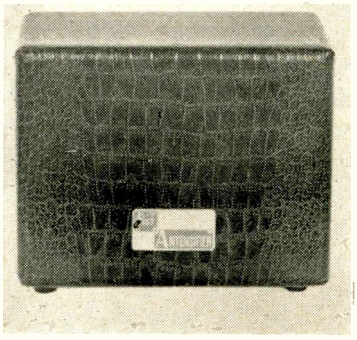
mount, will not turn in the strongest winds, according to the manufacturer.

The fixture is made of hard-temper aluminum alloy and is non-corrosive. It will accommodate masts from one to two inches O. D.

### TV PREAMPLIFIER

A new television booster which has a wide enough band to operate on all channels without tuning has just been announced by Blonder-Tongue Laboratories.

Called the "Antensifier," the new unit simultaneously amplifies the signals, including the sound, of all 12 channels,



according to the manufacturer, who reports that it may be installed inside the receiver cabinet and forgotten.

The on-off switch for the preamplifier is automatically controlled by the set's own power knob, the report says.

With four duo-triodes in the lineup, the unit provides an average gain of 20 Db, it is claimed, with a high signal-to-noise ratio. Cabinet size is 7½ by 5¾ by 4¼ inches.

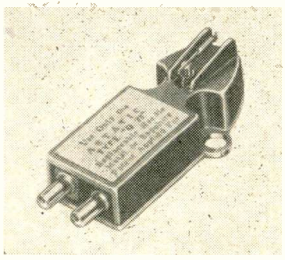
—RTM—

### LP CRYSTAL CARTRIDGE

A new, small-size crystal cartridge, the CAC-J, has been announced by Astatic.

Developed by engineers working with the research department of the Columbia Broadcasting System, the new unit is "internally equalized" to follow Columbia records. Ideal frequency response for the recording characteristics of the LP records is 30 to 11,000 cycles.

The new cartridge has a small, lightweight aluminum housing with ½-inch mounting holes to fit most tone arms. It is furnished with an adapter plate to permit mounting in RCA and similar 45 RPM pickups.



Output is listed at approximately six-tenths volt at 1,000 cycles per second on Columbia No. 103 test record and one volt on RCA 12-5-31-V test record.

—RTM—

## Association NEWS

### Krantz Urges Support of Natl. Technicians For New Assn.

WASHINGTON—Urging attendance at the first convention of a new national group of radio and television men, Dave Krantz, chairman of the organizing committee of the association, recently announced the date and place of the meeting.

Krantz, chairman of the board of a Pennsylvania federation of technicians' associations, explained the need for such an association at the present time in a letter to local groups.

"The entire electronic industry, from manufacturers to sales, is well organized, represented at its own councils, and recognized by the government," the letter said.

"Present national conditions make it necessary that the servicing dealers and technicians organizations meet and form a national association, in order to present our numerous problems to the electronic industry and to the proper government officials.

"The allocation of material for the service industry in the event of a national emergency will require united efforts of all associations. The combatting of local ordinances and licensing bills can be carried on successfully only by a united group. These are only a few of the things that make it necessary for the formation of a national association.

"I sincerely hope that your association will find it important enough to send a representative to our meeting in Washington, D. C., on January 28, at the Hamilton Hotel, 14th and K streets, N. W. The meeting is called for 11:00 a. m."

### RCA Develops 3 New Miniature 'Brain Cells' for On-Off Use

HARRISON, N. J.—Three new miniature tubes, "brain cells" of the electronic computer machines which far surpass the human mind in handling complex mathematical problems, have been developed by RCA.

The new tubes, types 5915, 5963, and 5964, have been especially designed for "on-off" control applications.

Special feature of the three tubes is their ability to respond instantly after being dormant for long periods of operation under cutoff conditions.

The 5915 is a pentagrid amplifier of the 7-pin miniature type designed especially for gated-amplifier service. Grids 1 and 3 can each be used as independent control electrodes.

The 5963 is a medium-mu twin triode, a 9-pin miniature, intended particularly for frequency-divider circuits. It has a mid-tapped heater to permit operation from either a 6.3 volt or 12.6 volt supply, and separate terminals for each cathode to provide flexibility of circuit arrangement. It has a maximum plate dissipation of 2.5 watts.

The 5964 is a medium-mu twin triode of the 7-pin miniature type for use in frequency-divider circuits. Its cathode is common to the two triode units. It has a maximum plate dissipation of 1.5 watts.

## Trade Literature

→ from page 20

cathode ray tube characteristics, instructions on building adapters, color coding, transformer, condenser, and resistor material is given in the volume.

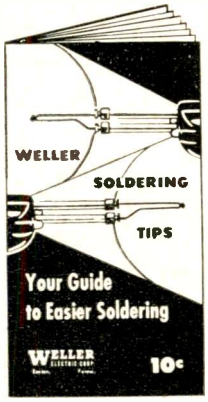
With 208 pages in a heavy paper cover, the 8½ by 11-inch book sells for $2.40.

—RTM—

### SOLDERING MANUAL

A NEW edition of "Soldering Tips," a 20-page pocket manual on soldering techniques in many applications, has been announced by the Weller Electric Corp.

Designed to be a reference work for professionals as well as to be an instruction book for novices, the booklet covers every important phase of soldering, the announcement said. Do's and




Don'ts are listed, as are fluxes and solder specifications, while difficult soldering operations are discussed in nontechnical language.

Copies are available by sending a dime to the company, at its Easton, Pa., address.

—RTM—

### TV CONTROL REPLACEMENTS

ABOUT 1,600 controls for all popular models of TV receivers are listed in the new television Control Guide put out by Centralab Division of Globe-Union Inc., Milwaukee.

In addition to the standard replacements listed for TV, the guide also contains what the company describes as "the industry's first printed electronic circuit replacement listing," which shows more than 1000 applications using 11 standard printed-circuit plates.

Those who order the guide early, the company announced, will also receive price lists and a bulletin of custom controls for older model radios. The complete package of leaflets is available from the company for 25¢.

### AUDIO EQUIPMENT CATALOG

A CATALOG of portable sound equipment manufactured by Newcomb Audio Products Co. was recently published. The book describes the company's line of combination transcription players and PA systems, with both two- and three-speed phono turntables. Other products listed in the catalog include a new portable radio, and portable phonographs featuring "Floating Sound," which the company says eliminates needle skipping.

—RTM—

## CBS Color Receivers, Adapters And Converters to Be Available

NEW YORK—Television Equipment Corporation, now in production on TV receivers built to CBS color standards has announced that it will make converters for existing sets available to the general public.

Cost of the converters, the announcement said, will probably be less than $50, while an expense of "not more than $25" will be a reasonable service charge for the technician doing the conversion.

Another development by the company will permit adaptation of conventional sets to receive CBS colorcasts in black and white "at nominal cost," according to the announcement.

—RTM—

## Know Your Meter

→ from page 11

get an erroneous reading, which will always be *lower* than the actual voltage.

### Errors Introduced

If, for example, we want to measure the AVC voltage in a receiver, we have to deal with a circuit whose internal resistance is on the order of three megohms. The voltages encountered are usually low, so let us assume we have 10 volts and atrempt to measure this voltage with our meters. The three conditions are shown in Fig. 5. Even though there is 10 volts in the circuit, we see that the needle on the 1,000 ohms per volt meter will hardly move, while the 20,000 ohms per volt meter will give an indication that is 93% in error. The closest reading is obtained with the VTVM. During actual measurements in receivers this effect is not so pronounced, because there are other circuits con-

nected to the AVC line that make the loading effect of the meter not quite as severe.

In typical superheterodyne receivers, readings on the grids of tubes and on AVC lines vary so widely with different meters, that 1,000 ohms-per-volt meters are useless for such measurements.

From these results it can be seen that, first of all, it is very important to know the sensitivity of the meters you use. Secondly, remember not to attempt to measure anything that is beyond the capabilities of your instruments.

—RTM—

## TV Visual Alignment

→ from page 14

to the grid of the 6CB6 first IF amplifier, and the detuning clip lead (if necesary) across the primary of the first IF transformer.

8. Adjust the primary of the second IF transformer to peak at 44 Mc, adjust its secondary for curve symmetry, and compare it with Fig. 1(c).

9. Remove shorting lead and couple the sweeping oscillator capacitively to the 6J6 mixer-oscillator through a tube shield (shield must not short to chassis). Turn capacitor trap (C318) completely clockwise to remove its effect at this point in the procedure.

10. Adjust the mixer output transformer to peak at 44 Mc, and the first IF transformer for curve symmetry, and compare with Fig. 1(d).

11. Use the CW output of the marker generator at 41.25 Mc, with an amplitude that is visible on the curve. Adjust the trap (C318) to minimize the amplitude of the 41.25 Mc marker on the curve.

12. Recheck the overall response as in step 9 to correspond to Fig. 1(d), and trim the mixer output and first IF transformers if necessary.

### Sound IF Alignment

In this procedure, a VTVM is used as an indicator in place of an oscilloscope, and the 4.5 Mc crystal oscillator portion of the marker generator is utilized.

1. Connect the 4.5 Mc crystal oscillator to the video test terminal through a 1000 mmf capacitor.

2. Set the VTVM on its 5 volt (—DC) scale, and connect its common lead to chassis ground (point "C" in the circuit diagram) and its high lead to the junction of the 6T8 ratio detector load resistors (point "A" on Fig. 2).

3. Adjust the first and second sound IF transformers along with the primary (bottom slug) of the ratio detector transformer for maximum meter indication. During these adjustments, keep the output of the marker generator at a level to give a meter reading of not more than —5 volts.

4. Connect the common lead of the VTVM to the junction of the 6T8 ratio detector load resistors (point "A"), and connect the high lead to the top of the volume control (point "B" on Fig. 2.) Here it is important that the case of the VTVM is not grounded to the receiver chassis. Otherwise, point "A" would be shorted to the chassis through the common lead.

5. Using the same marker amplitude as in step 3, adjust the secondary (top slug) of the ratio detector transformer for zero voltage on the VTVM. As the secondary is tuned through resonance, the voltage will change rapidly from one polarity to the other, and the point where the voltage is zero is the correct setting.

### Oscillator Alignment

Although it is possible to align the master oscillator by tuning in a TV station and adjusting the high (L110) and low (L109) band adjustment slugs until a proper pattern is observed, the use of a 12 channel crystal-controlled front-end marker and sweeping oscillator for visual alignment is much preferred.

1. The front-end marker and sweep generator are interconnected and their combined output fed through a 50 to 300 ohm matching transformer or resistance pad, to the antenna terminals of the receiver.

2. The oscilloscope and sweep generator connections are made in the same way as those for video IF alignment, with the 6AK5 RF amplifier returned to its socket.

3. The channel selector is then set to channel 6 and the fine tuning control set in the center of its range.

4. The sweep generator is adjusted for an RF response curve (Fig. 3), and the front end marker set to channel 6. The picture and sound carriers should then be observed and the low band adjustment slug (L109) tuned until the picture marker falls at approximately 50 per cent down on the response curve, and the sound carrier is at the knee of the curve.

5. The entire low band is then checked for the position of its carriers, and L109 trimmed slightly if necessary.

6. The same procedure is repeated for the high band with channel 13 and the high band adjustment slug (L110.)

7. Repeat steps 4 and 5 to recheck the low band adjustment.

### RF Alignment

The adjustment of the RF amplifier and mixer tuned circuits is normally a factory procedure. The circuit elements themselves are sufficiently stable so as not to change critically during the life of the set unless tampered with or accidentally damaged. Because the bandwidth of these stages is quite large, even replacement of the RF amplifier or mixer tubes will not adversely affect the overall response or impair the performance of the receiver. Hence, readjustment of these coils will not generally be required in the field, and should not normally be attempted.

—RTM—

## FM Alignment and Equipment

→ from page 9

cluded at all in some sets, because it is felt that the limiter will take care of all amplitude variations in signal. In this case, reverse limiting on strong signals is possible. With these sets, great care must be observed in the alignment to feed the alignment signal frequency into the receiver so that the limiter action just begins to take place: a fairly low level for some sets.

Some receivers employ limiters in cascade. Some of these arrangements are tuned-transformer coupled, while others are resistance coupled. For these units, adjustment is the same as for a single stage. In double limiting sets, the second limiter is designed to remove any residual noise that remains after the action of the first limiter.

### Limiter Voltages

Limiters in general are operated at a plate voltage of about ⅓ normal, with voltages on the other elements in proportion (except for filaments). If any really bad condition comes up in which the limiting action is not occurring properly, it is wise to check these voltages.

If the limiter is operating properly, its grid current increases and decreases in exact proportion to the signal input level. Breaking the lead at the ground end of the limiter grid leak makes a meter connection possible across an inserted 1000-ohm resistor. A 1 ma DC meter will indicate adequately the variation in grid current. This technique is used in some equipment as a tuning peak indicator. A complete check of the limiter action would require checking the output of the limiter at the plate with an RF voltmeter or a crystal diode detector connected to indicate on a VTVM. Properly operating, the RF voltage at the limiter plate will not change over a wide range of input signal variations.

### Adjustment

Up to this point, all adjustments are made by peaking the coils in the IF section. The coils preceding the limiter can be peaked by observing the maximum indication on the limiter grid current meter. The plate coil (discriminator primary) of the limiter must be peaked at the intermediate frequency. With a vacuum tube voltmeter connected across the discriminator output it will be possible to indicate the peaking of this coil. It will give a maximum deflection on the meter. For this adjustment the secondary must be detuned. After the primary has been peaked, the secondary is returned to zero output at the intermediate frequency. When properly adjusted, the discriminator will cause a positive deflection as the frequency is varied one way, and a negative indication as the variation is made in the opposite direction.

The adjustments just described can be made with a VTVM and a single frequency signal generator, unmodulated. A check of the efficiency of the adjustment can be made by turning on the modulation, (AM) and observing on an oscillograph the audio output of the discriminator. At center frequency there will be no amplitude indication. On either side of center frequency the audio wave form will be apparent. In the event that there is distortion in the audio component, the position of the distortion will reverse from the positive to the negative half cycle as you pass across the center frequency.

Without a sweep generator, the center frequency can be set to a satisfactory degree of accuracy, but the linearity will not be properly adjusted, except by chance.

→ to following page

### Sweep Generator and Scope

The linearity of the FM system's operation will determine the ultimate fidelity of the reception. The capabilities of FM are best exploited when it is possible to align the receiver with a sweep generator and a scope. The physical set-up of the test equipment is seen in the illustration. The "S" curve visible on the scope screen is an actual pattern being generated by the sweep through the receiver under test. The straight line of the diagonal slope of the "S" curve is the indicator of the linearity of the IF characteristics and the overall operation of the FM receiver, or sound portion of the TV set.

*This is the first of two articles on FM Alignment.*

—RTM—

## The RCA Service Company

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departments involved. Also, information of particular value to the servicing field is passed on by means of service clinics held periodically throughout the country. These clinics facilitate servicing of RCA TV receivers by bringing information regarding new engineering and servicing developments to the technicians. During 1950, more than 450 of these clinics were held.

These findings have enabled us to check service "epidemics" before they became serious, have suggested where design and production improvements could be made, and have spotlighted potential operation trouble spots. Disseminated to the servicing fraternity through the clinics, the information has benefitted independent technicians as well as our own workers.

From this fact-finding program, RCA Victor has a detailed operations report on every type of television receiver it has manufactured since 1946. Gathered on the scene, this information has proved invaluable to improvement and progress, and its influence can be seen in all of our latest instruments.

—RTM—

## Test Equipment and Procedure

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icing procedures of course, is the most desirable for every situation. Some problems may require a combination. In general, however, nearly all servicing in the field can be done by using methods 1, 2, and 4 above, either singly or in combination.

There are almost always visual indications in the picture or test pattern on a television receiver that will reveal defects in the circuit. The serviceman who gets to know the "Rogues' Gallery" of criminal pictures will be able to spot the trouble at a glance, because each screen pattern is an aid to quick and positive detection of circuit problems.

### Picture Analysis

Once the serviceman learns how to understand and interpret what he sees on the screen he will generally be able to tell by looking at the picture or test pattern:

1. Whether the set has the proper bandpass.
2. Whether there is sufficient signal or power voltage supplied to a stage.
3. How sensitive the receiver is.
4. Whether the horizontal and vertical sweeps are operating properly.
5. Whether the set focuses correctly.
6. The amount of detail being reproduced.
7. The proper placement of the scanning lines, or good interlace.
8. Whether the set provides a good shading range, from white to gray to black.
9. Whether there is proper linearity (revealed by the reproduction of circles).
10. Whether the picture remains locked in.

Most of these items may be better and more readily determined with a good test pattern than with a picture, and better with a live program rather than with a cable-network program. On a live program, the bandwidth will be 4 Mc, but on a program transmitted through coaxial cable, the bandwidth will be only about 2.7 Mc, since that is the limitation of the bandpass on coaxial cable.

### Use Minimum Equipment

It is generally conceded in the service industry that the RCA Service Company does a good, all-around servicing job. Each technician carries a minimum of equipment: a vacuum tube voltmeter, a kit of the common small tools, a soldering gun, service manuals, a selection of the commonly used tubes, a couple of picture tubes, an assortment of resistors and condensors, loudspeakers, power cords, etc. They do *more than 90 percent of their servicing jobs with this minimal equipment.*

### General Caution

Once a defect is traced to a given stage, a routine analysis of each component in that stage will in most instances reveal the cause of the trouble. But in probing around among the point to point connections on the underside of a chassis the serviceman should be careful not to disturb the position of wires, resistors, condensers, and particularly coils. The smaller the coils are the more critical they are likely to be. It is axiomatic that the position of a coil on the underside of the chassis is a highly important factor in overall alignment.

It is possible for a serviceman to do the right things in finding the cause of the trouble and replacing the defective component. But he still may have an inoperative receiver on his hands, or one that performs worse than when he started to work. The mystery may simply be that he neglected to replace

critical components in their original position after working on other parts.

### Compensating Condensers

Again, television circuits today contain compensating condensers, especially the oscillator circuits. The chief purpose of these condensers is to compeinsate for changes in electrical characteristics of coils and perhaps other condensers in the same circuit. When such a compensating condenser opens, it reveals itself in a detuned circuit. If the technician fails to realize what is wrong, he may realign the circuits. This will temporarily repair the trouble. The receiver will function normally for a time. But when the set warms up it will drift, and the drift may easily be sufficient to shift the circuit beyond the range of the signal desired. The station can be brought back manually by retuning, but this will have to be done each time the receiver is turned on, sometimes once, sometimes more than once.

In short, being a good television serviceman does not always require a large amount of test equipment. The most expensive piece of equipment necessary to handle most servicing is a good VTVM. The most important equipment the serviceman can have is a thorough knowledge of the typical receiver, a grounding in the fundamentals of basic theory, common sense to apply his knowledge to any given situation, and a good diagnostic sense to get to the root of the trouble in the shortest possible time.

—RTM—

## New Uses for Your Signal Generator

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The main signal generator, delivering unmodulated RF output, is tuned to the TV channel frequency and connected to the receiver under test. Any channel may be used. The auxiliary signal generator is tuned to 100 Kc or higher, depending upon the number of lines desired on the TV screen. When switch S is thrown to its VERTICAL position, the main signal generator output is modulated by the RF output of the auxiliary generator, and vertical black lines are produced on the screen. The number of lines may be increased by raising the frequency of the auxiliary generator. When switch S is in its HORIZONTAL position, the main signal generator out-

→ to following page

put is modulated by the 400-cycle audio output of the auxiliary generator, and horizontal black lines are produced on the TV screen.

The vertical and horizontal lines may be used for setting the horizontal and vertical linearity controls, respectively, in the receiver. These lines will be found of value also in setting the focus and contrast controls.

### Frequency Measurement

*Frequency Measurement:* The Type 216 generator has a self-contained heterodyne detector for frequency measurement. Fig. 4(a) shows in block diagram the layout of sections in this detector circuit. The RF signal of unknown frequency is applied together with the standard signal from the oscillator circuit to an untuned 1N34 crystal diode detector. The beat note between the two signals is amplified by the audio amplifier and delivered to a pair of high-impedance headphones which serve as the zero beat indicator. In operation, the oscillator is tuned for exact zero beat with the unknown signal. The frequency of the unknown signal then is read directly from the oscillator dial.

Figure 4(b) shows a similar setup which may be arranged with any unmodulated RF signal generator. The audio amplifier tube may be any small triode, such as 6C4, 6C5, 6J5, etc. The value of the cathode resistor and bypass capacitor will depend upon which type of tube is employed.

When making a frequency measurement, tune the signal generator carefully for exact zero beat with the unknown signal. Adjust the signal generator output, if necessary, to obtain a clean beat. In general, the loudest (or most distinct) beat note will be obtained when the fundamental frequency of the signal generator is equal to the fundamental frequency of the unknown signal. A beat note will be obtained also when the signal generator is set to one-half the unknown frequency or to twice the unknown frequency, but these beats will be less intense than the fundamental beat note.



### Inductance Measurement

*Inductance Measurement:* Fig. 5 shows a signal generator setup for measuring the inductance of radio coils of the airwound or powdered-iron-core type. In this arrangement, a mica capacitor of any convenient value is connected by means of the shortest possible leads to the high (usually 1-volt) output of the signal generator. The unknown coil then is connected in parallel with the capacitor. The signal generator is tuned through its range (starting from the highest frequency and progressing downward) until a sharp deflection of the output meter in the signal generator indicates that the resonant frequency of the coil-capacitor combination has been reached At this point, the inductance of the coil may be calculated by means of the equation: $L = (25{,}400)/f^2C$. L is the unknown inductance in microhenries, f the frequency in megacycles, and C the capacitance of the mica or ceramic capacitor in micromicrofarads.

The actual value of the test capacitor is not important except that this capacitance must be known very closely if the inductance measurement is to be accurate. If a capacitance of 0.0005 microfarad is used with a signal generator tuneable from 100 Kc to 50 Mc, inductance values may be checked in the range 20 microhenries to 5 millihenries. Higher inductance values can be accommodated by decreasing the capacitance value.

Short connecting leads must be employed between the signal generator and the test circuit, to prevent errors due to stray capacitance. If a signal generator is not available with a self-contained RF output meter, an RF vacuum tube voltmeter may be connected in parallel with the L-C test circuit in the same manner as shown previously in Fig. 2(b). The RF probe must be connected directly to the test circuit without intervening leads, in order to minimize stray capacitance in the metering circuit. The vacuum tube voltmeter will show peak upscale deflection when the signal generator is tuned to the resonant frequency of the coil-capacitor combination.

# 12 Improvements IN NEW 1951

MODEL O-6 PUSH-PULL

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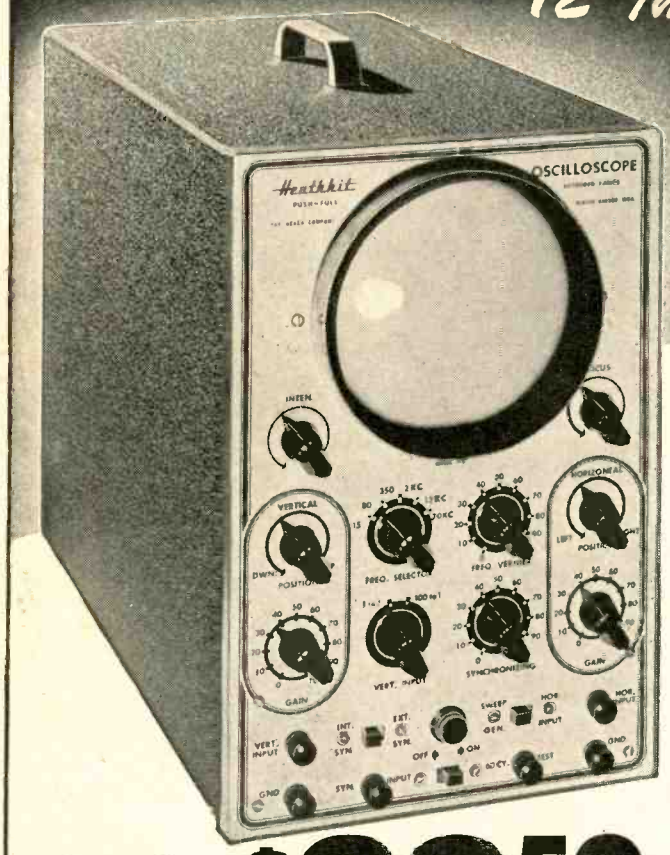


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- ★ New non frequency discriminating input control.
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- ★ New intensity circuit gives greater brilliance.
- ★ Improved amplifiers for better response useful to 2 megacycles.
- ★ High gain amplifiers .04 Volts RMS per inch deflection.
- ★ Improved Allegheny Ludlum magnetic metal CR tube shield.
- ★ New synchronization circuit works with either positive or negative peaks of signal.
- ★ New extended range sweep circuit 15 cycles to over 100,000 cycles.
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The new 1951 Heathkit Push-Pull Oscilloscope Kit is again the best buy. No other kit offers half the features — check them.

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The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage. The gain control is of the non frequency discriminating type — accurate response at any setting. A push-pull pentode stage feeds the C.R. tube. New type positioning control has wide range for observing any portion of the trace.

The horizontal amplifiers are direct coupled to the C.R. tube and may be used as either AC or DC amplifiers. Separate binding posts are provided for AC or DC.

The multivibrator type sweep generator has new frequency compensation for the high range it covers; 15 cycles to cover 100,000 cycles.

The new model 0-6 Scope uses 10 tubes in all — several more than any other. Only Heathkit Scopes have all the features.

New husky heavy duty power transformer has 50% more laminations. It runs cool and has the lowest possible magnetic field. A complete electrostatic shield covers primary and other necessary windings and has lead brought out for proper grounding.

The new filter condenser has separate filters for the vertical and horizontal screen grids and prevents interaction between them.

An improved intensity circuit provides almost double previous brilliance and better intensity modulation.

A new synchronization circuit allows the trace to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing.

The magnetic alloy shield supplied for the C.R. tube is of new design and uses a special metal developed by Allegheny Ludlum for such applications.

The Heathkit scope cabinet is of aluminum alloy for lightness of portability.

The kit is complete, all tubes, cabinet, transformer, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and pictorials of every section. Compare it with all others and you will buy a Heathkit. Model 0-6. Shipping Wt., 30 lbs.

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