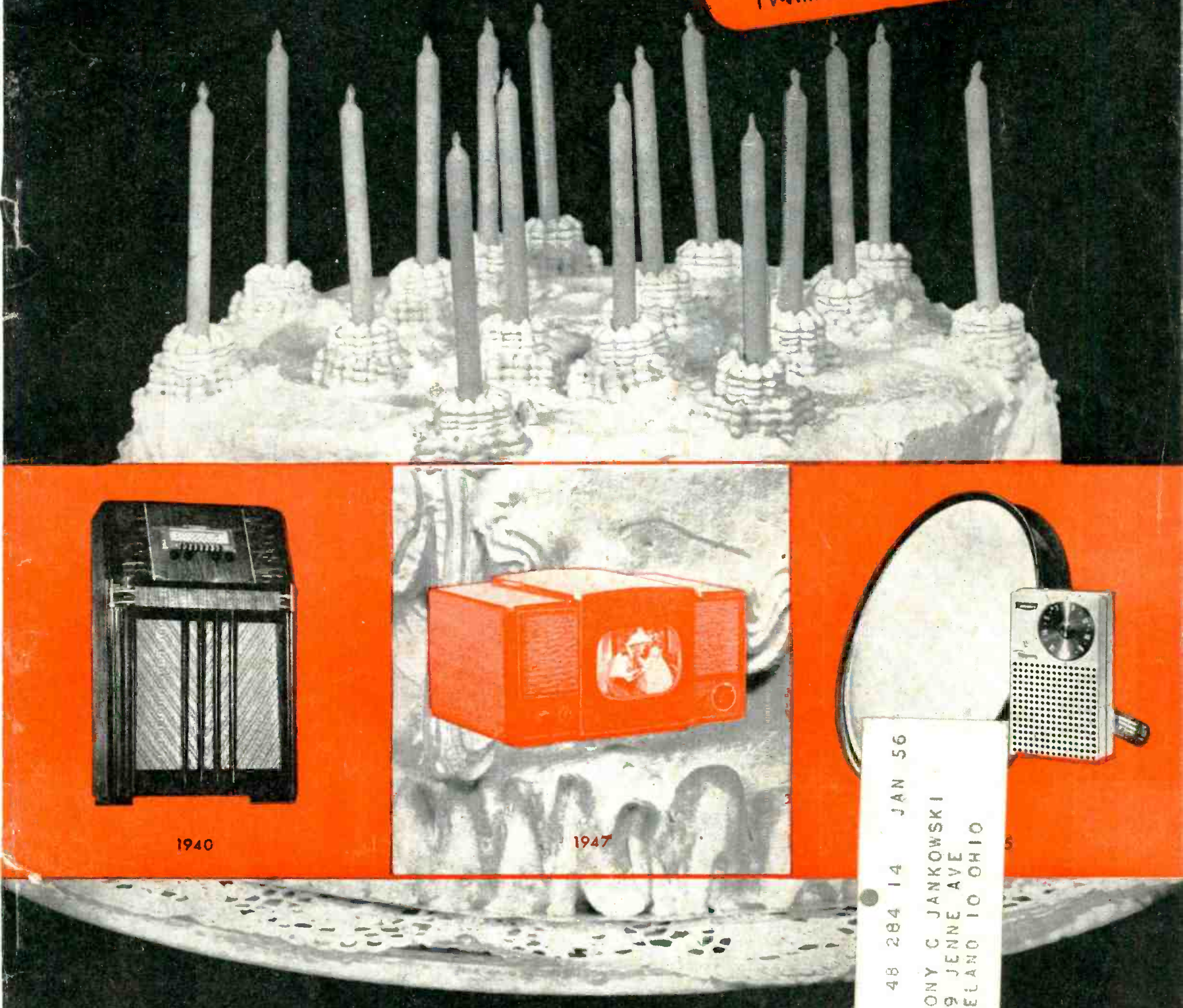
April, 1955

Radio-Television SERVICE DEALER

TV-AM-FM-RADIO-ELECTRONICS



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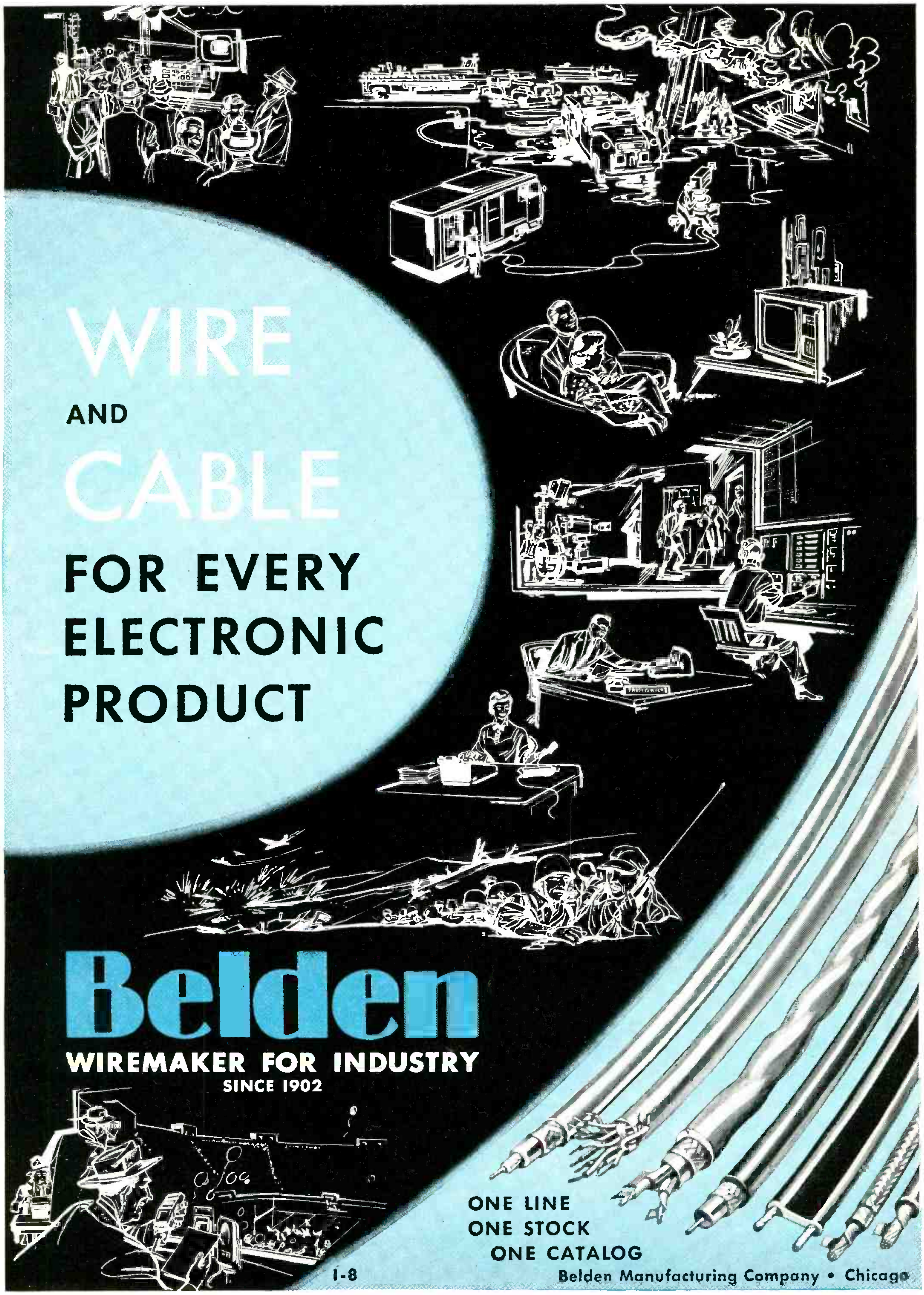
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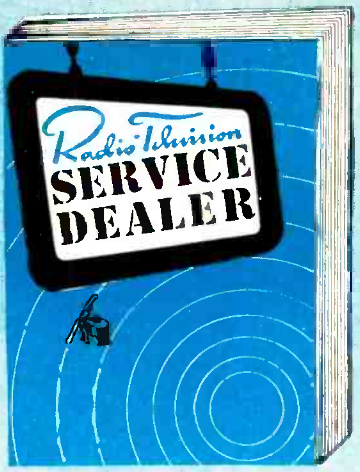

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COWAN PUBLISHING CORP., 67 West 44th Street, New York 36, N. Y.

VOL. 16, NO. 4 APRIL, 1955

FEATURE ARTICLES

CIRCUIT AND SERVICE FORUM

DEPARTMENTS

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EDITORIAL... by S. R. COWAN PUBLISHER

Another Milestone

This issue's front cover implies that a Birthday is involved. That's what we meant it to because this month we begin our 16th year of pleasant endeavors with servicemen. Only one other magazine has been in the service field longer than "Service Dealer."

When "Service Dealer" was launched in April 1940 we then boasted that the 18,000 service dealers who received it were "tops" in the field—selected by distributors—because they accounted for over 80% of the service work then being done in the USA. This issue of "Service Dealer" has a print run exceeding 71,000 with approximately 54,500 owners or managers of established service firms getting a copy. (That's all the legitimate, established service firms there are in the USA nowadays).

In 1940 television was still in the lab and made no impact until we were almost 8 years old. Then the first 630TS hit. Many experts still rate that basic circuit as the finest, most dependable ever marketed. It's a pity that only a few manufacturers are still using it. In 1952 color TV was "imminent" and even now is in swaddling clothes. (In 1954 less than 21,000 color TV sets were made).

Back in 1940 servicemen bought almost $175,000 worth of tubes, parts, instruments and accessories from distributors. Many manufacturers then considered servicemen as a necessary evil. Today's 54,000 service dealers are looked upon with loving gleams by manufacturers who know they'll buy almost $2 billion worth of replacement items and accessories during this year.

You may say to yourself that manufacturers are fickle. I've often said to myself that servicemen are fickle. I'll tell you why. I believe that every serviceman should read technical magazines in order to keep abreast of new techniques and developments. I also believe that the average serviceman can only spare time monthly to read, at most, two good technical journals. But—it seems to me that many servicemen pay from $6 to $20 yearly to subscribe to 3, 4, or 5 radio journals and then they have no time to read any of them properly. By subscribing to a wide assortment of magazines servicemen force advertisers to split their schedules into many small segments—and the publishers in turn thus have less revenue to work with. Consequently they publish less text per issue than would be their wont.

Think this over! Why subscribe to several magazines merely because their publishers want to get into the radio-TV service field? Confine yourself to two magazines at most; and let the manufacturers know what two they are. They'll be guided accordingly when the time comes to plan their next advertising schedules.

I've figured it out this way: If "Service Dealer" were to get 50% of the trade paper advertising intended for servicemen's eyes, we'd run 60 to 70 pages of advertising each issue and, in that event, we'd be able to publish an additional 90 to 100 pages of solid, exclusive, authentic text material every month. So, fellows—think this over and I'd be very pleased if you'll send me your opinions on the subject.

Two-Way Radio Servicing

Last June we ran an article titled: "Servicing Marine Radio." It was timely then and the subject is even more interesting now.

Dozens of service firm owners wrote saying that they wanted to get into industrial servicing—marine, taxi, airline and private planes, and similar 2-way radio usage having become big potential. To that we say an emphatic Agreed! Much money can be made by competent servicemen who have the required FCC second class license.

In the near future we will have a series of articles on several phases of industrial servicing. But remember, to enter this big field you'll need an FCC ticket. Several schools have specialized courses on the subject. These specialized courses are inexpensive, and for men with radio service experience are very easy. Obtaining the FCC ticket and getting industrial jobs are simple, too. It will pay to give the matter some thought.

Gyps Get Jail Terms

On January 28th two New York TV service firm owners were convicted of gyping customers. Found guilty of charging for repairs not required, and for new parts not used, each got sentenced to 6 month jail terms. One of the three justices who heard the case wanted to "mete out stiffer punishment as a warning to other gyps." Similar cases are now pending in many cities.

[*Continued on page 57*]

NOTE: Due to an unavoidable delay on the part of our printer, the April Rider Complete TV Service Information Sheets were not made available in time for this printing.

"Your Raytheon program* has gone far toward the needed understanding between customer and dealer..." says Bailey Root of ROOT TELEVISION

One need only glance at these pictures of ROOT TELEVISION'S modern, efficient looking operation and competent staff of technicians to realize that here is a well organized, dependable, profitable Radio-TV service business.

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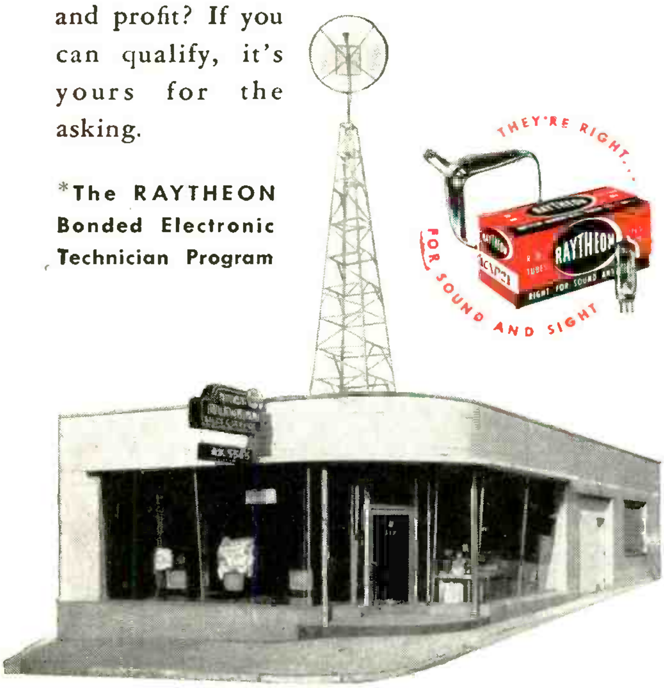

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Yours very truly,

Bailey S. Root

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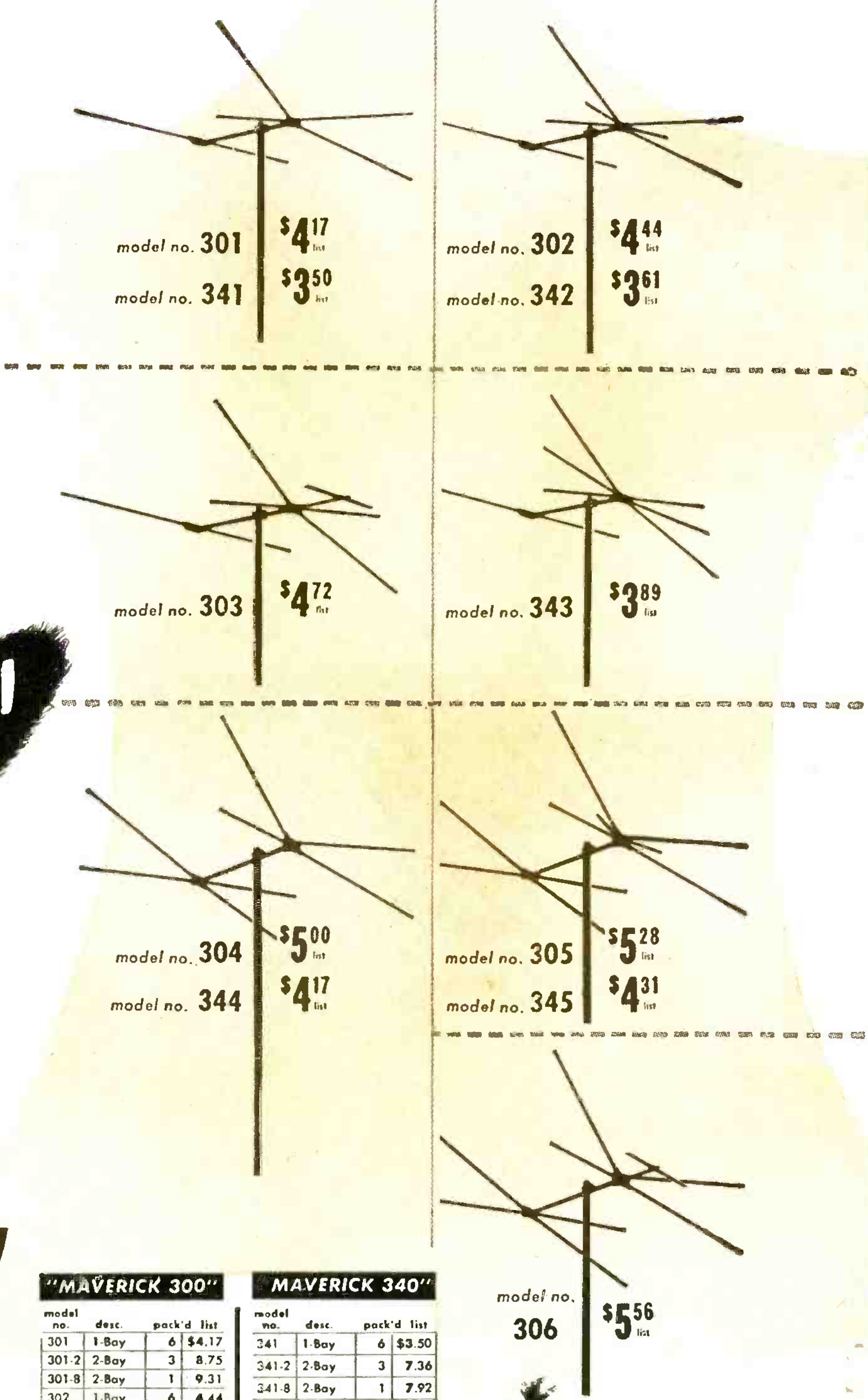

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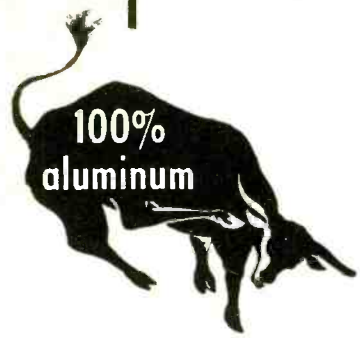
"MAVERICK 300"

model no.	desc.	pack'd	list
301	1-Bay	6	$4.17
301-2	2-Bay	3	8.75
301-8	2-Bay	1	9.31
302	1-Bay	6	4.44
302-2	2-Bay	3	9.31
302-8	2-Bay	1	9.86
303	1-Bay	6	4.72
303-2	2-Bay	3	9.86
303-8	2-Bay	1	10.42
304	1-Bay	6	5.00
304-2	2-Bay	3	10.42
304-8	2-Bay	1	10.97
305	1-Bay	6	5.28
305-2	2-Bay	3	10.97
305-8	2-Bay	1	11.53
306	1-Bay	6	5.56
306-2	2-Bay	3	11.53
306-8	2-Bay	1	12.08
301-3	Conn. Rods		.56

"MAVERICK 340"

model no.	desc.	pack'd	list
341	1-Bay	6	$3.50
341-2	2-Bay	3	7.36
341-8	2-Bay	1	7.92
342	1-Bay	6	3.61
342-2	2-Bay	3	7.64
342-8	2-Bay	1	8.19
343	1-Bay	6	3.89
343-2	2-Bay	3	8.19
343-8	2-Bay	1	8.75
344	1-Bay	6	4.17
344-2	2-Bay	3	8.75
344-8	2-Bay	1	9.31
345	1-Bay	6	4.31
345-2	2-Bay	3	9.03
345-8	2-Bay	1	9.58
341-3	Conn. Rods		.56



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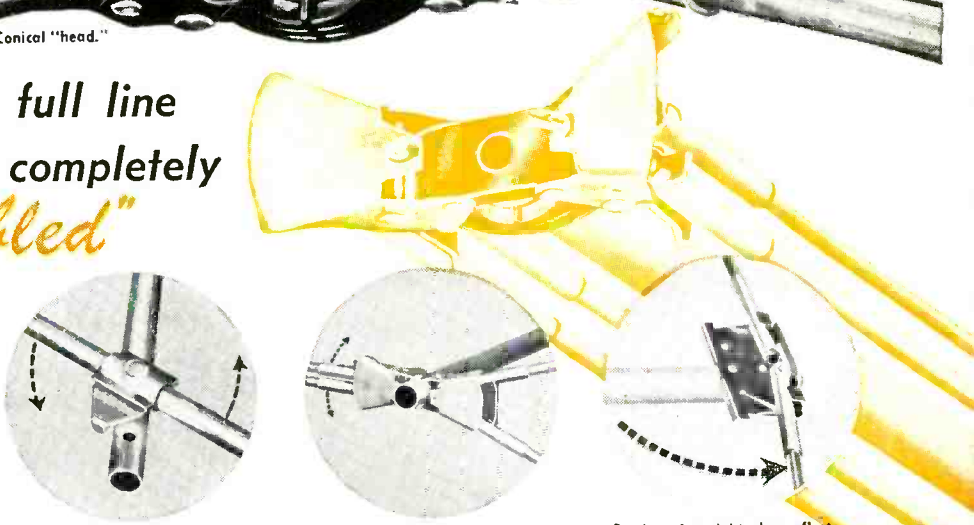
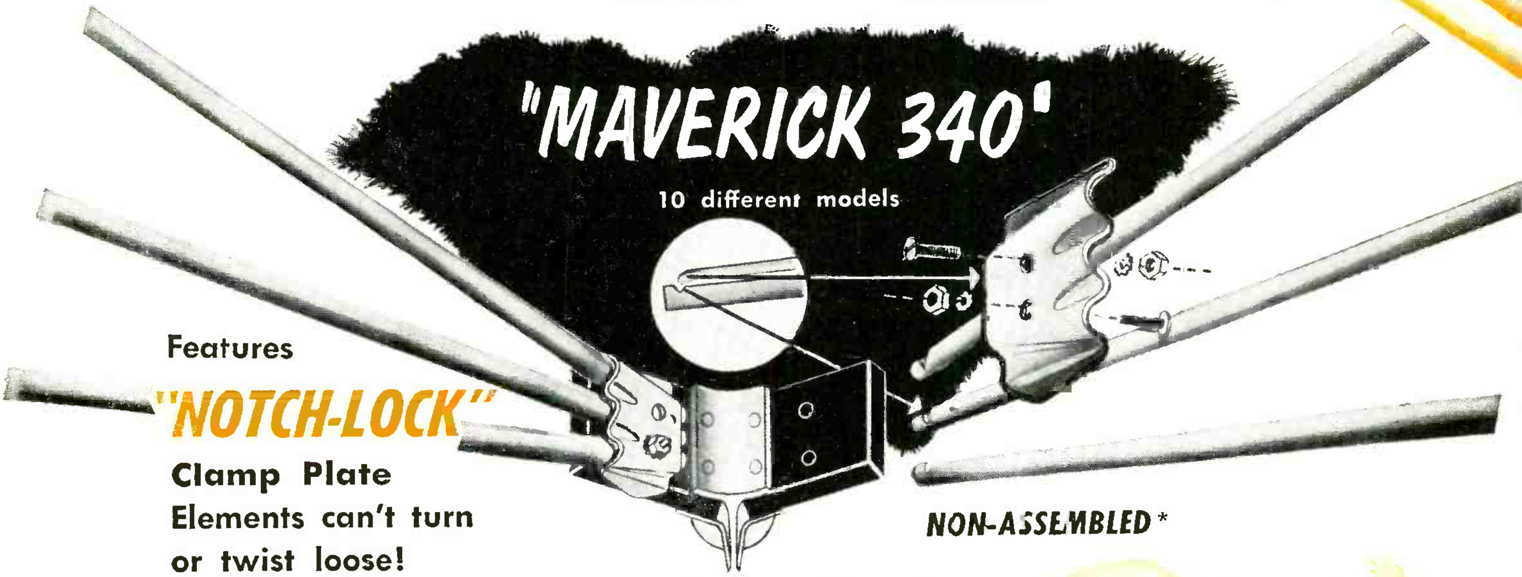


Director bracket. Bracket of X-type reflector. Bracket of straight- bar reflector.



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- Finest materials; durable, rugged construction.

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On all models with straight-bar reflectors, the reflector element is completely *preassembled* for snap-open installation.

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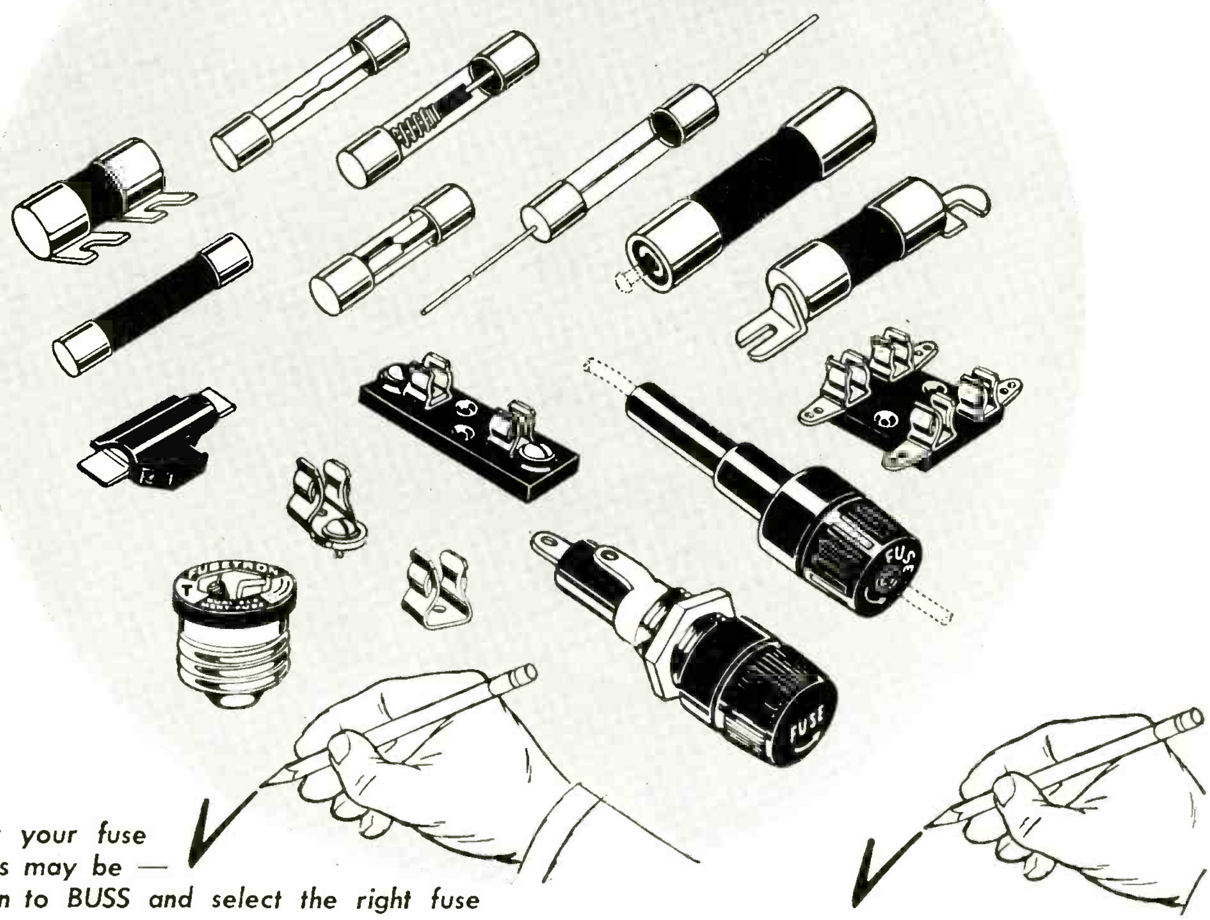

Whatever your fuse requirements may be — you can turn to BUSS and select the right fuse for the job.

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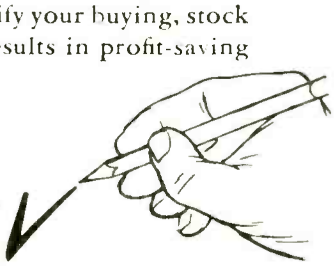

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color convergence with a white dot-linearity generator

by J. Joseph Hill

THIS article is intended to acquaint the serviceman with one of the basic color receiver adjustments, that of convergence. Quite a bit of mystery has surrounded convergence of the color picture, but there's nothing about convergence that a little know-how won't cure!

By convergence is meant the process of controling the three beams within a three gun color picture tube so that all beams meet at and pass through the same aperture in the shadow mask (see *Fig. 1*) during the time the raster is scanned from left to right and from top to bottom.

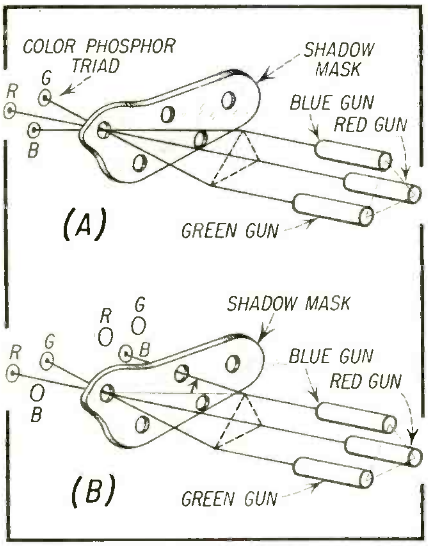

Fig. 1A—Correct convergence of the three beams.
Fig. 1B—Misconvergence of the blue beam. Blue beam passes through wrong aperture.

When the beam convergence is not properly adjusted multiple images will appear. This is generally referred to as misconvergence. Severe misconvergence on a color picture tube will give us the multiple pine tree effect shown in *Fig. 2B* instead of the single image of *Fig. 2A*. Significantly, each of the separate images appears in a *different color*.

Let us consider the latest type of convergence circuits in use on three gun color tubes. Some deluxe, large screen color receivers using magnetic convergence, have as many as sixteen rear apron controls devoted to convergence alone; so that convergence adjustments can really be a stumbling block.

These controls are divided into three similar sets of functions, one set of five for the red gun, another set of five for the green gun, a third set of five for the blue gun, plus a supplementary blue control for individual beam positioning of the blue gun.

The five basic adjustments that are needed for proper convergence are:

1—Static or *dc* convergence
2—Linear horizontal correction or horizontal tilt
3—Linear vertical correction or vertical tilt
4—Symmetrical or parabolic horizontal correction
5—Symmetrical or parabolic vertical correction

How To Adjust Convergence Controls

A black and white dot pattern provides the most convenient means of checking the convergence of a color receiver. Dot generators for this purpose are available from many instrument manufacturers. These provide round white dots or squares against a black background. Such dots provide a significant check because the three beams must coincide in order to appear *white*, see *Fig. 3A*. If the beams are not converged three dots will be seen instead of one, these being a blue dot at B, a red dot at R, and a green dot at G.

Static Convergence

The static convergence control has the effect of moving the electron beam in various directions in the plane formed by the surface of the phosphor plate of the picture tube. This is illustrated by lines BC, RC and GC of *Fig. 3B*. The beams should each be moved to point C, where all three would coincide. The beam formations shown in *Fig. 3B* and *3C* are an important part of converg-

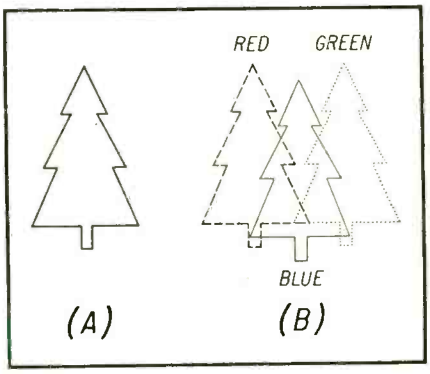

Fig. 2A—Three images exactly converged form single image.
Fig. 2B—Severe misconvergence resulting in three images on the screen.

ence and is referred to as a *triangle*. *Fig.* 3C is an inverted triangle, where the beams are placed on the other side of point C along lines BC, RC and GC.

To converge a triangle, first adjust the red static convergence, which will move the red beam along the line RC, until the red beam reaches point C. Next adjust the green static convergence control until the green beam moves along line GC and also reaches point C. Now if the blue static convergence control is adjusted the blue beam can be moved along line BC to point C, resulting in all three beams being superimposed or converged at point C, appearing as the white dot in *Fig. 3A*.

If the beams do not form a perfect triangle, but instead are randomly spaced on the screen as shown in *Fig. 4A*, the static convergence controls alone will not be able to move the beams into convergence. Any two beams could be converged such as the red and green beams at point #1, the red and blue at point #2, or the green and blue at point #3 of *Fig. 4A*; but at no point will all three beams converge. If the red and green beams are moved to point #1 they will both converge, but the blue beam cannot move to point #2 unless it is also moved from point b to point b'. This is where the blue beam positioning mentioned earlier comes in. The blue beam positioning control is a permanent magnet on the neck of the color tube, and its action on the beam is to produce motion at 90° with respect to line BC, and enables us to move the blue beam from its position at b to the required point b'. Between this action of the blue beam positioning control and that of the blue static convergence control the blue beam can be moved in a much wider area than either the green or red beams.

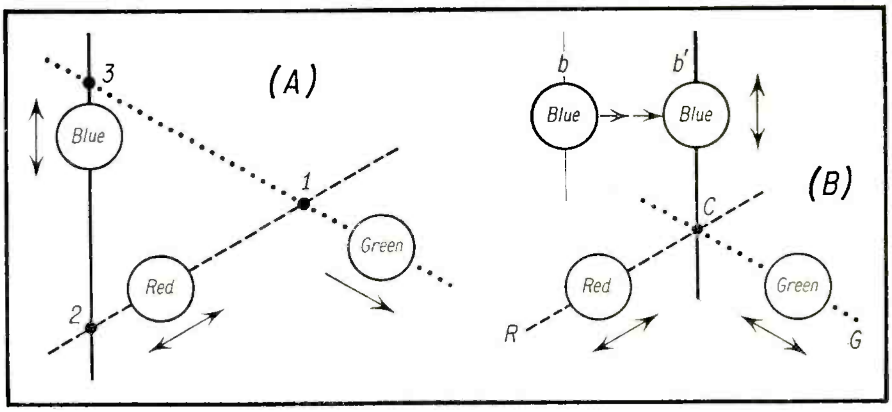

Fig. 4—Converging a random placement of beams, showing the action of the blue beam positioning. Motion of the three dots is in the plane of the phosphor plate.

All three beams can thus be *statically* converged for any triangle formation by using the following controls:

1. Red static convergence
2. Green static convergence
3. Blue static convergence
4. Blue beam positioning

Dynamic Convergence

Following these adjustments further complications usually arise. Although static convergence has been achieved with these four controls, it will be found that only a small area of the screen is converged at the center of the screen because of the inherent shape of the shadow mask. To achieve convergence over the *entire* screen additional controls are needed to make the necessary corrections, both horizontally and vertically.

These correcting voltages are called *dynamic* convergence voltages because their action changes while the raster is being scanned. The effect of the dynamic convergence voltages is along the same convergence lines RC, GC, and BC shown in *Fig.* 3, but they change the position of the beam along the lines during the scan so that convergence of all three beams is maintained for the entire scan.

The convergence error in either direction could require either of two types of correction. In *Fig.* 5*A* five dots along a horizontal line across the center of the screen are illustrated, with all beams converged at point H. Notice how the beams are further and further out of convergence as the line is scanned. Following static convergence of R and G, a linear correction is necessary here to converge the blue beam with the red and green. The correction voltage is zero at point H, where all beams are already converged but increases at point I enough to draw the blue beam down along line BC to meet the red and green beams. At point J the convergence voltage must be increased somewhat, because the blue beam now has a greater error. At K the blue beam is still further out of convergence and a larger correction is needed. At point L the blue beam is furthest from being converged and the maximum correction of the beam is necessary. With the proper correction the entire line is properly converged.

In another case, however, as in *Fig.* 5*B*, this linear correction would not result in convergence! Here the error is not linear, but rather follows a parabolic shape. The three beams are shown converged at point J but are out of convergence at each end of the scan. This is a symmetrical error and a symmetrical rather than a linear correction is needed to bring about convergence of the scanned line following static convergence of R and G. At point H, the beginning of the scan, the correction voltage must be maximum because the error is the greatest. At I less correction is

[*Continued on page 62*]

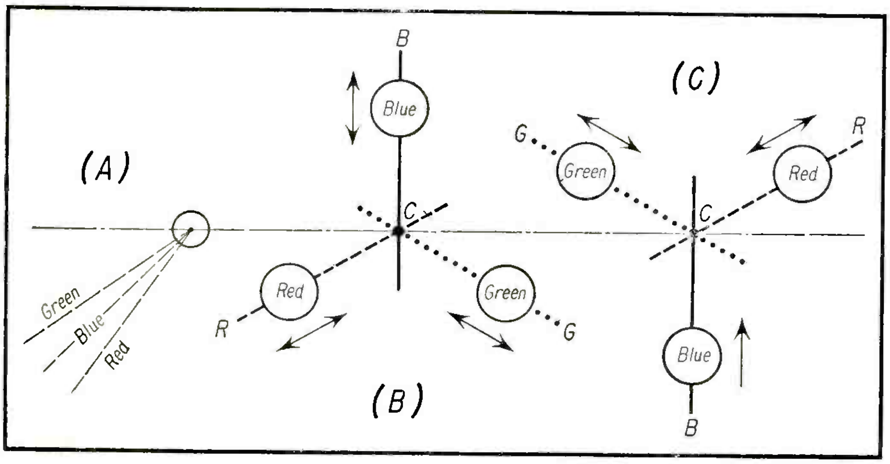

Fig. 3A—Three beams superimposed result in a white dot.
Fig. 3B—Three beams misconverged forming a triangle. Arrows indicate action of static convergence controls. Motion of three dots is in plane of phosphor plate.
Fig. 3C—Misconvergence resulting in an inverted triangle. Motion of three dots is in plane of phosphor plate.

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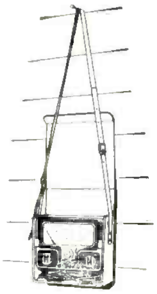

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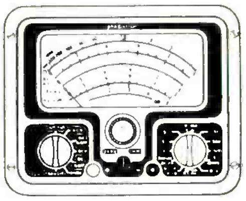

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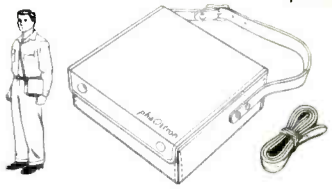

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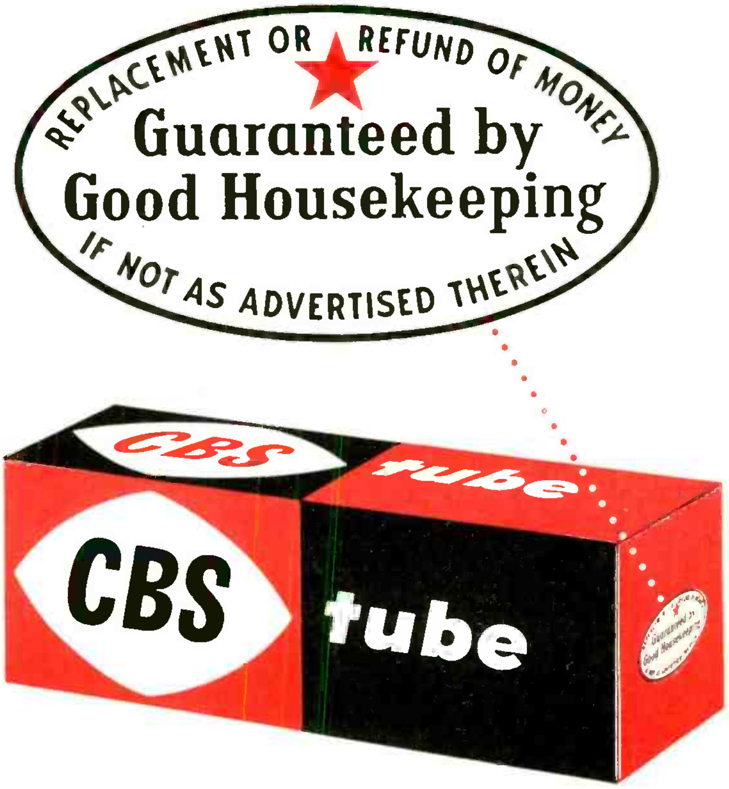

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Circuit Analysis

by the
Radio-TV Service Dealer
Technical Staff

This month's circuit
PHILCO
chassis TV-350, 354

THE use of a single tube for a multitude of different circuit functions is aptly illustrated in the Philco Chassis TV-350, 354. Here, S14, a 6CS6 tube is used as a sync separator, noise limiter, and *agc* tube. The noise limiting circuit has provisions for fringe, normal and strong signal operation. The 3-position switch controlling noise limiting simultaneously controls the *agc*, the latter having two delay circuits, one for the tuner and one for the *if* amplifier stages.

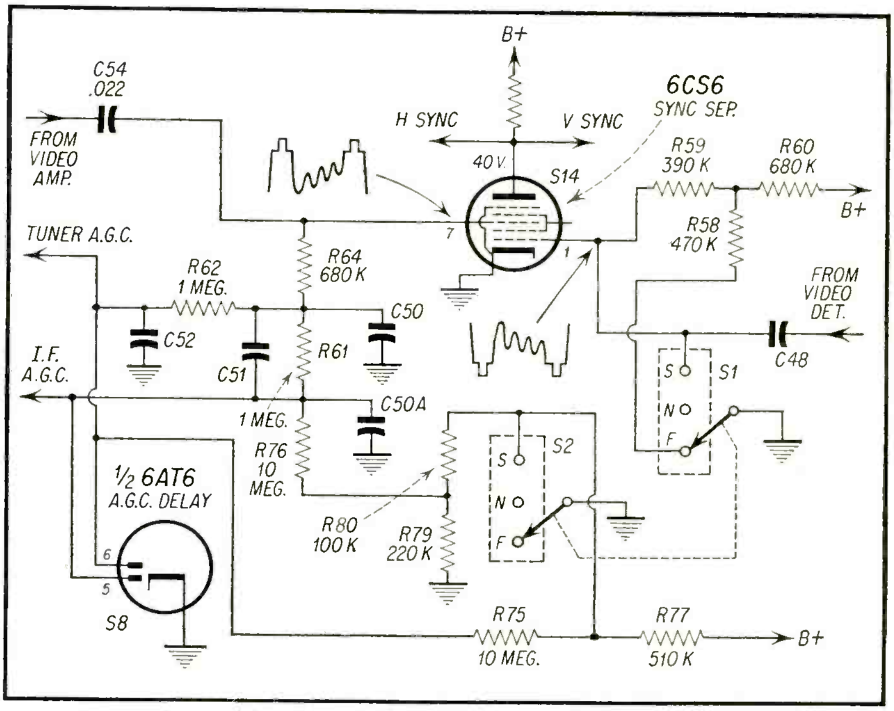

Fig. 1—Partial schematic of Philco chassis 350 and 354 showing sync separation, delayed AGC, noise suppression, et al circuits.

Sync Separation

Reference to *Fig. 1* for the sync separation action of S14 will reveal that the video signal is injected into G3 (pin 7) of the 6CS6 tube as a positive sync signal. The plate voltage on this tube is low and the following action results.

1. The incoming signal draws grid current on the positive going sync tips bringing the operating bias beyond cutoff so that only sync pulses permit plate current to flow. See *Fig. 2*.

2. The horizontal and vertical sync pulses are taken off the plate circuit and fed into the horizontal and vertical circuits.

Noise Limiting

The noise limiter circuit is designed to prevent noise pulses from entering the horizontal and vertical oscillators which may be triggered off prematurely by these noise pulses. The following sequence of events takes place in the noise limiting process.

1. A signal is taken off the video detector and applied to G1 (pin 1). See *Fig. 1*. The grid leak of G1 being returned to B plus, the bias on G1 is maintained close to zero because of the combined action of the small B plus voltage cancelling the small negative voltage developed as a result of grid biasing. See *Fig. 3*.

The incoming composite signal from the video detector has a negative going sync pulse. Therefore, if a strong noise pulse comes along it will drive the tube into cutoff and the noise signal voltage in the plate circuit will be zero. This cutoff occurs only when the noise pulse drives the grid more negative than the sync pulse.

Agc

The development of the *agc* voltages occurs as follows:

1. The positive going sync signal causes the grid to draw grid current charging up *C54* so that its grid end is negative.

2. The grid leak action occurs through *R64*, *R61*, *R76*, and *R79* with decreasing negative voltages across *C50* and *C50A*.

3. The tuner *agc* is taken off *C50* through *R62*.

4. The *if agc* is taken off *C50A* directly, and will be explained in item 6.

5. The tuner *agc* voltage is delayed by virtue of the circuit action involving one of the diode plates (pin 6) which is as follows:

A positive voltage is applied to pin 6 through *R75* from the voltage dividing network comprising *R77*, *R80* and *R79*. Diode conduction prevents the tuner *agc* buss bar from becoming positive because of the low internal resistance of the diode when the plate is made positive. As the signal voltage increases the net voltage at the plate (pin 6) becomes less and less positive being cancelled by the negative voltage developed in the grid leak network. However, due to the clamping action of the diode the tuner *agc* voltage is still nominally zero. At a predetermined signal level the *agc* voltage becomes more negative than the positive voltage on pin 6 and the diode ceases to conduct. At this point the tuner *agc* begins to take on a negative polarity.

6. The *if agc* voltage is also delayed, the action being as follows:

The positive voltage applied to the 2nd *agc* delay diode plate (pin 5) is obtained off at a point on the voltage divider network *R77*, *R80* and *R79* which is at a lower B plus voltage than in the previous case. For this reason less signal voltage will be required to cancel out the positive delay voltage and *agc* will begin controlling the *if's* before it does the tuner.

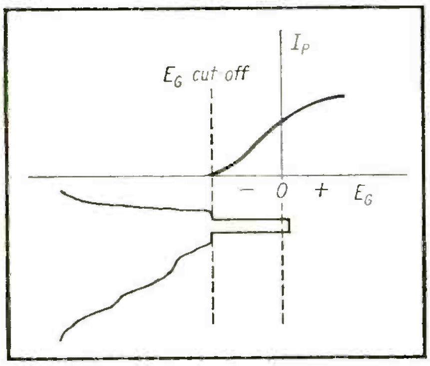

Fig. 2—Clamping action of grid leak biasing used in sync separator circuit.

Range Switch Operation

There are two separate 3-position switches controlled by a single shaft for providing optimum *agc* operation in areas of various signal strength. Switch *S1* provides a variable degree of *agc* by the following action.

1. Under conditions of strong signal strength grid #1 is grounded and grid #3 with relation to cathode performs as

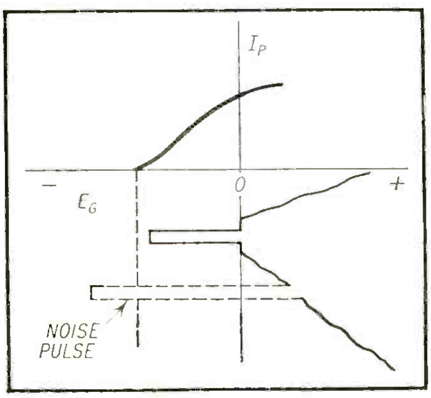

Fig. 3—How noise pulse cuts tube conduction off, thereby preventing disturbance of horizontal and vertical oscillators.

a very efficient diode; so that the greatest *agc* voltage is developed across the *agc* network.

2. When switch *S1* is in the normal position the grid leak action of *C48* in combination with *R59* and *R60* charges

[*Continued on page 59*]

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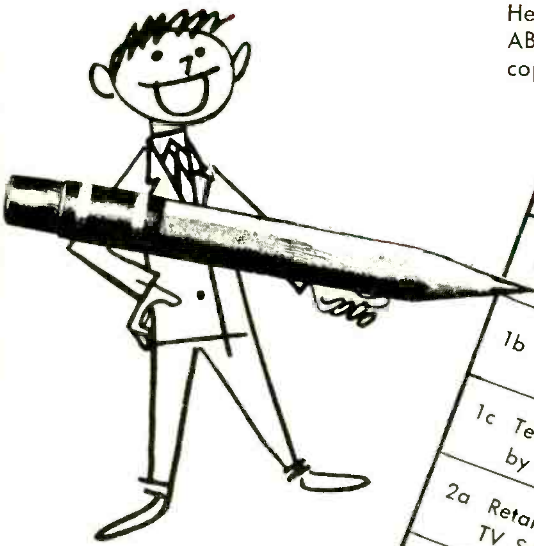

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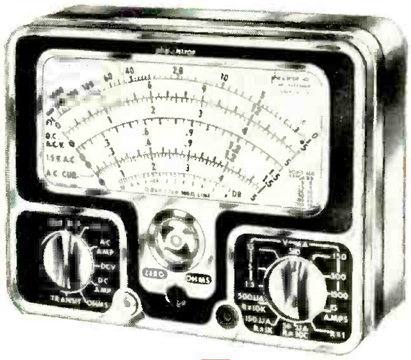

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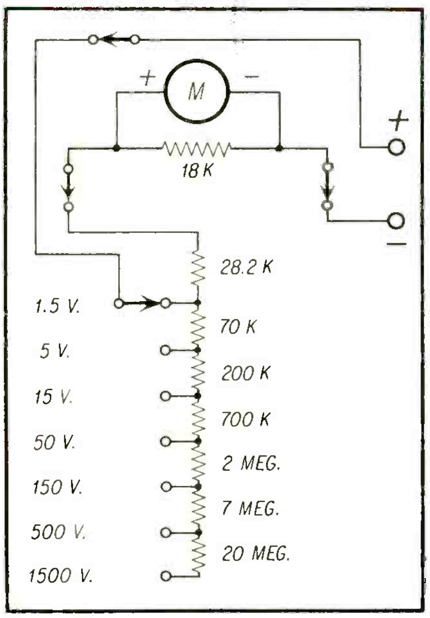


Fig. 1—Partial schematic of Phaostron Multimeter showing DC Voltmeter hookup.

A NEW look in portable multimeters is provided by the Phaostron Model 555. Basically this instrument employs a 20,000 ohm per volt meter. The electrical units measured and their ranges are as follows:

Voltage: Both *dc* and *ac* (the latter at 2,000 ohms per volt). There are six scale ranges, these being: 0-1.5, 0-5, 0-15, 0-50, 0-150, 0-500, and 0-1500 volts.

Current (DC): Eleven ranges are provided, these being, 0-50 microamperes, 0-150 microamperes, 0-500 microamperes, 0-1.5 ma, 0-5 ma, 0-15 ma, 0-50 ma, 0-150 ma, 0-500 ma, 0-1500 ma, and 0-15 amperes.

Current (AC): Eight ranges are provided, these being, 0-1.5 ma, 0-5 ma, 0-15 ma, 0-50 ma, 0-150 ma, 0-500 ma, 0-1500 ma, and 0-15 amperes.

Output (DB): Six ranges are provided, these being, −10 to +8 db, −2 to +16 db, +10 to +28 db, +18 to +36 db, +30 to +48 db, and +38 to +50 db.

[*Continued on page 19*]

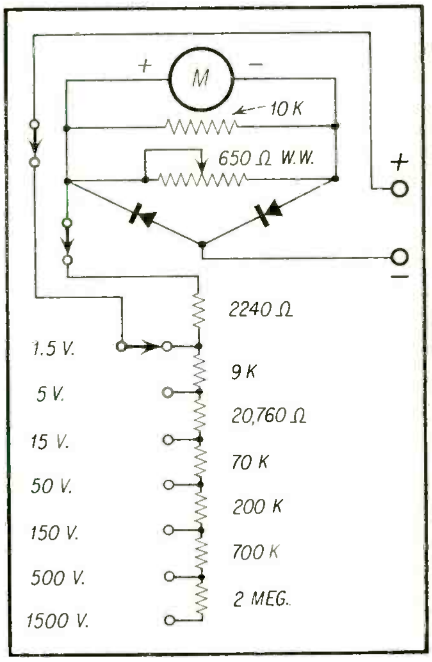


Fig. 2—AC Voltmeter hookup.

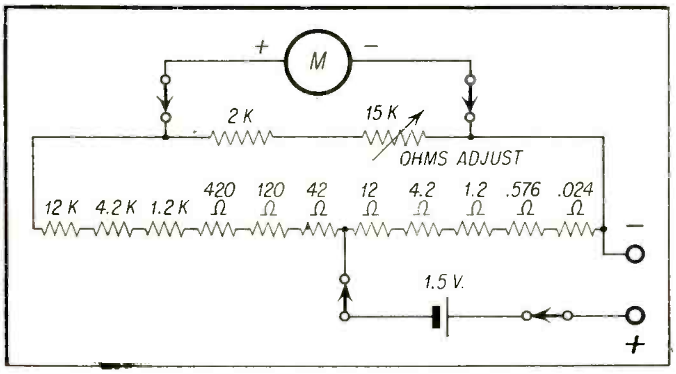


Fig. 3—Ohmmeter in RX1 position.

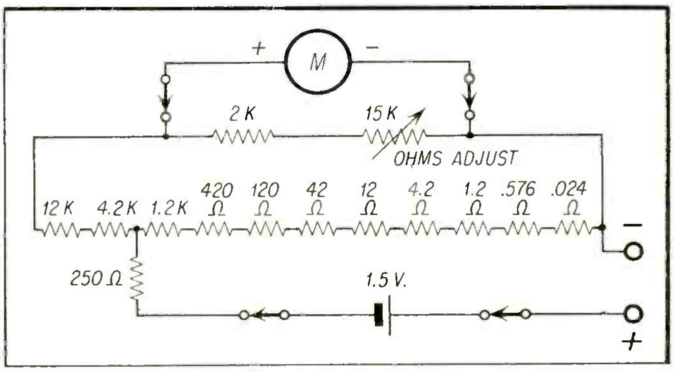
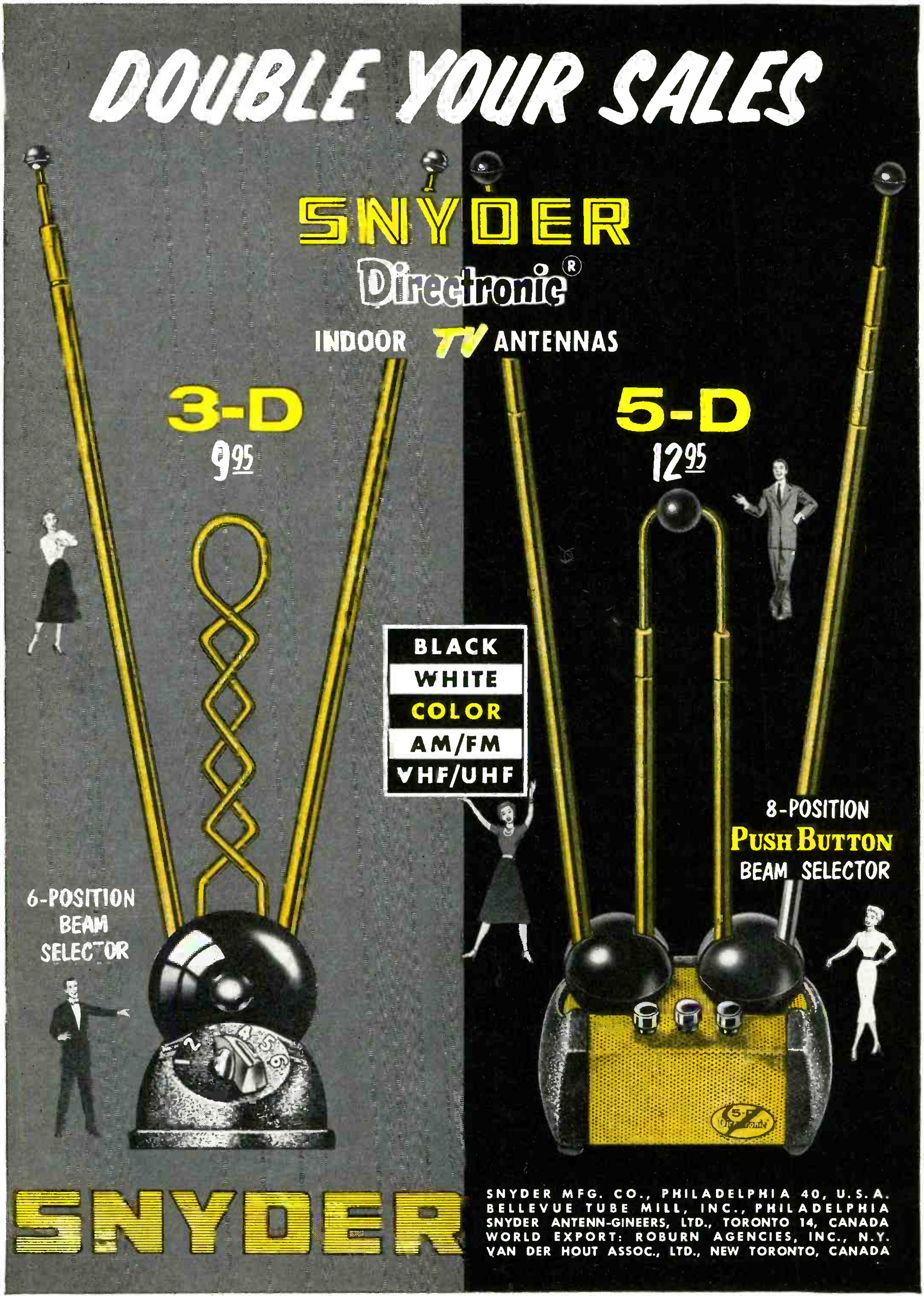


Fig. 4—Ohmmeter in RX100 position.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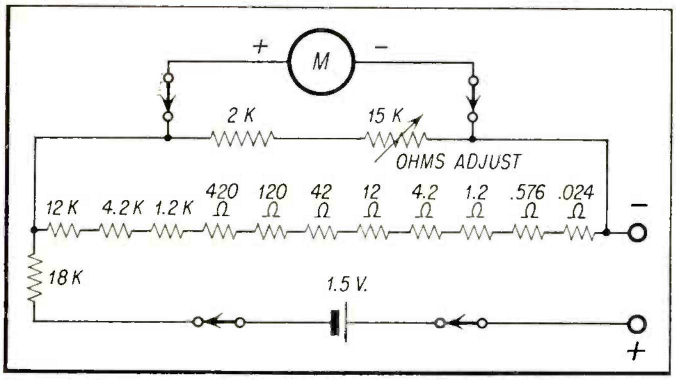


Fig. 5—Ohmmeter in RX1,000 position.

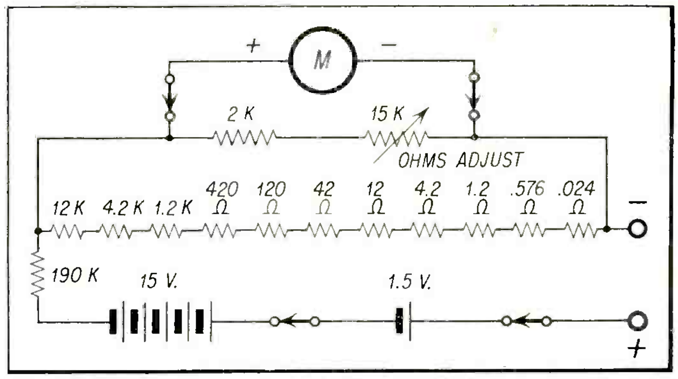


Fig. 6—Ohmmeter in RX10,000 position.

Resistance (Ohms): Four ranges are provided, these being, 0.25-1000, 25-100K, 250-1 meg, and 2500-10 meg.

The manner in which some of the above meter functions are obtained in this instrument is shown in simplified schematic form in *Figs. 1* to 8. When the function switch is in the output position, an internal .1 uf condenser is placed in series with the ac voltage circuitry of the "555" multimeter. This is done to block the *dc* component that is present if the desired circuit to be measured is made by making connection directly to the plate of a tube or a similar type of potential source.

Among the features of this instrument are its use of a double shield to prevent interference from stray fields, its ruggedized meter construction which permits it to take the gaff of portable handling, and its 15 ampere *ac* scale which enables the technician to make many measurements he could not make before with conventional instruments.

This instrument may also be employed for panel mounting by means of an adapter supplied by the manufacturer. This entails removal of four screws from the rear of the case and mounting the panel adapter on the instrument. Also available is an attractive leather carrying case which may also be used with a shoulder strap. The carrying case is designed to house the instrument firmly within its confines, and has a snap type opening at the front that enables the user to operate the meter without removing it from the case.

Simplified Circuit Analyses

In *Fig. 1* is shown the simplified circuit of the instrument as a multi-range 20,000 ohms per volt *dc* voltmeter. The basic meter, which has a somewhat higher sensitivity than 50 microamperes is shunted with an 18K resistor the combination of which results in a 50 microampere meter. The total resistance of this combination is 1.8K. Thus, with the range switch in the 1.5V position the total instrument resistance is 1.8K + 28.2K = 30K, which is correct for a 20,000 ohm per volt meter.

In *Fig. 2* is shown the same movement connected as an *ac* voltmeter. A full wave rectifier is used for converting the *ac* to *dc*. Also, a calibrated shunt is employed to make the meter in its *ac* position a 2000 ohm per volt meter.

In *Fig. 3* is shown the simplified schematic of the RX1 Ohmmeter. Here the negative side of the ohmmeter battery is connected to a tap corresponding to 18 ohms total. Shorting the ohmmeter input terminals (+ and −) and adjusting the Ohms Adjust control for full scale on the meter prepares the ohmmeter for external resistance measurement. Thus, if an external resistance of 18 ohms is connected across the ohmmeter input terminals the voltage applied to the meter circuit will be one half the previous voltage and the meter will read half scale.

Figures 4 and 5 illustrate the meter connections for the RX100 and the RX1,000 scales. These ranges are obtained by switching the selector arm to the desired range. This operation inserts the required resistors into the circuit as shown.

In *Fig. 6* the RX10,000 ohmmeter simplified schematic is shown. Here, an additional 15 volt battery is added to the 1.5 volt battery. By a suitable selection of resistance values as shown, and with the Ohms Adjust set for full scale, when a 180,000 ohm resistor is connected to the ohmmeter input terminals the meter will read half scale again, thus illustrating how a wide range of resistance ranges may be effected.

In *Fig. 7* is shown the simplified schematic of the DC Current meter. Here a tapped shunt is used, its in-

[*Continued on page* 57]

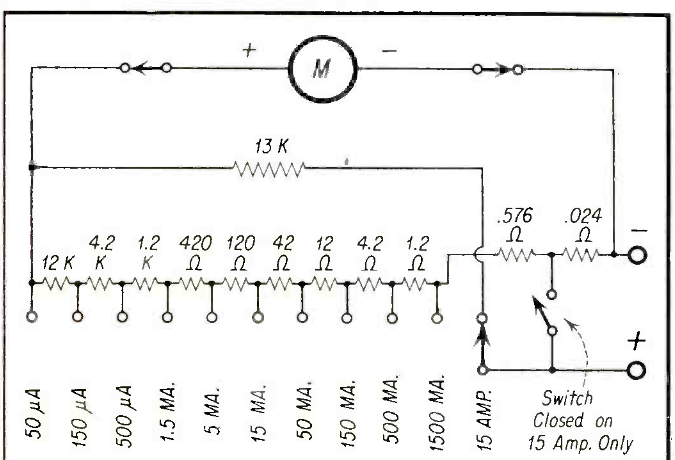


Fig. 7—Instrument as a DC ammeter.

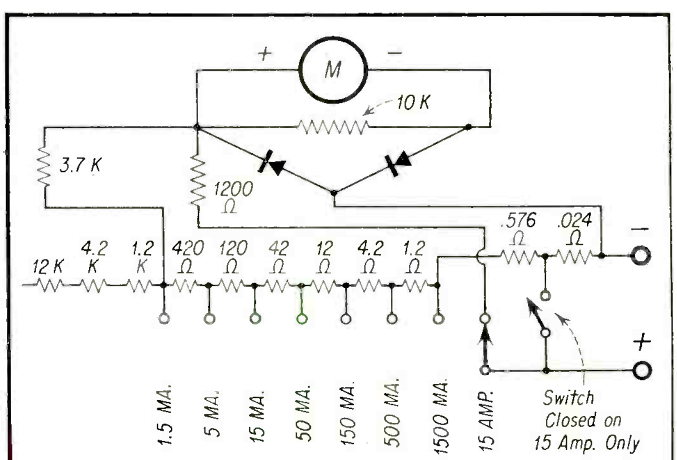
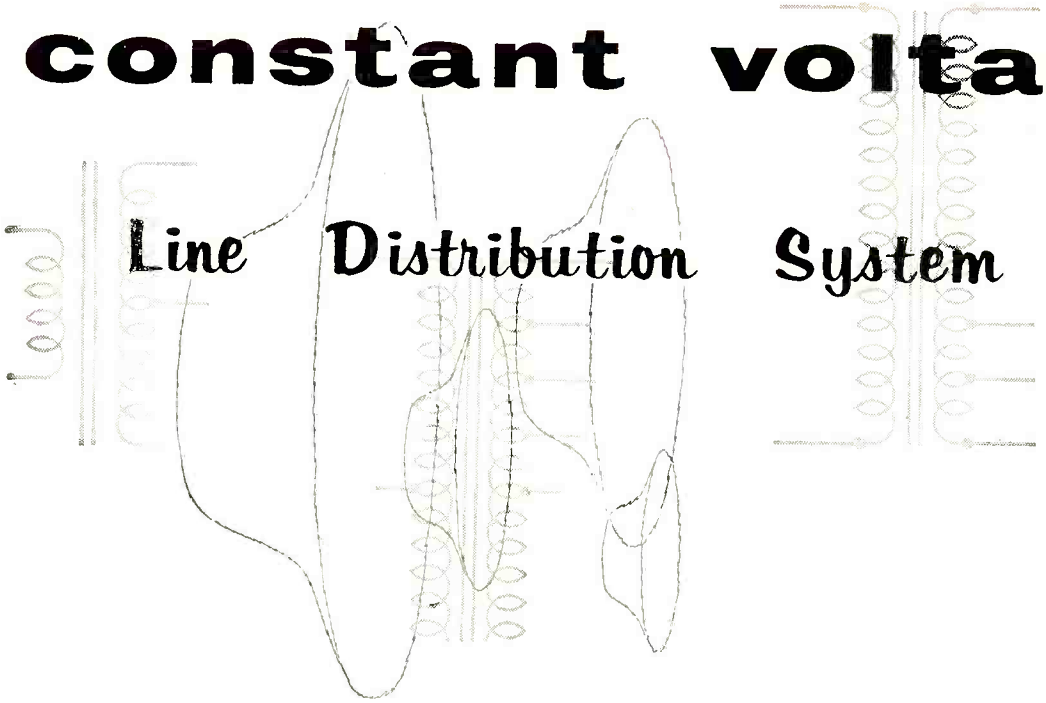


Fig. 8—Instrument as an AC ammeter.

constant voltage

Line Distribution System



by
L. A. STINEMAN
Chief Engineer
MERIT COIL & TRANSFORMER CORP.

BECAUSE of the increasing trend toward the use of the constant voltage line in commercial sound systems, it is the purpose of this article to elaborate somewhat upon the advantages of the constant voltage line over the old impedance matching method, and explain some of the techniques and methods which may be employed to most effectively utilize this type of system.

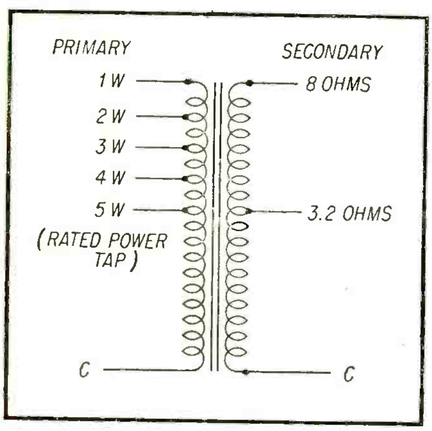


Fig. 1—Constant voltage line transformer having primary taps to provide reduction in power in 1 watt steps.

The Impedance Matching Method

In the impedance matching method a series of speakers are coupled, by means of impedance matching transformers, to a definite amplifier output impedance, such as a "500 ohm line." The disadvantage here, however, in using this method is that considerable calculation may be involved in figuring the individual transformer impedances required to present a correct match to the "500 ohm line." As an example, it is not difficult to calculate the individual speaker transformers impedance required to match, say five speakers, each drawing 5 watts of power to the 500 ohm tap of a 25 watt amplifier. When we recall the formula for parallel impedances, we obtain 2500 ohms for the primary impedance of each speaker transformers. However, suppose we want one speaker to draw 10 watts, one to draw 3 watts, and the other two to draw 6 watts each. Here we become involved in some lengthy calculations in attempting to select the proper individual speaker transformer matching impedance.

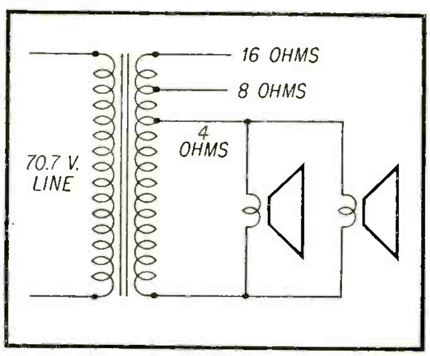


Fig. 2—Correct method of connecting two 8-ohm speakers to transformer secondary when used with constant voltage system.

The Constant Voltage Method

It is here that the advantage of the constant voltage line presents itself. In the foregoing case, where unequal powers are involved, we simply utilize the constant voltage tap of the amplifier, if it has one, or use an amplifier with such a tap, and secure matching transformers designed especially for use in constant voltage systems, preferably transformers having primary taps to provide power adjustments in steps of one watt. We then simply connect to the 5 watt tap, or to the 6 or 10 watt tap or any tap required to provide the combination we desire, provided we load the amplifier to approximately rated output. Then, with transformers having

[*Continued on page 56*]

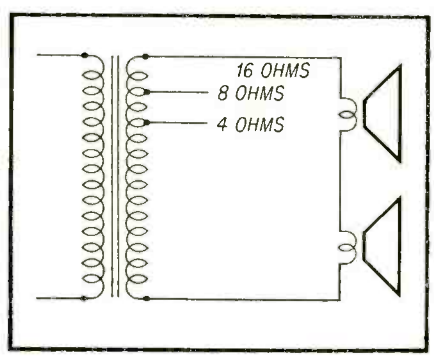


Fig. 3—Incorrect method of speaker connections when used with constant voltage system described in text.

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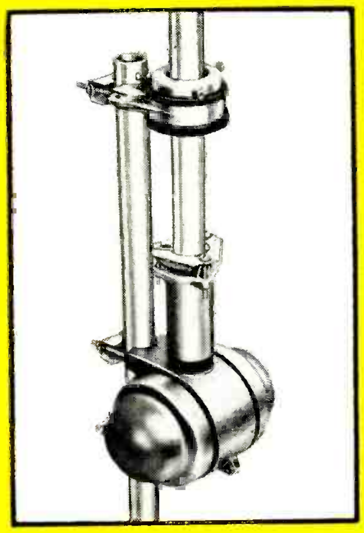

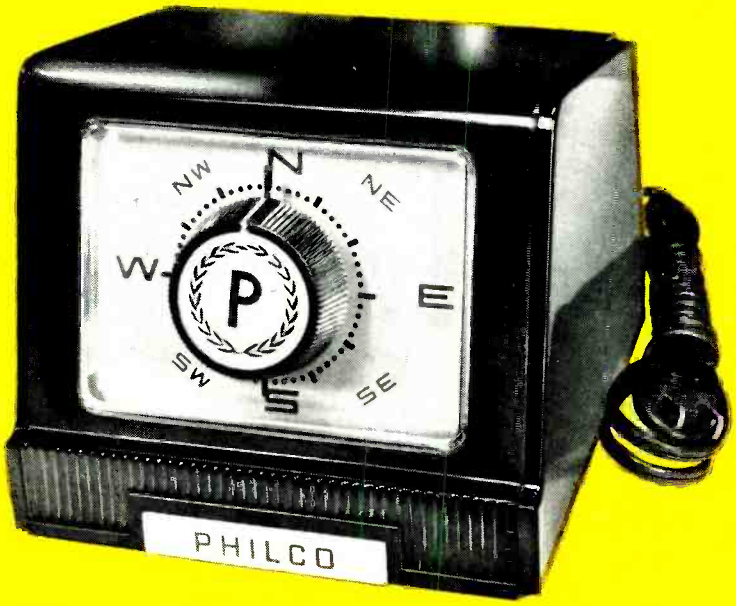

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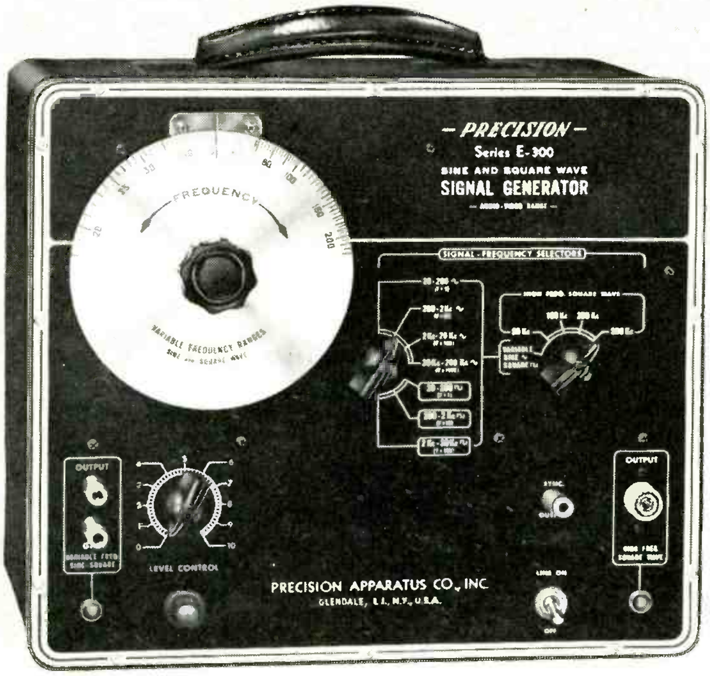

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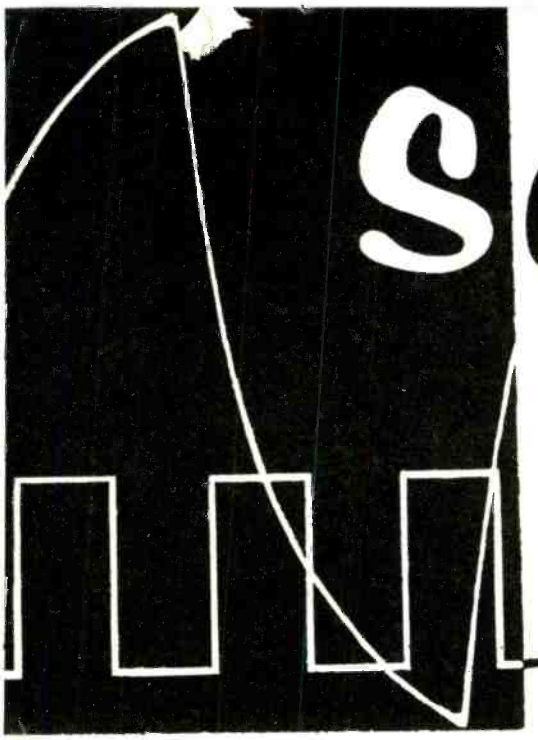


Servicing with the SQUARE-WAVE GENERATOR

Part 2

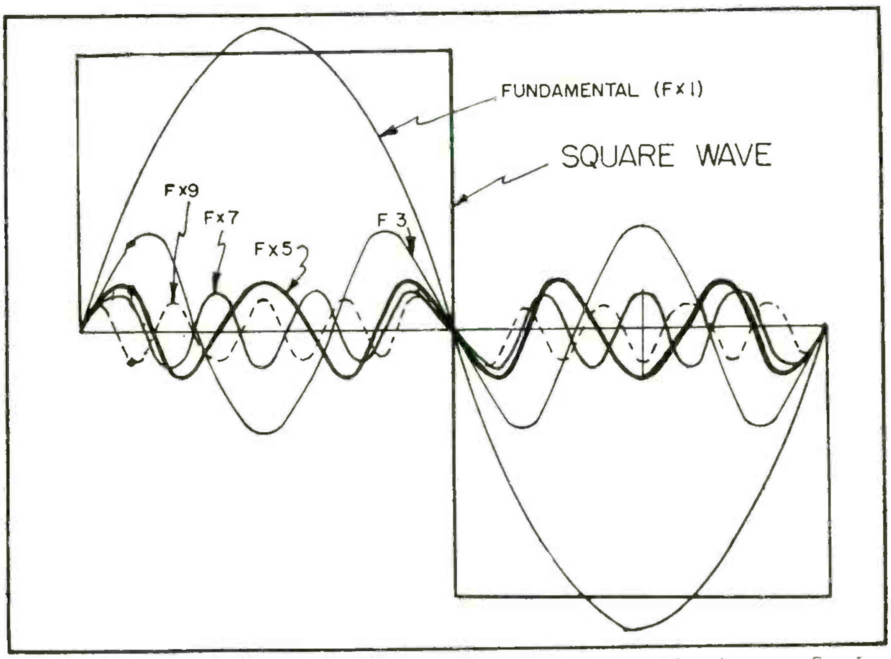
by OSCAR FISCH

IN the previous installment (March 1955) it was shown that a square wave may be considered as a combination of a fundamental sine wave with an infinite number of its odd harmonics. In addition, the amplitude of each of these harmonics becomes smaller as the order of the harmonic increases. The fifth harmonic, for example, has an amplitude one fifth that of the fundamental. The seventeenth harmonic would have an amplitude one seventeenth that of the fundamental. Finally, each harmonic must bear an "in phase" relationship with the fundamental. By this is meant that at the instant the fundamental is beginning its positive half cycle, each harmonic is also beginning a positive half cycle. *Fig. 1* summarizes the previous statements in graphical form. Obviously, we cannot show all the harmonics in such a graph, but the odd harmonics up to the ninth are shown. Thus, a perfect square wave is obtained when the three conditions outlined above are satisfied.

The square wave generator finds its most important application in the design and testing of wide band amplifiers such as might be found, for example, in high fidelity audio amplifiers, or in TV video amplifiers. In this connection it should be observed that if a square wave is fed into the input of such an amplifier, and if the output is then observed on an oscilloscope, a rapid diagnosis may be made on the overall characteristics of the amplifier. *Fig. 2* is a block diagram illustrating the setup used in square wave testing.

In passing through the amplifier any one or more of the following types of distortion might occur.

1. Amplification falls off at the low frequency end.
2. Amplification falls off at the high frequency end.
3. The phase relationships of the component frequencies may be changed



Courtesy Precision Apparatus Co., Inc.

Fig. 1—Square wave makeup. Note the decreasing amplitude of higher harmonics, also phase relations of all components at start of cycle.

relative to each other.

4. The response of the amplifier may exhibit a resonant rise or a resonant dip at certain frequencies.

5. Oscillation, or ringing, may occur where resonant compensating circuits are used, or where circuits have poor transient response.

From the previous analysis, it can be seen that any of these defects should have an effect on the shape of the emerging square wave. *Fig. 3*, for example, illustrates graphically the change which occurs when the fundamental leads the higher harmonics.

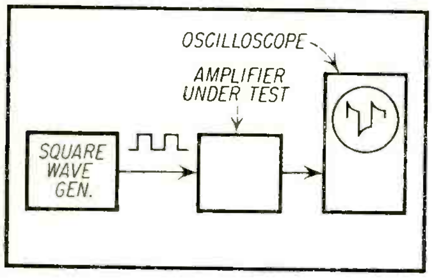


Fig. 2—Block diagram of setup used for square wave testing.

Figures 4 through *11* show the resulting square wave distortion for various other conditions. In *Fig. 4*, the curve of the top and bottom portions toward the zero line indicates poor low frequency amplification, but no phase shift. *Fig. 5* of course is a repetition of what was observed in *Fig. 3*, and is caused by a phase shift of the lower frequencies. Notice that this produces a *tilt* of the top and bottom portions of the square wave, but no curvature. *Fig. 6* shows the result of both phase and amplitude distortion at the low frequencies. Notice here that both tilt and curvature are present. In *Fig. 7*, the curvature of the top and bottom away from the zero axis indicates excessive amplification of the low frequencies. Rounding at all four corners as shown in *Fig. 8* indicates reduced amplification at the high frequencies but no phase distortion at these frequencies. *Fig. 9* exhibits rounding at two of the corners and indicates both phase shift and loss at the high frequencies. *Fig. 10* indicates the output wave for very poor response at both the high and low frequencies. *Fig. 11* is the result of ringing or shock oscillation. This is usually caused by peaking coils or transformers which are not sufficiently loaded.

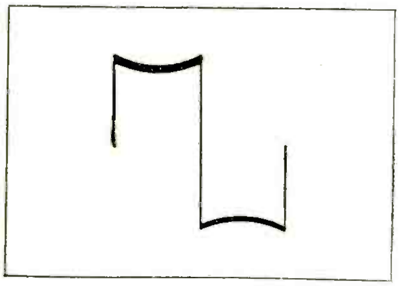


Fig. 4—Frequency distortion (amplitude distortion of low frequency component), no phase shift, produces above pattern.

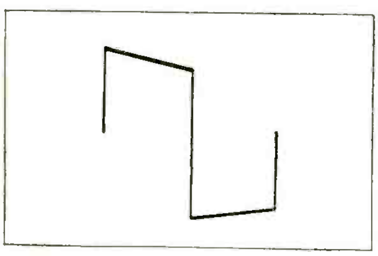


Fig. 5—Low frequency phase shift produces above pattern.

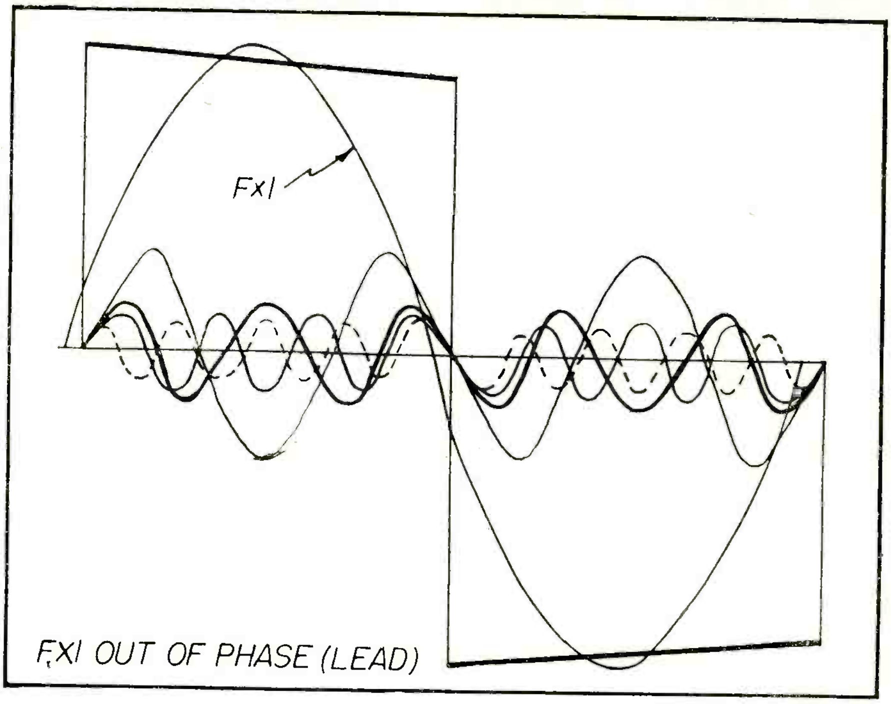


Fig. 3—Tilt in square wave caused by phase displacement of fundamental.

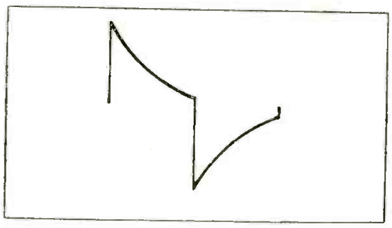


Fig. 6—Low frequency loss and phase shift results in above.

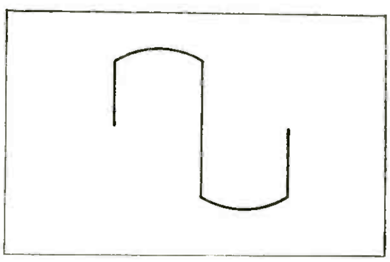


Fig. 7—Low frequency boost, or accentuated fundamental.

A comparison of the more familiar frequency response curve of *Fig. 12* with the square wave response of the same amplifier shown in *Figs. 13A* and *13B* should help to throw a little more light on the matter of the interpretation of square wave outputs. An examination of *Fig. 12* indicates that this amplifier has a flat response from 1 *kc* to 10' *kc;* that frequencies below 1 *kc* are

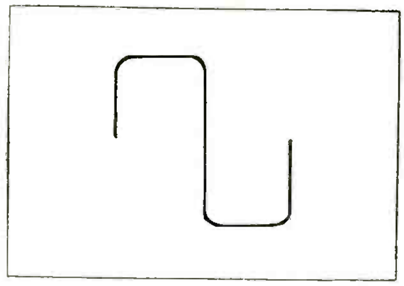


Fig. 8—High frequency loss and no phase shift results in above.

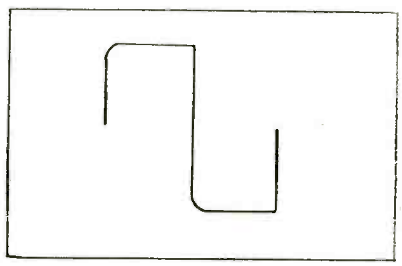
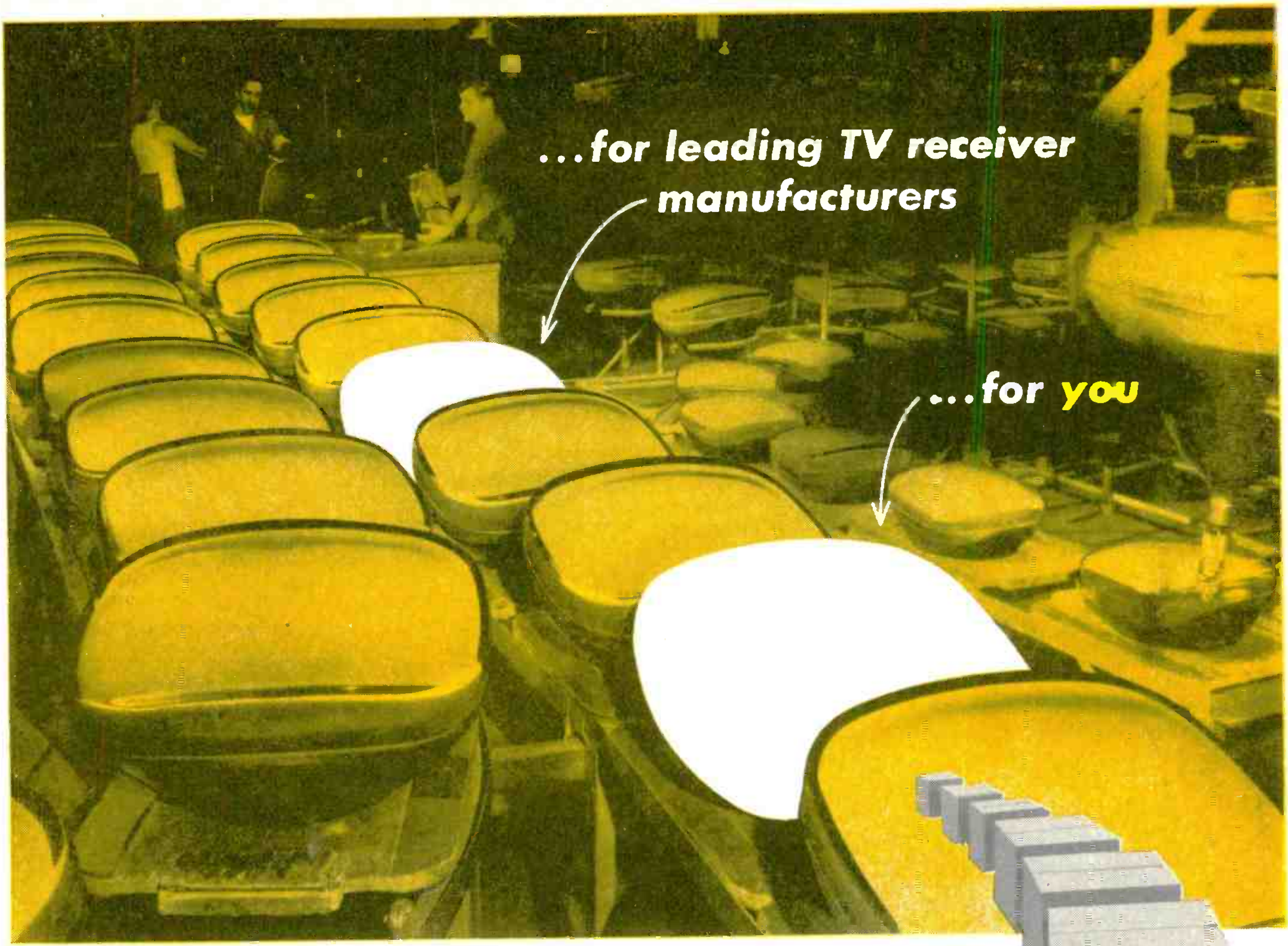


Fig. 9—High frequency loss and phase shift results in above.



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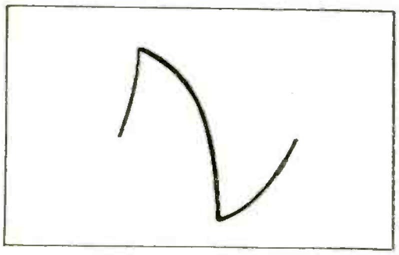


Fig. 10—High frequency loss and low frequency phase shift.

attenuated; and that there is a boost in the high frequency response between 10 *kc* and 100 *kc*.

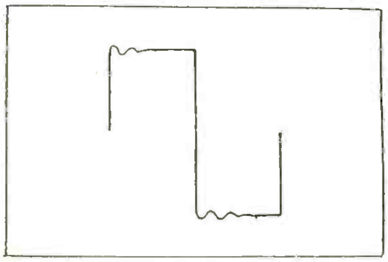


Fig. 11—Damped oscillations.

The square wave test is made in two steps. *Fig. 13A* shows the output when a 100 *cps* square wave is fed in at the input. *Fig. 13B* shows the output when a 1000 *cps* square wave is fed in.

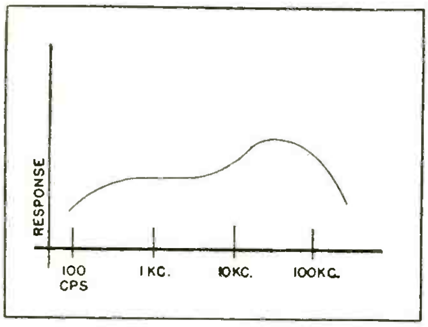


Fig. 12—Typical response curve of an amplifier designed to pass the frequencies shown above.

Before proceeding further, a restatement of the reason for this two-step testing procedure is in order. For practical purposes a square wave containing

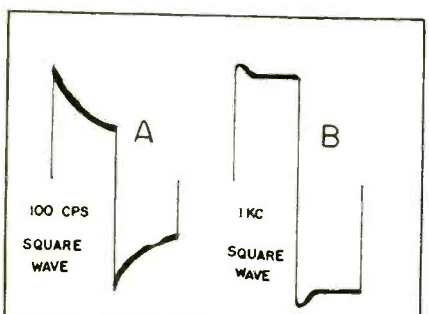


Fig. 13—Square wave representation of Fig. 12.

Various commercial sine and square wave generators. Top left is the Hickok Model 710; middle left is the EICO Model 377; middle right is the Measurements Corp. Model 71; and bottom is the Precision Series E-300.

the first 10 *odd* harmonics has sufficiently steep sides and sharp corners for almost any application. We may take it as a rough rule of thumb then, that the highest component frequency of any practical significance is about twenty times the fundamental frequency (since the 10th *odd* harmonic is actually the 19th harmonic if we count both odd and even harmonics) and consider the fundamental as the 1st odd harmonic. Thus, when the 100 *cps* square wave is used as an input, the component frequencies of any significance range from 100 *cps* to about 2000 *cps*. Obviously then the output wave can supply us with information for this frequency range only.

A second check is now made with a 1000 *cps* square wave. This will encompass the range from 1000 *cps* to 20,000 *cps*. It is most important to keep this concept in mind in order to avoid misinterpreting wave forms. Thus merely looking at a square wave on an oscilloscope and noting that it has square corners, steep sides, and a flat top and bottom does not necessarily mean that a good low frequency response is indicated. It would mean good low frequency response only if the frequency of the square wave were low, say 60 *cps*. It would tell us nothing about low frequency response if the frequency of the square wave were 1000 *cps*.

Looking again at *Figs. 12* and *13*, let us note the points of correspondence between the conventional display of *Fig. 12* and the square wave representation of *Fig. 13*. From *Fig. 12* we notice a falling off of low frequencies below 200 *cps* and a boost in the highs at 20 *kc*. The drop in low frequency response is indicated in the square wave by the curvature of the top and bottom portions in *Fig. 13A*. The square wave shows something that the response curve does not and that is the presence of low frequency phase distortion. This is indicated by the tilt of the top and bottom portions of the square wave. The high frequency boost shows up in the square wave as an overshoot at diagonally opposite corners of the square wave.

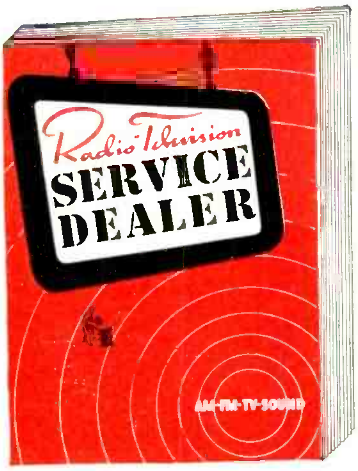
Trouble Shooting TV Receivers

It will be recalled that one of the fields in which the square wave generator may be used is that of TV video amplifier checking. Here it offers the possibility of quickly determining whether or not the cause of poor picture quality lies in the video amplifier section of the receiver. It must be admitted that for the simpler and more obvious types of trouble the expense of a square wave generator would not be warranted. However, in the case of elusive troubles such as intermittents, changes in value of components under operating conditions or open bypass condensers, the square wave generator may prove to be a valuable time saver. As with any other test instrument, or perhaps even more so, to achieve the most effective results the serviceman must be aware of the capabilities and the limitations of the instrument. He must be able to draw conclusions from the evidence presented by his test equipment. Let us examine, therefore, the important factors on which the technique of square wave testing of video amplifiers is based.

To begin with, the technician must

[*Continued on page 60*]

A MUST for every Serviceman



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CHROMINANCE Systems in Color TV Receivers

by BOB DARGAN
and SAM MARSHALL

Part 5

IN the previous installment the principles of high level demodulation were described whereby the color-difference signal outputs were provided by demodulating the chroma signal on the R-Y, B-Y, and G-Y axes (*Fig. 1*). As indicated in the figure the 3.58 *mc* reference signals are fed into the grids of each demodulator. Also, by means of a precision transformer the correct ratios of color-difference signals are made available at the demodulator outputs to drive the three grids of the picture tube. Finally, because the chroma signal is fed into each plate circuit high enough chroma signals are employed to drive the picture tube grids directly.

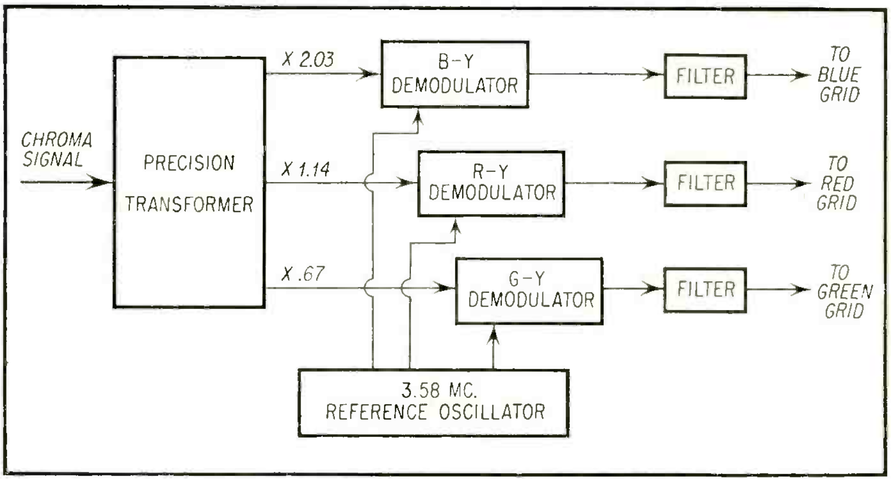

Fig. 1—Block diagram of high level 3-triode demodulator.

A clearer understanding of high level 3-tube triode demodulation may perhaps be obtained by a study of *Fig. 2*. Here we show an equivalent circuit diagram at the left of the figure as (A), along which are developed the plate voltages for three different chroma signal conditions. The chroma signal is shown applied in series in the plate circuit as E_B. In this illustration we arbitrarily assume a maximum peak chroma signal value equal to the battery voltage B. Of course this value may vary between zero and the maximum peak. The demodulated signal output which appears across the load resistor R_L is taken off at Point A.

The three different signal conditions referred to above are:

1. No chroma signal (Case 1.)
2. Chroma Signal (E_B) in phase with the 3.58 mc signal on the control grid (Case 2.)
3. Chroma signal 180° out of phase with the 3.58 mc signal on the control grid (Case 3).

Case 1

Here we observe a plate voltage +B for the time intervals from (O) to (1) and (2) to (3). During these time intervals the tube is in a non-conducting state. This non-conduction is brought about by the high "C" bias the tube develops as a grid-biased amplifier; this bias being brought about by the 3.58 *mc* reference signal voltage applied to the control grid.

During the intervals between (1) to (2) and (3) to (4) the positive 3.58 *mc* pulse is high enough to drive the tube into conduction. This results in a plate current I_1 as shown. As a result of this plate current a voltage drop takes place across R_L which is opposite in polarity to the battery voltage. For the *particular*, values shown in *Fig. 2* this voltage drop is equal to the battery voltage, and the voltage at point A drops to zero. In the above described action the on-off (conduction-nonconduction) behavior of the tube is like a switch. We assume, for this analysis, that the tube acts like a "short" from plate to cathode when it conducts, and an "open-circuit" when it is non-conducting.

The waveform shown in Case 1 resolves itself into an *average* voltage, E_{11} which is shown in the figure. We shall now see how this average voltage varies for different values of applied chroma signal.

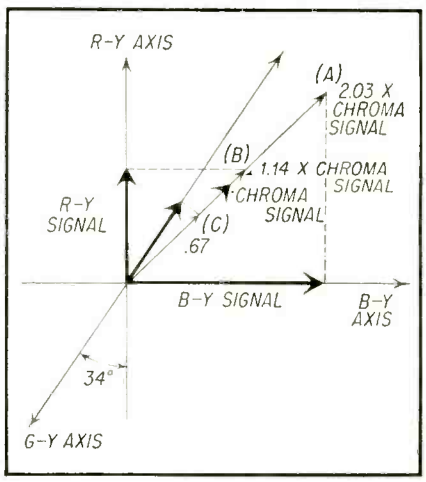

Fig. 3—Vector presentation of high level 3-tube triode demodulation with chrome signal multiplying factors.

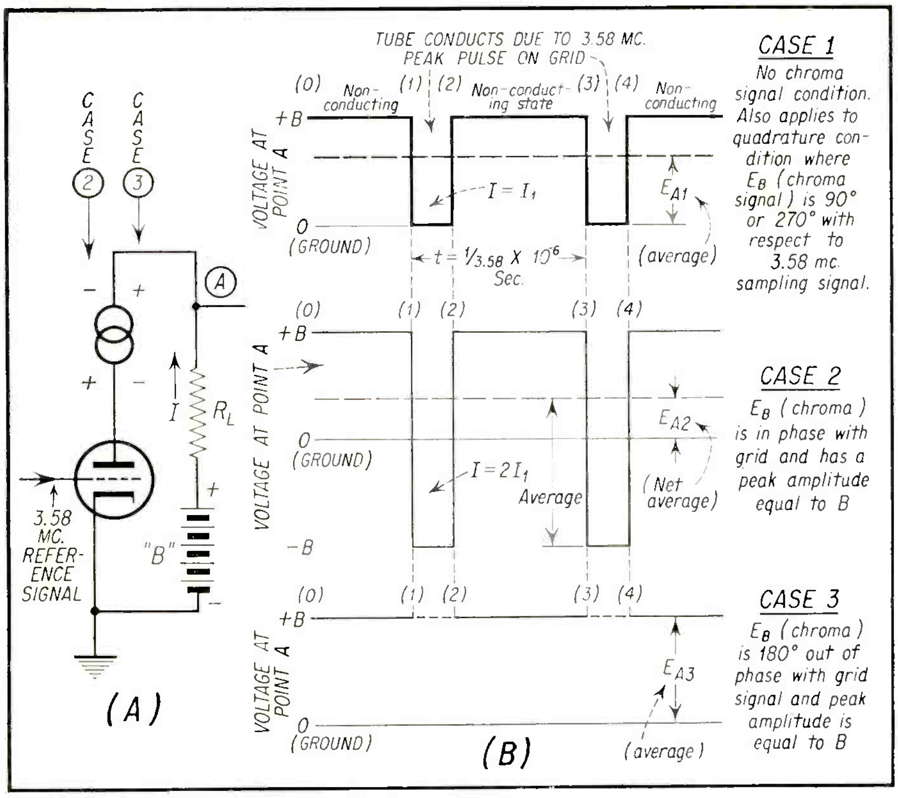

Fig. 2—Voltage at point "A" for various values of chroma voltage E_B.

Case 2

If the incoming chroma signal is in phase with the 3.58 *mc* sampling signal pulse it will have the polarity shown by the arrow marked Case 2 in *Fig. 2A*. During the intervals (1) to (2) and (3) to (4) the increased voltage on the plate, which is equal to "B", plus the E_B peak will increase the plate current (in this case to twice the original value) and the voltage drop across R_L will be twice that of before. Adding this negative voltage drop to the positive voltage of the battery will result in a voltage appearing at point A equal to –B. The absolute average voltage of this waveform is somewhat greater than for Case 1. However, as measured from the zero voltage reference line which is at ground potential, the *net* average plate voltage at point A will be E_{A2}, which is *lower* than in Case 1. Thus, a positive going chroma signal results in a reduced value of average plate voltage at point A.

A study of *Fig. 2-Case 2* will show this up clearly.

Case 3

If the incoming chroma signal is 180° out of phase with the 3.58 *mc* sampling pulse it will have the polarity as shown by the arrow marked "Case 3" in *Fig. 2A*. During the intervals (1) to (2) and (3) to (4) the applied plate voltage is opposite to the battery voltage and no plate current will flow. There will be no voltage drop across R_L, and the voltage at point A will be equal to the battery voltage +B.

This is the same voltage that is present at point A when the tube is in its non-conducting state and is shown as EA3. Thus, when the incoming chroma signal is negative the average plate voltage at point A is greater than the value for Case 1 when no chroma signal is present.

From the above analysis it is obvious that the average voltage developed at point A increases and decreases with the phase and amplitude of the applied chroma signal. This variation takes place around the average value of the voltage at point A established by zero chroma signal.

Further clarification of high level 3-tube triode demodulation can be obtained by a study of *Fig. 3*. Notice that the 3.58 *mc* demodulating axes coincide with the R-Y, B-Y, and G-Y axes. Notice also that before the chroma signal is demodulated by these respective axes the vector representing it is amplified by the following factors:

(a) 2.03 (for obtaining B-Y as shown at A.)

(b) 1.14 (for obtaining R-Y as shown at B.)

(c) .67 (for obtaining G-Y as shown at C.)

With these operations performed on the chroma signal, the relative amplitudes of the R-Y, B-Y, and G-Y demodulated filtered outputs will be correct.

High Level 2-Triode Demodulation

A variation of high level demodulation employing two triodes is shown in block diagram form in *Fig.4*. The operation of this demodulator is as follows:

1—The chroma signal is fed into a precision transformer where unity signal transfer is effected to the R-Y demodulator and the signal applied to the B-Y demodulator is 1.4 times this value.

2—At the same time sampling pulses from the 3.58 *mc* oscillator are applied to both demodulators with phase angles of 13° for the R-Y demodulator and 77° for the B-Y demodulator.

3—The R-Y signal is taken off the R-Y demodulator, the B-Y signal is taken off the B-Y demodulator, and the G-Y signal is taken off the cathode resistor R_K, the latter being in common with both demodulators. The plate lead resistor of the R-Y demodulator is 2 x

[*Continued on page 59*]

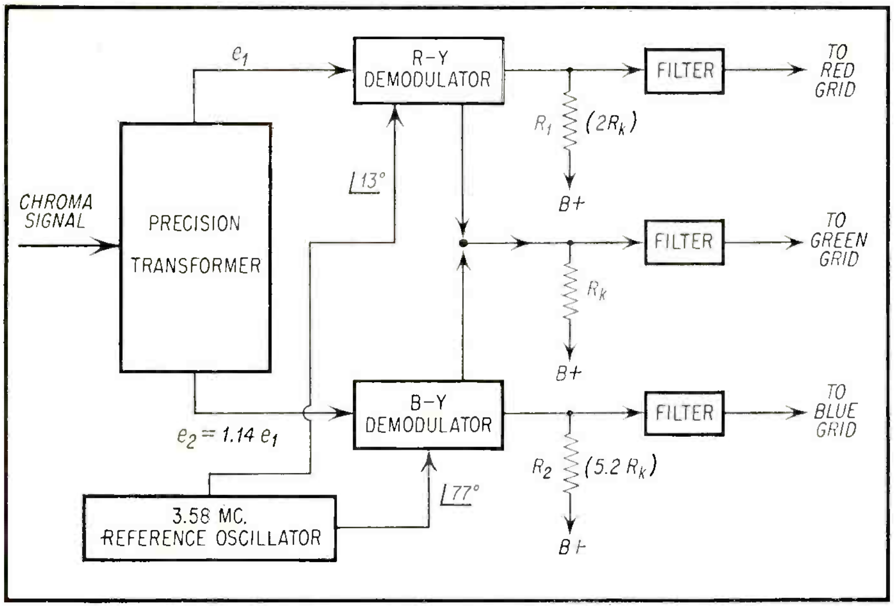

Fig. 4—Block diagram of high level 2-tube demodulation.

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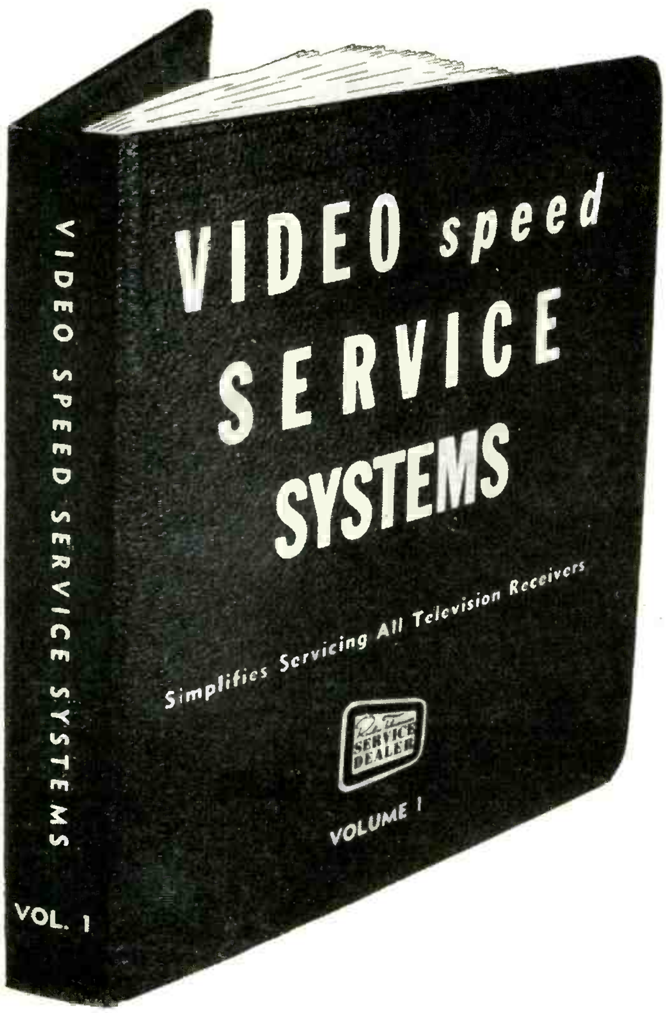

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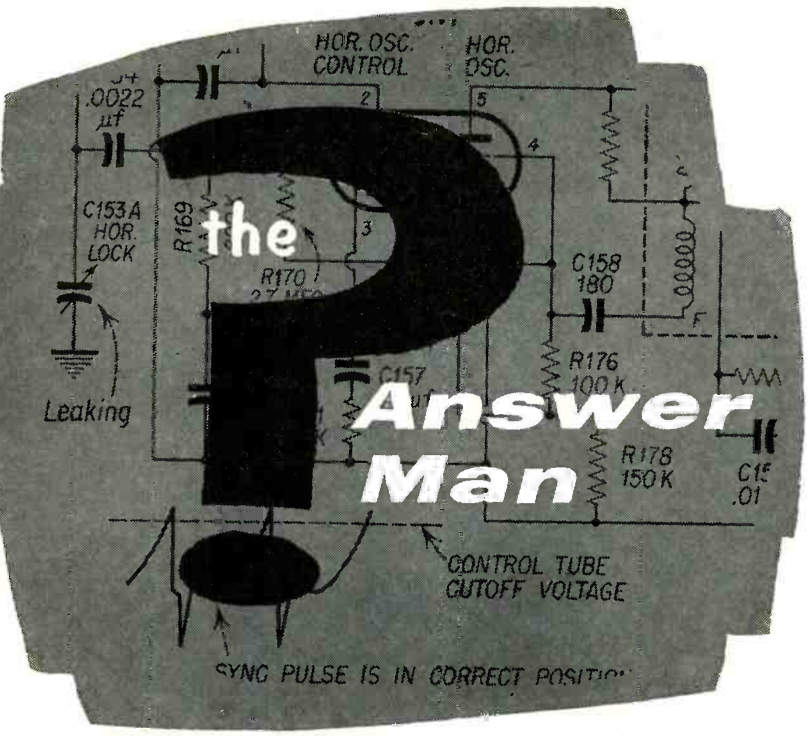


by Bob Dargan

Do you have a vexing problem on the repair of some radio or TV set? If so, send it in to the Answer Man, care of this magazine. All inquiries acknowledged and answered.

Note: Only communications with Radio-TV Service Firm letterheads will be considered and answered. Please indicate make, model, and chassis number of receiver.

Mr. Answerman:

I am having trouble with a no horizontal and vertical sync condition in a TV receiver. I have traced the sync pulses to the grid of a 12AU7 sync clipper stage where the signal voltage is about 50 volts peak to peak in amplitude. The signal at the plate circuit should be about 30 volts peak to peak with a good portion of the video information removed. However, it is very much smaller than this. In fact the signal is so small I have to increse the gain of the scope considerable to see it at all. The plate voltage is a little higher than called for in the service literature being about 36 volts. The components and tube in this stage have been thoroughly checked and some have even been substituted for. Enclosed is a diagram of the circuit.

Where do you think I may have slipped up.

W. T.
Chicago, Ill.

From the schematic supplied, *Fig. 1*, it can be noted that the plate voltage called for is 25 volts and as stated in the letter was found to be 36 volts. This

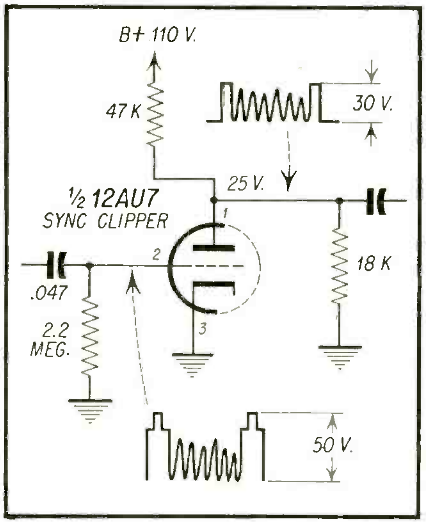


Fig. 1—A sync clipper stage where the video information should be partially removed.

would indicate that the tube is not conducting. It can be conclusively confirmed by measuring the voltage at the tube socket terminal #1 with the tube removed. It will undoubtedly be found that the voltage at the plate terminal will be the same with the tube in the socket and with it removed. If the tube were conducting the voltage would be lower than when the tube is out of the socket (open circuit voltage). This is an important test of tube conduction when there is no cathode resistor in the circuit. With a cathode resistor it is just a matter of measuring for cathode voltage to determine if the tube is conducting as shown in *Fig.* 2. Also measuring the *dc* voltage across the plate load resistor will indicate whether the tube is drawing current or not.

However, in this case with the 18K resistor to ground, a certain voltage would be found across the 47K plate load resistor in either case. This would be because of the *dc* current flow through the series 18K resistor to ground with the tube out of the socket.

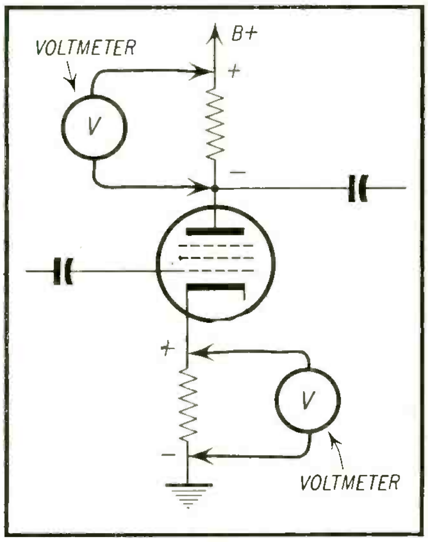


Fig. 2—Measuring voltage drops to determine if a tube is conducting.

Probably the fact that a small waveform was available at the plate of the tube along with plate voltage was misleading. It is suspected that the cathode circuit is open and the waveform obtained at the plate element was due to the signal being passed through the grid to plate internal capacitance of the tube.

It is suggested that the tube socket be closely examined, particularly the cathode pin #3. Probably this pin has been spread or damaged so that contact is not being made. This happens occasionally.

Dear Mr. Answerman:

Can you suggest an easy way to connect up two TV receivers to operate from the same antenna so that there is no interaction between sets.

S. D.
San Diego, Cal.

The two set coupler shown in *Fig.* 3 will permit two TV receivers to operate from the same antenna simultaneously and provide the same signal strength to each receiver input. Most important is the fact that it avoids upsetting the antenna to tuner match and at the same time prevents interaction between the two receivers on all channels.

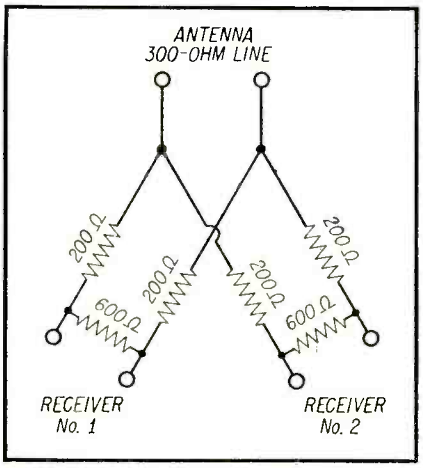


Fig. 3—A 2-stage coupler that will work well for UHF as well as VHF antennas.

The coupler attenuates the signal to each receiver to approximaetly one third of the strength provided by the antenna. This is usually sufficient signal strength to operate with. Within a 30 mile radius this coupler will perform very satisfactorily providing sufficient signal for receivers of recent vintage.

The antenna divider is designed to use 300 ohm transmission line and if care is employed in the construction to obtain a symmetrical layout it will work for UHF tuners as well as VHF receivers. The resistor must be non-inductive and a matched set should be obtained by checking a number of resistors. It is more important that the resistors be matched than it is that they equal the required values.

Of course, excellent two set couplers are available commercially and they will save the technician the time of bothering to obtain and fasten the resistors as well as provide a shielded compartment for the components. This is important in areas where auto ignition noise is a problem.

Dear Mr. Answerman:

I have run into something that has me stumped. How is it that some 1B3 rectifier tubes will work in certain TV receivers and not in others. Yet, on a tube checker they test normal.

W. C.
Philadelphia, Pa.

This is most probably because of the design of recent production 1B3-GT tubes which may have pins 3, 5, 7 and 8 tied together internally. Some TV receivers using voltage doublers may have pins 2 and 3 tied together at the socket to reduce corona effect. The filament winding on the transformer is shorted out if tubes with the above mentioned construction are placed in the socket.

Also, some TV models employ pins 3, 5 and 8 for tie lugs to mount filament dropping or isolating resistors on. The use of the above designed tubes will result in the shorting out of these resistors. This can be seen from an examination of *Fig. 4*. When a 1B3-GT tube is replaced in a receiver using filament dropping resistors or other connections at the 1B3-GT socket, pins 3, 5 and 8 of the tube should be checked to determine if the tube has internal connections to pin 2 or 7. If these connections are found, the wiring of the tube socket must be examined to ascertain if the use of the tube will cause a short circuit to any of the circuit connections. If this occurs, the offending pin or pins on the tube must be clipped off.

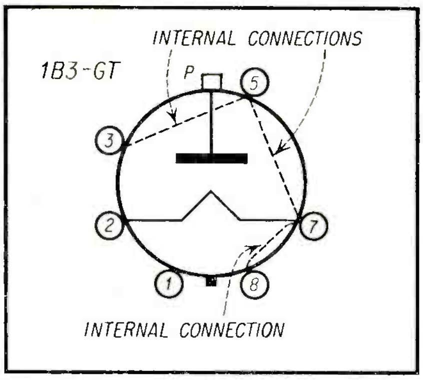


Fig. 4—Internal connections of some newer 1B3-GT tubes.

Present production of 1B3-GT tubes generally has pin 5 in the base but it is not connected to any element in the tube. Therefore, it will not necessitate the removal of this pin as indicated above.

The above information has become important since it has already cost many hours of wasted labor by technicians trying to determine why a particular receiver has no high voltage.

Dear Mr. Answerman:

I have often wondered if there is a suitable method of checking a long antenna lead-in for a break. It is not very desirable to have to climb to the top of the antenna to hook on a jumper so that the lead-in can be checked with an ohmmeter.

L.H.E.
Owensboro, Ky.

My suggestion is to permanently connect a 100,000 ohm resistor across the lead-in terminals at the antenna. Then, if there is any question about the lead-in it is only a matter of measuring the resistance of the lead-in at the TV receiver. This is shown in *Fig. 5*.

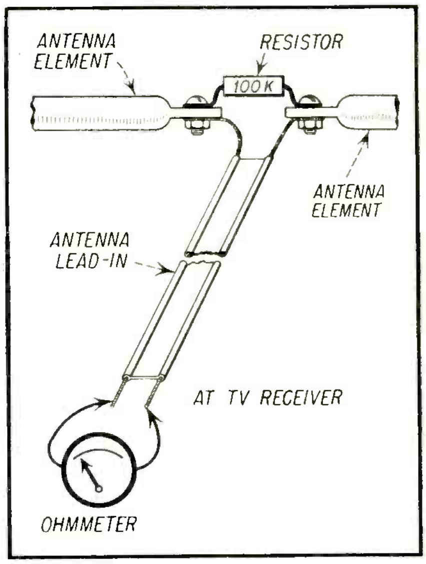


Fig. 5—The connection of a 100K resistor at the antenna provides an easy means of checking the lead-in for breaks.

Generally, the employment of a resistor at the antenna does not cause a reduction in signal strength provided to the receiver since it is so large in value. However, in locations near the ocean the corrosive effect of the atmosphere will cause a reduction of signal strength after a period of time. Because of this it should be used with caution in those installations, subject to salt water conditions, which are always a special problem anyway.

Dear Mr. Answerman:

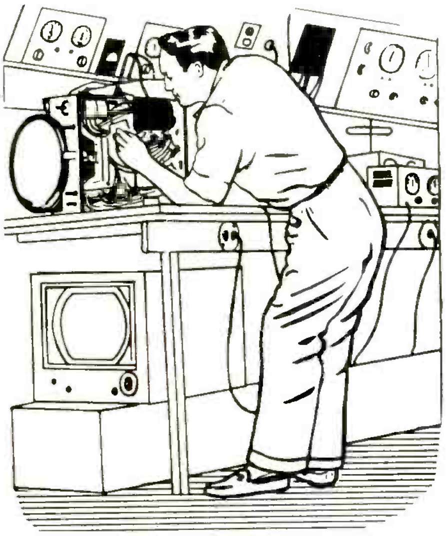
Is there a way to repair the caps on the 6BQ6 tubes when they become loose? Radio solder will not stand the heat and the caps soon become loose again.

F. C. V.
Chicago, Ill.

The extremely high temperature developed in power tubes such as the 6BQ6-GT generally causes the loosening of the top caps. This tube in many cases "runs hot" and the resultant tube life is thereby greatly reduced. In many TV receivers the tube is operated at its maximum capability. The replacement of this tube when it fails with a 6BQ6-GTA or a 6BQ6-GA will greatly eliminate this loosening of the tube cap and reduce early repeat failures.

The 6BQ6-GTA and GA tubes use a larger glass bulb which means that it will radiate the heat easier and operate cooler. A special mica is used with a new processing technique to permit

[*Continued on page 61*]



The Work Bench

by **PAUL GOLDBERG**

This Month:

AGC PROBLEMS

THIS installment is devoted to three *agc* problems involving different *agc* systems.

Shaw-X224

The receiver was turned on and a bad *agc* condition (overload) was observed. The first and second video *if* amplifiers V106 and V107 (*Fig. 1*) and the *rf* amplifier were next replaced individually but had no effect. V112 A and B, the *agc* and sync separater tube was next replaced but also had no effect. The *agc* control *R156* was next adjusted but without effect. A voltage check was now made at pin #1 of V112A which is the *agc* take-off point. The meter measured about 12 volts negative with no signal on the antenna.

At this point a study was made of the diagram. It was noted that this was a variation of a peaked *agc* system. When the composite video signal arrives at pin #7 of V112 B, only the horizontal sync pulse will cause it to conduct because of its bias. This is of course the normal function of the sync separater tube. The cathode voltage which varies in accordance with the size of the horizontal sync pulse at the grid of V112B is fed to pin #2 of V112A, the *agc* amplifier tube. The more positive the voltage at the grid of V112A, the greater the plate current flow, and thus the greater the negative *agc* voltage drop across *R154*, the *agc* load resistor. An *agc* control, R156, functions in the cathode circuit of V112A as a regulator of the *agc* voltage developed.

Knowing these facts, a voltage check was made at the plate of V112B. Here the voltage was substantially correct. Next a voltage check was made at the cathode of V112B. The voltage measured 21 volts negative instead of 30 volts negative (with no signal on the antenna.) This was it. The 21 volt buss was next checked and was found to measure correctly. Thus there was no voltage drop across *R160*, 470K.

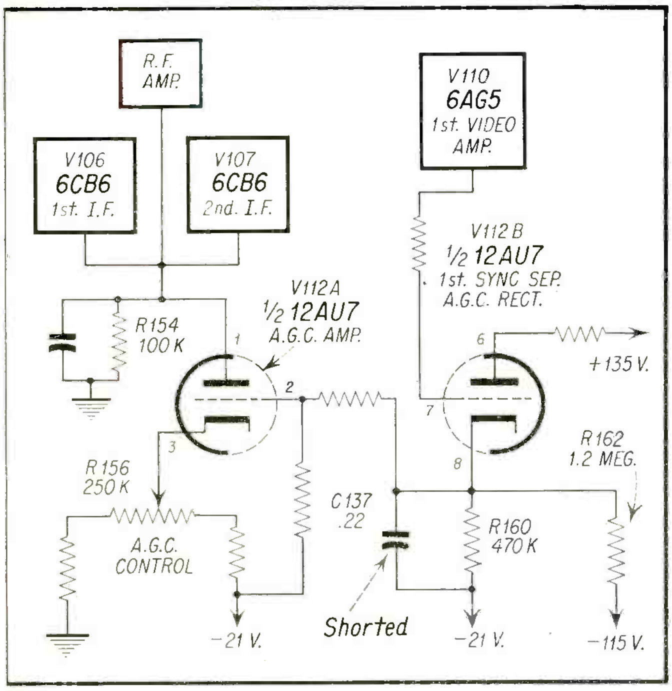


Fig. 1—Partial schematic of Shaw X224 receiver. Here a small difference in grid voltage from the normal turned out to be the real clue.

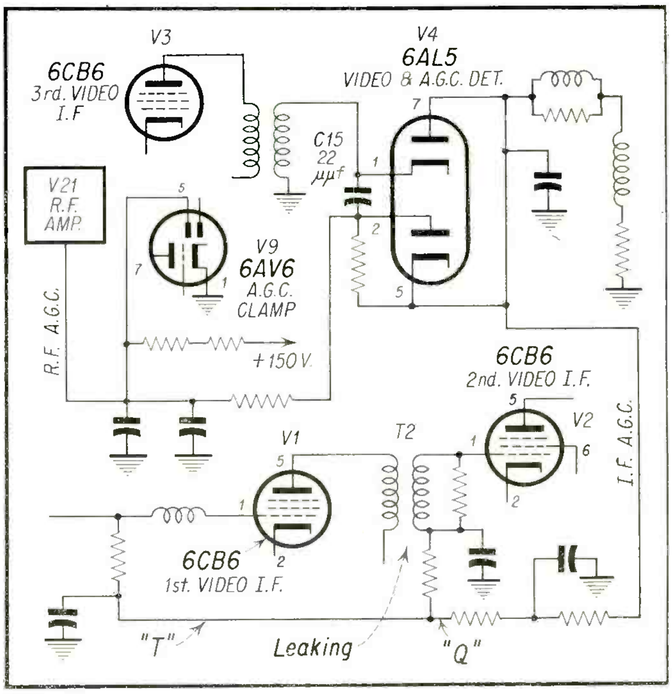


Fig. 2—Partial schematic of Emerson Chassis No. 120163D. In this receiver faulty operation was caused by a slight leakage in the I.F. transformer.

R160 was then resistance measured and was found to measure zero. C137, .22 μf was in parallel with R160 and we obviously assumed that this condenser was the cause of the trouble. C137 was then clipped out of the circuit and resistance checked. It was found to be completely shorted. Replacing the .22 μf condenser, we adjusted the *agc* control and the receiver now functioned properly.

It can be seen that because C137 shorted, the voltage on the grid of V112A became *less* negative by 9 volts (–30 V to –21 V) causing the higher plate current and the negative cutoff *agc* condition of –12 volts.

Emerson Chassis #120163D

The receiver was turned on and it was immediately noted that there was a video overload condition. Referring to *Fig.* 2 V1 and V2, the first and second video *if* amplifiers, V21, the *rf* amplifier, V4, 6AL5 video and *agc* detector, and V9, 6AT6, part of which is the *agc* clamper, were all replaced individually but had no effect on the trouble.

The diagram was then consulted and it was found that this receiver uses an *agc* detection system with delayed *agc* provided for the tuner. This is accomplished by an *agc* detector (V4 pins 2 and 5) which is used to rectify the positive half of the modulation envelope and is keyed with the negative sync pulses above the average *dc*. This voltage is superimposed on the average *dc* voltage developed by the video detector (V4 pins 1 and 7) across R17—4.7K. Thus fundamentally, the *dc* output of the video detector is being used for the video *if—agc* voltage.

Knowing this an *agc* voltage check was made at point "Q" to ground. The meter measured three volts positive. Here was trouble. The *agc* lead was then clipped at point "Q" and a voltage measurement was taken at point "T" to ground. Again the meter read three points positive. Obviously, the first and second video *if* amplifiers were causing some trouble. A voltage check was now made at pin #1 of V2 and the lead was now clipped at point "T". Again, the meter read three volts positive. V2, 6CB6 was removed from its socket as a final check. A voltage reading again showed three volts positive at V2's control grid. Thus, with everything clipped from V2's control grid circuit, the second *if* transformer T2 seemed to be the cause of the trouble. The grid side of T2 was next clipped from the circuit and was found after measurement to be leaking three volts primary to secondary. T2 was then replaced with a new *if* transformer. Everything we had clipped was then resoldered and the receiver was then turned on and performed normally.

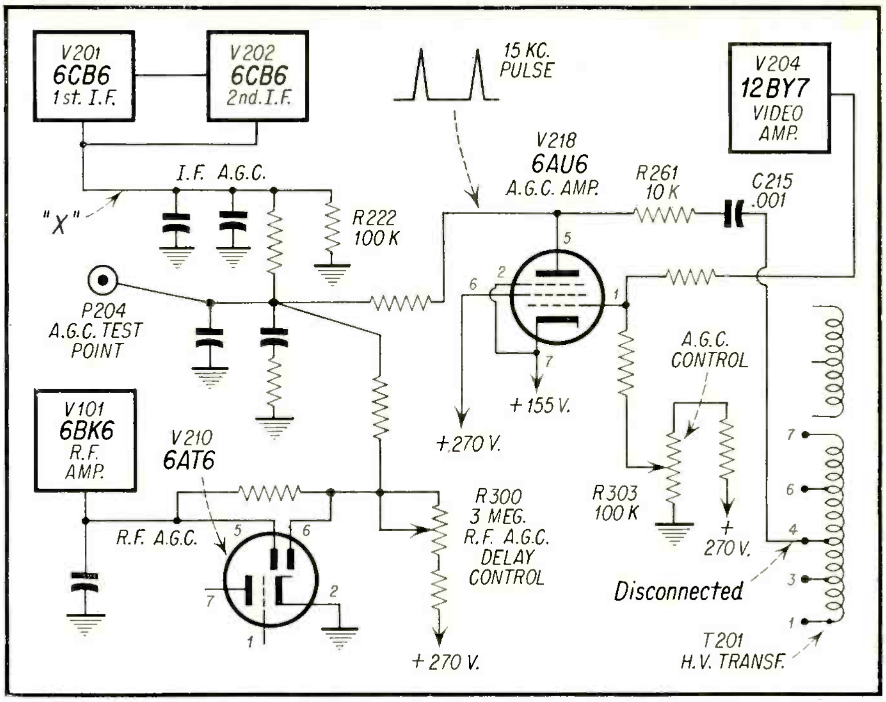


Fig. 3—Partial schematic of Du Mont RA-306 receiver. Here, an unusual break in the output transformer lead caused by faulty soldering produced an unusual agc condition resulting from the keyed system used.

DuMont RA-306

The receiver was turned on and it was observed that there was a severe video overload condition. Adjusting the *agc* control R303 and the *rf-agc* delay control R300 (See Fig. 3) had no effect. The *agc* amplifier V218, 6AU6, the first and second video *if* tubes, V201 and V202 and the *rf* amplifier, V101, 6BK7 were all replaced individually but had no effect. The 6AT6, V210 whose diodes act as the *agc* delay tubes were also replaced but had no effect.

Reference to the diagram revealed that this was a keyed *agc* system with delayed *agc* for the tuner. The composite video signal is fed from the plate circuit of the video output tube, V204, 12BY7, to the control grid of the *agc* tube V218. Arriving simultaneously with the horizontal sync pulse (only the horizontal sync pulse of the composite video signal is used to trigger the *agc* tube) at the control grid of V218, is a positive pulse from the H.O.T. at the plate of V218. The bias voltage of the *agc* tube is so arranged as to allow it to conduct only on the simultaneous arrival of the positive pulse at the plate and the horizontal sync pulse at the control grid. V218's plate current causes a negative voltage drop across its plate load, R222, 100K. This negative voltage drop is the *agc* voltage (the greater the horizontal sync pulse, the greater the *agc* voltage drop) which is fed back to the first and second video *if* amplifiers. To prevent *agc* action on the tuner on weak signals a damping diode V210B and bucking voltage are employed.

With these facts in mind, a voltage check was made at the *agc* test point P204. Instead of 7 volts negative as the diagram called for, a voltage reading of less than one volt was read on most channels. The *if-agc* buss was then clipped at point X and a voltage measurement was again taken at P204. The meter again read approximately one volt negative. The leads were then re-soldered at clipped point X. The scope was next set up and a pulse check was made at the plate, pin #5 of V218. No 15 kc pulse appeared on the scope. Here was the trouble.

A pulse check was next made at the high voltage transformer side of C215 the pulse coupling condenser. Here again, no pulse showed on the scope. It seemed improbable that trouble could occur in the high voltage transformer to only affect *agc* and not the high voltage. A waveform check was made nevertheless directly at terminal 4 of the high voltage transformer. Again no pulse could be viewed on the scope. Terminal 4 was now examined and the pigtail was found to be disconnected from the terminal. The transformer pigtail was next resoldered to terminal 4. The receiver was turned on, the *agc* controls were adjusted and the receiver now functioned properly.

The high voltage was not affected because, although the pigtail was disconnected from the terminal, it is made up of two thin leads which were nevertheless soldered together.

Mfr: Fada **Model No.** S4C20

Card No: S4C20-1

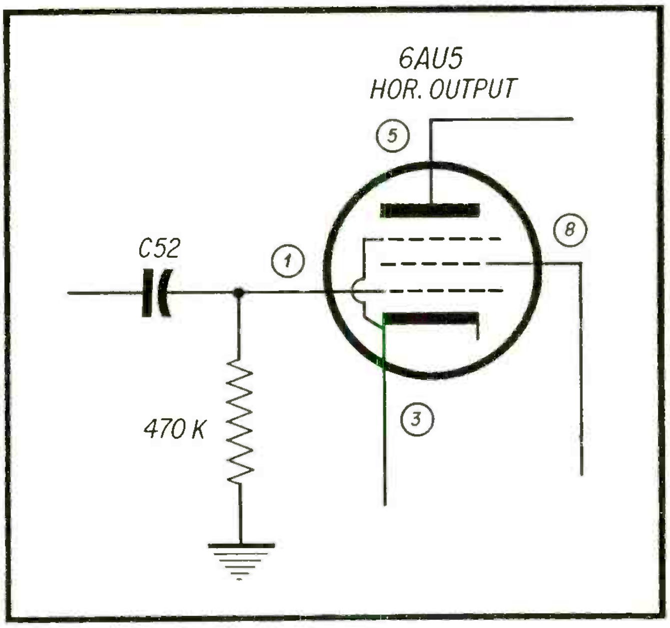
Section Affected: Raster

Symptom: No high voltage

Cause: Shorted condenser

What To Do:

Replace: *C52* (.01 μf)



Mfr: Fada **Model No.** S4C20

Card No: S4C20-2

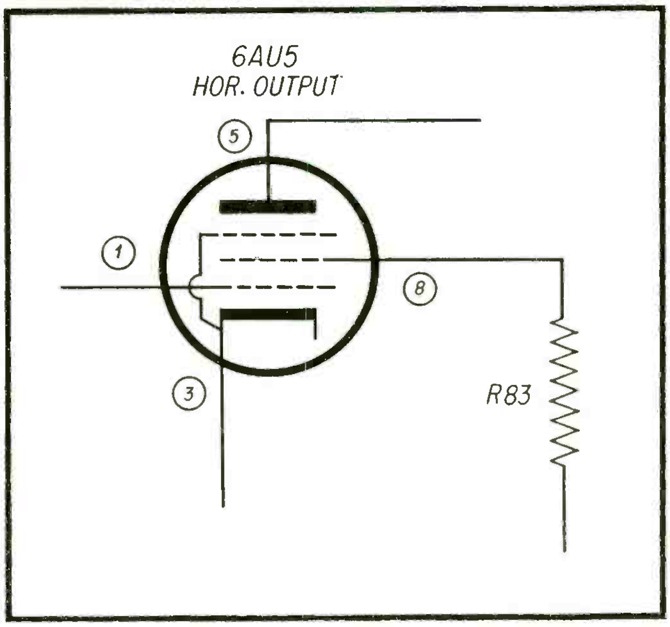
Section Affected: Raster

Symptom: Intermittent high voltage

Cause: Defective resistor

What To Do:

Replace: *R83* (8. 2K)



Mfr: Fada **Model No.** S4C20

Card No: S4C20-3

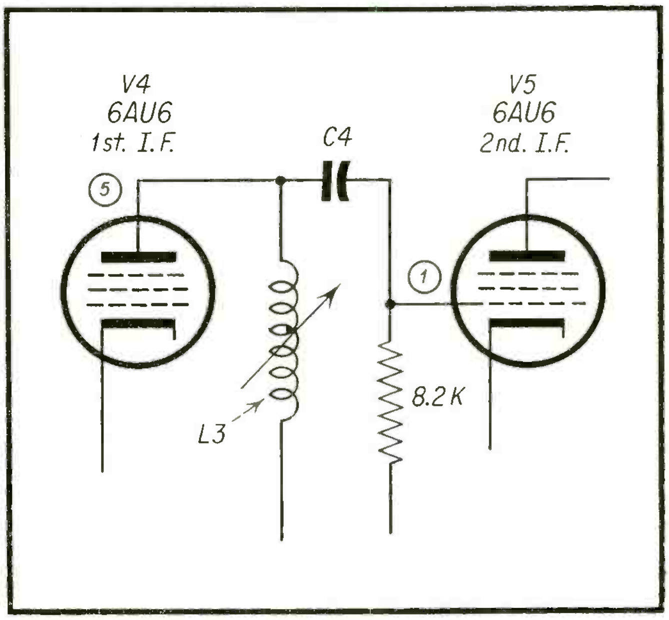
Section Affected: Pix

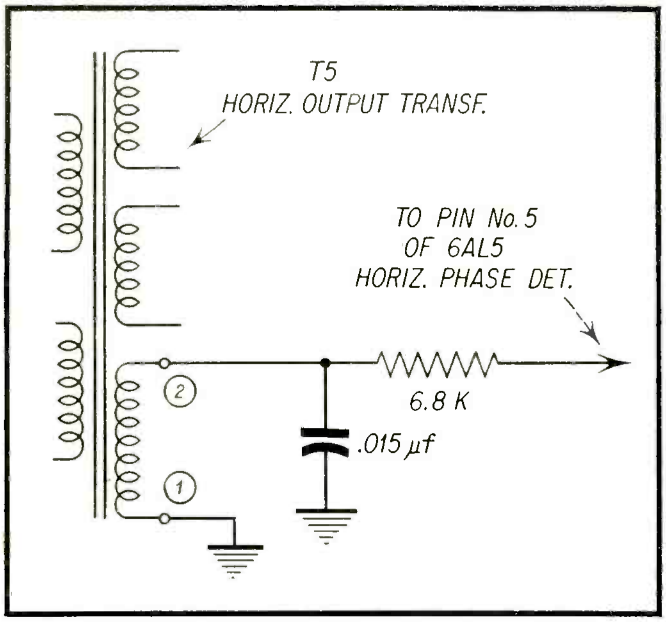
Symptom: Video Overload

Cause: Leaky condenser

What To Do:

Replace: *C4* (120 $\mu\mu f$)





Mfr. Fada **Model No.** S4C20

Card No: S4C20-4

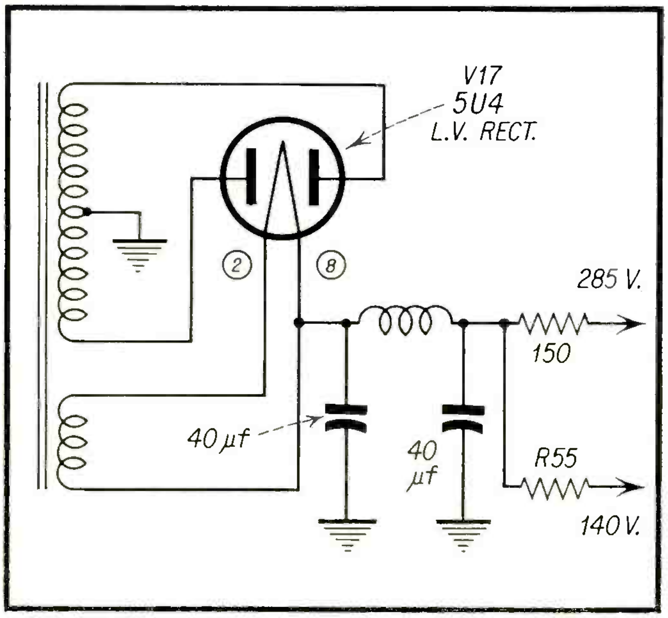
Section Affected: Sync

Symptom: No horizontal hold

Cause: Open H.O.T. feedback winding (terminals No. 1 and 2)

What To Do:

Replace: Horizontal output transformer (*T5*)



Mfr: Fada **Model No.** S4C20

Card No: S4C20-5

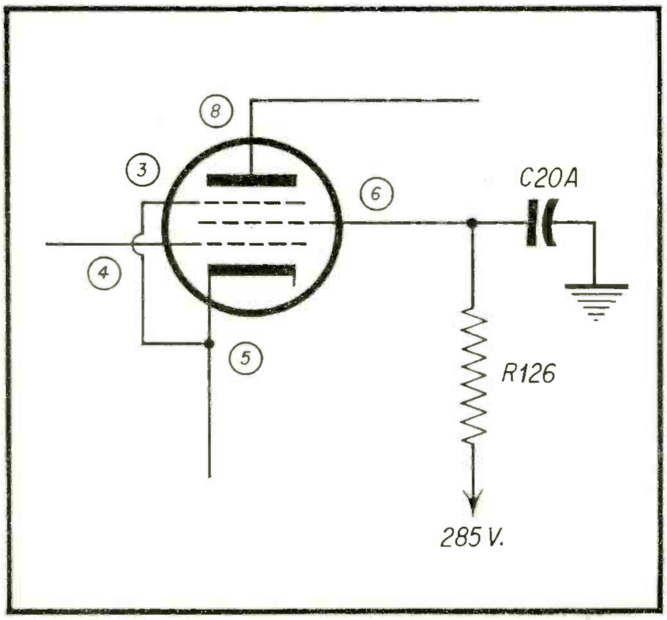
Section Affected: Pix and sound

Sympton: No pix, no sound

Cause: Open resistor

What To Do:

Replace: *R55* (2K)



Mfr: Fada **Model No.** S4C20

Card No: S4C20-6

Section Affected: Pix and sound

Symptom: No pix, poor sound

Cause: Open resistor (and/or) leaky condenser

What To Do:

Replace: *R126* (56K)
Check: *C20A* (20 µf) for leakage

Mfr: Silvertone **Model No.** 173-16

Card No: SI 173-1

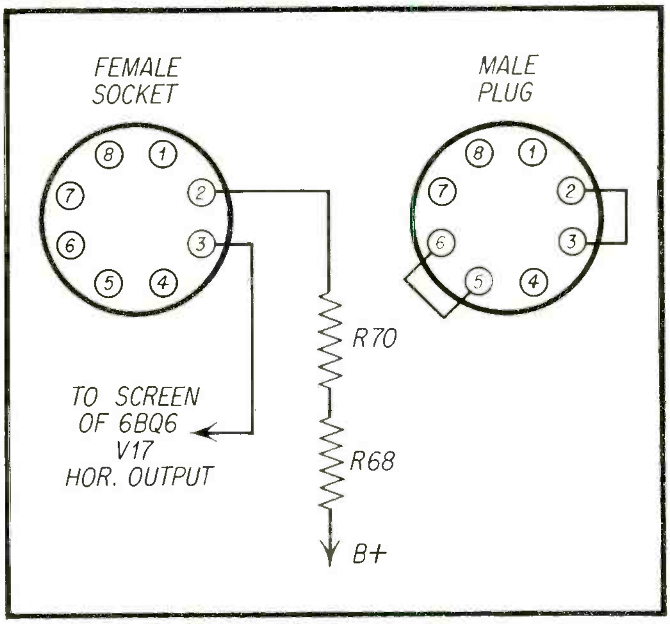
Section Affected: Raster

Symptom: Width collapses intermittently

Cause: Resistors change in value

What To Do:

Replace: *R68* (4.7 K), *R70* (4.7 K).



Mfr: Silvertone **Model No.** 173-16

Card No: SI 173-2

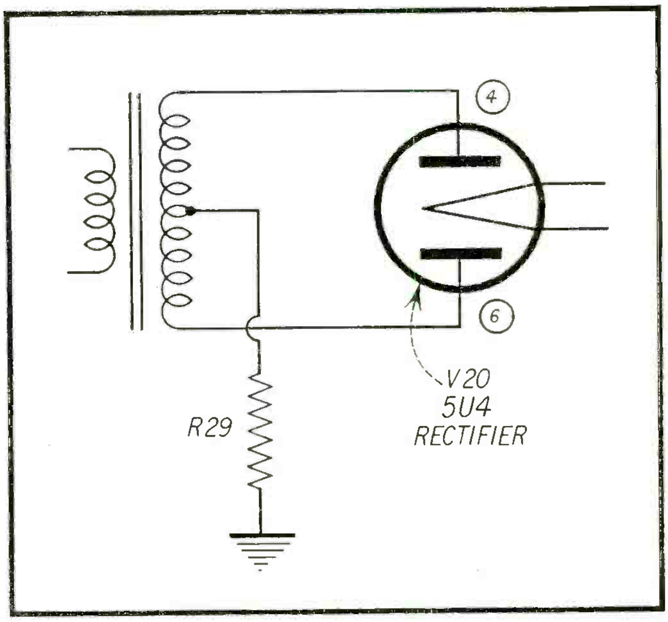
Section Affected: Sound and raster

Symptom: No sound, no raster (no B+)

Cause: Open resistor in B– circuit

What To Do:

Replace: *R29* (60 ohms)



Mfr: Silvertone **Model No.** 173-16

Card No: SI 173-3

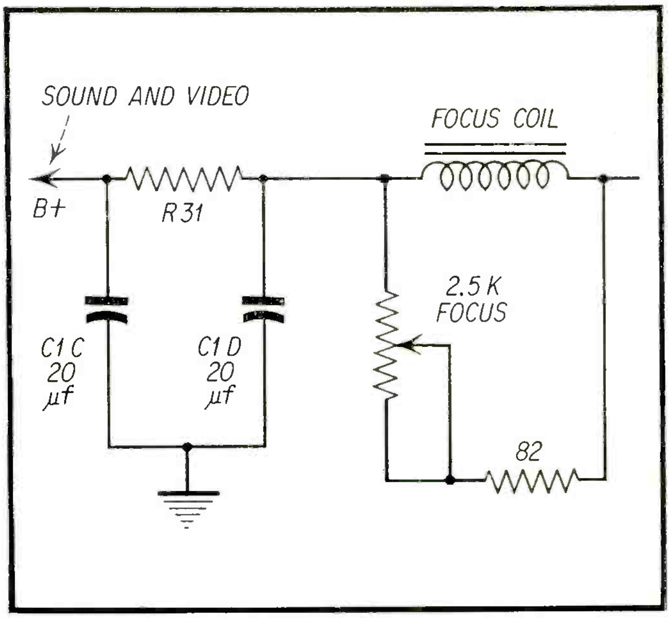
Section Affected: Sound and Pix

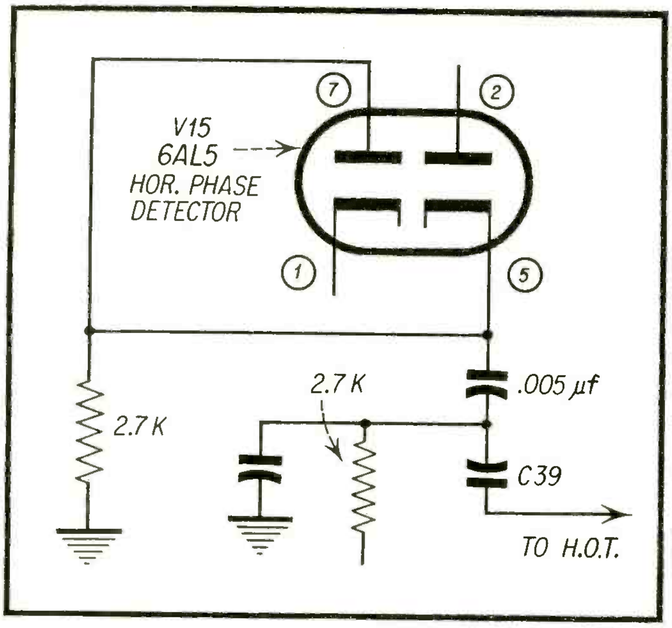
Symptom: No sound, no pix

Cause: Open resistor on B+ circuit

What To Do:

Replace: *R31* (2.5 K)





Mfr: Silvertone **Model No.** 173-16

Card No: SI 173-4

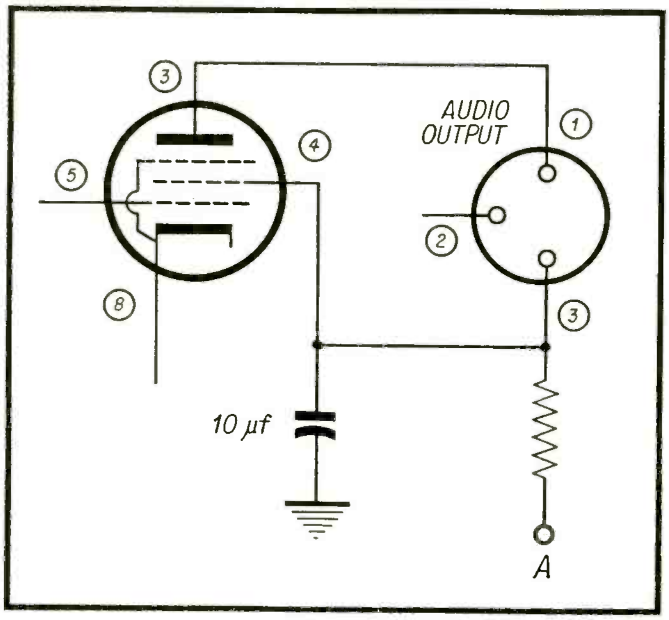
Section Affected: Sync

Symptom: Horizontal hold critical

Cause: Leaky phase detector coupling condenser

What To Do:

Replace: *C39* (.005 µf)



Mfr: Silvertone **Model No.** 173-16

Cardo No: SI 173-5

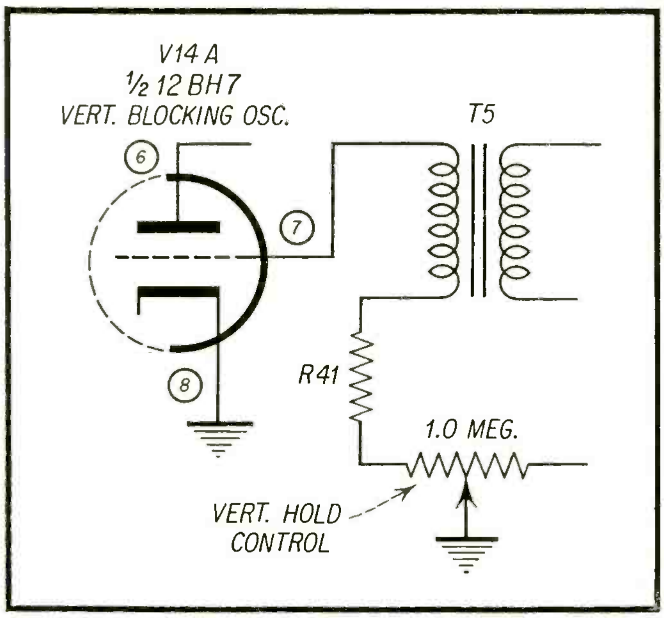
Section Affected: Sound

Symptom: No sound

Cause: Open B+ resistor

What To Do:

Replace: *R50* (3250 ohms)



Mfr: Silvertone **Model No.** 173-16

Card No: SI 173-6

Section Affected: Sync

Symptom: Vertical hold drifts out of range

Cause: Resistor increases in value

What To Do:

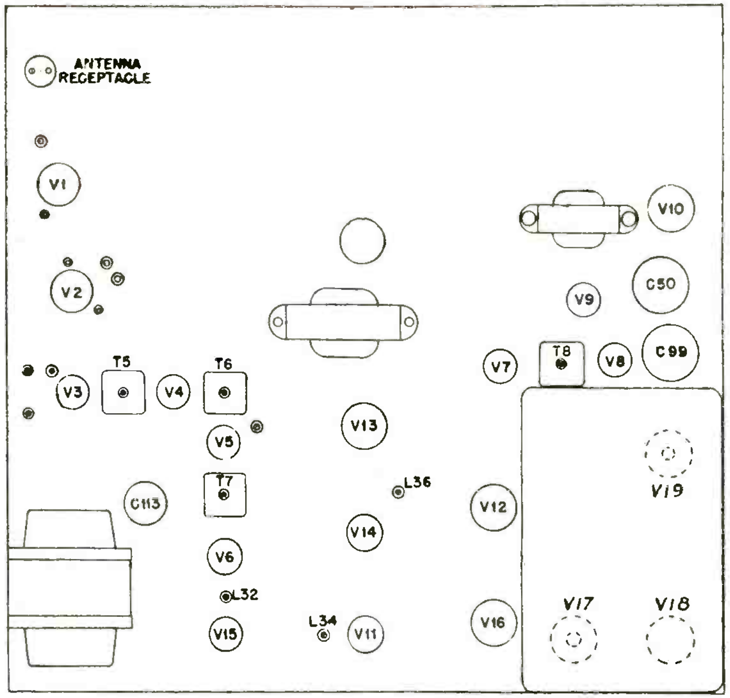
Replace: *R41* (1.2 meg)

MOTOROLA

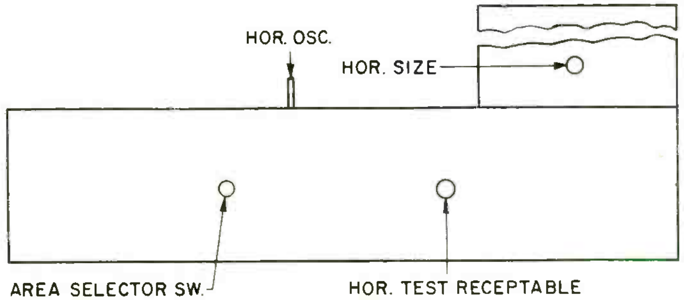
Models 24K1, 1B; 24K2, -2B; 24K3, -3W; 27K2, -2B; 27K3; Y24K1, 1B; Y24K2, 2B; Y24K3, 3W; Y27K2, 2B; Y27K3.

TUBE LIST

Symbol	Type	Circuit Function
V-1	6BQ7A (6BZ7)	RF Amp
V-2	6U8	Mixer-Oscillator
V-3	6CB6	1st IF Amp
V-4	6CB6	2nd IF Amp
V-5	6CB6	3rd IF Amp
V-6	12BY7	Video Amp
V-7	6AU6	2nd Audio IF Amp
V-8	6AL5	Ratio Detector
V-9	6AV6	1st Audio & RF AGC Clamp
V-10	6V6	Audio Output
V-11	12AU7	AGC
V-12A	½ 6SN7	Vertical Oscillator
V-12B	½ 6SN7	Phase Detector
V-13	6BX7	Vertical Output
V-14	12AU7	Sync Amp & 1st Audio IF
V-15	6CS6	Sync Sep & Noise Gate
V-16	6SN7	Horiz Oscillator
V-17	6CD6	Horiz Output
V-18	6AU4	Damping Diode
V-19	1B3	High Voltage Rectifier
V-20	24VP4 24CP4A	Picture tube with aluminized screen
	27RP4	Picture tube, aluminized screen
CR-1	Germanium diode	Video Detector



TOP VIEW

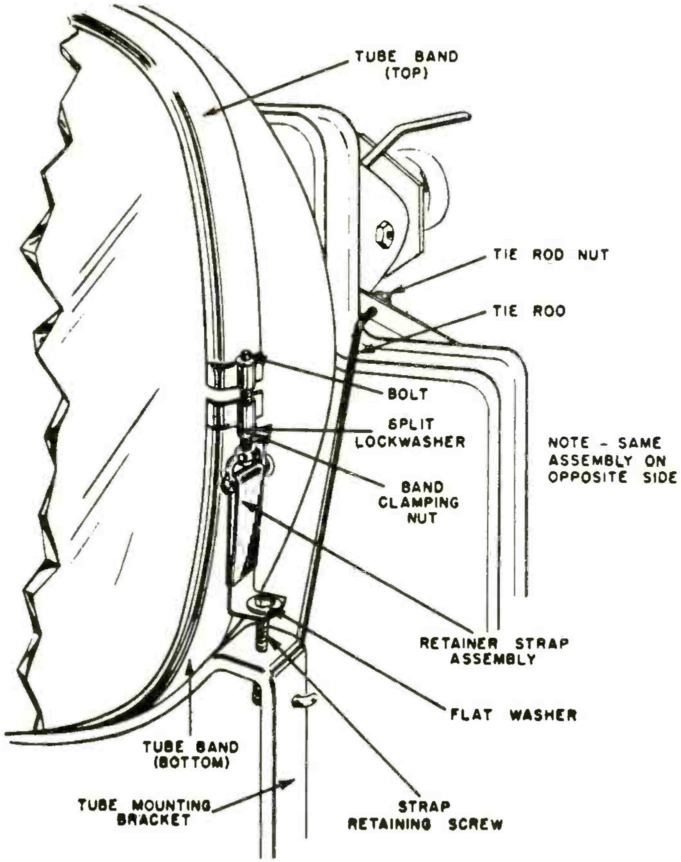


REAR CONTROLS

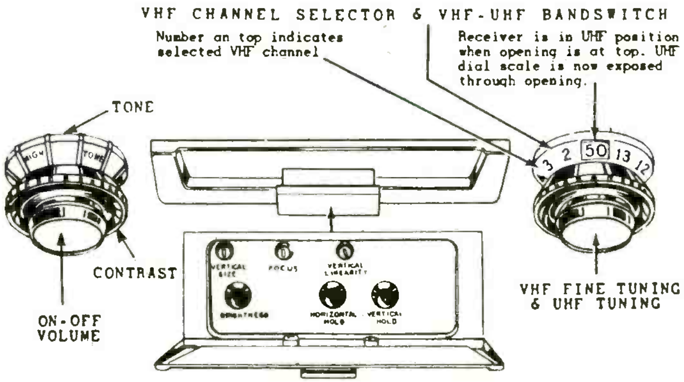
KEY VOLTAGES

B+, plate of damper, V18 pin 5	280 vdc	Plate(s) of Hor. Osc. V16 pin 2	160 vdc
Boosted B+, cath. of damper, V18 pin 3	580 "	pin 5	240 "
Plate of VERT. OSC., V12 pin 5	22 "	Grid of Hor. Out., V17 pin 5	-31 "
Plate of Vert. Out., V13 pins 2 and 5	260 "		

(All voltages are measured with a VTVM connected between the tube pins and chassis.)



PICTURE TUBE MOUNTING DETAIL



FRONT CONTROLS

TV FIELD SERVICE
Pre-published from Rider "TV Field Service Manual"
by Rider & Alsberg

ADJUSTMENTS

HORIZONTAL HOLD ADJUSTMENT

The HORIZONTAL HOLD should remain in sync throughout a 70° rotation of the control. If the control is too critical, adjust as follows:

1. Shunt the HORIZONTAL OSCILLATOR Coil L-37 to ground with a .25 mf 400V capacitor. This may be done with the chassis in the cabinet by placing the capacitor across the two-pin receptacle (J-9).
2. With the centering lever, move the picture to the left so that the right edge of the raster can be seen, as viewed from the front of the set. Adjust the HORIZONTAL HOLD control so that center of blanking pulse is on edge of raster. (The blanking pulse is the gray bar at the right edge of the raster.)
3. Remove the .25 mf capacitor from across the HORIZONTAL OSCILLATOR coil.
4. Adjust the HORIZONTAL OSCILLATOR coil until the same amount of blanking pulse can be seen as was noted in step 2.

AREA SELECTOR SWITCH

A three-position AREA SELECTOR switch, located on the back of the chassis, permits the receiver to be adapted to varying receiving conditions found in different localities.

The LOCAL SUBURBAN, and FRINGE positions correspond approximately with the setting required for strong, medium, or weak signals, respectively.

Since the AREA SELECTOR switch allows the receiver to operate under best conditions for the signal strength at your location, an incorrect setting may give poor picture quality, cause overloading, instability, or a buzzing sound in the speaker. Set this switch in the position which gives the clearest and most stable picture.

PICTURE TUBE REMOVAL & INSTALLATION

The 24" and 27" picture tubes have a metal band around the face of the picture tube intended to reduce the hazards of implosion as well as to simplify mounting of the picture tube.

PICTURE TUBE REMOVAL

1. Remove the mounting board containing the chassis and picture tube from the cabinet by removing the screws holding the board to the cabinet.
2. Remove the picture tube socket, ion trap, and high voltage lead.
3. Loosen the tie rod nuts.
4. Remove the strap retaining screws which hold the picture tube to the front picture tube support bracket.
5. Remove the picture tube and band, and place face up in unused tube carton.
6. Loosen the band clamping nuts and remove band from old tube. DO NOT BEND OR KINK BAND.

FUSE REPLACEMENT

B+ and Initial Surge Fuse (Special 7.5 ohm resistor)

This fuse is of the plug-in-type and is accessible by removing the cabinet back.

Filament Fuse F-1 (1" No. 26 copper wire)

To replace the filament fuse, the chassis must be removed from the cabinet. The fusing wire is in series with the heavy green lead from the filament transformer. To replace, use a piece of No. 26 wire 1" long soldered between the two lugs.

INSTALLATION OF PICTURE TUBE

Extreme caution should be observed when installing the new picture tube.

1. Open the picture tube carton, making sure the *face of the tube is up.*
2. Slit the carton down the corners about 4". Bend the sides of the carton down, so that the face of the picture tube is accessible.
3. Place picture tube band on the new tube, being very careful that the front of the band is snug to the face of the tube. BE SURE THE ANODE CONNECTOR IS ON THE CORRECT SIDE.
4. Tighten the band clamping nuts gradually, alternating between the left and right nuts until they are very secure (25 to 30 inch pounds). Hold the bolt heads with an open end wrench to prevent rotation.
5. Slip the neck of the picture tube through the yoke and focus coil until the flare of the tube is against the rubber cushion.
6. Insert the strap retaining screws through the strap retaining brackets and tighten the screws to tube mounting bracket.
7. After the strap retainer screws are tightened, go back and check the band clamping nuts to make sure they are secure.
8. Tighten tie rod nuts. Replace the ion trap and picture tube socket and proceed to check ion trap, deflection yoke, and focus coil adjustments, as described in this service manual.

CHANGING OF TUBES

1. The power should be turned off when changing tubes.
2. *Indiscriminate changing or interchanging of tubes should be avoided for the following reasons:*

a. A change of IF or RF tube or crystal detector can cause loss of sensitivity or poor picture quality. Check alignment and sensitivity after making such changes.

b. A change of limiter or ratio detector tubes can cause distorted audio, buzz, or loss of audio sensitivity. Check audio alignment and sensitivity.

c. Changing the horizontal oscillator tube can result in poor noise rejection or cause the horizontal hold control to be out of range. This may necessitate readjustment of the horizontal oscillator coil.

MOTOROLA TROUBLE SHOOTING CHART

NO RASTER—NO SOUND
- Power input circuit
- Check B+ fuse (7.5 Ω special res. filament)
- Check Selenium Rectifiers

NO RASTER—SOUND OK
- Brightness con.
- Ion trap
- V16, V17, V18, V19, V20
- HV trans. Hor. yoke CRT connections

WEAK PIX—SOUND AND RASTER OK
- Tuner fine tuning
- Contrast con.
- V3, V4, V5, V6, V11
- Check Vid. Det. xtal (Top of T7)
- Check Area Selector

POOR HOR. LIN.
- V17, V18
- Check 0.47 μf cap. connected to terminal 1 of hor. out. trans.
- Hor. Out trans.

POOR VERT. LIN.
- Vert. Size and Lin. con.
- V12, V13
- Check 0.047 and 0.15 μf caps. connected to pin 5 of V12
- Check 250 μf Elec. cap. connected to pin 3 of V13
- Vert. Out. trans.

PIX JITTER UP & DOWN
- Vert. Hold and Contrast con.
- V12, V13, V15
- Check Area Selector
- Check 4700 μμf cap. connected to pin 6 of V12

SMEARED PIX
- Tuner fine tuning
- Contrast con.
- V3, V4, V5, V6, V11
- Check Vid. Det. and Amp. peaking coils
- Check Vid. Det. xtal (Top of T7)
- Check Area Selector
- IF and RF alignment

SOUND BARS IN PIX
- Tuner fine tuning
- V1, V2, V3, V4, V5, V6
- Check adjustment of L32
- IF and RF alignment

ENGRAVED EFFECT IN PIX
- Tuner fine tuning
- Contrast con.
- V2, V3, V4, V5, V6, V11, V12, V20
- Check Area Selector
- Check Vid. Det. and Amp. peaking coils

VERT. BARS
- V17, V18
- Check 82 μμf cap. connected to yoke terminal 7
- Defl. yoke ringing

PIX BENDING
- Hor. Hold and Osc. con.
- V11, V12, V16, V17
- Check 3300 μμf and 0.01 μf caps. connected to pin of V16

INSUFFICIENT BRIGHTNESS
- Ion trap
- Brightness con.
- V17, V18, V19, V20
- Low line voltage

RASTER BLOOMING
- V17, V19, V20
- Check HV Filter cap.

INSUFFICIENT RASTER WIDTH
- Hor. Size con.
- V16, V17, V18
- Check 470 and 4700 μμf caps. connected to pin 2 of V16
- Hor. Out. trans.
- Low line voltage

INSUFFICIENT RASTER HEIGHT
- Vert. Size and Lin. con.
- V12, V13
- Check 0.047 and 0.15 μf caps. connected to pin 5 of V12
- Check B+ voltage
- Vert. Out. trans.
- Low line voltage

NO VERT. SYNC.—HOR. SYNC. OK
- Vert. Hold con.
- Vert. Int. network
- V12, V13
- Check 4700 μμf cap. connected to pin 6 of V12

NO HOR. OR VERT. SYNC—PIX SIGNAL OK
- V11, V12, V14, V15
- Check 0.047 μf cap. connected to pin 2 of V14
- Check 0.022 μf cap. connected to pin 2 of V11

DISTORTED SOUND
- Tuner fine tuning
- V2, V7, V8, V9, V10, V11, V12, V14
- Check 0.0047 μf cap. connected to pin 5 of V10
- Sound and Vid. IF alignment L34, L36
- Det. alignment T8

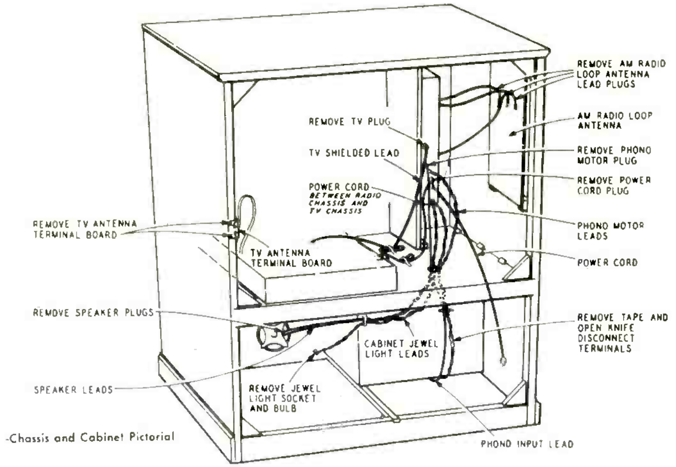
MONTGOMERY WARD

Models 25WG-3060A
25WG-3070A

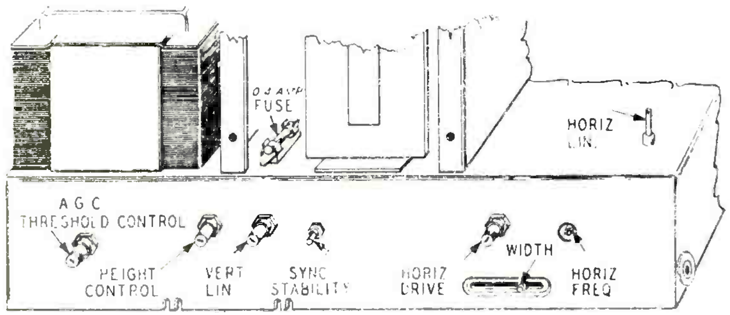
TUBE LIST

SYMBOL	TYPE	CIRCUIT FUNCTION
Tuner	6J6	R-F Osc. and Mixer
*Tuner	6BQ7	R-F Amp
V-1	6CB6	1st I-F Amp.
V-2	6CB6	2nd I-F Amp.
V-3	6CB6	3rd I-F Amp.
V-4	6AL5	Video Det., DC Rest.
V-5	12AT7	Video Amp. and Phase Splitter
V-6	6AH6	Video Output
V-7	6BE6	Sync. Separator
V-8	6SN7-GTA	Vert. Osc. & Output
V-9	6AU6	Auto. Gain Control
V-10	6AU6	1st Audio I-F
V-11	6AU6	2nd Audio I-F
V-12	6AL5	Ratio Detector
V-13	6AV6	1st Audio Amp.
V-15	6AL5	Phase Detector
V-16	6SN7-GTA	Horiz. Oscillator
V-17	6BQ6-GT	Horiz. Output
V-18	6W4-GT	Damper
V-19	1B3-GT	High Voltage Rect.
V-20	5U4-G	Low Voltage Rect.
V-21	21MP4	Picture Tube

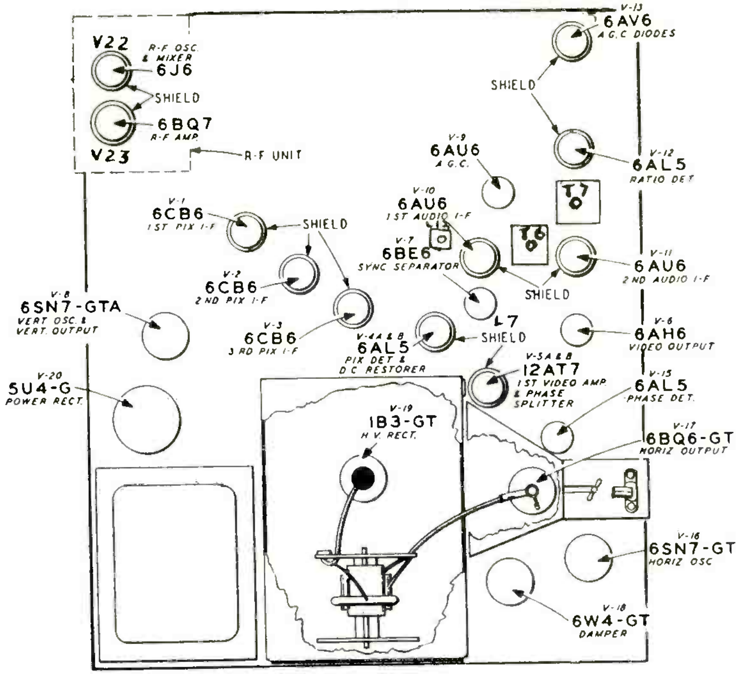
*For replacement purposes a 6BZ7 tube may be used in place of a 6BQ7 tube.



-Chassis and Cabinet Pictorial



REAR CONTROLS

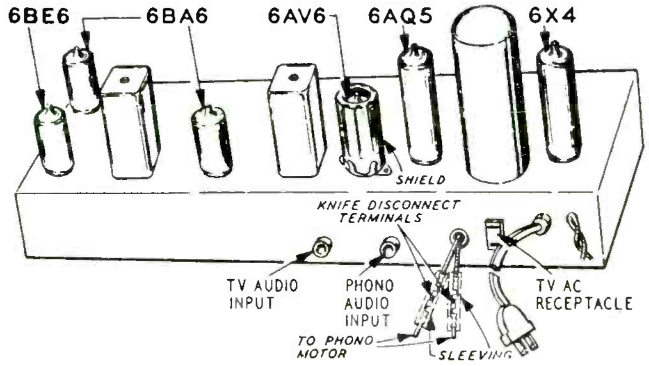


TOP VIEW

KEY VOLTAGES

B+, plate of damper, V18, pin 5 — 300 vdc
Boosted B+, cath. of damper, V18, pin 3 — 510 "
Plate of VERT. OSC., V8 pin 2 — 75 to 200 "
Plate of Vert. Out., V8 pin 5 — 500 "
Plate(s) of Hor. Osc. (and control), V16
pin 2 — 175 to 200 "
pin 5 — 260 "
Grid of Hor. Out., V17 pin 5 — −26 to −35 "

(All voltages are measured with a VTVM connected between the tube pins and chassis.)



TUBE LAYOUT (RADIO CHASSIS)

ADJUSTMENTS

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT

Tune in a station and adjust the horizontal hold control until the picture falls into sync. Momentarily remove the signal by switching off channel and then back. The picture should pull into sync over a range of 90° rotation of the horizontal hold control. If in the above check the receiver fails to hold sync or the pull-in range is at the extreme end of the control, it will be necessary to make the following adjustment.

HORIZONTAL FREQUENCY ADJUSTMENT

With the horizontal hold control set to the center of its range of rotation, adjust the horizontal frequency control until the picture pulls into sync. Recheck the "Horizontal Oscillator Alignment."

HEIGHT AND VERTICAL LINEARITY ADJUSTMENT

Adjust the height control until the picture fills the mask vertically. Adjust the vertical linearity control until the picture is symmetrical from top to bottom. Adjust the picture centering device to align picture with the mask. Adjustment of any control will require a re-adjustment of the other control.

WIDTH, DRIVE AND LINEARITY ADJUSTMENTS

While receiving a signal from a station (with picture locked in sync) turn contrast control fully counter-clockwise, turn the brightness control up so that the picture appears washed out. Adjust width control until the picture fills the mask. Turn the horizontal drive control clockwise until white bars appear in the left center portion of the raster, then turn counter-clockwise until the white bars just disappear. This adjustment will allow the horizontal system to operate at maximum efficiency. Adjust horizontal linearity control for best linearity. If adjustment of the horizontal drive or horizontal linearity is required, it usually will be necessary to recheck the horizontal oscillator alignment. If adjustment of the horizontal linearity control is required, readjustment of the horizontal drive control will be necessary. Adjust the picture centering device to align the picture with the mask.

PICTURE TUBE SAFETY GLASS

CAUTION—UPON REMOVAL OF THE LAST SCREW AND THE CLEAT THE GLASS WILL FALL FORWARD. SUPPORT THE GLASS WITH ONE HAND AS YOU LIFT IT GENTLY FROM THE CABINET. Clean the safety glass and the face of the picture tube with a soft lint-free cloth dampened with water or mild soapsuds.

ION TRAP MAGNET ADJUSTMENT

The ion trap magnet should be positioned close to the base of the tube with the magnet of the ion trap on the side where the electron gun is nearest the glass neck of the picture tube. From this position adjust the magnet by moving it back and forth and at the same time rotating it slightly around the neck of the picture tube until the brightest raster is obtained on the picture screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Readjust the ion trap magnet for maximum raster brilliance and best focus. MAXIMUM RASTER BRILLIANCE AND BEST FOCUS OCCUR AT THE SAME POINT. Do not sacrifice brilliance for best focus. The ion trap magnet adjustment is a very critical one especially with the electrostatic type zero focus picture tube. Consequently, great care should be taken to make sure that the ion trap magnet is correctly adjusted

ADJUSTMENT OF AGC THRESHOLD CONTROL

Tune the receiver to the strongest station in the area in which the receiver will be used. While observing the picture and listening to the sound, turn the control clockwise until signs of overloading (buzz in sound, washed-out picture) appear. Then turn the control a few degrees counter-clockwise from the point at which overloading occurs. (The stronger the signal input, the more counter-clockwise this setting will be.) In areas where the strongest signal does not exceed 10,000 uv the setting will usually be maximum clockwise. With the control set correctly the AGC will automatically adjust the bias on the R.F. and I.F. amplifiers so that the best possible signal to noise ratio (Minimum snow) will be obtained for any signal input to the receiver.

ADJUSTMENT OF SYNC STABILITY CONTROL

When receiving strong (500 MV or more) signals, set hold controls so that the picture is locked in. Turn the sync control fully counter-clockwise, then, while observing the picture, turn the control slowly clockwise until a minimum amount of bending occurs. If the control is set incorrectly bending, tearing, etc., will be present and when switching from channel to channel the picture will not lock in quickly.

In weak signal areas the control should be set for maximum picture stability. In general the weaker the signal the more clockwise the control should be turned.

When the sync stability control is correctly adjusted the receiver will hold sync without tearing or rolling under even the most adverse noise conditions.

MONTGOMERY WARD TROUBLE SHOOTING CHART

ENGRAVED EFFECT IN PIX
Tuner fine tuning
Contrast con.
V1, V2, V3, V4, V5, V6, V7, V9, V23
AGC con.
Check 0.047 μf cap. connected to pin 1 of V6
Check Vid. Det. and Amp. peaking coils

VERT. BARS
Hor. Drive con.
V17, V18
Check 56 μμf cap. connected to yoke terminal
Defl. yoke ringing

PIX BENDING
Hor. Hold and Freq. con.
AGC and Sync. Stability con.
V9, V15, V16, V17
Check 0.047 and 0.0047 μf caps. connected to pin 4 of V16

INSUFFICIENT BRIGHTNESS
Ion trap
Brightness and Hor. Drive con.
V4, V17, V18, V19, V21
Low line voltage

RASTER BLOOMING
Hor. Drive con
V17, V18, V19, V21
Check HV Filter cap.
Check 1 Meg Ω Res. connected to HV Filter cap.

INSUFFICIENT RASTER WIDTH
Hor. Drive and Width con.
V17, V18, V20
Check 220 and 330 μμf caps. connected to pin 2 of V16
Hor. Out. trans.
Low line voltage

NO RASTER—NO SOUND
Power input circuit
V20
Check B+ Fuse F1 (0.4 Amps.)

WEAK PIX—SOUND AND RASTER OK
Tuner fine tuning
Contrast con.
V1, V2, V3, V4, V5, V6, V9
AGC con.

POOR HOR. LIN.
Hor. Lin. and Drive con.
V17, V18
Check 0.047 and 0.1 μf caps. connected to hor Lin. coil
Hor. Out trans.

INSUFFICIENT RASTER HEIGHT
Vert. Size and Lin. con.
V8, V20
Check 0.1 μf cap. connected to pin 4 of V8
Check 0.047 μf cap. connected to vert. osc. trans.
Vert. Out. trans.
Low line voltage

NO VERT. DEFL.
Check 0.1 μf cap. connected to pin 4 of V8
Check 0.047 μf cap. connected to vert. osc. trans.
Vert. Defl. coils (yoke)
V. O. T. and Vert. Osc trans.

NO VERT. SYNC.—HOR. SYNC. OK
Vert. Hold and Sync. Stability con.
Vert. Int. network
V7, V8
Check 4700 μμf cap. connected to vert. int. network

NO HOR. OR VERT. SYNC.—PIX SIGNAL OK
AGC and Sync. Stability con.
Check 0.01 μf cap. connected to pin 7 of V7
V5, V7

NO HOR. SYNC.—VERT. SYNC. OK
Hor. Hold and Freq. con.
V5, V15, V16, V17
Check 430 μμf cap. connected to pin 1 of V16

NO SOUND—PIX OK
Tuner fine tuning
Vol con.
Speaker (open voice coil or defective connection)
Sound and Vid. IF alignment L13, T6
Det. alignment T7
V10, V11, V12, V13

SYNC. BUZZ IN SOUND
Tuner fine tuning
V9, V10, V11, V12, V13
AGC con.
Sound IF and Det. alignment L13, T6 and T7

POOR PIX DETAIL
Tuner fine tuning
Focus con.
V1, V2, V3
Check Vid. Det. and Amp. peaking coils
IF and RF alignment

SOUND BARS IN PIX
Tuner fine tuning
V1, V2, V3, V4, V22, V23
Check adjustment of L-7
AGC con.
IF and RF alignment

Unusual TUBE TROUBLE Case Histories

by ARTHUR COLEMAN

ALL servicemen will agree that about 90% of the TV service calls are tube troubles. They also will agree that many times they have pulled chasses into the shop only to find to their amazement that a tube was at fault.

This writer has chosen six unusual troubles which he hopes will demonstrate the value of the proper diagnosis of tube troubles.

Emerson 120169B

Trouble: Vertical Range Drifts

Normally, the 6W6 (V-19) in *Fig. 1* would not affect vertical range. However, in this case, pin #1 (N.C.) 6W6 is used as a tie point and pin #1 is leaking to pin #8, the cathode. The leakage becomes greater as the 6W6 heats up. The leakage resistance, as can be seen in the diagram, is in parallel with the vertical hold; thus causing the vertical drift.

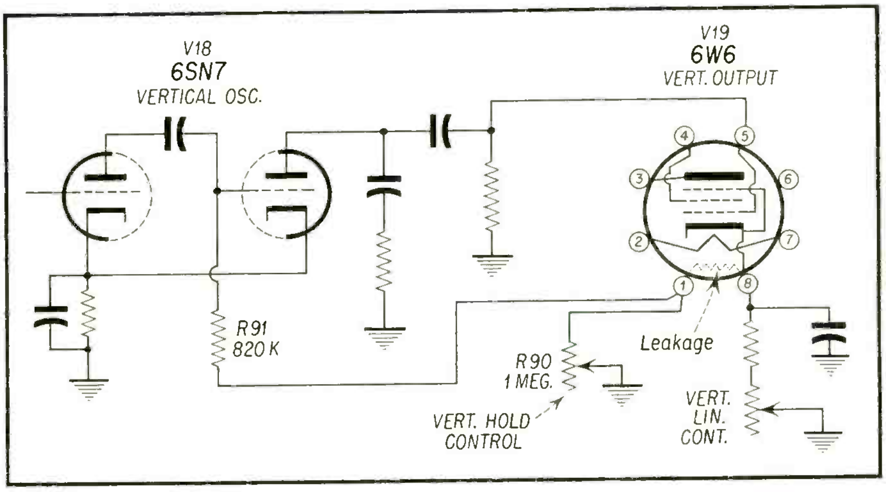


Fig. 1—Partial schematic of Emerson 120169B. Leaky 6W6 causes vertical range to drift. Leakage is between pins 1 and 8.

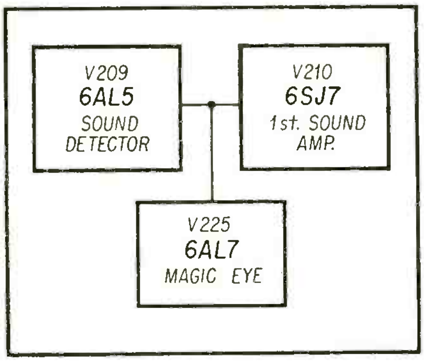


Fig. 2—Trouble caused by 6AL5.

Dumont RA-103C

Trouble: Intermittent 60 Cycle Hum

All the tubes were tapped and checked individually but the trouble could not be found. However, when the 6AL7 (*Fig.* 2) magic eye tube was tapped the hum would appear immediately. Thus, we cannot disregard the 6AL7 as a tube that can also cause trouble. In this case there was an intermittent cathode to filament short causing the 60 cycle hum.

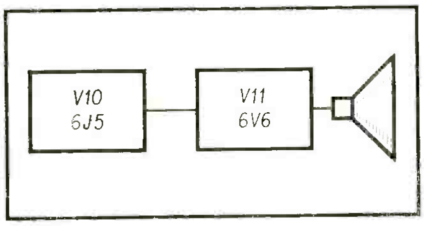


Fig. 3—Trouble due to glass tube.

Motorola TS95

Trouble: Vertical Buzz at Minimum Volume Control Setting

The serviceman changed the vertical tubes (*Fig.* 3) but neglected to change the audio tubes. The trouble was that a glass 6J5-GT was being used instead of a metal 6J5. The vertical section of this receiver being physically close to the audio section, a vertical buzz was picked up by the unshielded 6J5 (V10).

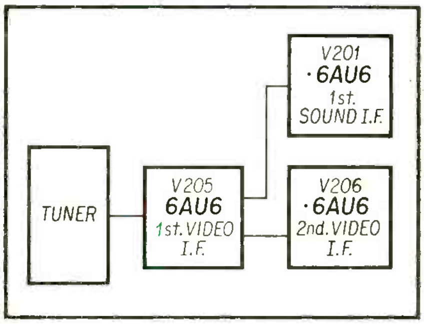


Fig. 4—Misalignment due to tube.

Dumont RA-111

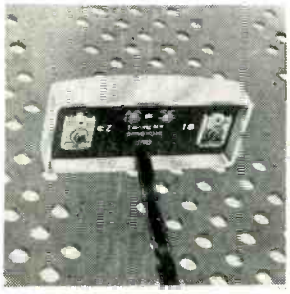
Trouble: Weak Sound

This trouble was caused by V205—*Fig.* 4, the first video *if*, 6AU6. This

[Continued on page 55]

NEW products

for better sales and service

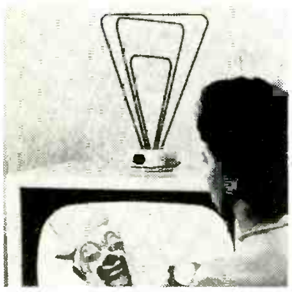


JFD Interference Filter

JFD has developed an interference filter to eliminate "venetian blinds" from the TV screen. It reputedly wave-traps TVI caused by adjacent channel and spillover signals, though it cannot solve the co-channel problem. Its 35 *db* attenuation factor is said to be very effective in dealing with adjacent channel and spillover interference. For info, write: JFD Mfg. Co., 6101 16th Ave., Brooklyn 4, N. Y.

S-R Tuner

The Sargent-Rayment Co., 1401 Middle Harbor Rd., Oakland 20, Calif., has announced the SR-808 Professional Tuner Tone Control. Outstanding features include dual concentric Bass, Treble and Volume, allowing extreme flexibility. Bass can be varied plus or minus 12*db* while independently operated tap control varies turn-over point and rumble filter. Treble can be varied plus or minus 12*db* while independently operated "M" derived low pass noise filter chops 4 positions at a rate of 26*db* per octave.

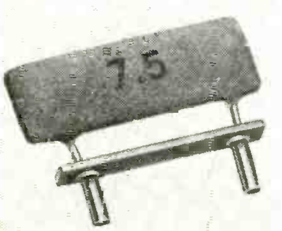


Walsco Indoor Antenna

The Walsco "Star" offers a built-in, electronic rotating and tuning control. Turning the control changes the directivity by selecting the correct combination of elements for each channel. External interference is reported noticeably reduced or eliminated without moving or twisting to find the best angle. For additional information write directly to Walsco Electronics Corporation, 3602 Crenshaw Boulevard, Los Angeles 16, California.

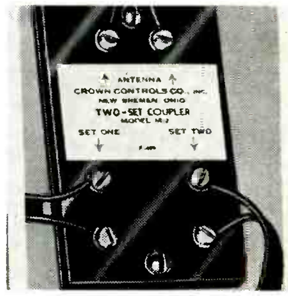
Jensen Strong Box

Jensen Industries, 7333 W. Harrison St., Forest Park, Ill., is offering needle retailers a special deal: with any assortment of ten Jensen diamond needles, Jensen will ship the order in the gray metal strong box shown above at no extra charge. The dealer keeps the strong box and can then use it for storing the diamond needles or as a cash box.



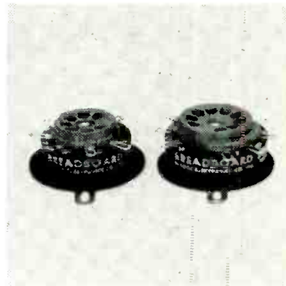
Tru-Ohm Resistor

Tru-Ohm Products, Division of Model Eng. & Mfg., Inc., announces a new jobber resistor for TV replacement use . . . the ECONOHM FUSED RESISTOR. This 7½ ohm fused resistor is actually interchangeable with any television set; is made to U. L. specifications. For further information, write Tru-Ohm Prod., general sales office, 2800 Milwaukee Avenue, Chicago 18, Illinois.



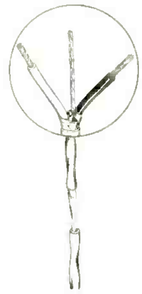
Crown Two Set TV Coupler

This simple device permits operation of two TV sets simultaneously from one antenna on any combination of channels. Coupling is by high efficiency induction and is designed for 300-Ohm match, giving excellent response on all channels. Internal signal loss is negligible. It is quickly and easily installed indoors or outdoors. For info write Crown Controls Co., Inc. New Bremen, Ohio.



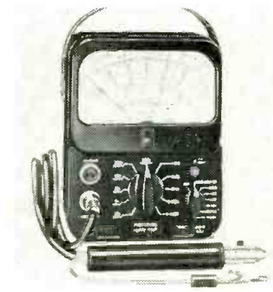
Pomona Breadboard Sockets

Pomona Electronics Co., Inc., has introduced breadboard sockets to be used by electronic technicians in industry. Mounting the Breadboard Sockets requires only a 3/32" diameter hole in the breadboard chassis. Circuits can be wired on top of the chassis with ease. Each socket is equipped with a ground lug attached to the socket mounting. The silver plated phosphor bronze socket connections are numbered for easy identification. For further information write, Pomona Electronics Co., Inc., 524 W. 5th Ave., Pomona, California.



Belden P.A. Cable

A newly designed P.A. and Sound System Cable has just been announced by Belden Manufacturing Company, Chicago, Illinois. The cable, Belden No. 8790, a balanced twisted pair, features a new *spiral wrapped* tinned copper shield, which offers greater coverage than the average braided shield. It also eliminates time-consuming terminations. The spiral is easily unwrapped, twisted, soldered.

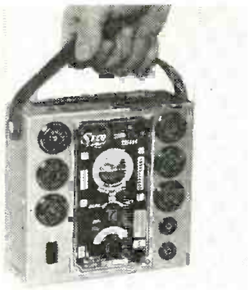


Precision VTVM

The Precision Model 88 is a compact, wide range VTVM-Ohmmeter, for general service-maintenance. Its many features include specially engineered Peak-to-Peak voltage ranges which afford a new high in P-P reading accuracy of pulsed waveforms encountered in TV and similar applications. For information write to Precision Apparatus Company, Inc., 70-31 84th Street, Glendale 27, L. I., N. Y.

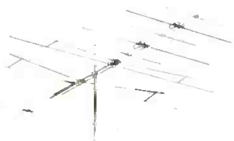
Clarostat "Standee" Resistors

"Standee" or above - chassis-mounted power resistors feature a resistance element wound on a glass fiber core inserted and sealed in a ceramic tube. They are mounted by ring brackets which can be fastened by use of rivets, screws, etc. The "Standee" resistor protrudes above the chassis for maximum heat dissipation while "hot" terminals (approved Underwriters' Laboratories requirement) are accessible below the chassis. For info write: Clarostat Mfg. Co., Inc., Dover, N. H.



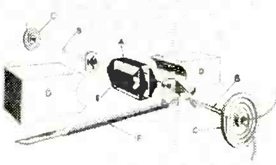
Seco Tester

The new model Seco-Tester, GCT-5, that detects the condition of over 40 tubes in *agc, rf, if* and sync circuits while at the same time permits customers to actually see the weaknesses in defective tubes. The units are distributed internationally by the Seco Manufacturing Co., 5015 Penn Avenue South, Minneapolis, Minnesota.



Telrex "Thunderbird"

The Telrex "THUNDERBIRD" Antennas are loop phased, multi-element, "Beamed Power" Arrays for fringe and "sub-fringe" area TV reception. Element functions are duplexed by means of variable impedance phasing loops to produce effective high-gain Yagis for Hi and Lo channel VHF Bands in an all-in-line array which actually produces a superior gain and directivity. For details, write: Dept. ET, Telrex, Inc. Asbury Park, N. J.



Simpson-Greibach Meter Movement

The Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill., has a patent agreement as exclusive licensee of Greibach bifilar suspension type meter movements. The armature is held in place by fine bifilar wires that are kept under precise tension by disc springs contained in the adjustable end pieces of the movement cartridge. Friction inherent in common pivot and jewel construction is eliminated by the unique bifilar suspension principle, contributing to ruggedness and accuracy.

Centralab Shaft-Kut Kit

Centralab has brought together into one kit, a selection of 6 tools to aid in the adapting of control and switch shafts to individual requirements. A custom made shaft clamp tool, similar to that used by many tool makers has been produced specially for this kit. The tools holds a variety of diameters of shafts in a vice without damage for a clean cut. For details, write Centralab, 900 East Keefe Avenue, Dept. C-44, Milwaukee 1, Wisconsin.

Trio VHF Array

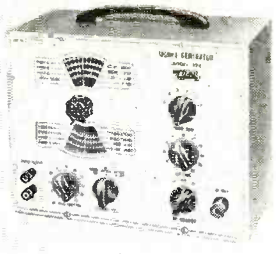
Trio Mfg. Co. has announced addition of the TRIO "77" to their TV antenna line. The "77" is an all *vhf* channel Yagi type using intermixed high band and low band elements arranged for single line operation. Among claims made are: High gain Yagi performance on all *vhf* channels; No interaction between high and low channel elements; Very high rejection of signals off rear and sides; For details, write the manufacturer at Griggsville, Illinois.

Du Mont Oscillograph

Precise measurements and analyses of phenomena which take place at extremely high rates of speed may be made with the new Du Mont Type 336 Cathode-ray Oscillograph. The Y-amplifier of Type 336 has a rise time of 0.02 microseconds with less than 2% overshoot, and useful response from dc to beyond 30 megacycles. For details, write: Instrument Division, Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Avenue, Clifton, New Jersey.

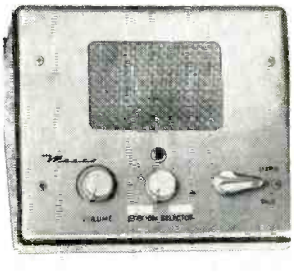
EICO RF Signal Generator

The Electronic Instrument Co., Inc., 84 Withers Street, Brooklyn 11, N. Y., has introduced its Model 324 Signal Generator. Its claimed characteristics: It can be used for if-rf alignment, signal tracing, troubleshooting of AM, FM, and TV receivers, as a marker generator for TV if alignment, and for 400-cycle sine-wave audio testing.



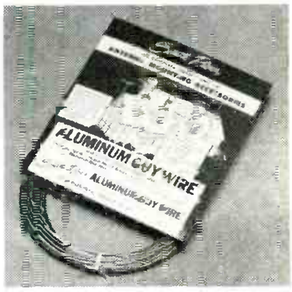
Masco Door Answering Intercom

A flush mounted door answering intercom system has been announced by the Mark Simpson Mfg. Co., Inc., Long Island City 3, New York. The system consists of a flush-mount master and/or a portable master and a remote door station. All power is off until the master talk-listen switch is operated to "talk" or "listen." Instant heating tubes take only two seconds to put the unit in operation. *Cost of operation is less than 1 cent a month.*



South River Guy Cable

A corrosion-resistant aluminum guy cable has been introduced by South River Metal Products Co., Inc., of South River, N. J. The 7-strand, 17 guage cable has a breaking strength of 500 lbs., equivalent in strength to 6/18 steel wire, and roughly 1/3 the weight of equivalent steel wire. Available in 100-foot lengths, in boxes, coils or interconnected coils.



Central CRT Rejuvenator

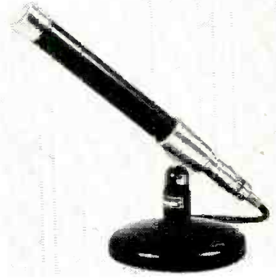
A new CRT Rejuvenator called the Multiphase "Rejuva-Tube" has just been announced by Central Electronics, Inc. 1247 West Belmont Avenue, Chicago 13, Ill. Available in both kit form or factory wired, the new unit tests, repairs and rejuvenates all types of electrostatic and electromagnetic TV picture tubes without the necessity of removing the tube from the set. The "Rejuva-Tube" is a complete tester—it detects open or shorted elements and leakages as high as three megohms between elements.

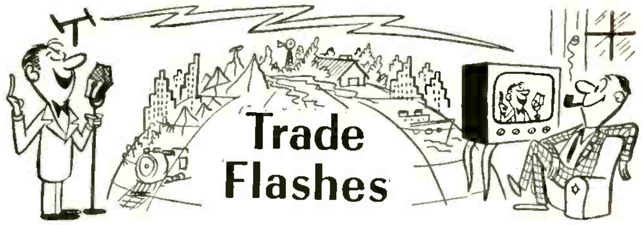
CBS-Hytron Soldering Aid

CBS-Hytron of Danvers, Mass., has introduced two hexagonal-handled models of its original Soldering Aid. One of the just redesigned "hex" Soldering Aids has the original straight reamer tip. The other offers an angled tip for reaching into a close-packed chassis. The new flat-sided handle gives the tool a firm grip and checks elusive rolling when it's set down; and, as in the earlier model, the new Soldering Aids fit a busy hand like a pencil.

Turner Model 57

The Turner Company is now in production on a new slender-type, high-fidelity dynamic microphone for use recording and public address. Users of this Turner Dynamic may select either high or low impedance by making connection to the proper pair of conductors at the terminal end of the 20-ft. 3-conductor shielded cable. Literature on the Model 57 is available. Write to the Turner Company, 937 17th Street N.E., Cedar Rapids, Iowa. Ask for Bulletin No. 966.





. . . Production of TV and radio receivers, and receiving and cathode ray tubes in January were considerably above the level of the same month a year ago . . . Over 7.1 million TV receivers and over six million radios, excluding automobile receivers, were shipped to dealers during 1954, which puts the industry a little over par in relation to the previous year.

The Cornell-Dubilier Corp. has erected a new Los Angeles Division plant on the west side of the city. The new division is being fully equipped with the latest equipment to handle all phases of engineering, design and sample production of C-D capacitors and filters.

The state government of New York is investigating ways of legislating against fraudulent radio and TV repair practices. On March 15, Governor Harriman held an executive conference, attended by representatives of the appliance industries, the Better Business Bureaus, law enforcement agencies and consumer representatives, at which a comprehensive program for strict law enforcement was purportedly discussed. In conjunction with this program, a campaign for consumer education will be considered, which is expected to generate wiser purchasing habits.

The Nebraska State Legislature has killed a bill that would have instituted a lien on services for planning and installation of television apparatus. The bill would have extended the existing mechanic's lien to embrace TV maintenance operations.

Students enrolled in the resident school of RCA Institutes numbered 2,200 at the end of 1954, an increase of about seven per cent over the previous year. Of this number, 1,000 are veterans of World War II and Korea, studying under the GI Bill of Rights. The Home Study Department's TV servicing course had 1,700 students enrolled at year-end and more than 10,000 students enrolled in a supplementary course on service color TV.

Howard S. Orcutt (left), Jack K. Poff, and William J. Slawson, of Pyramid Electric Co., discuss the proposed 27,000 square foot addition to the plant currently under construction.

Harry N. Reizes, Managing Director of Audio Fairs and pioneer in developing the High Fidelity industry, received of special certificate of recognition from the Audio Engineering Society at the annual convention banquet of the Society's Los Angeles Section on February 9th. Conducted in conjunction with the Las Angeles Audio Fair, which opened on February 10th in the Hotel Alexandria, the banquet was the scene of awards to other prominent individuals who have made distinguished achievements in the audio industry.

Arthur Shesser, Sales Manager for the Haydu Brothers Division of Burroughs Corporation in Plainfield, New Jersey announced inauguration of the "Trade-in System," which emphasizes the increased volume that dealers and jobbers will experience by accepting used TV tubes as credit toward the purchase of processed Haydu Tubes. The "Trade-in System" exploits the theory accepted throughout America that the "used" or out-dated article is turned-in or traded-in when making new purchases.

Du Mont Laboratories announced that the patent suit initiated by them against the Tel-O-Tube Corporation of America, and which has been in progress in the Federal Court in Newark has been settled. The Tel-O-Tube Corporation has entered into a standard cathode-ray tube license agreement with Du Mont and a settlement for past infringement has been worked out between the two companies.

The 500,000th instrument has recently come off the production lines of Electronic Instrument Co., Inc. The photo shows EICO President Harry R. Ashley turning over the ½ Millionth instrument to Mr. Alex Brodsky of Allied Radio Corp.

Philco Corp. has contended in U.S. Court that its distribution policy increases competition in the sale of television receivers, radios and major appliances. The Company made a sweeping denial of Government charges that Philco violates the anti-trust laws by restricting operations of its distributors and dealers, and further declared that sales by untrained and unqualified dealers are harmful to the public and damaging to the Company's reputation. The Government filed a civil action in the United States District Court for the Eastern District of Pennsylvania on December 15, 1954, alleging that Philco violates both the Sherman and Clayton acts by requiring wholesale distributors to sign contracts agreeing not to sell or ship Philco products to retailers outside their territories.

Nathan Chirelstein, 55, Chairman of the Board of Allied Electric Products, Inc., tubes and other electronic products, died today at Irvington General Hospital, Irvington, N. J., after a short illness following a heart attack.

W. Walter Jablon has been appointed Sales Manager of Radio City Products Co., Inc. and its affiliate, Reiner Electronics Co., both of Easton, Pa. Radio City Products and Reiner Electronics manufacture in their own completely equipped plant, a complete line of servicing and testing instruments such as used in radio, television and radar.

Appointment of Robert L. Jablonski to the post of national service manager of Hoffman Radio Division of Hoffman Electronics Corp. has been announced. It was stated that Jablonski's background and complete familiarity with all aspects of the Hoffman line of television, radios and high fidelity phonographs made him an ideal choice for the new assignment.

Establishment of "Tube Sales" as a central sales service organization for electronic tubes and radio and television components has been announced by GE's Tube Department.

HIGH VOLTAGE CAPACITANCE PROBE [*from page 20*]

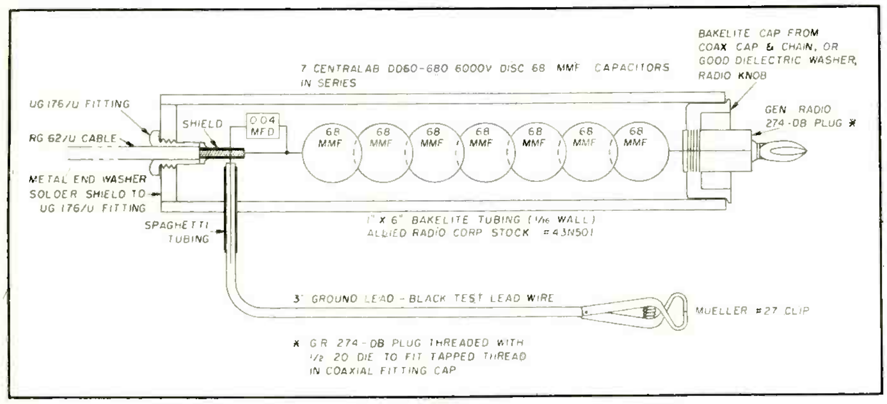


Fig. 2—General mechanical construction of high voltage capacitance probe. It must be emphasized that high voltages are present on the probe tip and that every consideration should be given to choosing materials of the best insulating qualities for safety from shock.

have sensitivities of at least 125 millivolts, a 500 volt circuit can be examined with a 4000 to 1 ratio probe. Calibration after assembly can be conveniently carried out at about 500 volts using a 60 cycle sine wave from a power transformer and a voltmeter of known accuracy. Don't forget to multiply the sine wave value by 2.83 if a scope is used to read the attenuated value. It would seem more convenient for the average builder to use an *ac* vacuum tube voltmeter for the calibration.

Calibration is unnecessary if *C1* and *C2* can be checked on a bridge, it only being necessary to rough check the probe for general operation. Purchasing close tolerance parts for the capacitors is another method. It is recommended that *C2* not be of the metallized type since a small constant voltage is required to keep this type of capacitor clear of shorts and the low energy in *C2* is not sufficient to clear these shorts. *C2* is a pair of 2 × 0.01 μf disc capacitors in the probe described here. *C1* is made up of a series of the new 6000 wvdc disc capacitors made by Centralab. Seven of these in series give *C1* a value of 10 $\mu\mu f$ and 42 kilovolts working voltage. It should be remembered that a liberal allowance should be made for the tolerance of the capacitors in *C1* in estimating the maximum voltage since the capacitors divide the applied voltage by the exact values of their capacitances. Thus if one capacitor were 10% lower in value than the rest, it would receive 10% more voltage. The particular capacitors used were found to be very close, i.e., within plus or minus 2 $\mu\mu f$ for the 68 $\mu\mu f$ nominal value. The tolerance is given at 20% for the Centralab DD-60 series discaps in catalog data. The use of the Centralab DD-60 capacitors permits the probe diameter to be only 1". If the TV receiver high voltage supply filter type ceramic were used, the probe would be much larger in diameter and length and an expensive quantity of them would be required to reach a series effective value of 10 $\mu\mu f$.

Figure 2 shows the general mechanical construction. Various modifications can be made depending on the availability of certain parts around the shop. It is emphasized that high voltages are present on the probe tip and that every consideration should be given to choosing materials of excellent insulating quality. In use the probe ground is connected first, and it is preferable to connect the tip with the equipment off. The use of a separate ground is important not only from a safety standpoint but to prevent the inductance of the probe cable from ringing which would be the case if the regular scope ground were used. In the probe shown here, a leakage guard is formed by the metal washer which is grounded to the separate ground lead and cable sheath. The cable sheath is soldered to the UG176/U fitting (for RG62/U cable) which is screwed in the metal end washer after tapping with a 7/16:14 tap. This also provides strain relief for the cable. The probe is capped on the front end with a bakelite coaxial cable weather cap, the cap and banana plug having threaded to fit each other with a ½:20 thread. After preliminary wiring the capacitors are covered with a layer of plastic tape, and if desired can be "potted" by pouring coil dope inside the probe after initial check out for operation. Neatness in laying out the wiring of the capacitors will make the job easy. The junction connections between capacitors should have a piece of spaghetti slipped over them to reduce corona tendencies from the sharp point created by the junctions. The material list shown is intended only as a guide. Unfortunately, the type number of the bakelite coaxial connector cap, used as a bushing in the tip of the probe because of the convenient press fit and long insulation path, cannot be identified. Perhaps a certain size radio shaft knob can be found to take the place of the cap. The General Radio banana plug was chosen because of the coincidental fit to a ½:20 die. For normal test work, an alligator clip is attached to the banana plug tip.

Material list:

Quant.	Description	Type or part number
1	Bakelite tubing, 1" o.d. x 6", 1/16 wall	Allied Radio 43N501
7	Disc Capacitor, 68 mmf., 6000 wvdc. Centralab DD60-680	Allied Radio 11L470
2	Disc Capacitor, 2 X 0.01 mfd. Centralab DD3-103.	Allied Radio 11L030
1	Coaxial fitting, UG176/U*	Allied Radio 40H359
1	Sided Mesh Clip, Mueller # 27	Allied Radio 45N015
6'	Coaxial cable, RG62/U	Allied Radio 47W518
3'	Test lead wire, black	Allied Radio 48W900
1	Banana plug, General Radio 274-DB	

* UG176/U fits RG 59, 62, 63 and 71 cable.

Material list shown above is intended as a guide.

ASSOCIATION NEWS

NATESA

Vincent Lutz. President of TISA of St. Louis and NATESA West Central V.P. was selected as the officer who during 1954, rendered the best cooperation and the greatest contributions to the advancement of NATESA and independent service.

Mr. Moch also announced the appointment of Mr. Albert C. W. Saunders to a new post of Technical Director. Mr. Saunders is well known throughout the industry for his exceptionally fine methods of teaching TV-radio-electronic service.

Syracuse Television Technicians Ass'n Inc.

STTA is asking representation at N. Y. State conferences regarding possible legislation affecting servicemen. Below, in part, is an excerpt from a statement by its Board of Directors on the subject:

"The Board of Directors of the STTA believes these Bills are of no help to the industry as written or to the public in the form of protection."

Television Installation Service Association (TISA)

TISA of Illinois has taken cognizance of their community responsibility by donating $100.00 to help finance Channel 11, Chicago's Educational TV station. Individual companies have also made monetary contributions and have undertaken to distribute informational literature through their servicemen.

Hazleton (Penn.) Service Group

A Radio and Television Servicemen's association is being initiated in the Hazleton, Penn. area. An association committee has been established and is arranging a schedule of lectures by representatives of the electronics industries who will speak about equipment developments in their special fields.

Associated Independent TV Servicemen—Buffalo, N. Y.

The function of the proposed N.Y. State Licensing Bill, which would license Radio-TV servicemen and shops, was condemned by AITS of Buffalo, N. Y. This association, which is largely composed of part-time repair men, stated that the bill may make it impossible for the one-man shop to operate, and that it would not necessarily end malfeasance within the industry.

NEW TUBES & SEMI-CONDUCTORS

• • •

CBS Hytron

The CBS-Hytron *HA-1, HA-2, HA-3, HA-8, HA-9,* and *HA-10 P-N-P* junction transistors are specially designed for use in hearing-aid circuits. These CBS-Hytron transistors are designed to meet realistic specifications that satisfy the requirements of the modern hearing aid. Power-gain and power-output limits are specified to provide units that will provide sufficient gain and output in a 3-stage hearing-aid circuit. Source and load impedances used in these measurements are typical of those employed in transistor hearing aids. In addition, actual test conditions for power output . . . power gain . . . current amplification factor . . . and noise are similar to those found in typical hearing-aid operation. As a result, the CBS-Hytron hearing-aid transistors are engineered to the requirements of transistor hearing aids.

The *2N38A* P-N-P junction transistor for hearing-aid applications has been announced by CBS-Hytron, a Division of Columbia Broadcasting System, Inc. This transistor is especially designed and tested for low noise operation. Its peak maximum noise rating is 27 decibels per microvolt at a frequency of 1000 cycles per second, with load resistance of 20,000 ohms and input resistance of 1000 ohms. This new germanium transistor is unilaterally interchangeable with CBS-Hytron Type 2N38 and differs from its prototype primarily in the special low noise characteristic. Its nickel silver can, 0.330 inch long by 0.225 inch in diameter, is hermetically sealed against surface contamination, light excitation and humidity.

The 2N82 is a P-N-P junction transistor for high-temperature amplifier applications. This new germanium transistor, known as the Type 2N82, is capable of 35 milliwatts collector dissipation at 71°C. Its metal case, only 0.33 inch long by 0.225 inch in diameter, is hermetically sealed against surface contamination, light excitation, and humidity.

RCA

The *5U4-GB* is a full-wave vacuum rectifier of the glass-octal type intended for use in the power supplies of television receivers and in radio equipment having high *dc* requirements. In comparison with the 5U4-G, the new 5U4-GB has the same maximum voltage ratings but higher current ratings. The 5U4-GB is rated to withstand a peak plate current of 1.0 ampere per plate—a value 48 per cent higher than for the 5U4-G. For the same applied *ac* plate voltage, the 5U4-GB can deliver a *dc* output current approximately 22 per cent higher with capacitor-input circuits, and 28 per cent higher with choke-input circuits. The 5U4-GB is designed to be a mechanical and electrical replacement for the 5U4-G.

The *6AF4-A* is a 7-pin miniature triode designed especially for use as an oscillator in tuners of *uhf* television receivers covering the range from 470 to 890 Mc. It is similar to the 6AF4, but is ⅜ inch shorter to permit more compact tuner designs. Like the 6AF4, the 6AF4-A has good frequency stability and features a small mount structure with small elements to provide low interelectrode capacitances; short internal leads to reduce lead inductance and resistance; silver-plated base pins to minimize losses caused by skin effect at the ultra-high frequencies; and double base-pin connections for both plate and grid. The double connections are arranged so as to facilitate use of the 6AF4-A with either series- or parallel-resonant lines and to offer greater flexibility in circuit connections.

The *6CG7* is a 9-pin miniature version of the popular 6SN7-GT intended for use particularly as a vertical deflection oscillator and horizontal deflection oscillator in television receivers. This type is designed with a *600-milliampere* heater having a controlled warm-up time to insure dependable performance in television receivers employing a *single, series-connected heater* string. The structure incorporates an internal shield which provides effective shielding between the triode units to prevent electrical coupling between them. The 6CG7 may also be used as a phase inverter, multivibrator, synchronizing separator and amplifier, and resistance-coupled amplifier in electronic equipment.

Raytheon

The *5AV8* is a heater-cathode type medium-mu-triode-sharp cutoff pentode of miniature construction designed for a wide variety of applications in color receivers. The 5AV8 is the "Series String" counterpart for the 6AN8.

The *12X4* is a full-wave rectifier of the heater-cathode type designed for service in vibrator-type power supplies of automobile radio receivers using 12V storage batteries as well as in *ac*-operated radio receivers.

The *21ALP4* is a direct view, electrostatic focus and magnetic deflection picture tube. Uses a spherical rectangular filter-glass face plate for elimination of reflection. Uses an external ion-trap magnet of the single field type. The external conductive coating, when grounded, serves as a filter capacitor.

The *21AVP4* is a direct view, low-voltage electrostatic focus and magnetic deflection picture tube. Uses a spherical rectangular filter-glass face plate for elimination of reflection. Uses an external ion-trap magnet of the single field type. Has external conductive coating.

The *21AVP4A* is a direct view, low-voltage electrostatic focus and magnetic deflection picture tube. Uses a spherical rectangular filter-glass face plate for elimination of reflection. Uses an external ion-trap magnet of the single field type. Has an aluminized screen. Has external conductive coating.

The *21AWP4* is a direct view, magnetic focus and magnetic deflection picture tube. Uses a spherical rectangular filter-glass face plate for elimination of reflection. Uses an external ion-trap magnet of the single field type. Has an aluminized screen. Has external conductive coating.

Sylvania

The *12KP4A* is a 12" direct view, round glass type, gray filter glass, aluminized screen, magnetic deflection, magnetic focus, spherical faceplate, picture tube. Has an external conductive coating. No ion trap is required.

The *17BP4B* is a 17" direct view, rectangular glass type, gray filter glass, aluminized screen, magnetic deflection, magnetic focus, spherical faceplate picture tube. Uses a single field ion trap.

The *17HP4B* is a 17" direct view, rectangular glass type, gray filter glass, aluminized screen, magnetic deflection, electrostatic focus, spherical faceplate picture tube. It uses a single field ion trap.

The *17LP4A* is a 17" direct view, rectangular glass type, gray filter glass, aluminized screen, magnetic deflection, electrostatic focus, cylindrical faceplate picture tube. It uses a single field ion trap.

The *20CP4B, 20CP4D* is a 20" direct view, rectangular glass type, gray filter glass, aluminized screen, magnetic deflection, magnetic focus, spherical faceplate picture tube. It uses a single field ion trap.

The *20DP4B, 20DP4C* is a 20" direct view, rectangular glass type, gray filter glass, aluminized screen, magnetic deflection, magnetic focus, spherical faceplate picture tube. It uses a single field ion trap.

The *20HP4C, 20HP4D* is a 20" direct view, rectangular glass type, gray filter glass, aluminized screen, magnetic deflection, electrostatic focus, spherical faceplate picture tube. It uses a single field ion trap.

TUBE TROUBLES

[from page 45]

tube showed a slight leakage, grid to cathode; thus causing an out-of-alignment condition which was not too noticeable and a weak sound condition that was very noticeable.

GE 830 "T" Version

Trouble: No Brightness, High Voltage Okay

The picture tube was replaced but did not solve the problem. In this case, the trouble was a shorted 6W4 (V15—*Fig.* 5). The short was from filament to cathode. The filaments of the CRT and the 6W4 receive their voltage from the same source. (Points *A* and *B*). This secondary is ordinarily ungrounded. Therefore, when the short occurred, the high voltage was affected only slightly while 560 volts of the 6W4 cathode was applied to the CRT cathode cutting the picture tube brightness off.

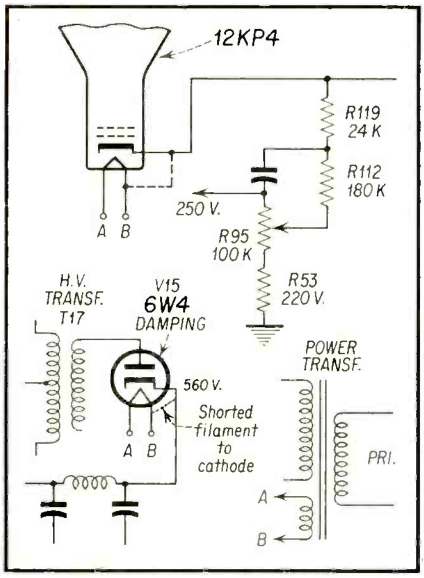


Fig. 5—6W4 affects brightness.

Freed Model 55—#1620 C

Trouble: A. G. C.

Some channels were full of snow while others did not come in at all; these being the strong channels. When the 5Y3 (V131—*Fig.* 6) low voltage rectifier was replaced, the trouble was cured. This tube when weak produces about 95 volts instead of 140 volts. Thus, the voltage becomes low at many points including the A.G.C. tube (V113) 6AU6 cathode. This causes an increase in total 6AU6 current and therefore an increase in *agc* negative bias voltage; causing the video to cut off on strong signals.

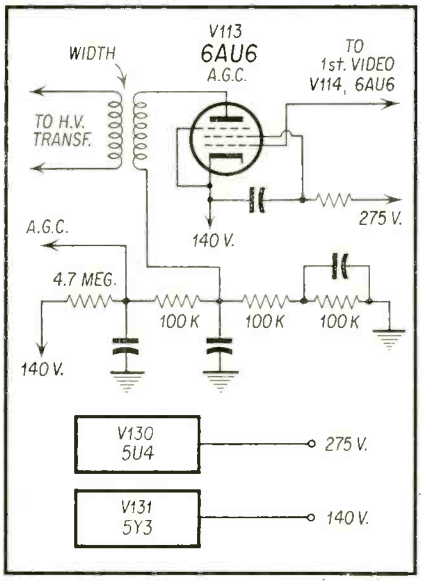


Fig. 6—5Y3 results in weak pix.

CONSTANT VOLTAGE

[from page 28]

taps in steps of 1 watt, we can adjust the individual primary taps a watt or so either way to suit the requirement of a particular location without disturbing, appreciably, the balance of the system.

Adaptability to Increase in Power

A further advantage of the constant voltage system is the ease with which a power increase can be accommodated without disturbing the balance of the original system. Suppose a series of speakers were connected to the 70 volt output tap of a 20 watt amplifier. Suppose at a later date it was found desirable to add additional speakers to the system, necessitating an increase in power to 40 watts. In this case, the 20 watt amplifier could be replaced with a 40 watt unit, connection made to the 70 volt tap, and additional speaker-transformer combinations added to the line without any disturbance of the original system. If the impedance matching method had been used it would have been necessary, in addition, to completely rematch the original system.

Gain Control Adjustment

In this connection, it should be brought out that, in connecting a series of parallel speakers to a constant voltage amplifier output, it is good practice to select the transformer watt tap for the maximum amount of speaker output that may be required for each individual speaker location, keeping in mind that, without regard to the actual amount of power to be used, the total of the power taps of all the transformer-speaker units is to equal the rated power of the amplifier. We then rely upon gain control adjustment of the amplifier for normal volume. As an example, suppose we have a power amplifier rated at 50 watts, but feel that normal power demand is going to be approximately 35 watts. In choosing transformer watt taps for the various speakers, we should select watt taps which will total 50 watts for the system. The reason for this is that in selecting our watt taps for the maximum power condition we reflect the correct plate to plate load impedance into the amplifier for this power. When the gain control is adjusted for the lower nominal power condition, the plate to plate impedance remains at a higher value than required for this output, but, due to the inherent characteristics of the power tubes, a higher than nominal plate load will not result in appreciable distortion. If the transformer taps were selected for the 35 watt condition, then turning up the gain control for maximum 50 watt output results in the condition of a lower than nominal plate impedance than required for this output power. This lower value of plate impedance tends to increase distortion and should be avoided.

Correct Connection of Speakers

Another point that should be emphasized is the correct connection of speaker voice coils to the transformer secondary. While line coupling-speaker combinations are always connected in parallel across the line in constant voltage systems, in some cases the possibility of connecting voice coils in series and in turn connecting to a higher secondary impedance tap of the transformer may be considered. Avoid series connection wherever possible. One reason is that should one speaker become defective the entire system will be thrown out of operation. It is difficult then to readily identify the defective unit. Another reason is that, with several speakers wired voice coils in series, a voltage surge could cause damage to one or more of the units because of excessive voltage adding up across the voice coil windings.

Conclusions

From the foregoing it can be seen that the constant voltage distribution system has features which present definite advantages over the impedance matching system. Involved calculations are avoided. The system is adaptable for future expansion without change in the existing layout. By employing the new type speaker coupling transformers, having watt taps rated in steps of 1 watt, a distribution system can be designed which is not complex, yet possesses the flexibility required in a good installation.

PORTABLE MULTIMETER

[from page 19]

dividual resistance values calculated to provide the desired current range at the corresponding switch setting. This circuit utilizes a special .024 ohm shunt for the 15 ampere range.

For *ac* current measurements the same tapped shunt is used in conjunction with the 3.7K, 10K and 1200 ohm compensating resistors necessary to take into consideration the reduced average *dc* available to the meter because of full wave rectification of the incoming *ac*. The same shunt used in *dc* is employed for the 15 ampere *ac* range.

This is shown in *Fig. 8.*

EDITORIAL

[from page 4]

The precedent having been established, now every service firm owner, regardless of his past record for integrity and honesty, must immediately evaluate just what risks he incurs by merely being engaged in the radio-TV service business. There is nothing to stop any disgruntled set owner, regardless of whether he is right or wrong, from lodging a complaint against the service firm he's sore at.

But, service firms can take a few simple steps that will protect them from being unjustly convicted and they *must* do this at once.

Paramount, as a protective measure, is the maintenance of proper business records. In this regard, a proper system recording time spent on any given job is a "must." Itemized bills showing exactly what services were rendered, etc., must be given to every customer for every job and the copy must be kept in the service dealer's files for future reference. Also, when replacements are used, the old parts and tubes must be turned over to the customer.

This may sound elementary, but there are valid reasons for the suggestion. A service firm of integrity will do these things and be prepared to support its position in case of a dispute. An "indifferent" service firm failing to use the precautions advocated is always subject to severe penalties for mere laxity. Any judge will tell you "seeing is believing!"

There is no law saying that a service dealer may not charge more than list price for any given item; nor does the law require a serviceman to charge any fixed hourly labor rate. The law does insist upon honesty in business transactions. But there are ethical ways to circumvent cases where hourly charges and prices for components might conflict in an itemized bill and cause you grief with a customer.

I'll tell you a true story about a serviceman's experience which is somewhat related to the case in point. In 1935 a serviceman fixed a radio set. It took but a few minutes. He merely replaced a burned-out resistor. He gave a customer an itemized bill reading: Labor $2.00, Resistor 50¢, Total—$2.50. The customer claimed that the labor charge was excessive. The serviceman wasted an hour trying unsuccessfully to explain why he believed he was entitled to fair recompense for his skill, investment, etc. Several days later the same serviceman had an identical call. He fixed in a few moments a set that had a burned-out resistor. This time he submitted an itemized bill reading: Labor 50¢, New Part Used to Replace Burned-Out Resistor $2.00, Total $2.50. The customer was delighted and paid promptly. Such is human nature!

For a serviceman to do this today is an invitation to disaster. Whatever parts are installed should be so stated and their true prices listed; and whatever time is spent in the repair should be so stated and the full charges so listed. Whether you charge $3.00 an hour or $10.00 an hour, you have a right to collect provided the customer is aware of your fee. So protect yourself by always issuing an itemized bill and making sure that your customer knows in *advance* your labor charges.

Most important of all, however, is this: from here on, to protect their professional status, all servicemen must be organized. The logical method is to affiliate with servicemen's associations—and these associations in time must find the ways and means to stop parts distributors from selling tubes and components, etc., at less than list price, to any but full-time established service firms. The present practice of most distributors—that of selling all items at a discount to any Tom, Dick & Harry is the worst evil and greatest deterrent to stability facing the radio-TV service business today.

CIRCUIT ANALYSIS

[*from page 15*]

up C48 to a small bias. This makes the combination of G3 and cathode less efficient as a diode, and decreases the *agc* voltage developed for a given signal input.

3. When the switch *S1* is in the fringe position a greater bias is developed at grid #1 causing G3 and cathode to perform as a *very* inefficient diode and the least amount of *agc* voltage is developed at G3 for a given signal input.

Range Switch Operation S2

Switch S2 provides a variable delay action for different signal area conditions. It is evident that in strong signal areas no delay of the *agc* is desired. On the other hand for weak signal maximum delay is desirable. The operation of this switch to accomplish this is as follows:

1. For strong signals the switch is turned to the "S" position which grounds out the positive voltage applied to both plates of the *agc* diodes. This provides full *agc* to the *if* and tuner *agc* lines without delay.

2. In the normal (N) position one of the voltage divider resistors *R79* is shorted out, thus removing the positive voltage from the *if agc* diode, but still providing a slight positive voltage to the tuner *agc* diode. Thus, in this position a delay voltage is made available only to the tuner *agc* network.

3. In the fringe (F) position the *if* diode now receives some positive voltage and *agc* delay is effected. The tuner diode receives a greater positive voltage than before so that the greatest *agc* delay action takes place.

From the previous circuit analysis it should become apparent that when servicing modern TV receivers where a single tube performs so many different circuit functions the breakdown of a component might produce a chain reaction somewhat comparable to an "A" Bomb. Furthermore the symptoms resulting might well require the technician to provide himself with a Univac in order to locate the faulty circuit, let alone the faulty component.

COLOR

[*from page 31*]

R_K and that of the B-Y demodulator $5.2 \times R_K$.

4—The outputs of all demodulators are passed through low pass filters, from which they are fed directly into the grids of the color tube.

As a brief summary of the action taking place,

1—With the chroma signal ratio 1:1.4

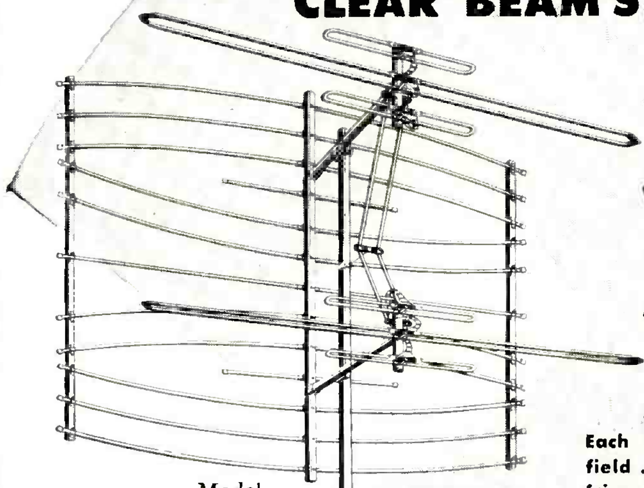
2—With the R-Y/B-Y sampling pulses at their respective demodulating angles of 13° and 77°

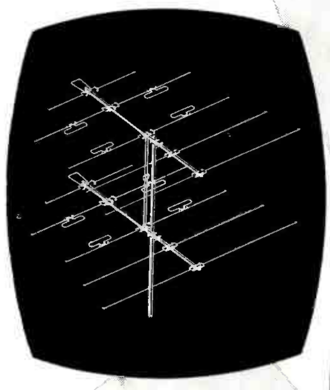
3—With the load resistors in the following ratios:

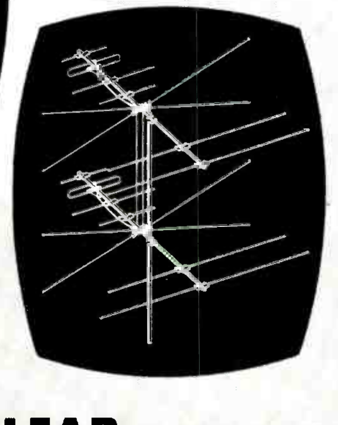
$R_K : R_1 : R_2 = 1 : 2 : 5.2$

the proper R-Y, B-Y, and G-Y signals will be obtained at the filtered outputs of the demodulators.

(*To Be Continued*)







SQUARE WAVE

[*from page 28*]

know what wave forms to expect from a normally operating video amplifier. *Fig. 14* indicates the low frequency response as seen at the output of a typical, normal video amplifier (grid of the picture tube) when a 40 *cps* square wave was fed in. Notice both tilt and curvature, indicating phase shift and attenuation at the low end. *Fig. 15* indicates a normal response at a square wave frequency of 100 *cps*. A very important word of caution is appropriate at this point. If the scope is used in the usual way, that is, feeding the signal into the vertical posts on the front panel, then the signal must pass through the vertical amplifier within the scope. We cannot overlook the possibility, therefore, that the observed wave might be distorted by the scope amplifier rather than the amplifier under test. A striking example of this is brought out by the photographs in *Figs. 16* and *17*. *Fig. 16* shows the scope pattern when a 100 *cps* square wave was fed from the square wave generator directly to the scope vertical input terminals on an oscilloscope which we shall identify as brand A. A good square wave is observed. The same setup was then used, but using a different oscilloscope, brand "B." The distorted pattern in *Fig. 17* resulted. This distortion was due to the internal vertical amplifier of the scope.

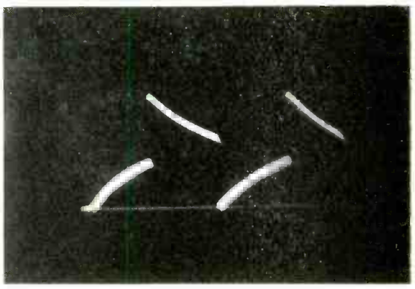


Fig. 14—Square wave response of normal video amplifier at 40 cps.

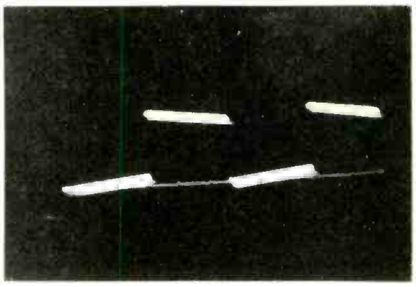


Fig. 15—Square wave response of normal video amplifier at 100 cps.

It was pointed out that *Fig. 15* shows

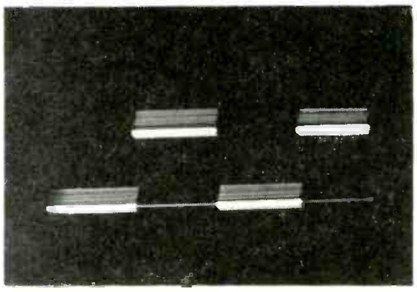


Fig. 16—Scope pattern when 100 cps square wave is fed directly into scope "A".

the response of a normal video amplifier to a 100 *cps* square wave. Yet, if scope "B" had been used to observe the output, the result would be to add the slight distortion of *Fig. 15* to the much greater distortion of *Fig. 17,* with a resulting pattern which would make this normal video amplifier appear to have a much poorer low frequency response. To avoid errors arising from this source, the following procedures may be used.

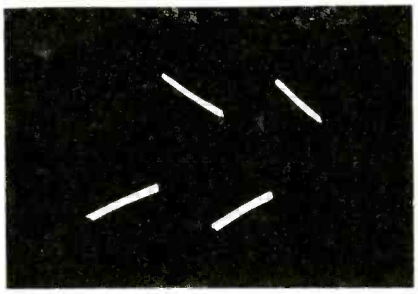


Fig. 17—Scope pattern when square wave is fed directly into scope "B".

1. Check the scope by feeding the square wave directly from the generator to the vertical input terminals. If a good square wave is obtained, the scope may be used in the normal manner.

2. If the square wave is distorted (because of the scope's vertical amplifier) do not use the vertical input terminals on the front panel of the scope, but connect the output of the amplifier under test directly to the vertical deflection plates. Most oscilloscopes make provision for such connection at the rear. Follow the instruction manual for the particular scope being used.

(To be continued)

ANSWERMAN

[*from page 34*]

higher pulse voltage voltages without possible internal tube arcing and breakdown. More important, the plate cap is connected with a special high-melting point solder that will not become loose anywhere nearly as easily as the older type. The 6BQ6-GA or GTA tube should be employed where this failure is common.

Of course, it is possible to secure high melting temperature solder. However the occasion for using it is not frequent enough to make it worth while obtaining this special type of solder.

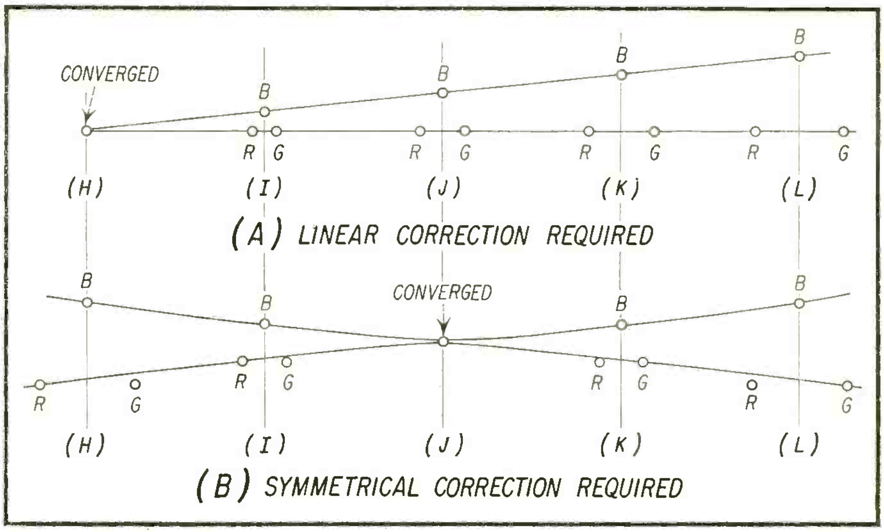


Fig. 5—Horizontal errors in convergence.

CONVERGENCE

[*from page 10*]

required, and we see that at J no correction is required. At point K, however, the blue beam is again in error, and the correction necessary is similar to that needed at point I. At point L the error is again maximum, and a correction similar to that at H is required here to converge the blue beam with the red and green beams.

In this case the proper amount of symmetrical correction will converge the three beams for the entire scan. Linear and symmetrical voltages, then are the basic "tools" of dynamic convergence by which overall correction of the raster is attained. The necessary type and amount of correction will be different in any particular case, but correction will always follow these principles.

In *Figs. 6A* and *6B* cases are illustrated wherein the error appears vertically. These errors are corrected by the linear vertical correction controls (red, green and blue) and the symmetrical vertical correction controls (also red, green and blue). The action and purpose of these vertical controls is similar to their horizontal counterparts.

A typical problem of convergence, would require that after static convergence is achieved, a combination of dynamic corrections must be performed for complete convergence.

The following is a recommended procedure:

First—adjust red *static* convergence until the red and green beams coincide at the center of the screen.

Second—adjust the blue beam positioning magnet and the blue static convergence until the blue beam meets the red and green beams.

Third—examine a horizontal line of triads for any misconvergence. Adjust the red, green and blue *linear* horizontal correction until only symmetrical horizontal error remains for each beam.

Fourth—examine a vertical line of triads for any misconvergence and add any necessary *linear* vertical correction for the red, green and blue guns until only symmetrical vertical error remains.

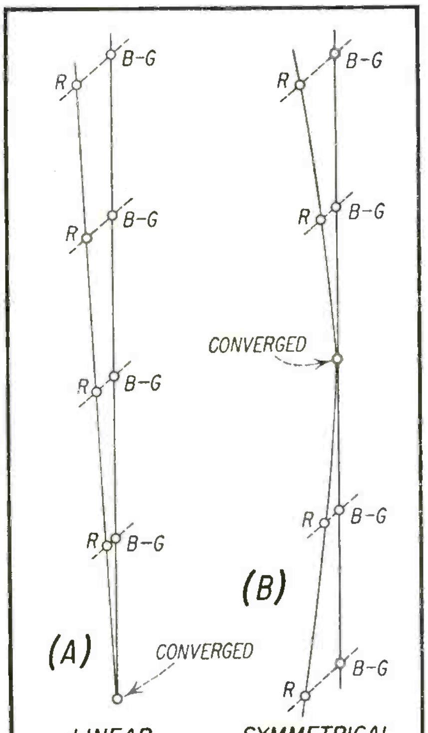


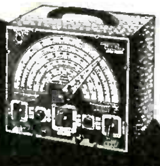
Fig. 6 — Vertical errors in convergence.

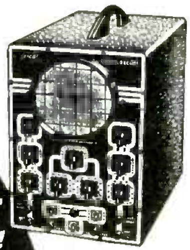
Fifth—add the necessary *symmetrical* horizontal correction for the red, green and blue beams until the entire horizontal scan is fully converged.

Sixth—add the necessary *symmetrical* vertical correction for all beams until the full vertical line is converged.

The entire screen should now be converged. However, at many points during its application an interaction of controls may require the readjustment of previous steps. For instance after adding blue *linear* horizontal correction it may then be necessary to readjust the blue *static* convergence. In addition, a satisfactory convergence may require repeating steps one to six. The general procedure is to go through the operations *once* to correct gross errors, and then *follow up* with a repeat adjustment to correct minor misconvergences which might remain.

Advertising Index





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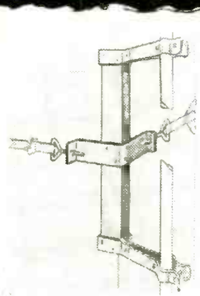

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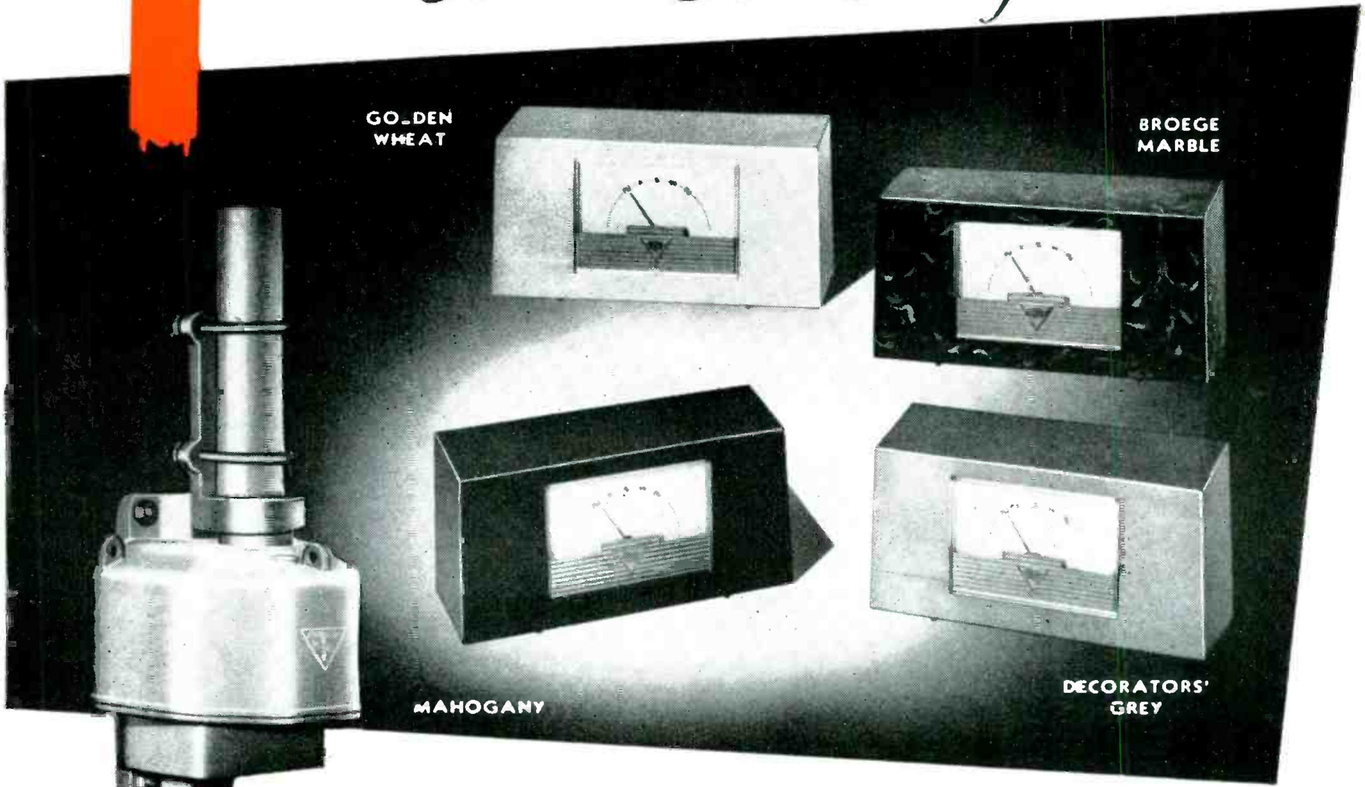

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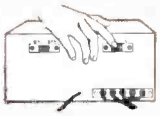

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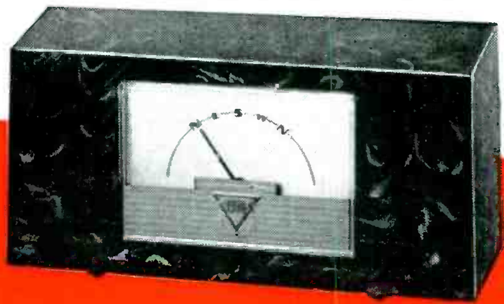

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