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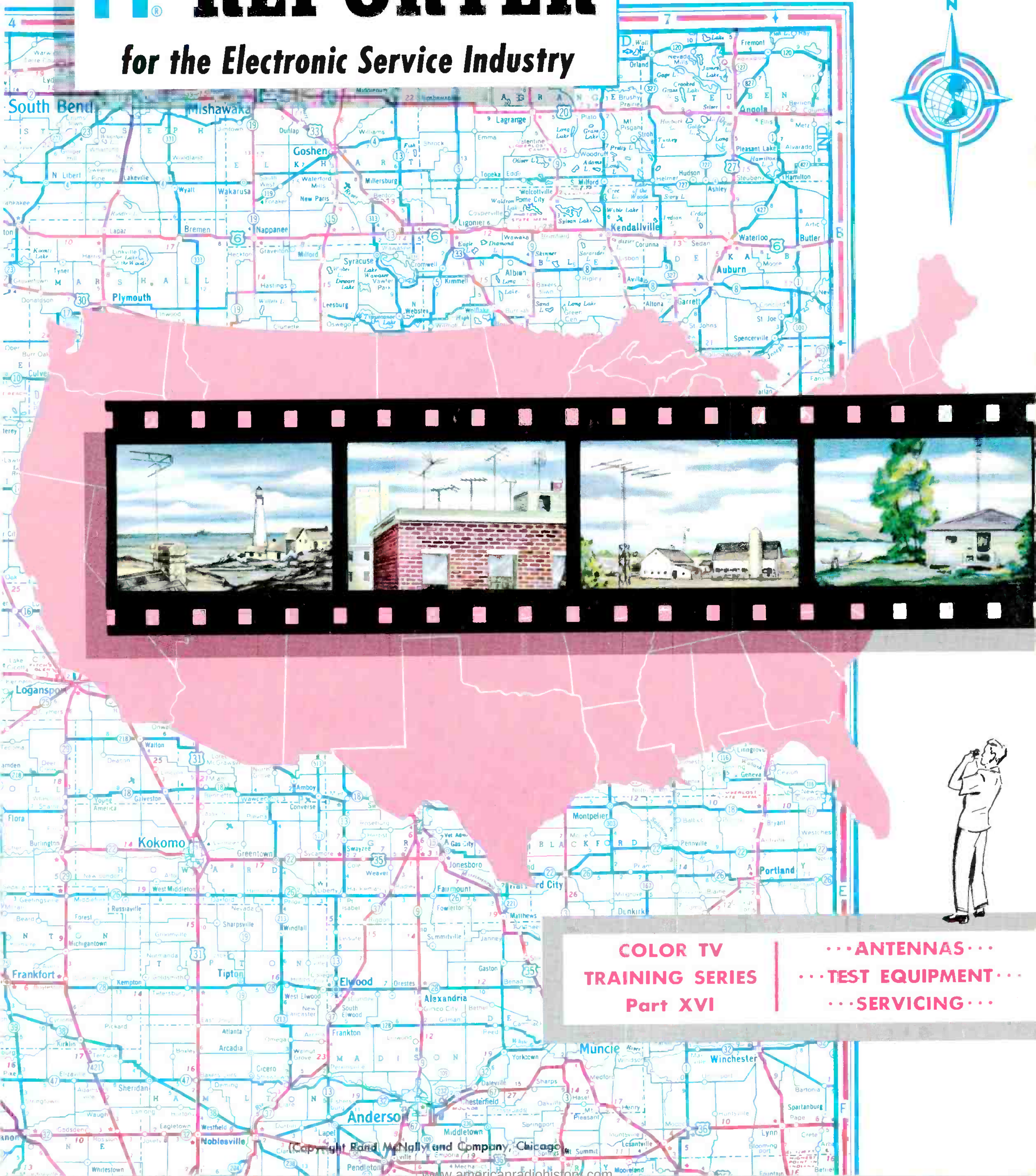

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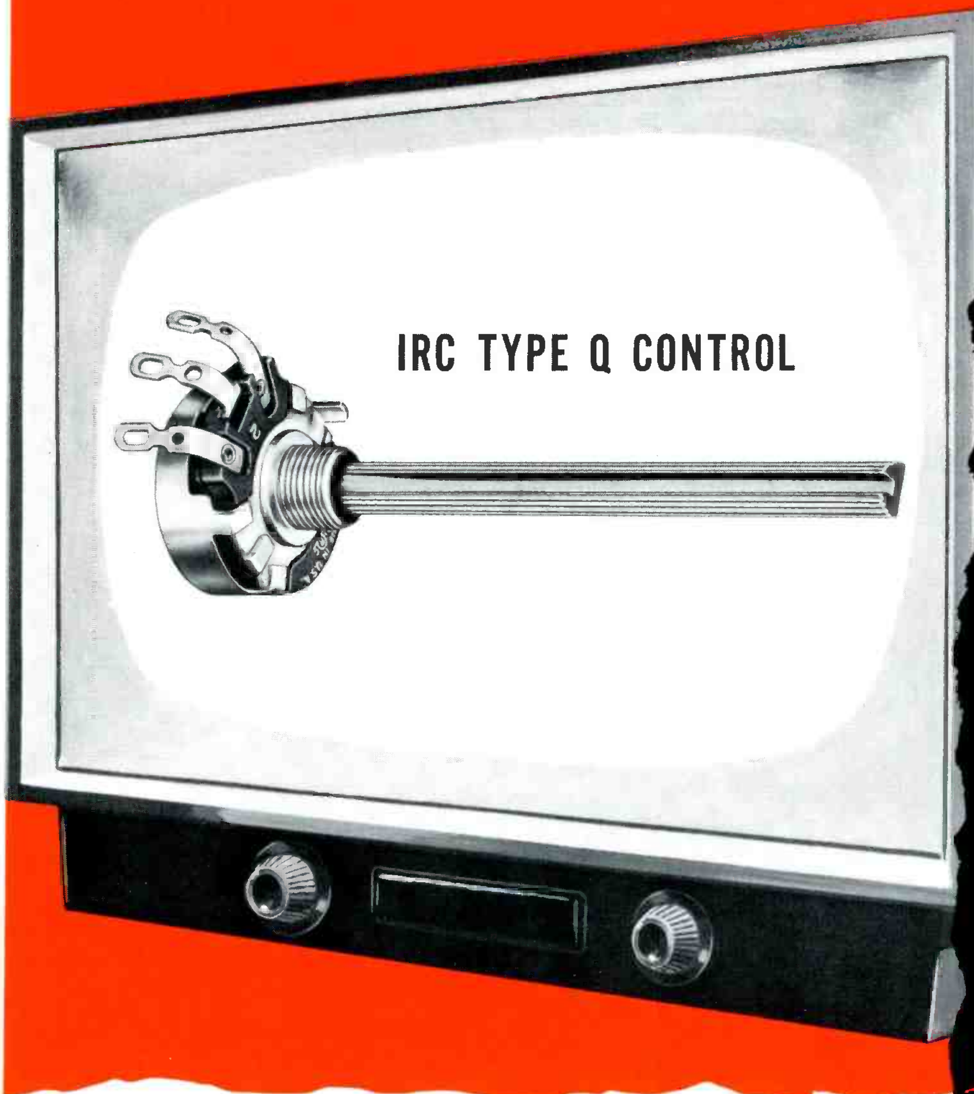

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PF REPORTER

for the Electronic Service Industry

VOL. 5 · NO. 9 SEPTEMBER · 1955

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SUBJECT REFERENCE

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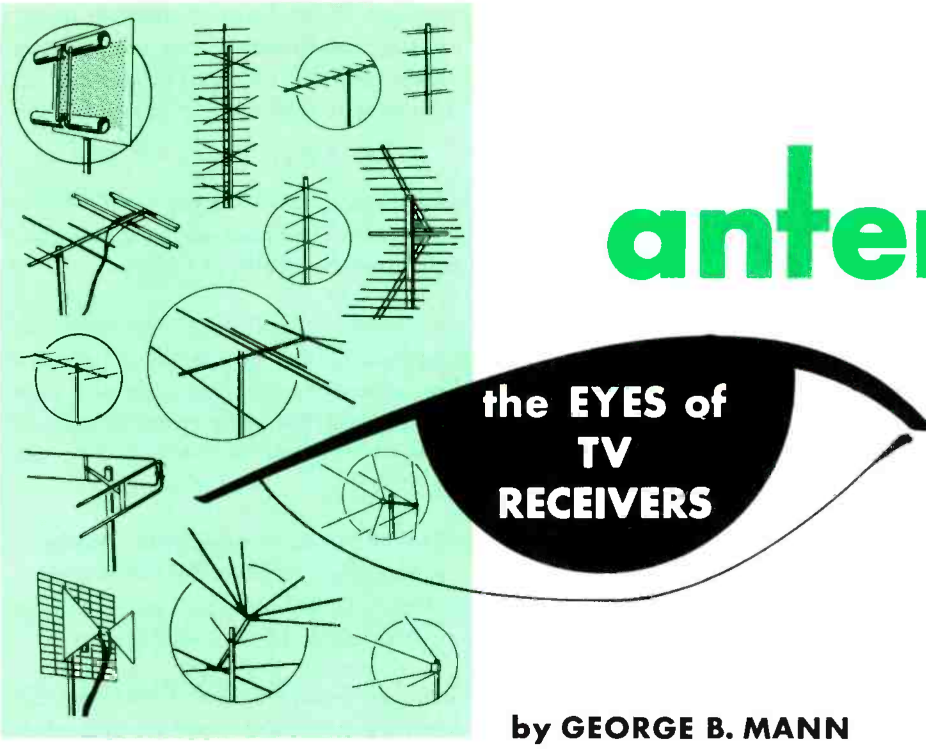

antennas

the EYES of TV RECEIVERS

by GEORGE B. MANN

The eye is one of the most important sense organs in the human body. Its function can be likened in many ways to that of a simple type of television antenna. The eye receives light waves; whereas, the antenna receives radio-frequency waves.

Limitations

Both the eye and the antenna have limitations in what they can do. The human eye can perceive only a limited range of light frequencies. This frequency range extends from red at the low end of the visible spectrum to violet at the high end. One might say that the eye is "tuned" to this range of light frequencies in much the same manner that a television antenna may be tuned to a certain band of television frequencies. The RF response curve of a simple type of television antenna closely resembles the light-frequency response curve of the human eye.

Another limitation of human eyes and antennas is the inability to isolate a weak source of energy in the presence of strong sources of energy. An example of this, in the case of the human eye, is the fact that a neon sign will appear dim in the daytime. Although the neon sign is the same brilliance day or night, the surrounding light has reduced the apparent brilliance to a very low level and the eye has difficulty in seeing the neon sign. A simple form of television antenna also has difficulty in isolating a signal in the presence of high-level atmospheric noise and strong local interference. It might be said that the antenna is blinded by the interference.

Another limiting factor associated with the eye and the antenna is the amount of receiving area presented to the incoming wave. The total receiving area which the eye presents to the incoming light is very small. If the light intensity is very low, the amount of light striking the retina in the eye will not be great enough to cause a response which the human brain can interpret. Similarly, the simple television antenna presents a limited area to the incoming radio wave. If the incoming wave is weak, the receiver will detect the signal but it will be unable to produce a usable picture.

Another comparison between human eyes and television antennas is the limited range of direction from which maximum energy can be received at any one instant. When looking straight ahead at a certain object, there is a circular field of clear vision around this object. As the eye is shifted, the field moves; and as this field of clear vision moves farther away from the object, the object becomes less distinct. The field in front of the eye is analogous to the field directly in front of the antenna. As the antenna is turned away from the energy source, the amount of energy which the antenna can receive becomes less. This characteristic of a television antenna is referred to as directivity.

These limits are imposed upon the human eye because of the basic make-up of the eye. The human eye as a receiving element cannot be changed to accommodate other frequency ranges or wider bandwidths. In contrast to this, the antenna receiving element can be designed for any particular range of radio frequencies and can also be designed for a certain bandwidth. This allows us to obtain greater versatility in antenna performance.

An example of this versatility is in overcoming the limitations of bandwidth. A receiving element composed of thin conductors like those shown in Fig. 1A has a narrow bandwidth. This means that the response to signals drops off rapidly at either side of the resonant frequency. A tuned element can be made

* * Please turn to page 81 * *

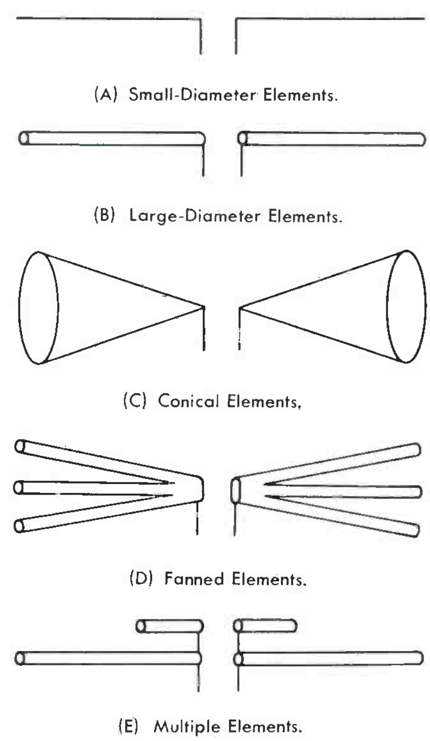

Fig. 1. Receiving Elements Showing Methods of Increasing Bandwidth.

COLOR TV TRAINING SERIES

PART XVI
TROUBLE SHOOTING

by C. P. Oliphant and Verne M. Ray

In Part XV of this Color TV Training Series, trouble-shooting procedures were discussed for the condition of hum in the monochrome picture and for the condition of wrong colors. In this part, the subject of trouble shooting will be concluded by a coverage of the troubles which cause loss of color synchronization and those which affect purity and convergence.

Loss of Color Synchronization

Whenever the chrominance and reference signals are arriving at the color demodulators, the chrominance signal will be demodulated and color will be reproduced, provided that the circuits which accomplish demodulation and those which handle the color signals after demodulation are operating properly. It has been shown in previous discussions that if either the chrominance or the reference signals are absent at the inputs of the demodulators, the receiver will not reproduce color. It has also been shown that the colors will not be right unless the chrominance and reference signals have the correct amplitudes and phase relationships.

When the frequency of the reference signals is incorrect, loss of color synchronization will be experienced. This trouble will be indicated on the screen by horizontal or diagonal stripes of variegated colors. The stripes may be either in motion or stationary. If the oscillator is operating at a random frequency, the stripes will be in motion. Fig. E1 of the Color Plate shows the appearance of the screen when the 3.58-mc oscillator is not operating at the correct frequency. As indicated by the small number of diagonal stripes, the frequency of the oscillator is only slightly off. If the oscillator were operating at a frequency that is far from correct, there would be a large number of horizontal or diagonal stripes.

The circuit of a color-sync section is shown in Fig. 12-22. This circuit is employed in the RCA Victor Models CT-100 and 21-CT-55 color receivers. Let us briefly review the operation of this type of circuit.

The output of the 3.58-mc oscillator is amplified, then a portion of it is fed back to the phase detectors where it is compared with the color-burst signal. If the

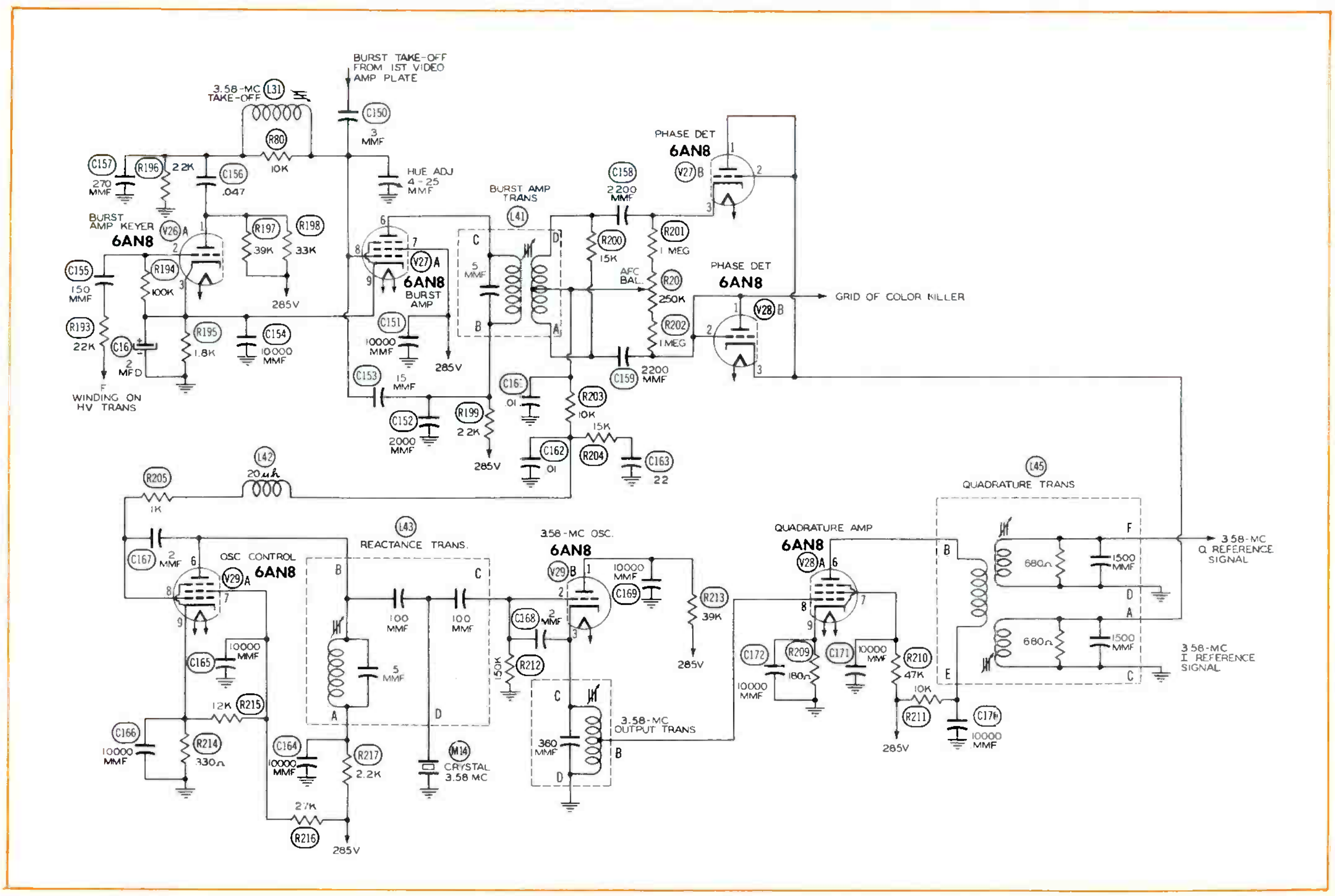

Fig. 12-22. Color-Sync Circuit Employed in RCA Victor Model CT-100 Color Receiver.

oscillator signal is not of the correct phase and frequency, a DC correction voltage will be developed by the phase detectors. This correction voltage is applied to the grid of the control stage which will then add more or less capacitive reactance to the grid circuit of the oscillator. The frequency and phase of the oscillator are closely controlled in this manner.

When the reference signal begins to lag behind the burst signal, the following events occur. Phase detector V28B conducts more than V27B. The negative DC correction voltage which is developed is added to the bias of the control stage. The gain of the control tube is reduced, and the amount of capacitance in the grid circuit of the oscillator is effectively decreased. The frequency and phase of the oscillator will tend to advance until the oscillator is in step with the color-burst signal.

If the reference signal begins to lead the burst signal, a positive correction voltage is developed and opposite events occur. For a more detailed discussion concerning the operation of the color-sync section, refer to Part VI of the Color TV Training Series in the November 1954 issue of the PF REPORTER.

If anything should happen in the color-sync circuit to interrupt or change the value of the DC correction voltage, the reference signal would be caused to change and would be thrown out of step with the incoming burst signal. When color synchronization is lost, the cause of the trouble will be located in some circuit ahead of the 3.58-mc oscillator.

If the pattern on the screen appears like that shown in Fig. E1 of the Color Plate and if the color-sync circuit under consideration is of the type shown in Fig. 12-22, the first thing to check is the control tube V29A. This is the only tube that can cause loss of color synchronization in this receiver. If the burst amplifier or either of the phase detectors were inoperative, the color killer would be allowed to conduct, in which case the bandpass amplifier would be biased to cutoff. The chrominance signal would be absent at the color demodulators, and the condition of no color would exist.

In a receiver which does not employ a color killer, it would be necessary to check the tubes in the burst amplifier and phase detector because color synchronization would be lost if one of these tubes were inoperative.

If replacement of tubes does not cure the trouble, a check of the circuit is in order. When checking the circuit, the best place to begin is in the oscillator-control stage. By making a voltage check, the technician can determine whether the operating voltages in this stage are correct or not. With abnormal plate or screen voltages at the control tube, the oscillator will drop out of synchronization.

If the plate and screen voltages are found to be normal, the next place to check is at the control grid of the oscillator-control tube. The voltage at this point should be approximately one volt positive. With a defective component in the circuit ahead of this point, the voltage at the control grid will be affected. For instance, if capacitor C162 were to develop a short to ground, the voltage on the control grid would go to zero and loss of color synchronization would result.

With capacitor C158 open or capacitor C159 shorted, the voltage at the grid of the control tube would drop below 15 volts negative. This amount of negative voltage places the control stage below cutoff. The control tube no longer governs the operation of the oscillator; therefore, the reference signal drops out of synchronization with the burst signal. If resistor R201 becomes open, the same thing will happen. The grid voltage will drop to approximately 40 volts negative.

A voltage check at the phase detectors can be very helpful. For instance, if capacitor C158 should become open, the voltage at the cathode of phase detector V27B would drop far below normal. Under normal operation, the voltage at the cathode of V27B and the voltage at the plate of V28B are equal in amplitude but of opposite polarity. If these voltages are found to be unbalanced, the cause of the trouble will often be found in the circuit of the phase detector.

If the operating voltages at the control stage are found to be normal, the tuning of coil L43 in the plate circuit of the control stage should be checked. If this coil were misadjusted, color synchronization would be lost.

Troubles With Color Purity

Improper color purity is noticeable when there is color contamination in parts of a reproduced monochrome picture or test pattern. It is also noticeable when the colors in various portions of a color picture are not pure. It signifies that the beams are not striking the correct sets of phosphor dots on the portions of the screen where the contamination is present. In order to obtain correct purity, the beam from the red gun must be striking only the phosphor dots which emit red light, the beam from the blue gun must strike only the phosphor dots which emit blue light, and the beam from the green gun must strike only the phosphor dots which emit green light.

Whenever color contamination is present, the adjustments of the purity devices associated with the picture tube should first be checked. The procedure for making these adjustments was outlined in previous sections of this Color TV Training Series. This adjustment procedure concerning the electrostatic picture tube appeared in the April 1955 issue, and the procedure concerning the electromagnetic picture tube appeared in the May 1955 issue. If adjustment of the purity devices does not correct the contamination, the purity circuits and the devices will need to be checked for defects.

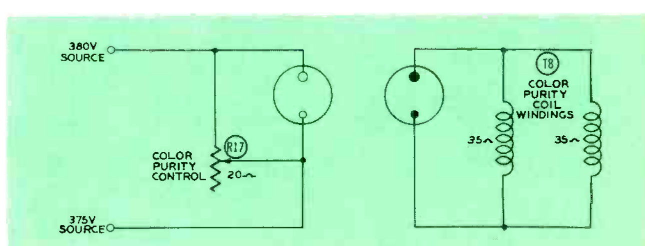

Fig. 12-23 Color-Purity Coil and Control Circuit Used in RCA Victor Model CT-100 Color Receiver.

For the electrostatic type of picture tube, there are three devices which affect purity. These are the purity coil, the deflection yoke, and the field-neutralizing coil. If any one of these units should become defective, the achievement of satisfactory purity would not be possible.

The circuit of the purity coil and its control is shown in Fig. 12-23. If purity adjustment is unsuccessful, first check the voltages at the input of this circuit. If they are normal, check the purity control and the purity coil. Direct replacement of the purity coil is the surest method

* * Please turn to page 41 * *

REFERENCE PATTERNS FOR TROUBLE SHOOTING

COLOR TV TRAINING SERIES

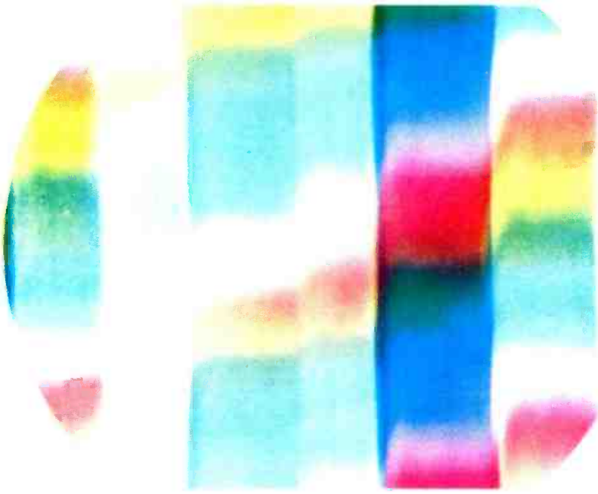

Fig. E1. Color-Bar Pattern Indicating Loss of Color Synchronization.

Fig. E2. Pattern Produced When Purity Coil Is Open.

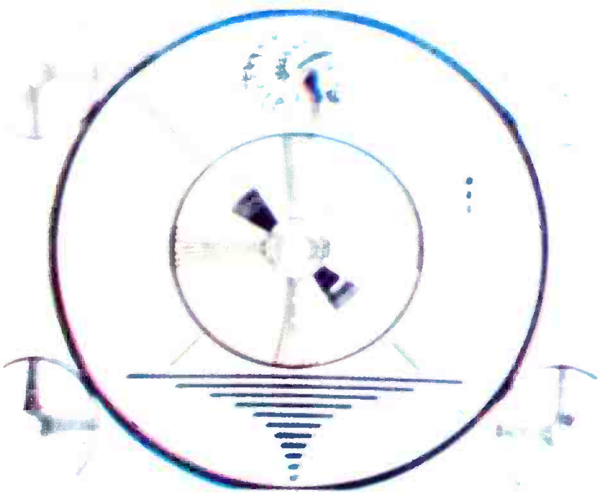

Fig. E3. Test Pattern Indicating Poor Vertical Dynamic Convergence.

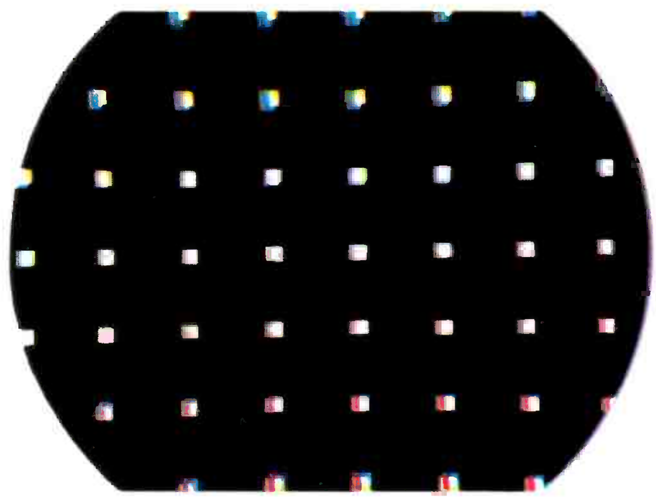

Fig. E4. White-Dot Pattern Indicating Poor Vertical Dynamic Convergence.

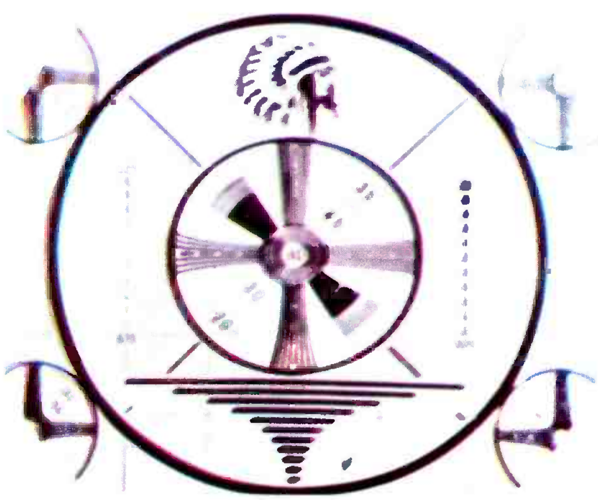

Fig. E5. Test Pattern Indicating Poor Horizontal Dynamic Convergence.

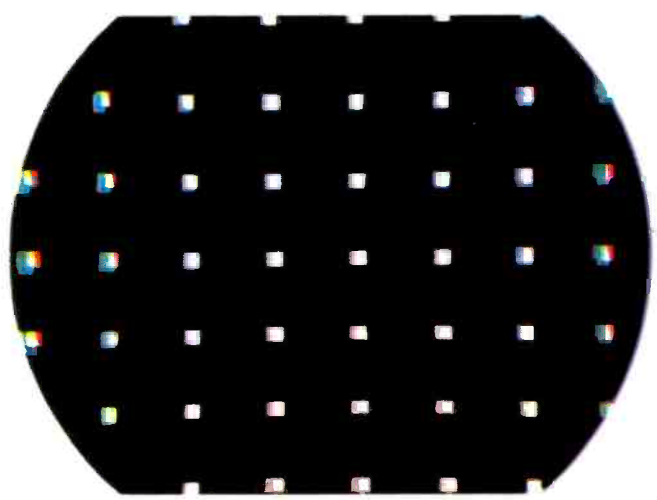

Fig. E6. White-Dot Pattern Indicating Poor Horizontal Dynamic Convergence.

Shop Talk

MILTON S. KIVER

President, Television Communications Institute

Test Equipment for Rapid Checks

Parts replacement occupies a considerable amount of the service technician's time. It is not unusual to have to unsolder and resolder a half-dozen components during the course of any ordinary service job. Since the service technician is always working against the clock whether he is in business for himself or is an employee of someone else, it is very clear that anything which will reduce the amount of time used in finding and changing defective components will definitely be advantageous.

A further reason for paying attention to the problem of reducing service time stems from the increased use of printed circuits which, as anyone who has worked with them knows, are set up in such a way that changing the parts is not an easy task. Considerable care must be exercised not only to see that adjacent portions of the circuitry are undisturbed but also to see that no damage will come to the wiring, components, or baseboard of the section being serviced. You want to be absolutely certain that the part is truly defective when you decide to change a component.

There have appeared in recent months a number of test instruments which tend to ease the service technician's job because they enable him to check the condition of a component while it is still wired into the circuit. Among the most important of these instruments are those which reveal whether a capacitor is open, shorted, leaky, or intermittent. Other instruments enable the technician to check the condition of horizontal-output transformers, yokes, and other inductive components such as width and linearity controls. For the latter, some unsoldering of leads may be required although a substantial amount of time is still saved by this method when compared to the substitution method.

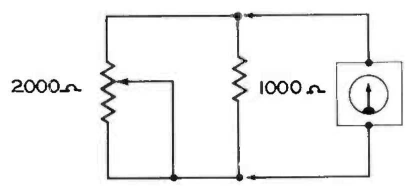

Fig. 1. The Measured Value of This Parallel Combination Depends Upon the Setting of the Potentiometer.

The common resistor is another item in plentiful supply in every receiver. Ordinarily, resistor values can be checked directly without unsoldering of leads. If two resistors are connected in parallel, as shown in Fig. 1, the technician can still check them by comparing their measured value with their computed value. The total value of two resistors in parallel may be computed by using the equation:

$$R\ (\text{resultant}) = \frac{R_1 \times R_2}{R_1 + R_2}$$

If the arm of the variable resistor in Fig. 1 is set at the bottom of the control so that both resistors will be fully in the circuit, the values of 1000 and 2000 ohms can be substituted in the foregoing equation.

$$R = \frac{1000 \times 2000}{3000} = 667 \text{ ohms.}$$

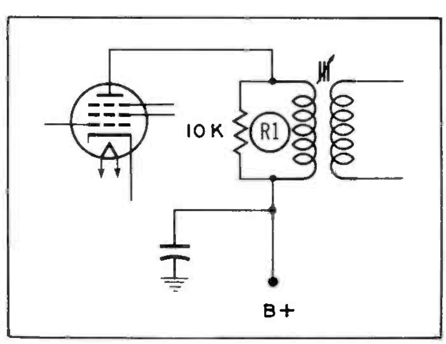

Fig. 2. Typical Circuit in Which Resistor Must Be Unsoldered Before Being Measured.

When the arm of the variable resistor has been moved to the top, the value of the parallel combination is zero ohms.

If you find that these computations are too difficult to do, then you would have to unsolder one end of one of the resistors and measure each unit individually. If you find the computations easy to do, then you do not need to go to the trouble of unsoldering a component to find out whether it is defective or not.

If you meet a condition such as that shown in the drawing in Fig. 2 and feel that the resistor may have changed value, then you would need to do some unsoldering; but it need not involve the resistor. The physical layout of the circuit may be such that it is easier to unsolder one end of the coil. A moment's inspection, while comparing the schematic diagram with the receiver, may save you a little time.

This preoccupation with time-saving methods, while of interest to all, is probably pursued with greatest vigor by the larger servicing outfits. This writer has had occasion to sit in on many such conferences at Central Television Service, Chicago, an organization that employs nearly a hundred men. Some of the time-saving devices and procedures instituted by this company would not be suitable for smaller firms, but one recently developed device designed and manufactured by the B & K Manufacturing Company is currently being made available to other service firms.

The need for this instrument, a simplified tube checker, arose because of two problems that Central encountered. One stemmed from the length of time it took to check tubes in the home on a conventional tube

* * Please turn to page 35 * *

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DIAGRAMS FOR SETTING UP TEST EQUIPMENT

INTRODUCTION

The following diagrams are designed to show methods of application of test instruments that the technician can use in servicing radio and TV receivers. Reading matter has been kept to a smaller amount than usual, and an attempt has been made to convey as much information as possible through the use of diagrams.

A complete alignment procedure for a TV receiver has been selected as an operation which brings into use several of the more important test instruments that the service technician may use in a single project. These instruments include the sweep signal generator, RF marker generator, oscilloscope, and VTVM.

Obtaining a Response Curve

Diagram No. 1

*NOTE 1. Some form of detector is almost always used when a response curve is being obtained, although a response indication can be obtained without a detector if the sweep frequencies applied do not go above the response characteristics of the vertical amplifier of the oscilloscope. Typical receiver points which give detection are the mixer grid of the tuner, the video detector, the sound-limiter grids, and the ratio detectors or discriminators. If a detector that is external to the receiver circuits is used, it is usually in the form of an RF detector probe.

*NOTE 2. Oscilloscope controls are set to the horizontal-input position.

Marking a Response Curve

Diagram No.2

Sound IF Detector Alignment Using the VTVM and the RF Generator

Diagram Nos. 3 and 4

*NOTE. A blocking capacitor should be used if the generator is connected at a point where considerable DC voltage is present or where any current drain would upset the circuit operation. The capacitor also serves to protect the generator. The termination network found at the output of most generators has characteristics of low impedance and low wattage. If this network is connected directly to a voltage source, it may draw enough current to damage the low-wattage resistors.

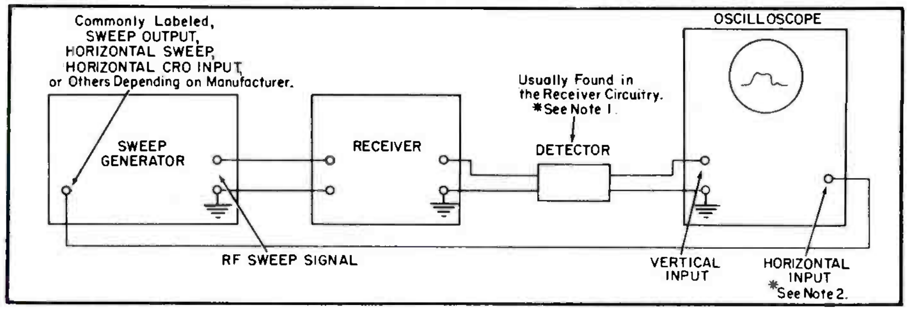

Diagram No. 1. Minimum Equipment Necessary to Obtain a Response Curve.

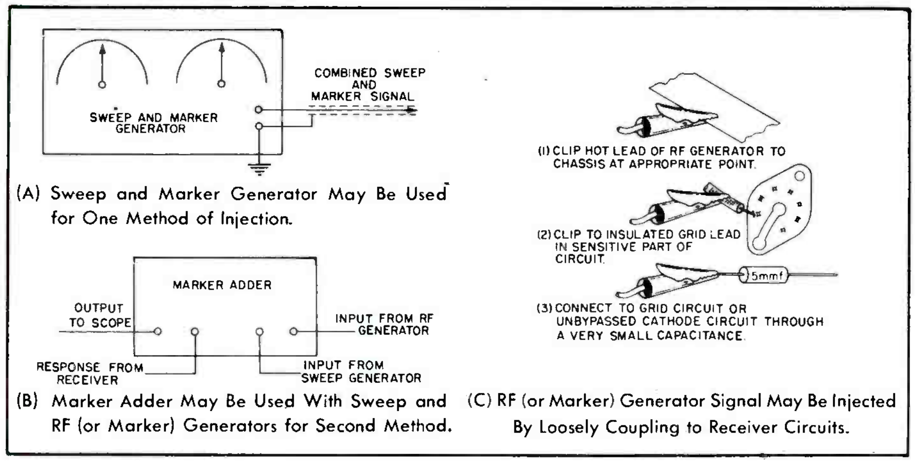

Diagram No. 2. Marker-Injection Methods.

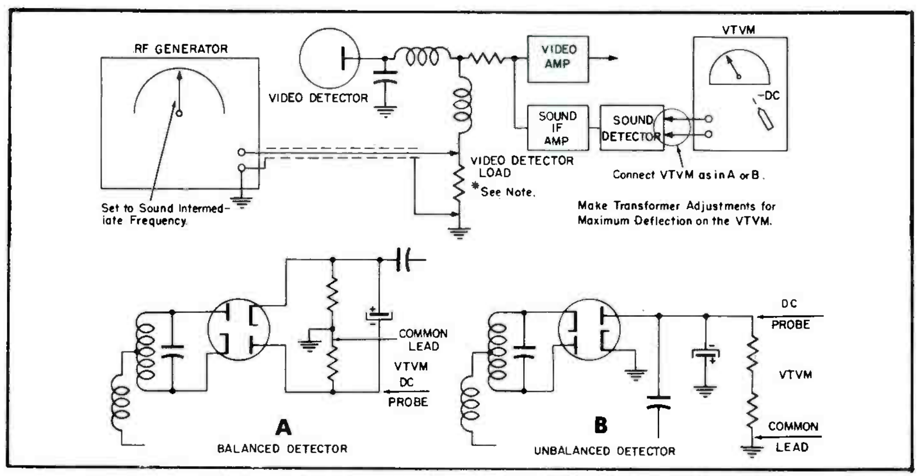

Diagram No. 3. Equipment Setup Used for Adjustment of Sound IF Transformers and of Primary of Sound-Detector Transformer.

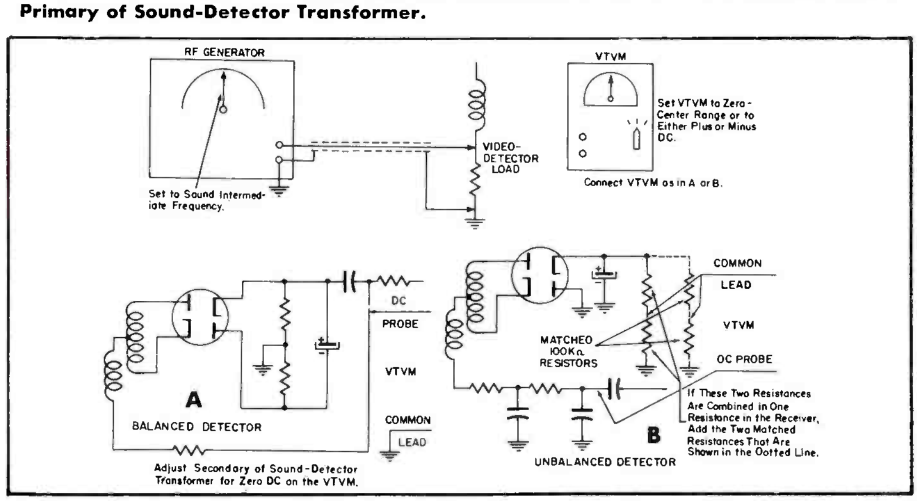

Diagram No. 4. Equipment Setup for Adjustment of the Secondary of Sound-Detector Transformer.

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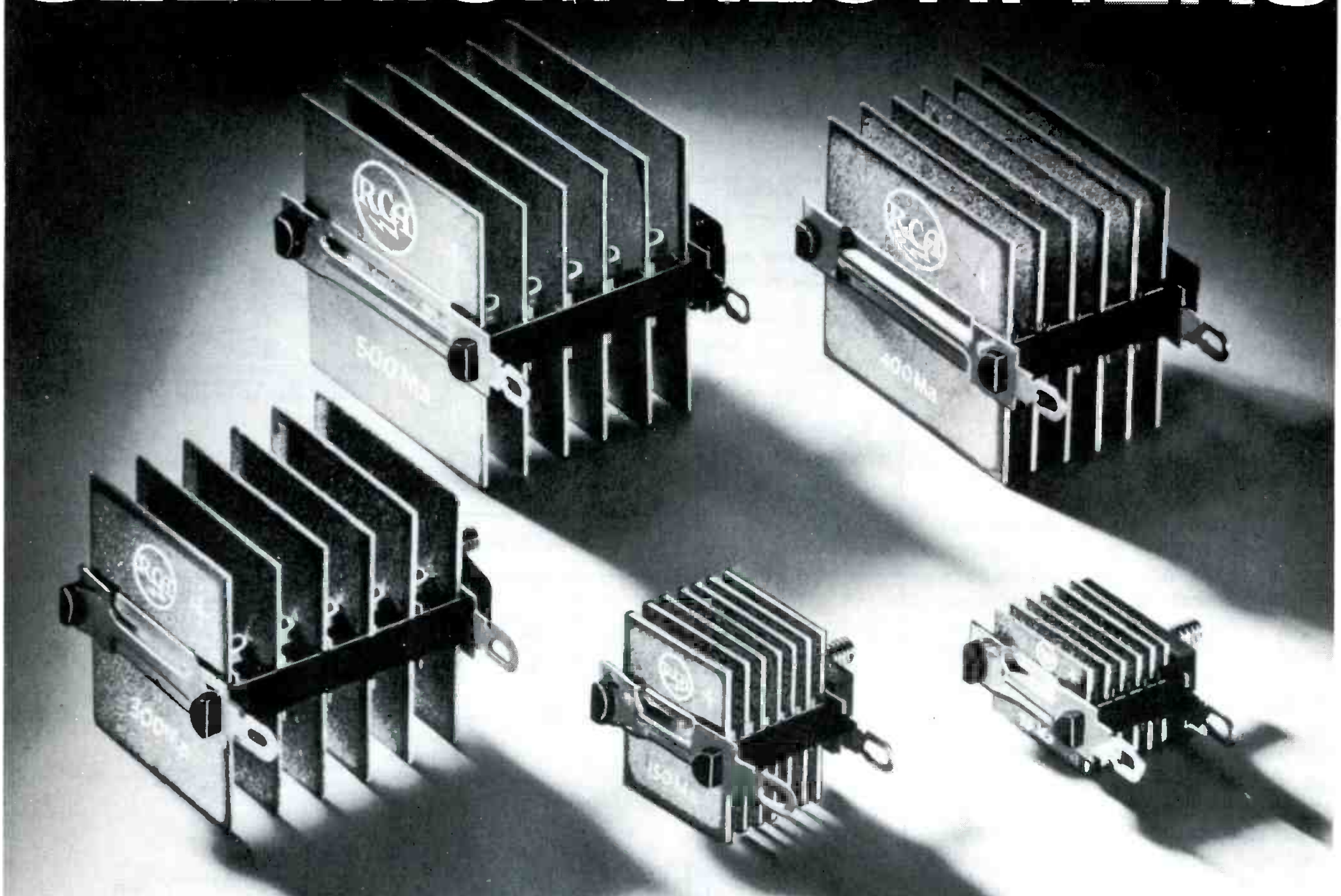

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204 G1	500 MA	130V	4.40

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Sound IF and Detector Alignment Using an Oscilloscope and FM Generator

Diagram Nos. 5 and 6

Video IF Alignment

Diagram No. 7

*NOTE 1. It is desirable to disable the oscillator section of the mixer stage so that there will be fewer confusing indications on the VTVM. A good way of doing this is to substitute another mixer-oscillator tube which has had the plate pin of the oscillator section removed.

*NOTE 2. Trap adjustments are made for minimum deflection on the VTVM at the trap frequency. The other adjustments are normally made to obtain maximum deflection at the frequency indicated for each adjustment.

Video IF Response Check

Diagram No. 8

*NOTE 1. A bias supply is usually connected at some point on the AGC line. This is for the purpose of maintaining the gain of the video IF stages as nearly as possible to that obtained when a station signal is being received. The value of bias and the point for application may vary somewhat and are usually given in the alignment instructions.

*NOTE 2. Connect leads from the generator in the same manner as that shown in Diagram No. 7. Moreover, the oscillator in the tuner should be disabled in the manner described in Note 1 for Diagram No. 7.

Tuner Alignment

Diagram No. 9

*NOTE 1. Many generators do not include a termination network or matching pad at the end of the output cable. In some cases, such a termination is advisable in order to eliminate distortion caused by standing waves on the output cable. The matching pad is designed to present an input impedance which matches the characteristic impedance of the output cable and to present an output impedance which matches the input impedance of the receiver.

*NOTE 2. The looker point is one of the points previously mentioned as affording a detector action; consequently, no detector is needed at the oscilloscope. Only one or two stages are normally found between the antenna and the looker point; therefore, maximum output from the generator and maximum gain of the oscilloscope are usually necessary to obtain a usable response curve. For the same reason, bias is seldom applied to the stages during alignment because the gain would be reduced as a result of such application.

PAUL C. SMITH

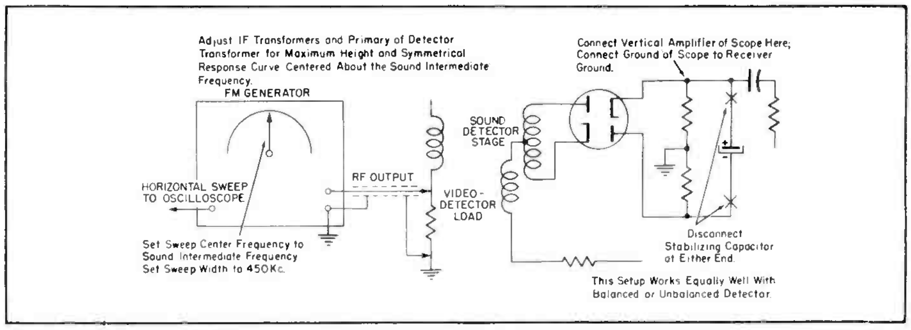

Diagram No. 5. Connections to Be Made for Adjustment of Sound IF Transformers and of Primary of Detector Transformer.

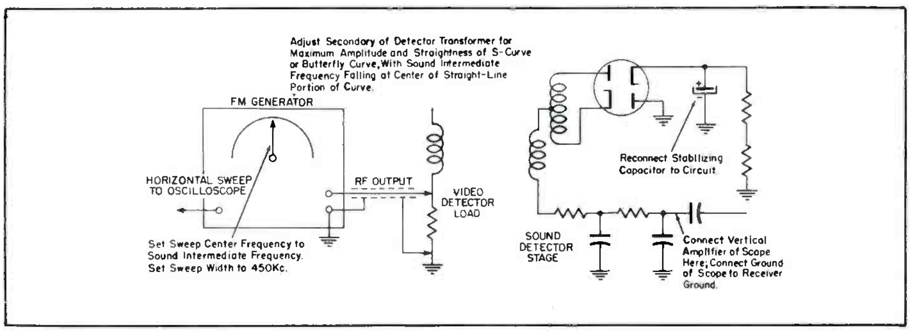

Diagram No. 6. Connections to Be Made for Adjustment of Secondary of Detector Transformer.

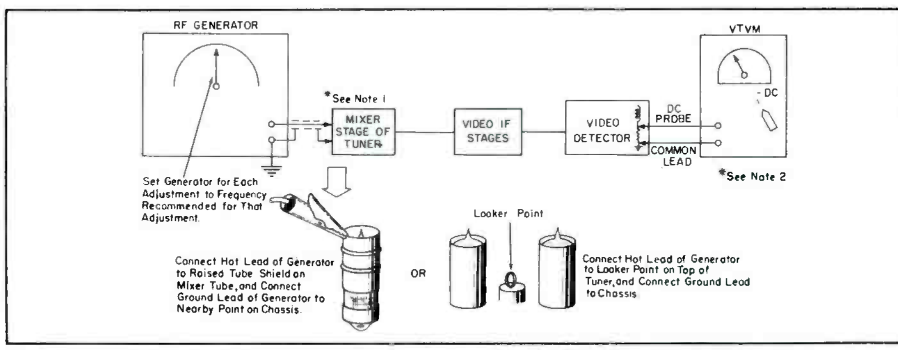

Diagram No. 7. Equipment Setup for Video IF Alignment Using RF Generator and VTVM.

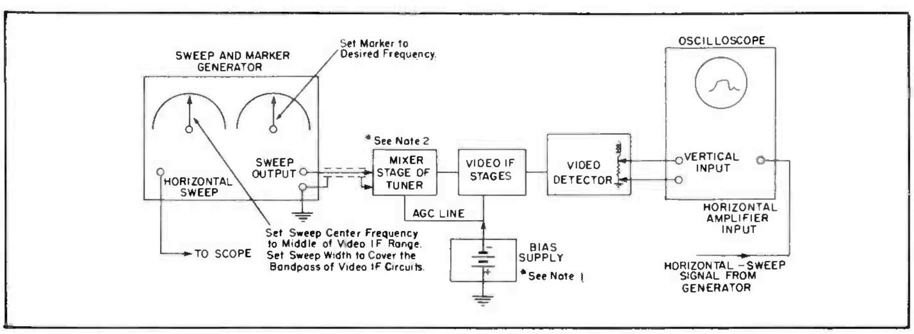

Diagram No. 8. Equipment Setup for Video IF Response Check.

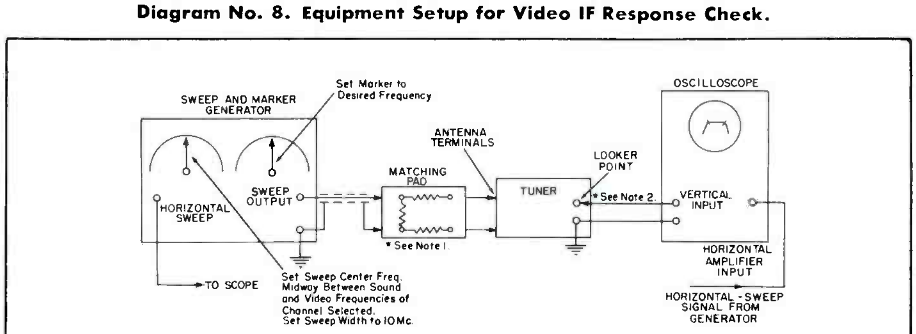

Diagram No. 9. Equipment Setup for Tuner Response Check and Alignment.

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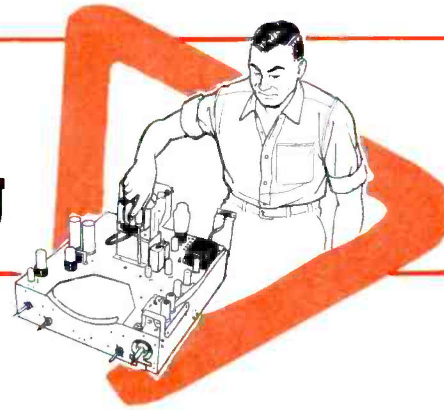

In the Interest of . . .
Quicker Servicing

by **Calvin C. Young, Jr.**

LINE-VOLTAGE VARIATIONS

Television receivers are designed to operate with power-line voltages of approximately 115 to 117 volts AC. These units will operate, however, at 105 to 125 volts AC; but certain troubles may occur at these extreme voltages. At 105 volts, a set may operate with reduced efficiency; and at 125 volts, the tubes and other components in a set may have a tendency to fail more rapidly.

Low line voltages are most often encountered in the city where the power lines are heavily loaded, and high line voltages are most often encountered in certain rural areas where the power lines are not heavily loaded. There are also localities in which the line voltage may be satisfactory during the day but may fall to a low value at night. In some extreme cases, the voltage may even vary from a value that is too high to one that is too low during a 24-hour period.

Fig. 2. Acme Electric Model T-8394M Manual Voltage Adjustor.

To combat these various line-voltage conditions, it would obviously be desirable to have a device which when installed between the power line and the receiver would maintain a constant 117-volt AC output regardless of the input voltage. Such units or devices are available; but, unfortunately, they are very expensive. For monetary or practical reasons, therefore, a unit which may be manually adjusted to compensate for low or high voltages is desirable. These units should provide some means for the user to check the output voltage so that the correct voltage can be maintained.

Shown in Figs. 1 and 2 are two of the many different makes of adjustable line-voltage transformers. The unit shown in Fig. 1 is representative of a type that uses two neon bulbs to reveal the approximate value of the output voltage. The unit which is pictured is the Regency Model VB-1 voltage booster made by I.D.E.A., Inc. The neon bulbs can reveal three conditions:

1. Output voltage too low — neither bulb is lit.

* * Please turn to page 56 * *

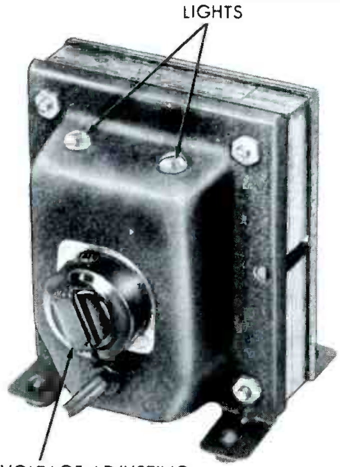

Fig. 1. Regency Model VB-1 Voltage Booster.

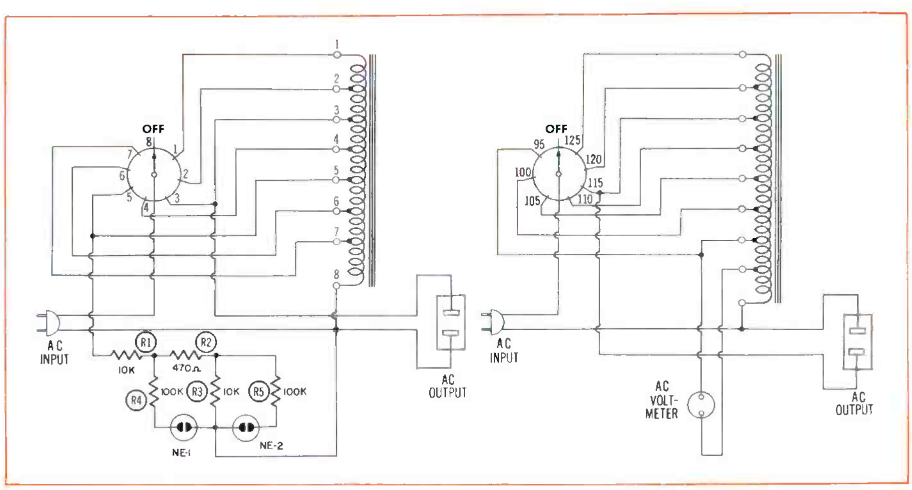

Fig. 3. Schematic Diagrams of Two Typical Voltage-Booster Transformers.

this TV serviceman uses

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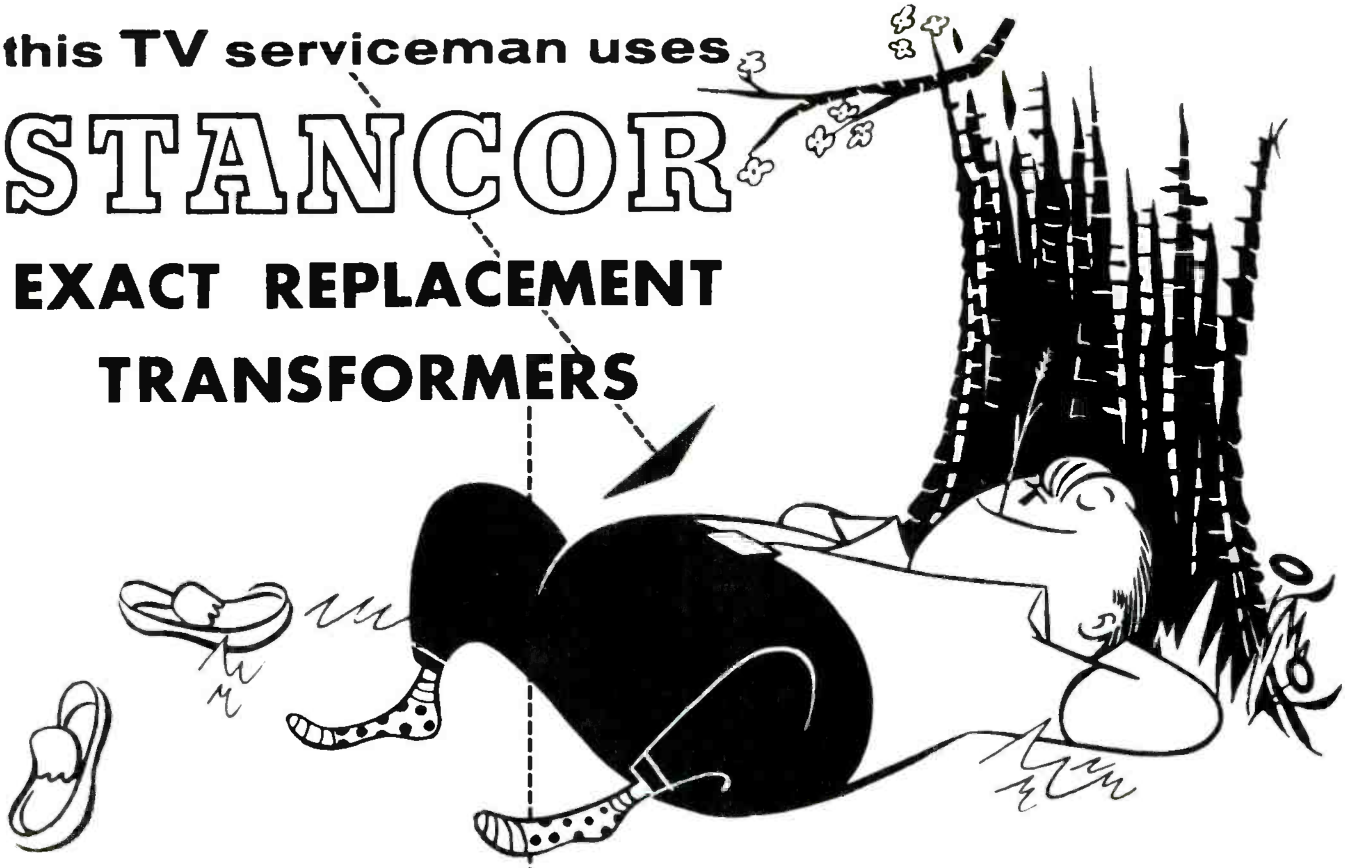

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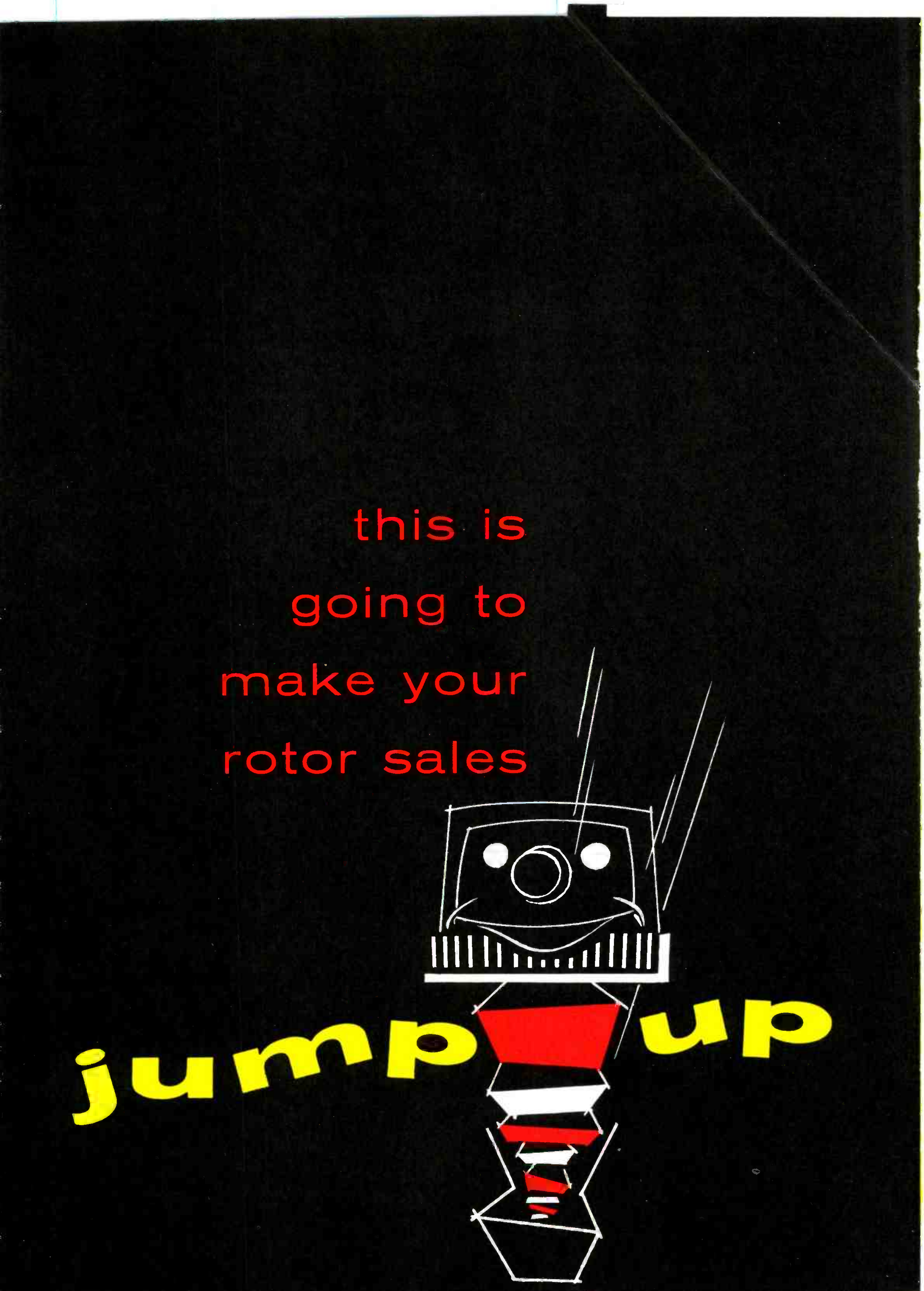
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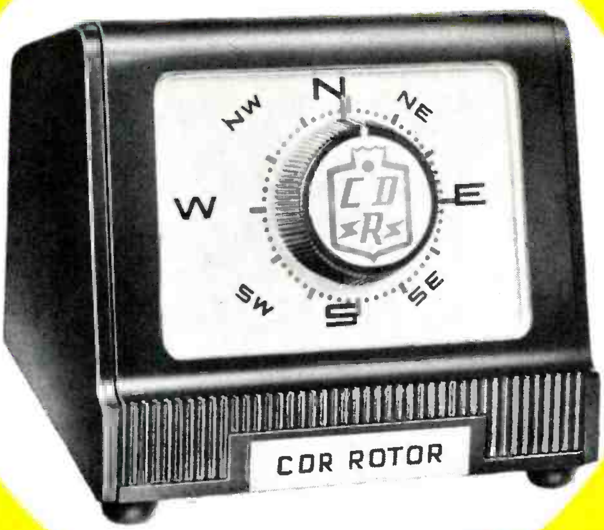
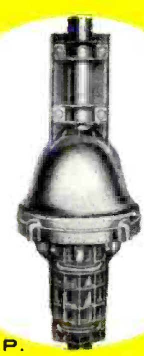


AR-1

AR-2

AR-22



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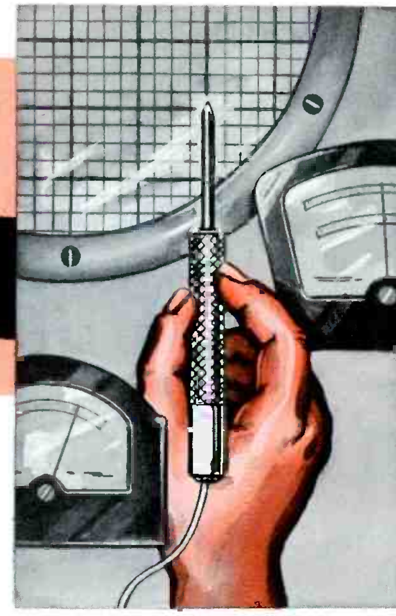
Notes On
TEST EQUIPMENT



Presenting Information on Application, Maintenance, and Adaptability of Service Instruments

by Paul C. Smith

HYCON MODEL 617 OSCILLOSCOPE

Recently, we obtained a Hycon Model 617 oscilloscope. We have had occasion to use this instrument a number of times, and we would like to pass along to our readers some information which may be of interest.

One of the features that was first noticed was the relatively small size of this oscilloscope. When measured, it proved to be 8 1/2 inches wide, 11 inches high, and 10 3/4 inches deep. This small size is an advantage if bench space is at a premium. For a further saving of space, the case and handle are designed to permit stacking with other Hycon test instruments.

The oscilloscope is equipped with a 3RP1A cathode-ray tube. The face of the tube is fitted with a green filter to ensure maximum contrast of the trace. Horizontal and vertical lines are ruled on the filter so that it may also be used for calibration purposes.

An interesting method is used to illuminate the calibration graph. A small lamp has been mounted so that its light strikes the edge of the plastic filter disc. In this manner, only the ruled lines are illuminated. The lines have an orange-red hue which can be easily seen against the green background of the filter. The operator has full control of the degree of illumination by means of a front-panel knob. This knob also controls the operation of the ON-OFF switch of the oscilloscope when the knob is turned to its extreme counterclockwise position.

The sensitivity of the vertical amplifier is 10 millivolts rms per inch, and the vertical bandwidth is from 6 cycles to 4.5 megacycles per second plus or minus 1 db. The input impedance (less probe) is 1 megohm shunted by 30 micromicrofarads plus or minus 2 micromicrofarads. The sensitivity and high-frequency response of the vertical amplifier were checked and found to be well up to the manufacturer's specifications. The low-frequency response was beyond the reach of the signal sources at hand and was not checked.

The sensitivity of the horizontal amplifier is 75 millivolts rms per inch, and the horizontal bandwidth is 6 cycles to 500 kilocycles per second plus or minus 3 db. The input impedance of the horizontal amplifier is 1 megohm shunted by 35 micromicrofarads.

Sawtooth sweeps ranging from 15 cycles per second to 100 kilocycles per second are provided in four ranges. Two additional positions of the sweep-range switch furnish automatic sweep rates of 30 and 7,875 cycles per second. These are the sweep rates which the technician commonly uses for viewing the vertical- and horizontal-deflection waveforms in TV receivers.

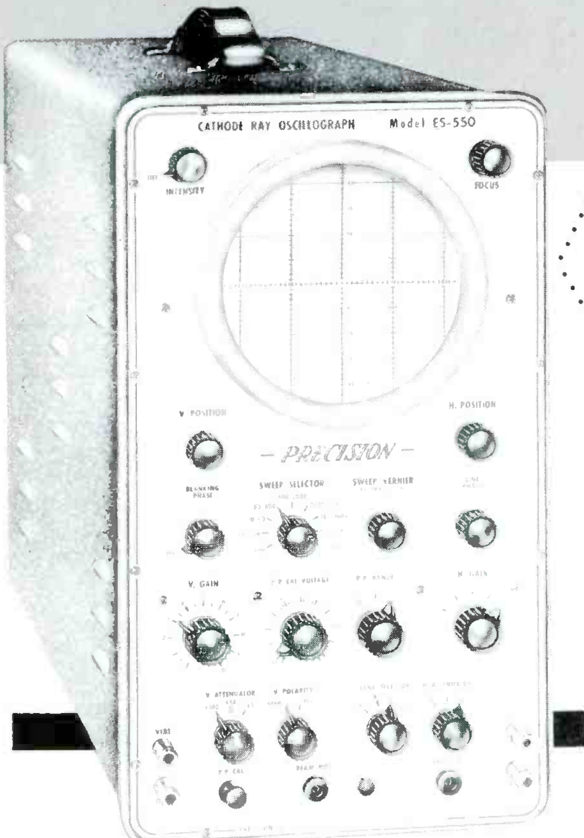
A 60-cycle sinusoidal sweep is provided for use in alignment procedures or wherever such a sweep is desirable. The phase of the sinusoidal sweep may be varied by means of a phasing control on the oscilloscope panel. The phasing control acts as an amplitude control for the synchronizing signal when the horizontal-selector switch is in either the INT (internal), LINE, or EXT SYNC position.

The oscilloscope trace is blanked during retrace time. When the internal sawtooth sweep is used, this oscilloscope provides for three types of synchronization: (1) INT (internal), during which a portion of the vertical-input signal is applied to the sync section; (2) LINE, during which a signal at the line frequency is applied to the sync section; and (3) EXT (external), during which an external signal can be applied to the sync section. The sync-amplifier section also functions as a sync limiter in order to prevent distortion

* * Please turn to page 69 * *

Fig. 1. Hycon Model 617 Oscilloscope.

5 Megacycles Bandwidth
10 Millivolts per Inch Sensitivity
in the NEW *PRECISION* ES-550
5 inch OSCILLOSCOPE



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The Model ES-550 is the *PRECISION* answer to laboratory, industrial and technician requirements for a rugged, dependable instrument for broad coverage of modern electronic oscillograph applications, INCLUDING COLOR TV. It provides a new and unparalleled standard of high sensitivity with single, overall wideband frequency response, plus other special performance features—at most sensible selling price.

- ★ **Push-Pull, Wide-Band Vertical Amplifier:** 10 MV/inch sensitivity.
  Input Characteristics: 2 Megohms, 22 mmfd.
  Response: One DB from 10 cps. to 3.5 MC—3 DB at 5 MC.
  Attenuator: 3 step freq. compensated plus a continuously variable gain control in cathode follower circuit.
- ★ **Direct Reading, Peak to Peak Voltage Calibrator**
- ★ **Vertical Pattern Reversal Switching Facility**
- ★ **Push-Pull, Wide-Range Horizontal Amplifier:** 100 MV/inch sens.
  Input Characteristics: 2 Megohms, 25 mmfd.
  Response: One DB from 10 cps. to 1.0 MC—3DB at 2 MC.
  Attenuator: 3 step, freq. compensated, plus a continuously variable gain control in cathode follower circuit.
- ★ **Linear, Multi-vibrator Sweep Circuit:** 10 cycles to 100 KC plus automatically synchronized 30 cycles and 7875 cycles sweep for TV sync-pulse analysis. Amplified sweep retrace blanking.
- ★ **Amplified Auto-Sync Circuit** active on all internal sweep ranges.
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- ★ **All 4 Deflection Plates Available** with full beam centering facilities.
- ★ **Tube Complement:** 12AV7 "V" Cathode Follower-Amplifier. 6U8 "V" Amplifier-Phase Splitter. Two 6CL6 Push-Pull "V" Drivers. 6U8 "H" Cathode Follower-Amplifier. 6C4 "H" Phase Splitter. Dual 12BH7 Push-Pull "H" Driver. 12AV7 Linear-Sweep Multivibrator. 6BH6 Auto-Sync Amplifier. 12AU7 Sweep Retrace Blanking Amplifier. OA2 Voltage Regulator. 5V4 Low Voltage Rectifier. Two 1V2 High Voltage Rectifiers. 5CP1/A CR Tube.
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Model ES-550 Standard: Electrically identical to above but in standard black cabinet with black anodized aluminum panel. Case dimensions 8¼ x 14½ x 18½ inches. Complete as above........ **Net Price: $210.00**

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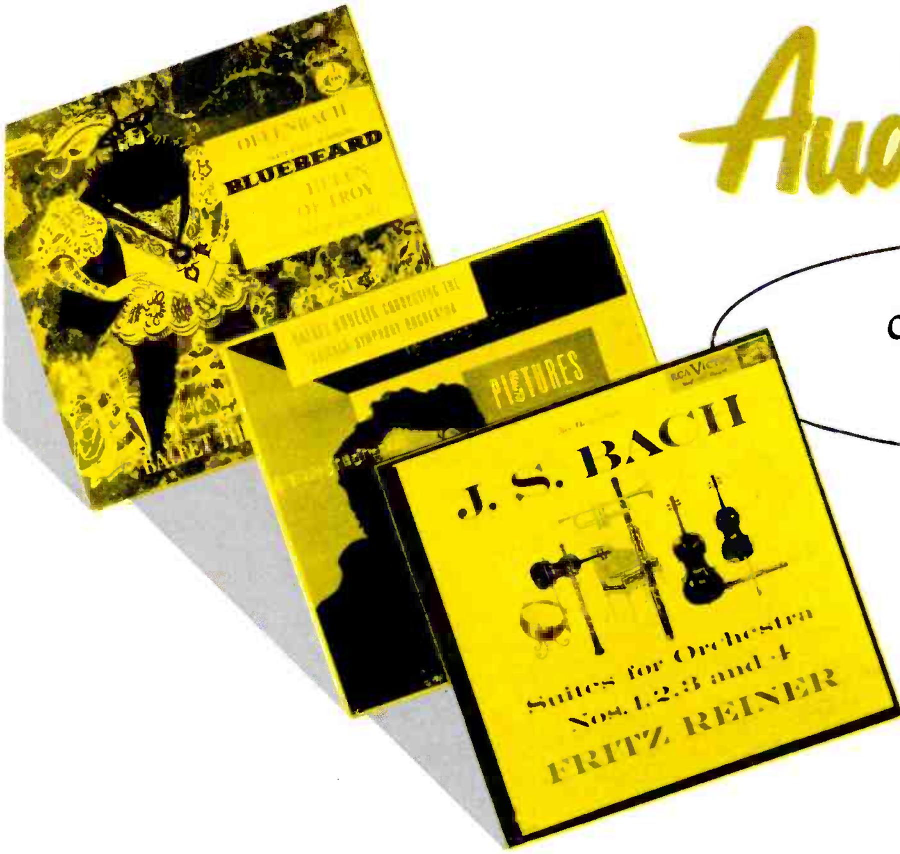


Audio-Facts

CARE and HANDLING of RECORDS

by ROBERT B. DUNHAM

Good music for listening pleasure is the primary reason for having a high quality audio system in the home. This fact has been mentioned several times in these columns and is the reason why we usually use the term "home music system."

If we are to obtain high quality reproduction of music from an audio system, no weak links can be tolerated. Every unit or section of the system must do its part and do it well. The program material, obtained from records in most cases, must be considered as a critical part of the system because any faults or undesirable effects will be reproduced as well as the desired portions. In fact, the undesirable things are often more disturbing when heard from the loudspeaker of a high quality system which reproduces everything faithfully than they would be if reproduced by a mediocre outfit.

Anyone not acquainted with the effect produced by defective or damaged records is usually amazed to find just how severe the disturbance can be. An example is the recent experience of an owner when he turned on his audio system in his newly constructed home and operated a high quality music system for the first time. The writer was requested by the perplexed owner to come and find out what was wrong with the outfit. He said it seemed there were many high-pitched sounds coming out of the loudspeakers. As was suspected, the disturbing sounds were found to be ticks and pops caused by damaged records.

The records were new but had been removed from their protective jackets and subjected to handling in the unprotected state. The interior of the house was not completely finished, and most surfaces were covered with a film of dust and grit from sawing and sanding. The records had been laid on bookshelves; consequently, they had received many small scratches and were more or less covered by the dust and grit. The resulting ticks and pops were very noticeable and disturbing when heard in the large rooms which were still empty.

The owner was relieved to learn that the system was operating satisfactorily but was surprised to find that the care and handling of records is so important and critical. He was convinced by the satisfactory reproduction obtained from clean and undamaged records.

Proper care and handling of records are so important that correct methods should be understood and used by everyone who uses or handles records. The satisfactory reproduction and the extended useful life to be obtained from records as the result of using and handling them with care should surely point out the value of a discussion of the measures to be observed.

Most present-day records are 33 1/3-rpm and 45-rpm microgroove disks played with a 1-mil (.001-inch) stylus. Some manufacturers have discontinued production of 78-rpm (3-mil) records. Microgroove records are made of plastic and are termed unbreakable, but the small and delicate grooves in the playing surface can be damaged. Any small scratch, if it cuts into the wall of a groove, will be heard as a tick or pop from the loudspeaker when the record is played. The loudness will depend upon the depth and size of the scratch. Dirt, dust, grit, or any other foreign matter in the grooves can cause noise as the stylus moves through the contaminated grooves. Furthermore, such foreign matter can cause permanent damage when forced against the walls of the grooves by the stylus as the record is played. The damaged record cannot be repaired when the grooves become deformed by being gouged, scored, or imbedded with grit.

Handling

A record, when not in use on a turntable, should be kept in its protective container. Many types of containers are used with records. These include boxes, envelopes, and various types of jackets and sleeves. It is now becoming a common practice to use some form of lightweight paper or plastic envelope or sleeve on the record inside the heavier outer container for added protection.

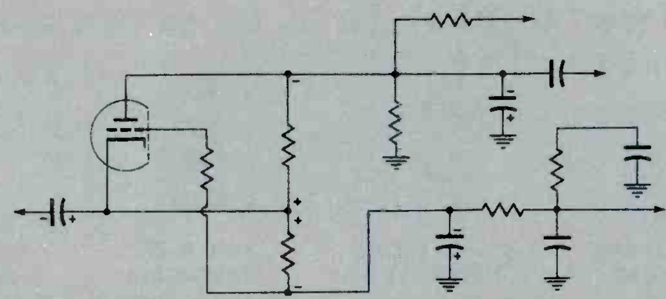
The manner in which a record is removed from its protective cover

* * Please turn to page 65 * *


PYRAMID
imp

THE TRIODE PHASE DETECTOR

Theory of Operation With Waveform Illustrations



by THOMAS A. LESH

The phase detector, one type of circuit used to supply horizontal AFC in television receivers, commonly employs a dual diode such as the 6AL5. Occasionally, the technician will find sets which have a modified circuit using a triode.

The function of both types of phase detectors is to compare two voltages — sync pulses from the incoming signal and a sawtooth voltage developed usually by integration of a pulse from the horizontal-output transformer of the receiver. If the voltages are not in phase, a correction voltage is applied from the phase detector to the horizontal oscillator in order that the frequency and phase of the oscillator will be the same as the frequency and phase of the sync signal. The oscillator that is teamed with the phase detector is usually either a cathode-coupled multivibrator or a combination of a sine-wave oscillator and a reactance tube. In the first case, the correction voltage is fed to one grid of the multivibrator tube; and in the second case, it is placed on the grid of the reactance tube.

Dual Diode

A review of the operation of a phase detector using a dual diode should be helpful in explaining how the triode circuits differ from the diode circuits. Fig. 1A is a schematic diagram of one arrangement of a diode type of circuit. Sync pulses of two polarities are taken from a phase-inverter stage. Positive sync pulses are applied to the plate of V1A, and negative pulses are applied to the cathode of V1B. The sawtooth wave is applied to the cathode of V1A and to the plate of V1B.

If the oscillator is on frequency and in phase with the sync pulses, the pulses will occur at instants when the value of the sawtooth voltage is zero. The pulses, which are of equal amplitudes, cause the diodes to conduct equally and to charge C1 and C2 in the polarities shown on the diagram. Between pulses, C1 discharges through R5 and R7; at the same time, C2 discharges through R4 and R7. The voltages developed across R7 by these discharge currents are opposite in polarity, and they are equal because the capacitors were equally charged and because the resistances in the discharge paths are equal. The resultant output voltage taken from the top of R7 is zero.

The sawtooth wave causes some conduction in addition to that caused by the sync pulses, but this conduction is equally divided in the two diodes. The voltage produced by the sawtooth wave has an average value of zero, when measured across R7, no matter what the phase of the sawtooth wave may be.

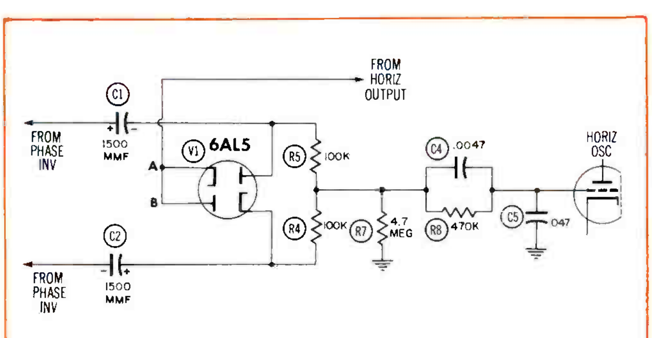
Production of a correction voltage is the result of an unbalanced condition in which one diode conducts more than the other during a sync-pulse interval. When the oscillator associated with the circuit shown in Fig. 1A is running too fast, the sawtooth voltage reaches a positive value by the time the sync pulse arrives. The diodes are therefore biased in such a manner that V1B conducts more heavily than V1A, and C2 is given a greater charge than C1.

The resultant voltage across R7 is positive. A voltage of this polarity is needed to slow the oscillator used with this phase detector. If the oscillator tends to run at a reduced rate, V1A conducts more heavily than V1B and the correction voltage is negative.

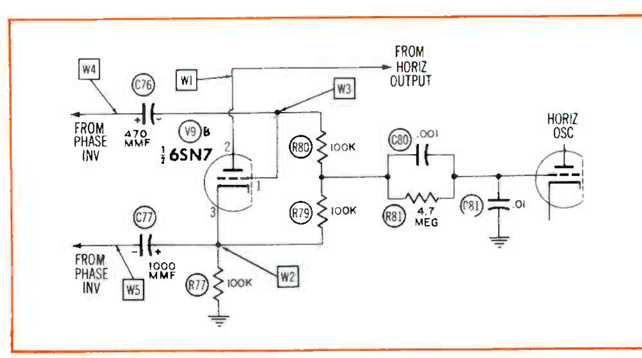
Triode in Motorola Model 21T21E

There are some similarities between the diode phase detector and one type of triode phase detector. A circuit in the Motorola Model 21T21E is shown in Fig. 1B. The triode receives the same input sig-

* * Please turn to page 76 * *



(A) Dual-Diode Circuit.



(B) Triode Circuit in Motorola Model 21T21E.

Fig. 1. Typical Phase Detectors for Horizontal AFC.

G-C CRT DUO-DECAL TEST SOCKET ADAPTER
For top-of-chassis tests.
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Various sizes and patterns.
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Many types & sizes; plastic box.
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G-C "99" SPRING ASSORTMENT
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G-C "99" WASHER ASSORTMENT
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No. 9119 NET $0.99
G-C SCREW-STARTER SCREW DRIVER
Starts screws in tight spots.
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G-C K-27 PRINT-KOTE
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No. 14-6 NET $2.17
G-C SPRAY-KOTE HAMMER-KOTE
Brown hammer finish, air dries.
No. 83-12 NET $1.83
G-C DUAL SPEAKER SWITCH ASSEMBLY KIT
Wired, ready to use.
No. 9188 NET $1.17
GENERAL
G-C
CEMENT
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SERVICE AIDS
...at Your Jobber
G-C SPRAY-KOTE APPLIANCE WHITE
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G-C PHONE DUPLEX JACK AND PLUG
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Large, roomy kit with 7 tools.
No. 9052 NET $8.10
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Safe, slow-burning, inexpensive.
No. 11-G NET $2.10
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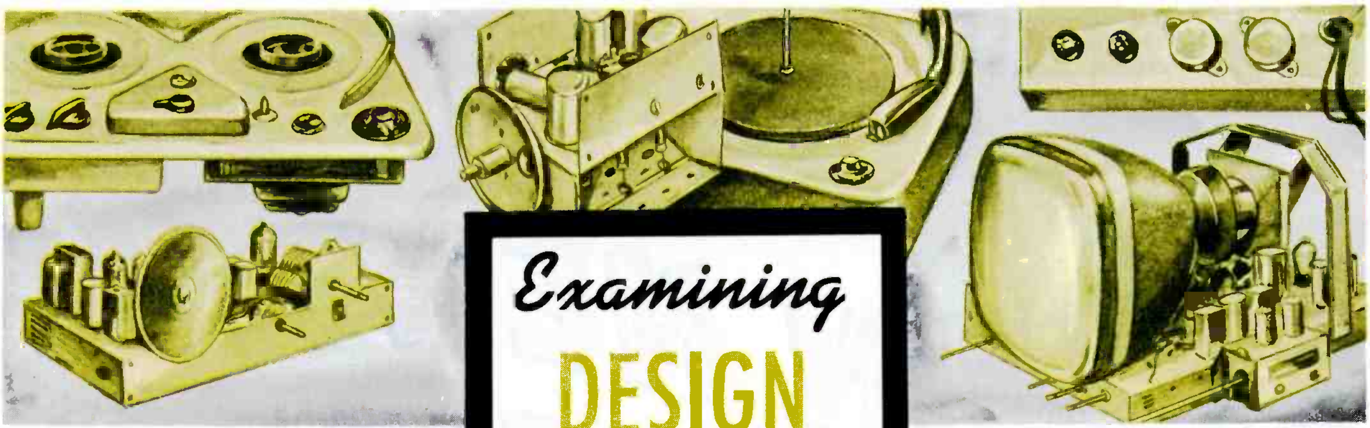

Examining DESIGN Features

by LESLIE D. DEANE

Raytheon Transistorized Radio With Chassis 8RT1

The receiver pictured in Fig. 1 is an example of Raytheon's new portable transistorized radio. There are very few transistorized radios on the market at the present time; but what the future holds for this new field, only time can tell.

The Raytheon receiver shown in Fig. 1 incorporates Chassis 8RT1. The physical locations of some of the components in the Raytheon transistorized radio are indicated in the photograph of Fig. 2. A schematic diagram of this chassis is given in Fig. 3. The unit employs eight transistors which actually replace the vacuum tubes that would normally be employed in a conventional portable AM radio. The transistors used in the RF, IF, and detector stages are the CK760 type made by Raytheon. The ones used in the audio stages are the CK721 or the CK722 type and are also produced by Raytheon. These types are shown in the photograph of Fig. 4.

The antenna, which is attached to the chassis, consists of a coil wound on a long ferrite rod. This type of antenna provides a rather high Q for the input circuit. The tuning capacitor is of the conventional ganged type, and the receiver has a frequency range from 540 to 1,600 kilocycles.

The signal from the antenna is inductively coupled to the base circuit of the mixer which is a CK760 transistor having a relatively low input impedance. Another CK760 transistor is employed as the oscillator.

A superheterodyning action takes place at the mixer because of the oscillator injection voltage which is coupled through the oscillator coil L2 to the emitter circuit of the mixer. The IF transformer L3, which also has a low input impedance, allows the proper intermediate frequencies to pass from the mixer to the first IF stage. The intermediate frequency is 455 kilocycles; and the IF transformers L3, L4, and L5 are all single-tuned units. The first and second IF transistors operate in a similar manner to that of triode RF amplifiers and therefore require neutralization. Capacitors C12 and C17 function as neutralizing components, and they feed back a portion of the output signal to the input of each IF stage.

A negative AVC voltage is fed back from the detector to the base connection of each IF transistor in order to control the gain of each IF stage. Resistors R13 and R18 develop the proper bias voltages required for

* * Please turn to page 61 * *

Fig. 1. Raytheon Transistorized Portable Radio Using Chassis 8RT1.

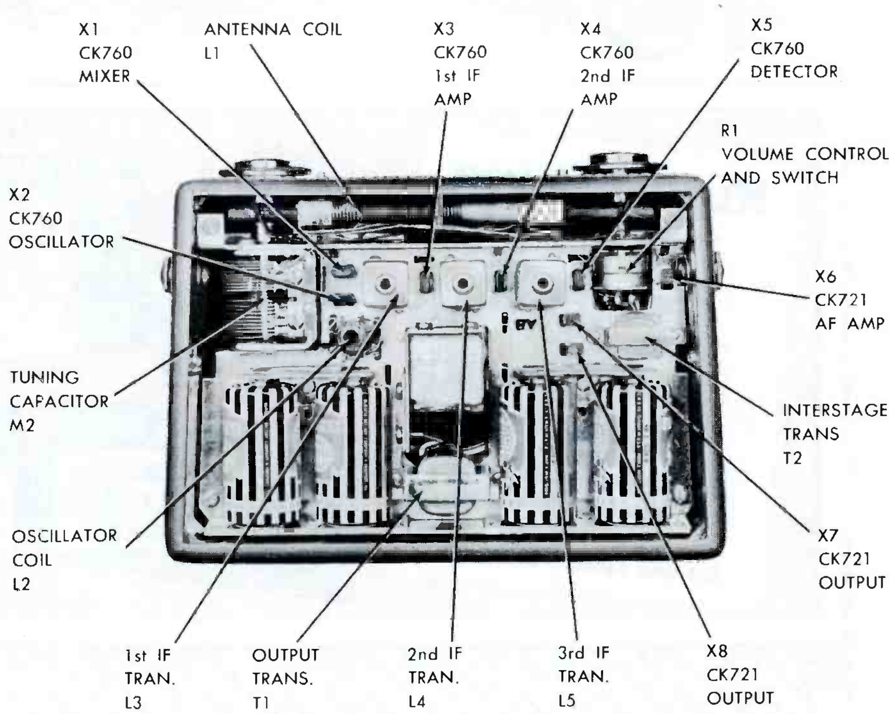

Fig. 2. Rear View of Raytheon Transistorized Radio With Cover Removed.

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TROUBLES in VIDEO IF and DETECTOR SYSTEMS

A Servicing Guide Arranged by Symptoms

BY LESLIE D. DEANE

and **CALVIN C. YOUNG, JR.**

The video IF strip, including the video detector, forms the link between the RF tuner and the video-amplifier stages. The IF amplifier stages use tubes which may be dual purpose and which may function in other sections of the receiver.

The video IF strip has three main purposes. The first is to amplify the signal from a station after that signal has been converted to intermediate frequencies, the second is to reject all other signals, and the third is to detect the video signal so that it may be applied to the video-amplifier stages. Even though different IF strips may tune to widely different frequencies, the problems associated with each are very similar.

The troubles usually encountered in a video IF strip are generally associated with certain symptoms either in the sound, in the picture, or in both. The following list contains many of these symptoms.

1. Raster, no picture, and no snow.
2. Snowy picture.
3. Ringing in picture.
4. Poor vertical synchronization.
5. Pulling in picture.
6. Lack of picture contrast.
7. Intercarrier buzz in sound.
8. Negative picture.
9. Hum in picture.
10. Intermittent troubles.
11. Smeared picture.
12. Overloading in picture.

General Discussion

A brief review of the different designs employed in the video IF and detector stages along with a few general servicing hints will be presented at this point. It is hoped that this general discussion will better equip the service technician to trouble shoot these stages of the television receiver.

There are two major classifications for video IF circuits. One is the split-sound system in which the video IF and sound IF signals are amplified separately. The other is the intercarrier system in which both the sound and video IF signals are amplified through one common IF strip. In the split-sound system, the sound IF signal is extracted from the composite IF signal at some point ahead of the video detector. In the intercarrier system, the sound IF signal is permitted to pass through the video IF stages; however, its amplification is held to only about 5 per cent of that of the video IF signal. The majority of television receivers now in the field incorporate the intercarrier system.

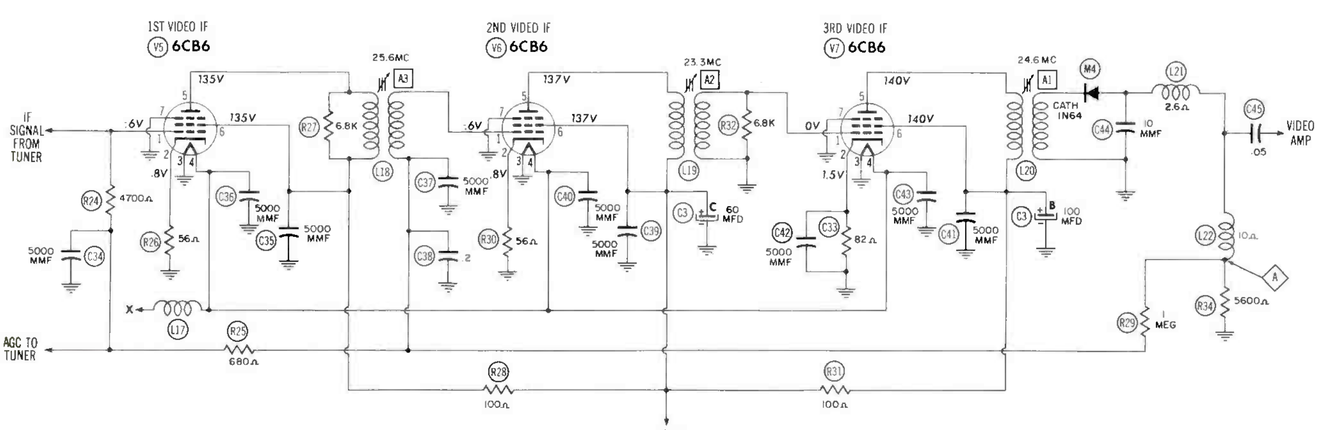

Fig. 1. Video IF and Detector System Which Employs a Crystal Detector and Transformer Coupling Between Stages.

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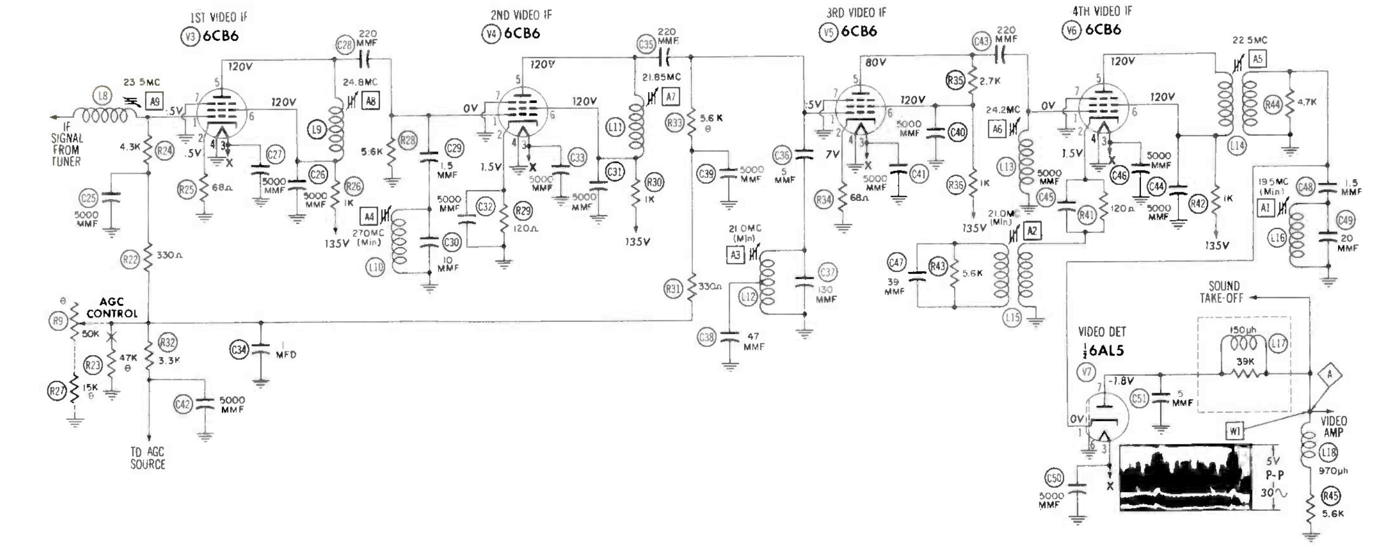

Fig. 2. Video IF and Detector System Which Employs a Diode Detector and Capacitive Coupling Between Stages.

The resonant circuit employed in the majority of IF stages consists of a coil or transformer in combination with the associated capacity of the circuits. Adjustment is provided by movable metal cores, and the stages may be overcoupled or stagger-tuned in either the intercarrier or split-sound systems.

The number of IF stages in a TV receiver will vary from two to four, and the stages may employ a wide selection of high-gain tubes. At the present time, the two IF ranges most commonly used in TV sets are the ranges between 21 and 26 megacycles and between 41 and 46 megacycles.

The video-detector stage will employ either a crystal diode or a vacuum tube connected in a series or shunt arrangement. The detected output signal from this stage will either be positive or negative, depending upon the polarity required by the video-output stage. The detector stage is sensitive to stray pickup and therefore requires adequate shielding.

The IF signal is usually inductively or capacitively coupled through the IF strip. A schematic diagram of a typical IF section which is transformer coupled is shown in Fig. 1. This circuit also employs a 1N64 crystal as a video detector. The schematic of Fig. 2 illustrates another typical IF strip; however, it utilizes capacity coupling and a 6AL5 tube as a detector. These schematics will be referred to from time to time in connection with the possible causes of each symptom.

Proper operation of the video IF strip depends upon three basic voltages: (1) the RF signal voltage supplied by the tuner, (2) the B+ voltage which is usually furnished directly from the low-voltage power supply or indirectly from the audio-output stage, and (3) the AGC voltage which automatically controls the gain of one or more of the IF amplifiers. The AGC voltage is usually derived from the video-detector stage or from a keyed AGC circuit.

A trouble symptom that may point to an inoperative IF strip can often be caused by a defective component in another section of the receiver if the trouble affects one or more of the three voltages mentioned in the previous paragraph. The B+ and AGC voltages applied to the IF section can be checked with an ordinary voltmeter. If these voltages appear to be incorrect, it may be necessary to make a resistance check of the components in the B+ and AGC circuits.

It is rather difficult to formulate one universal trouble-shooting procedure to cover all symptoms that may develop because of a faulty video IF or detector stage; therefore, only a general procedure for localizing the defective section will be presented.

Isolating the trouble to the RF, IF, or video-output circuits may be accomplished by tracing the signal with the aid of an oscilloscope. One of the first logical steps would be to check the signal at the video-detector load. If a normal signal is present, it usually indicates that the trouble exists in the video-output stage or that the picture tube is defective. If a normal signal is not encountered across the video-detector load, then the trouble is probably in the RF or IF stages.

The next step would be to check the tuner. One method to determine if the signal is getting through the tuner is to connect an RF signal generator across the antenna terminals. A signal modulated with 400 cycles should be used. Two resistors of about 100 ohms each should be placed in series with the generator leads. The oscilloscope detector probe may then be placed at the grid of the first IF stage, and a 400-cycle pattern will be observed if the tuner is passing the input signal. The 400-cycle signal can also be traced on through the IF stages. A more detailed procedure for trouble shooting the IF section is outlined under symptom No. 1.

In trouble shooting an IF system, a check of the IF alignment is often very helpful. This check can help to determine two conditions: (1) the frequency response and (2) the relative gain of the IF strip. The frequency response of the IF strip is represented by the shape of the IF response curve as seen on the face of the scope. The relative gain is represented by the height of the curve.

In order to be able to evaluate relative gain, it is necessary for the technician to be familiar with his particular alignment equipment and also to be familiar with the approximate gain of an IF strip that is operating normally. These things can both be obtained by checking the IF response and gain of several receivers that are operating normally and by maintaining the same gain settings on the generator and oscilloscope. A check on the frequency response of the IF strip can be had by comparing the response pattern obtained on the oscilloscope face with

* * Please turn to page 47 * *

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World's only *silent* automatic antenna rotator! No gears, no click, no clatter. Electronic fingertip VP* tuning. Antenna rotation and control is smooth, not in "steps" like ordinary automatics — *provides a new standard of tuning accuracy for Fringe, UHF and Color reception.* Write today for specifications.

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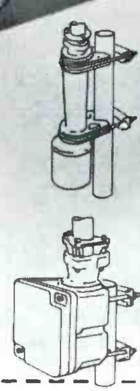

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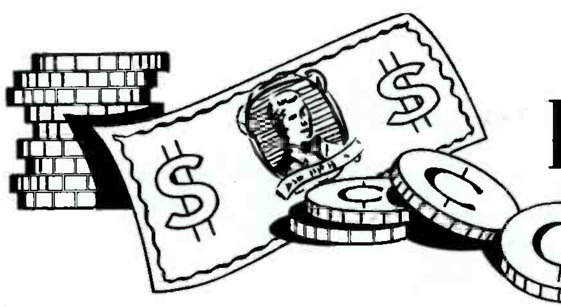


Dollar and Sense Servicing

by *John Markus*

Editor-in-Chief, McGraw-Hill Radio Servicing Library

SURVIVAL. The secret "White House" outside Washington will be linked by a closed-circuit survival TV network with several other retreats to be occupied by government officials in the event of enemy attack. There will also be facilities for linking to commercial networks for reporting to the nation.

BLOOD. With an arm around each combatant at a boxing match, the referee adds an afterthought to his routine instructions: ". . . and, oh yes, one more thing — this is color television! . . . . So, bleed a little." Saw this in Walt Ditzen's FANFARE cartoon strip recently.

Wonder how many other TV programs will be affected by color. Will girls have to learn to blush all over again as they did in the gay nineties?

At least, we know that commercials adjacent to or within regularly scheduled NBC color programs will have to be in color; the notice went out to all advertisers. After Sept. 1 on WRCA-TV in New York and WNBQ in Chicago, advertisers will either use color at $500 extra per 20 seconds or lose their place to some other client who will. It makes sense, too; in those first few minutes after a fine color program, any black-and-white commercial would look pretty sick.

Here's something to keep you up nights. Suppose that each tone of color was represented by a specific shade of gray in the range from white to black. Then, with a camera to translate colors into equivalent grays, color could be transmitted as a black-and-white program for reception on black-and-white sets, provided that we had something to change the grays back to their colors for color viewing. Well, one firm claims to have done exactly this; you watch the receiver with binocularlike eyeglasses that convert the grays back into the original colors. The operating principle involves color temperatures in some way. Until we see a demonstration, though, we'll continue rooting for compatible color.

SURVEY. Checkup by General Electric of 150 models of 1954 and 1955 TV sets showed 119 different types of receiving tubes in a total of 2,950 sockets for an average of about 20 tubes per set. The new RCA color TV line thus has only 6 more tubes per set than the average for black and white.

TAPED TUTORING. A classified ad in Tape Recording magazine may well be indicative of a new way of learning by mail. A professor offers correspondence courses on tape in five different languages. You state your knowledge level and objective, and he outlines your program and gives the price.

Many types of courses could be offered on tape, with associated booklets of diagrams when necessary. Music, languages, dramatics, public speaking, and singing are just a few courses that come to mind. Completed lessons on tape could be returned in trade for the next, thus keeping down costs. Practice assignments could be recorded on separate tape by the student for analysis by the instructor, and the latter's comments and advise could in turn be recorded for the student.

In the same magazine, there is another unique use for magnetic recording. The Baltimore YMCA has three automatic announcement machines hooked to its telephone lines. When their number is called, one of the machines answers automatically with a 30-second recorded message of inspiration. A newspaper announcement of the service resulted in some 6,000 completed calls and over 16,000 "busies" during a 24-hour period, with all three machines running. Here's a typical message:

"Hello — we're glad you called! A wise man knows what to do next; a skilled man knows how to do it; and a successful man does it. God giveth to man that which is good in His sight — wisdom, and knowledge and joy. (Eccles. 2:26) Your YMCA reminds you that families that worship together are happy families. — Thank you!"

TRANSISTORS. Pointing up the reliability of transistors, General Electric has increased the warranty period on its units from 90 days to a full year.

LAMPLIGHTERS. The arrival of the arc lamp for street lighting put our dad out of work back in the days when dogs lay waiting to nip him as he trudged the streets with his flaming torch to light the gas lamps at twilight. Then in turn the guy who replaced the carbon pencils of the arc lamps lost his job when they changed over to Edison's incandescent invention. And now the switch-thrower for these "gets the gate." In Manhattan and the Bronx, they're putting phototransistors right on the lamps to turn them on and off automatically. Or will the switch-thrower be put back on the beat to replace phototransistors as they go bad?

* * Please turn to page 54 * *

INTRODUCING THE

New GEOMATIC TV ANTENNAS

(pat. pend.)

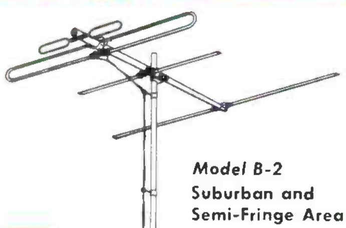
BY FINCO®

Model B-1
Metropolitan and Suburban

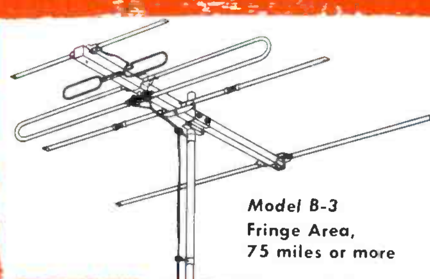
with exclusive Fidelity Phasing*

* *Dictionary: the highest degree of accuracy in the reproduction of a signal*

Here are the antennas they said could never be developed — combining the finest features of an impedance matching, driven folded dipole on low-band with super-gain of a 3-element colinear on high-band (without the use of matching harness) to produce the — GREATEST BROAD-BAND ANTENNAS EVER BUILT! In addition, the new GEOMATIC Series features extremely high FRONT - TO - BACK RATIO! Models range from "in-town" types to super-fringe area antennas.



Model B-2
Suburban and Semi-Fringe Area



Model B-3
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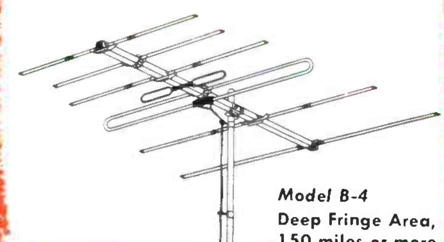

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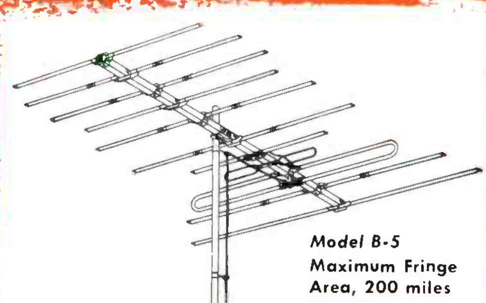
GEOMATIC means *customized for your locality*

Now For The First Time —
Regardless of channels, distance from station, or terrain FINCO can deliver a model that is *perfectly suited* for your area — at no extra cost!



Model B-5
Maximum Fringe Area, 200 miles or more

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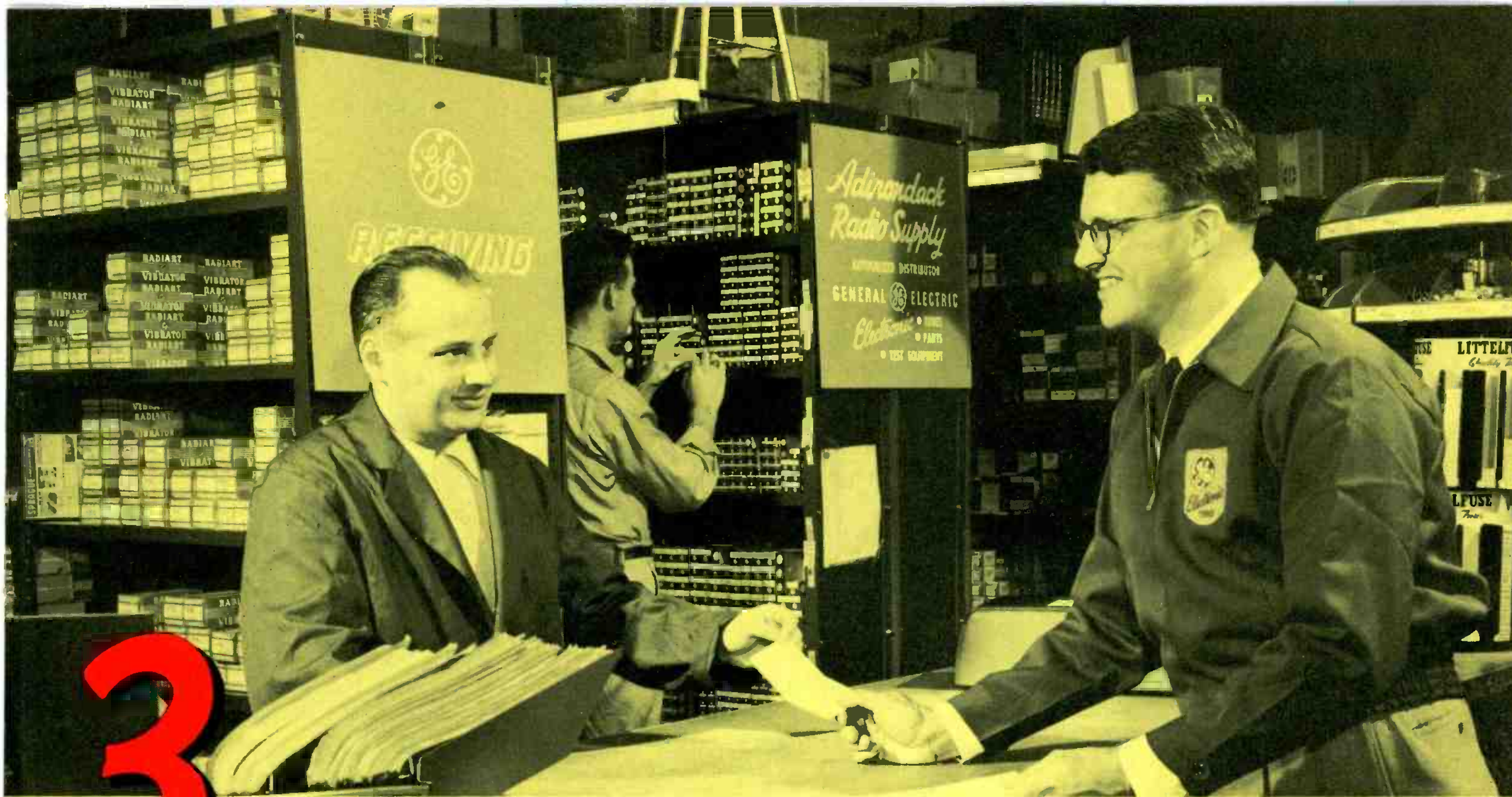
2.

You explain G.E.'s easy payment terms. The customer welcomes the opportunity to sign the contract. You then proceed to make the installation, and put your customer's TV in tip-top shape.

One call to your G-E tube distributor will bring full



3.

Next day you turn over the contract to your G-E tube distributor, who reimburses you for the complete installation job, including labor.

READ HOW YOU CAN USE THIS GREAT NEW GENERAL ELECTRIC CREDIT PLAN!

OFTEN the price of a new picture tube keeps customers from having their TV sets serviced properly. They are forced to get along with an inferior picture, or no picture at all, while you lose a profitable repair job.

Now G.E. gives you a way to turn these lost jobs into service dollars. No longer need your customers pay cash in full. You can give them as long as six months to pay out of income, with a down payment as low as $5.

Yet you get reimbursed immediately by your G-E tube distributor. Furthermore, you endorse no notes, have no collections to make. That part is handled by the General Electric Credit Corporation in cooperation with your distributor.

Act today! Ask your G-E tube distributor to show you how to obtain . . . on easy credit terms . . . picture tube installation jobs you've never been able to sell before! *Tube Department, General Electric Company, Schenectady 5, N. Y.*

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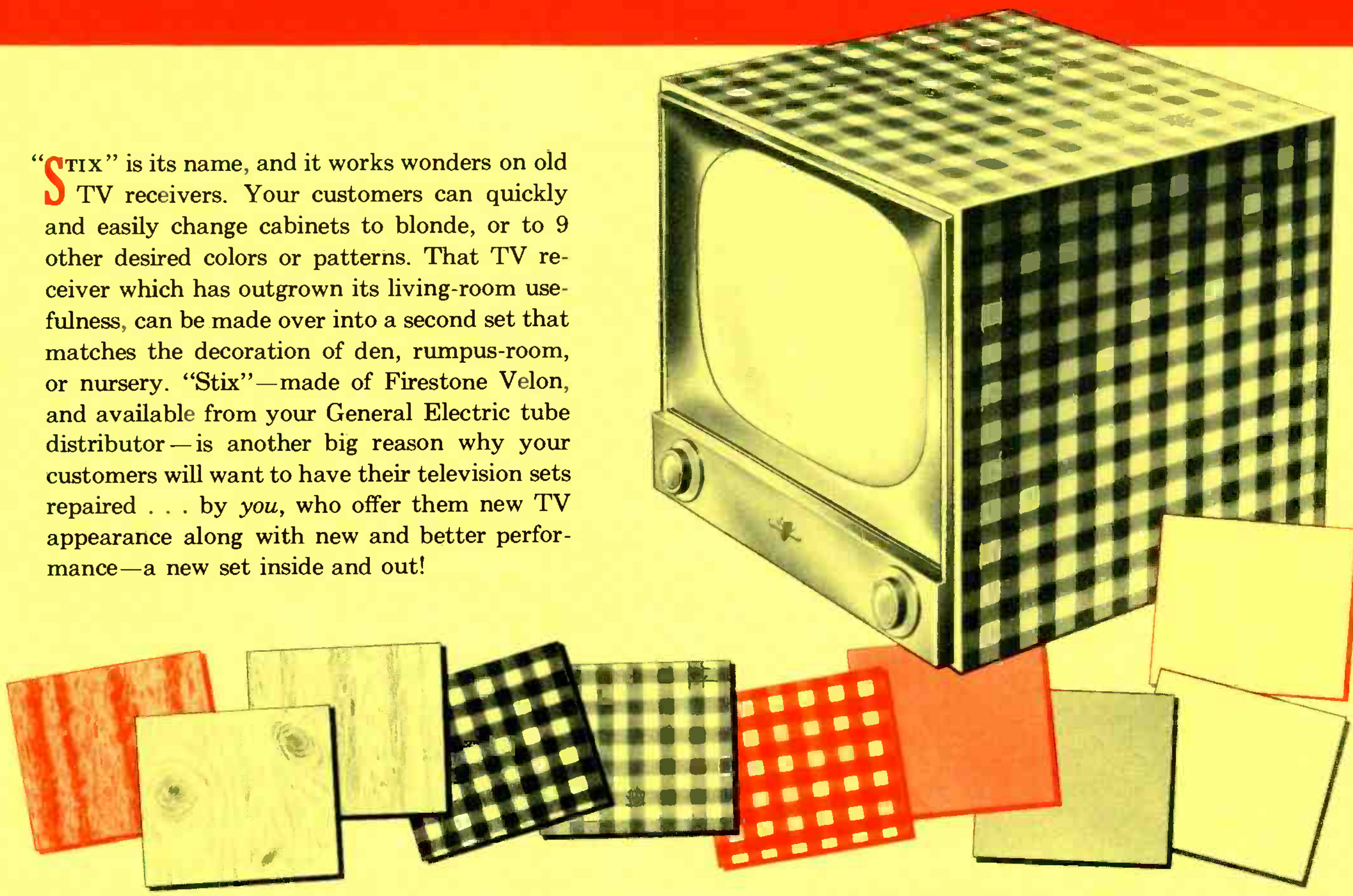
A New Look FOR OLD TVs

Choice of 10 decorator colors and patterns

"STIX" is its name, and it works wonders on old TV receivers. Your customers can quickly and easily change cabinets to blonde, or to 9 other desired colors or patterns. That TV receiver which has outgrown its living-room usefulness, can be made over into a second set that matches the decoration of den, rumpus-room, or nursery. "Stix"—made of Firestone Velon, and available from your General Electric tube distributor—is another big reason why your customers will want to have their television sets repaired . . . by *you*, who offer them new TV appearance along with new and better performance—a new set inside and out!



NINE OUT OF TEN TV OWNERS right in your neighborhood will read about the sensational new G-E picture tube credit plan—and about the new decorator coverings for old TV's

. . . in every Sunday newspaper supplement—and TV Guide—reaching 46,500,000 homes.

. . . in colorful posters, displays, and other promotion material G.E. is providing for your local use.

GENERAL ELECTRIC

Shop Talk

(Continued from page 11)

tester (whether it is a g_m or emission type). To check even as few as five tubes would take between 7 and 10 minutes because of the various controls that had to be set before the value test could be made. To do a thorough service job, it is frequently desirable to check more than 5 tubes, and the time required would be increasingly longer. This is valuable time to the technician and his organization. The longer each job takes, the fewer the calls that can be made. Time is also important to the customer because he is being charged on a time basis. Anything that would reduce this checking time and still provide the necessary information would thus be beneficial to both the technician and his customer.

That was the first consideration, but there was a second problem which apparently was not unrelated. Central found that when the low-voltage rectifier tube was replaced in a set, one or more tubes went bad soon afterward. This happened often enough to make it significant. The customer would call and lodge a complaint. Since this trouble occurred shortly after the service call, the customer felt that the set had not been repaired properly the first time. Trying to assure these customers that this was not the case seldom evoked any understanding, and it is not difficult to appreciate their reasoning. Even if the customer had complete confidence in the service organization, it would still seem suspicious that the set would fail so soon after a service call. What makes the evidence even more conclusive in their eyes is the fact that the set had worked for "umpteen" months before the call. If the job had been properly performed, they conclude that it should certainly take more than a week or two before the set should go bad again.

When you stop to think of counterarguments to this reasoning, you readily see that they concern technical matters which the customer cannot understand; therefore, in 7 out of 10 cases you end by losing a customer unless you forego the charge for the second call. This generosity might wipe out any profit you may have made on the original call.

This is a problem that happened often enough to warrant special consideration. The reasons for the subsequent tube failures after the power tubes had been replaced were felt to be the increased stresses produced by the higher voltages that the new rectifier tubes developed and the fact that the other tubes were near the end of their useful lives anyway. A verification of this supposition was not made because the conditions under which the failures occurred did not lend themselves to individual examination. The manner in which the problem was solved seemed to substantiate the assumptions made.

After examining the various aspects of such a situation, the conclusion was reached that more extensive tube testing during a service call should be required. The ideal condition would be to test all the tubes in a set, since this would essentially constitute an over-all preventive maintenance check. All tubes that checked weak would then be called to the set owner's attention, and failure to replace them would then become his responsibility. From past experience, it was felt that the set owner would approve replacement of these tubes.

As the reader will immediately note, the one drawback to this solution was that it only tended to aggravate the first problem, namely, the time required to test tubes. It was apparent that a checker was needed to test tubes rapidly, and a project to develop one along these lines was started.

The result of this development program was the instrument shown in Fig. 3. This is a tube tester which incorporates a large number of sockets instead of the few sockets and numerous switches found on conventional testers. There are 30 sockets, and each is wired to accommodate only the specific tubes which are indicated for that socket. This arrangement permits 400 of the most widely used tubes to be checked. At the bottom of the instrument, there are two controls — one marked "Heater" and one marked "Sensitivity."

To test a tube, first locate its appropriate socket from the socket listings. The same listing also indicates the proper settings for the two controls. After the controls are set, the tube is inserted into the socket. By means of a test switch, the condition of the tube is revealed on a built-in meter.

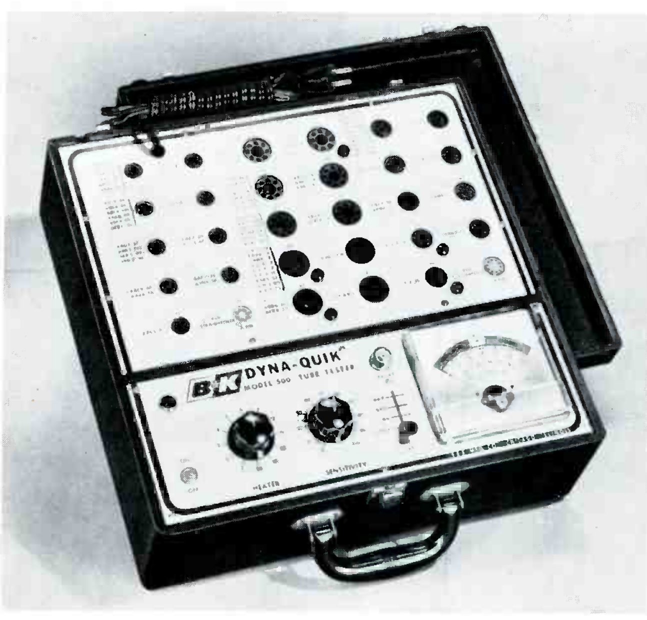


Fig. 3 B & K DYNA-QUIK Model 500 Tube Tester.

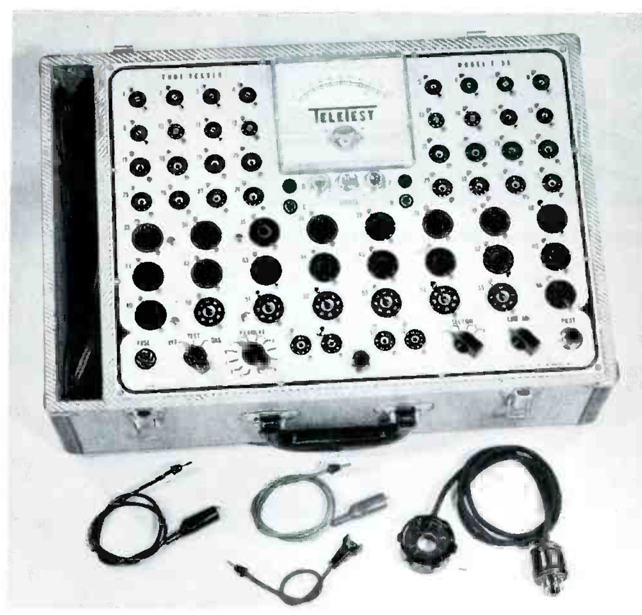


Fig. 4. Another Tube Checker for Rapid Testing.

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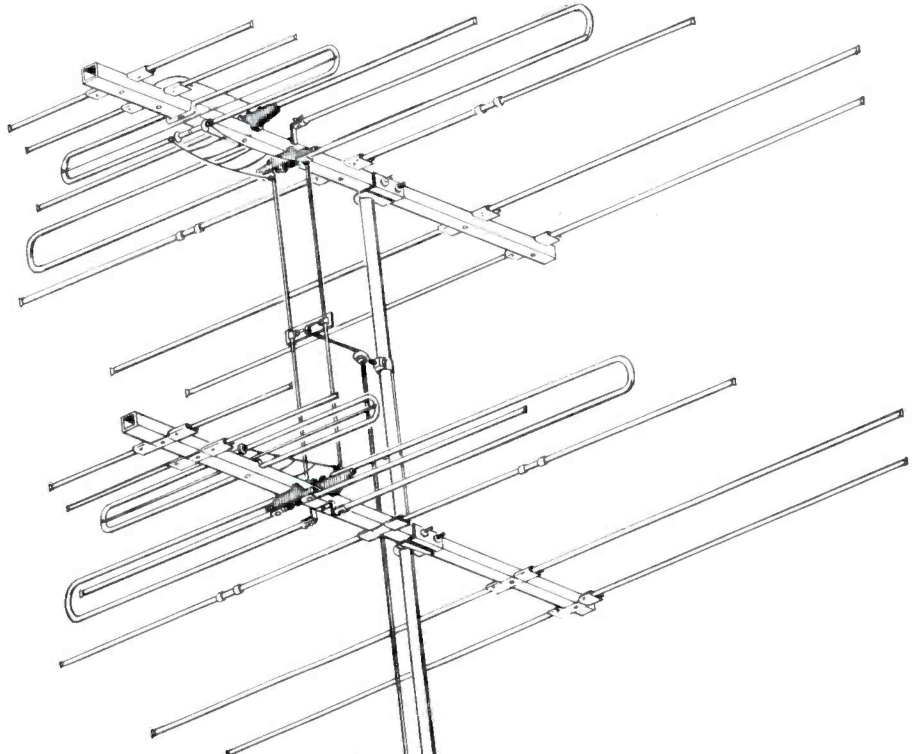

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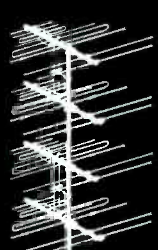

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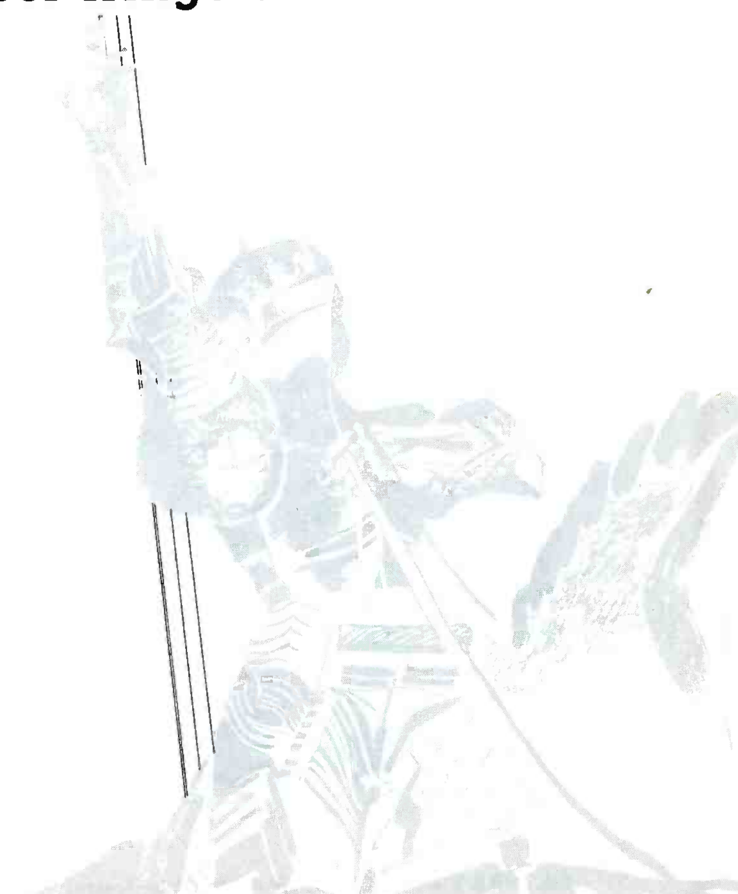

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With this newly developed tester, a complete set of tubes for an average TV set can be checked in 12 minutes. If fewer tubes are tested, the time is correspondingly less. In addition, the tube-testing facility is complemented by a number of features which are desirable, as experience has indicated. For example, the instrument will indicate tube shorts and do this before the g_m test is made. It also possesses a life-test feature which indicates the ability of a tube to operate when its filament voltage is reduced. (The reader will recall that mention of such a test was made in last month's column.) It contains a sensitive check designed to reveal whether a tube contains gas, a contaminated grid, or grid-to-cathode leakage.

The idea for a quick-check tube tester is not new. One unit that has been available for some time is the TeleTest instrument shown in Fig. 4. This checks tube emission under loaded conditions; and it will reveal gas, grid emission, or interelectrode shorts. Undoubtedly, there are other such instruments on the market; and as their worth is recognized, more will appear.

The trend toward the development of instruments which enable a service technician to carry out his test procedures in less time than before is a healthy one that is indicative of a vigorous and expanding field. The customer will benefit by the lower charges, and the saving of time will aid the technician by permitting him to do more and better work in the same length of time. A number of worthless gadgets will appear along with the desirable instruments, and caution will be needed to "separate the wheat from the chaff." The criterion which every test instrument must satisfy is: "Does this enable me to do a job better and faster than I am doing it with my present equipment?" If the answer is yes, the instrument is worth while. If the answer is no, then the instrument may be nice to have; but from a business standpoint, it certainly would not be needed.

REVIEW

Auto-radio repair generally poses no more of a problem insofar as circuitry is concerned than any home receiver. Actually, the biggest difficulty that one encounters with this type of servicing is either in gaining access to the chassis or in removing the set from its mounting. Once these have been accomplished, 75 per cent of your work is completed.

Circuitwise, only a few of all the possible causes are responsible for more than 90 per cent of the troubles found in auto radios. Once the technician has become familiar with these, he may perhaps find it profitable to pay more attention to repairing auto radios and thus open up a new potential source of income.

An article that discusses the major troubles that befall auto radios appeared in the March 1955 issue of Radio and Television News Magazine. The article was entitled, "Servicing Automobile Radios." It was written by I. Silverstein.

Radio and Television News Magazine is published monthly by the Ziff-Davis Publishing Company at 366 Madison Avenue, New York 17, N. Y. Subscription rates are $4.00 per year for the United States, its possessions, and Canada.

The schematic diagram of a typical auto-radio receiver is shown in Fig. 5. It contains a 6BD6 RF amplifier; a 6BE6 converter; a 6BD6 IF amplifier; a 6AT6 detector, 1st AF amplifier, and AVC stage; and a 6AQ5 audio-output amplifier. Thus far, with the possible exception of the RF amplifier (which most home sets do not have), the circuit differs in no important respect from the AM radios that the technician sees every day. The significant difference between auto and home receivers is in the power supply. In the auto radio, we find a vibrator and either a gaseous or a vacuum-tube rectifier. The vibrator converts the applied DC voltage to pulsating DC which is stepped up to a high AC voltage by a transformer and then converted by the rectifier into a DC voltage suitable for use in the receiver.

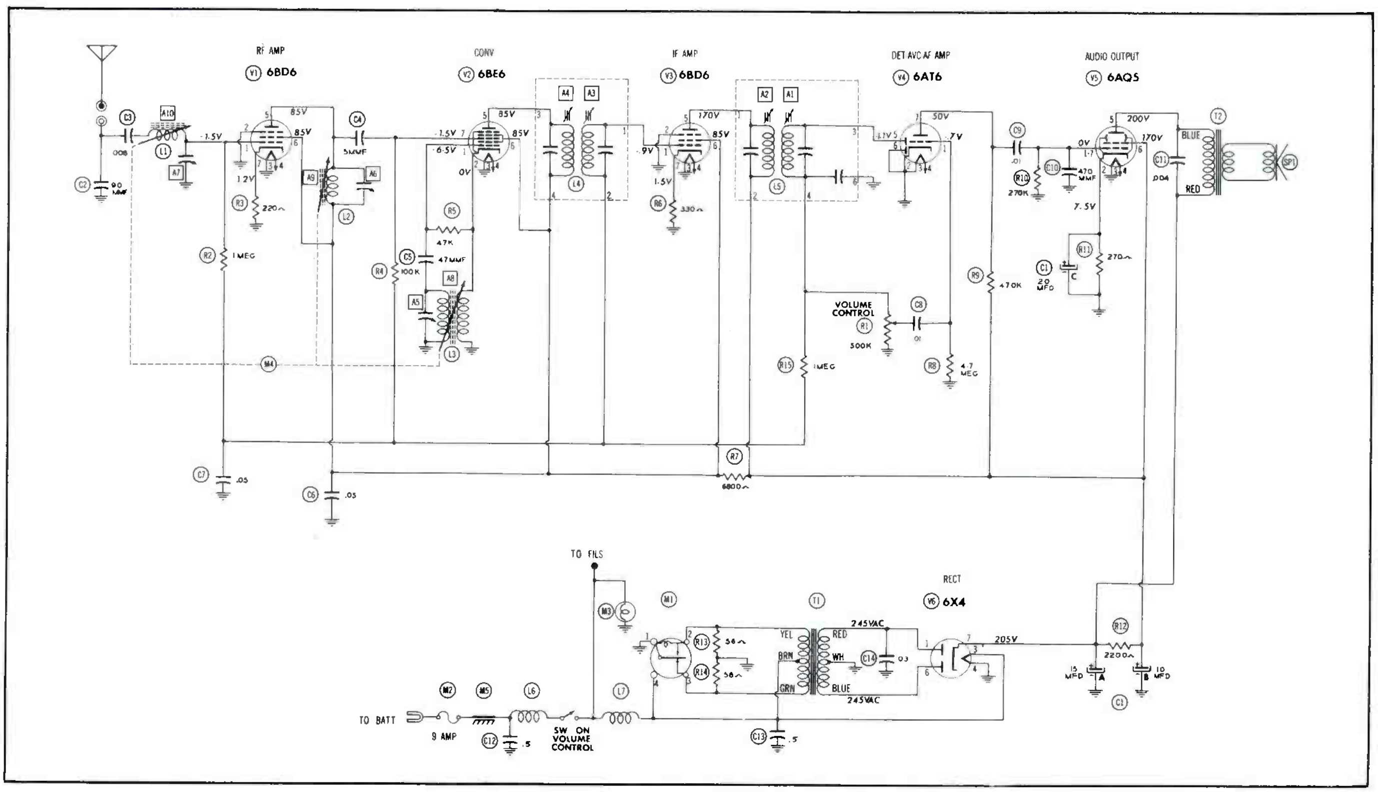

Fig. 5. Schematic Diagram of a Typical Auto-Radio Receiver.

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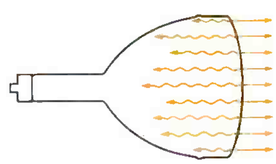
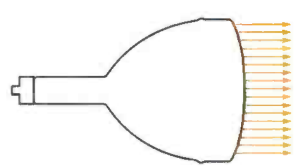
For further details, including Tung-Sol's sales aids and advertising support, call your Tung-Sol supplier today.



ORDINARY TUBE—Only *half* the light produced by the phosphor screen is utilized in the picture. Other half radiates wastefully back into tube.

RESULT—A light background within the tube which reduces picture contrast.



MAGIC-MIRROR ALUMINIZED TUBE — Aluminized reflector allows electron beam through. Blocks wasted light from backing up into tube. Reflects *all* the light into picture.

RESULT—Pronounced increase in contrast to make a bright, clear, more realistic picture.

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It is in the power-supply section that a high percentage of the troubles arise in auto radios. Mr. Silverstein lists three that he says affect 49 out of every 50 sets.

1. Bad rectifier.

Until just before 1950, the gaseous OZ4 tube was in general use; but since then the 6X4 vacuum tube has largely taken over (although OZ4's are still in use). Behavior of the 6X4, when it is going defective, is similar to that of other vacuum-tube rectifiers. It may become completely inoperative all at once, or the receiver volume may decrease gradually as the tube emission decreases. Intermittent conditions that persist are not frequently encountered. In the case of the gaseous rectifier, intermittent operation is more prevalent.

2. Bad vibrator.

The second item that is responsible for a high percentage of trouble is the vibrator. When it is operating, a mechanical buzz will be heard. This does not necessarily mean that the unit is functioning satisfactorily, because a buzzing vibrator can still be defective. On the other hand, when a vibrator does not buzz at all, then it is not operating. The trouble may lie in the vibrator, or the radio fuse may have blown so that no power is reaching the receiver. Common reasons for vibrator failure are: pitted points (which may tend to stick) or metal fatigue in the vibrating arms. Under these conditions, replacement with a new unit is the only desirable solution. Occasionally, a technician will try filing pitted points. This affords only temporary relief, and the unit will soon become defective again.

3. Defective buffer capacitor.

The third major source of trouble in auto-radio sets is the buffer capacitor across the secondary of the power transformer. The current drain of the car radio rises 20 per cent or more when this capacitor is bad, and the trouble may even cause the vibrator or the power transformer to fail or the fuse to blow. In replacing this buffer capacitor, use one having the same capacitance value. This particular precaution cannot be stressed too strongly because a capacitor of the wrong value can reduce the life of a vibrator by as much as 50 per cent. Also pay particular attention to the voltage rating of the buffer capacitor, and never install one of a lower rating.

A desirable check to run on every auto-radio receiver before it leaves the shop is measurement of its current drain. This value should be within one ampere of the figure established by the manufacturer as normal. If it exceeds this limit, additional troubles exist in the set. Excessive current drain is not only detrimental to the car battery; but when the extra drain is through the power supply, the vibrator arms may lose temper and possibly stick. Bad buffer and electrolytic capacitors are the most frequent causes of excessive current through the power supply.

While we are on the subject of current drain, it should be noted that the current used by an auto radio goes through three circuits: the tube heaters, the vibrator power supply, and the dial lights. Excessive current drain may stem from any one of these paths; but the most frequent offender is the power supply or a circuit which draws current from the power supply.

While the three troubles outlined are responsible for most breakdowns of auto radios, they are not the only ones. For example, a common complaint is weak volume. For this, the most likely causes are a weak tube (or tubes) or an open or partially shorted antenna. To shield the auto receiver from the electrical disturbances generated in the motor and also to protect it physically, the entire receiver is encased in a metal container. This shield prevents reception of any signals except those which are brought in by the antenna. Consequently, an auto radio is much more dependent upon its antenna than a home radio, and any factor which interferes with or otherwise weakens this signal path will have a marked effect on speaker output. A car antenna is connected to the receiver through a low-loss lead — a very thin wire designed to reduce capacitance in this circuit. Excessive movement of this lead will frequently cause it to break. A continuity check between the antenna and the receiver end of the cable will reveal any open circuit. An intermittent connection can also be uncovered by tapping the antenna and noting whether the ohmmeter needle is affected.

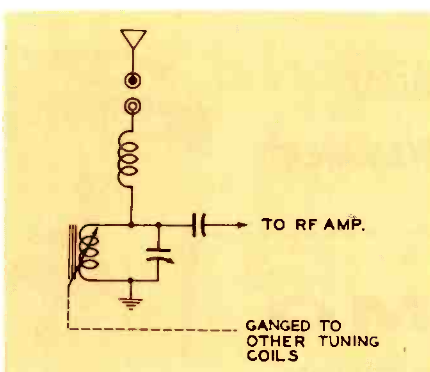

Fig. 6. The Antenna Input Circuit of Some Auto-Radio Receivers.

A continuity check between the antenna and the car chassis is also useful for uncovering short circuits. Before making this test inspect the circuit diagram to see whether the set has a low-resistance circuit connected between the antenna input and ground. See Fig. 6. If it does, remove the antenna plug from the set and make the same measurement. The circuit should be open.

For a quick method of localizing other troubles, the author suggests the old stand-by system of tube pulling. Start with the power-output stage, and remove the tube from its socket. If the stage is operative, a click will be heard in the loudspeaker. If a push-pull arrangement is employed, try both tubes. Then proceed to work back through the set, stage by stage, until you reach the point where a click does not appear. This is the section on which to concentrate.

There are additional troubles that may afflict a receiver. Intermittent operation is among the more common of these. Before the set is taken out of the automobile, make certain the trouble is not due to the antenna. Wiggle the antenna back and forth, and check to make sure that no intermittent grounding condition exists. Check the plug at the input terminal of the receiver to make certain that a good connection is being made. Poorly soldered connections or breaks may be found by moving the lead-in wire back and forth.

Once you are certain the trouble is not in the antenna system, the set may be removed from the car and taken into the shop where the search follows closely the procedure employed with home sets, except that there exists a greater possibility of broken connections or loose components because of the physical vibrations to which auto receivers are subjected.

Mr. Silverstein has chosen to concentrate only on those troubles which account for the majority of servicing of auto radios. Within these limits, the information is valuable; however, if extensive auto-radio service work is contemplated, additional reading along these lines would be advisable.

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Color TV Training Series

(Continued from page 8)

of determining whether or not the coil is functioning properly.

Fig. E2 of the Color Plate illustrates the appearance of the screen when the purity control has become open. With this control open, excessive current is allowed to flow through the purity coil. This current produces a very strong magnetic field around the coil. The central axis of the three beams is greatly displaced from the central axis of the tube by this strong magnetic force. As a result, the center of the raster moves away from the center of the screen and becomes greatly contaminated with color.

The circuit and control of the field-neutralizing coil is shown in Fig. 12-24. This circuit is used to obtain color purity at the edges of the screen. After a pure red

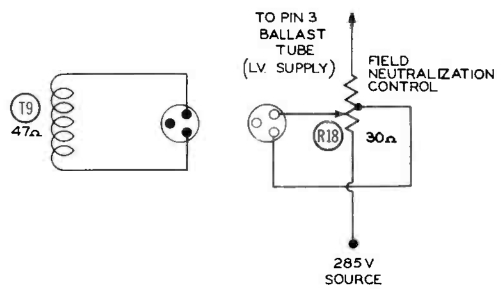

Fig. 12-24. Field-Neutralizing Coil and Control Circuit Used in RCA Model CT-100 Color Receiver.

screen (except at the edges) has been obtained during the setup procedure, the field-neutralizing control is adjusted to obtain purity at the edges. If this cannot be achieved, check the circuit in Fig. 12-24. If the voltage at the input of the circuit is correct, check the control and the coil for defects.

The electromagnetic type of picture tube employs neither a purity coil nor a field-neutralizing coil to obtain color purity. Instead, permanent magnets are used. The purity magnet, which is similar to the centering device used with some types of monochrome picture tubes, is placed around the neck of the tube. It has two rings which can be rotated when purity adjustments are made. If one or both of these rings loses its magnetism, correct purity cannot be achieved. The condition of the purity magnet is checked by direct replacement.

The field-neutralizing device in an electromagnetic tube consists of a series of permanent magnets mounted around the rim of the face plate of the picture tube. All the magnets can be positioned individually to obtain purity at the edges of the screen. A magnet should be replaced if very little or no effect is noticed when the position of that magnet is altered.

Convergence Troubles

Shown in Fig. 12-25 is the convergence circuit employed in the RCA Victor Model CT-100 color receiver. This circuit supplies the vertical and horizontal voltages used to obtain dynamic convergence of the beams.

Whenever it is noticed on the screen that the beams are not converging properly, the adjustments of the convergence controls should first be checked. The setup procedure for obtaining beam convergence was discussed in Part XI of the Color TV Training Series in the April 1955 issue.

By close examination of a monochrome picture on the screen, it can be determined in which portions of the screen the beams are misconverged. Shown in Fig. E3 of the Color Plate is one example of misconvergence. Notice that along a horizontal line through the center of the test pattern there is very little misconvergence. Along the top and bottom of the test pattern, it can be seen that the convergence is very poor. This is signified by color fringing on the edges of the black lines in these areas of the test pattern.

Fig. E4 of the Color Plate shows how the same condition appears when a white-dot pattern is being viewed. The dots in the horizontal center row are converged properly, but those in the vertical center row are not. By examination of the appearance of the screen, it can be determined that the cause of the trouble is in the vertical-convergence circuit. First, the controls for vertical amplitude and phase are adjusted. If this does not cure the trouble, then the circuit is checked. In the circuit of Fig. 12-25, a vertical-convergence amplifier is employed. This tube should be checked before other components are tested. If the tube is found to be good, the circuit can be checked by using an oscilloscope.

The waveform at the grid of the first half of V19 should be like that shown in Fig. 12-26. This is the pulse that is derived from the vertical-output stage. If the pulse is found to be abnormal at the first grid of the amplifier, check the circuit between this point and the point where the pulse is obtained at the vertical-output stage.

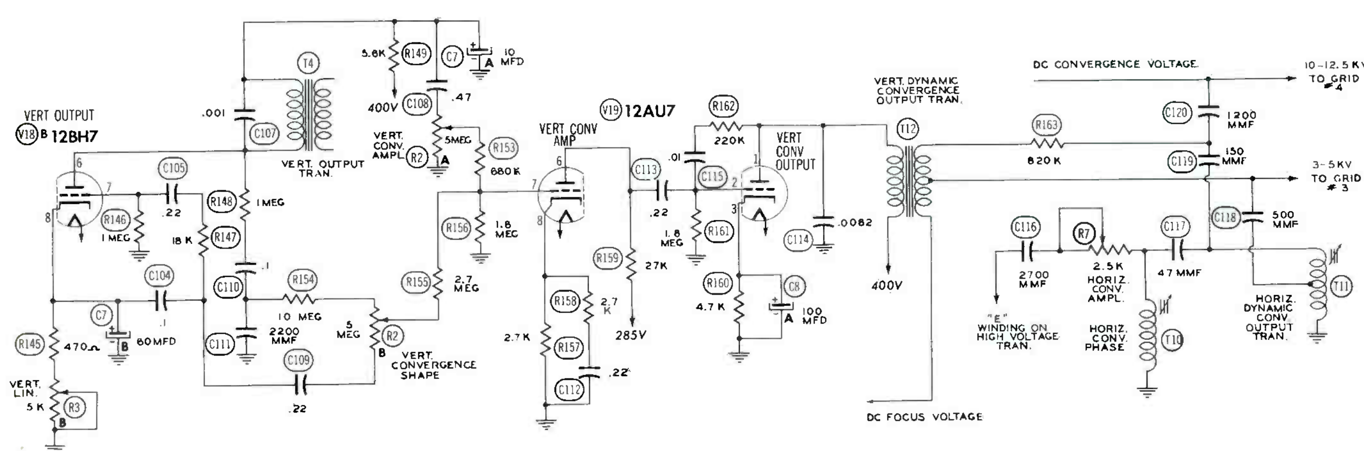

Fig. 12-25. Dynamic-Voltage Supply in RCA Victor Model CT-100 Color Receiver.

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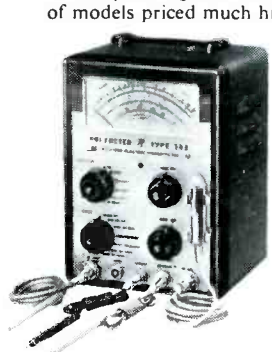

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The waveform at the second grid of V19 should appear like that shown in Fig. 12-27. If it has been found that the signal is normal at the first grid but is abnormal at the second grid, the cause of the trouble is located between these two points. The defective component can then be located by making a voltage and resistance check. If the waveform at the second grid is found to be normal, the cause of the trouble is between this point and the output of the vertical-convergence circuit.

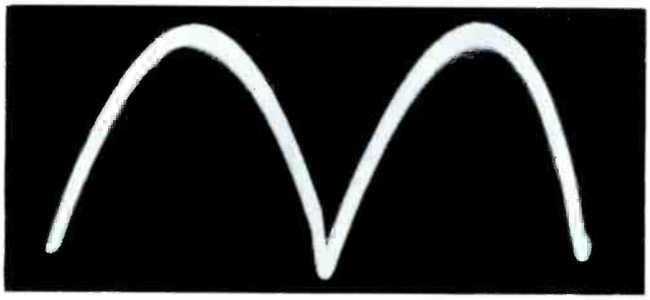

Fig. 12-26. Waveform of Signal at Pin No. 7 of V19 in Fig.12-25.

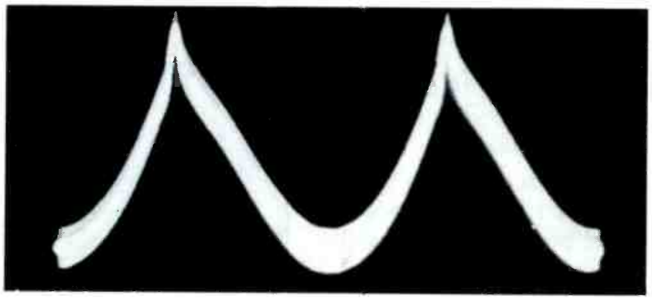

Fig. 12-27 Waveform of Signal at Pin No. 2 of V19 in Fig.12-25.

Fig. E5 of the Color Plate shows the appearance of a test pattern when misconvergence is present in the horizontal direction. Notice that convergence of the beams is correct through the vertical center of the test pattern. On the left and right sides of the test pattern, convergence is very poor. This indicates that the horizontal dynamic convergence is not correct but that the vertical dynamic convergence is all right. The white-dot pattern for the same condition is shown in Fig. E6 of the Color Plate.

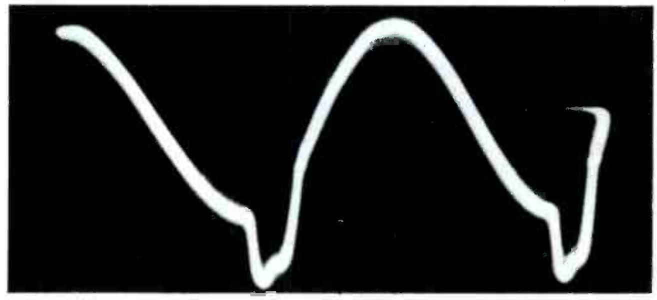

Fig. 12-28. Waveform of Signal at Junction of R7 and T10 in Fig. 12-25.

The convergence trouble is known to be in the circuit for horizontal convergence.

If it is not possible to obtain proper convergence in the horizontal direction by adjustment of the controls for horizontal amplitude and phase, check the appearance of the waveform at the junction of the horizontal-phase control T10 and the horizontal-amplitude control R7. This waveform should appear like the one in Fig. 12-28. If the waveform at this point is correct, the trouble is located after this point. If the waveform is incorrect, the trouble is located before this point.

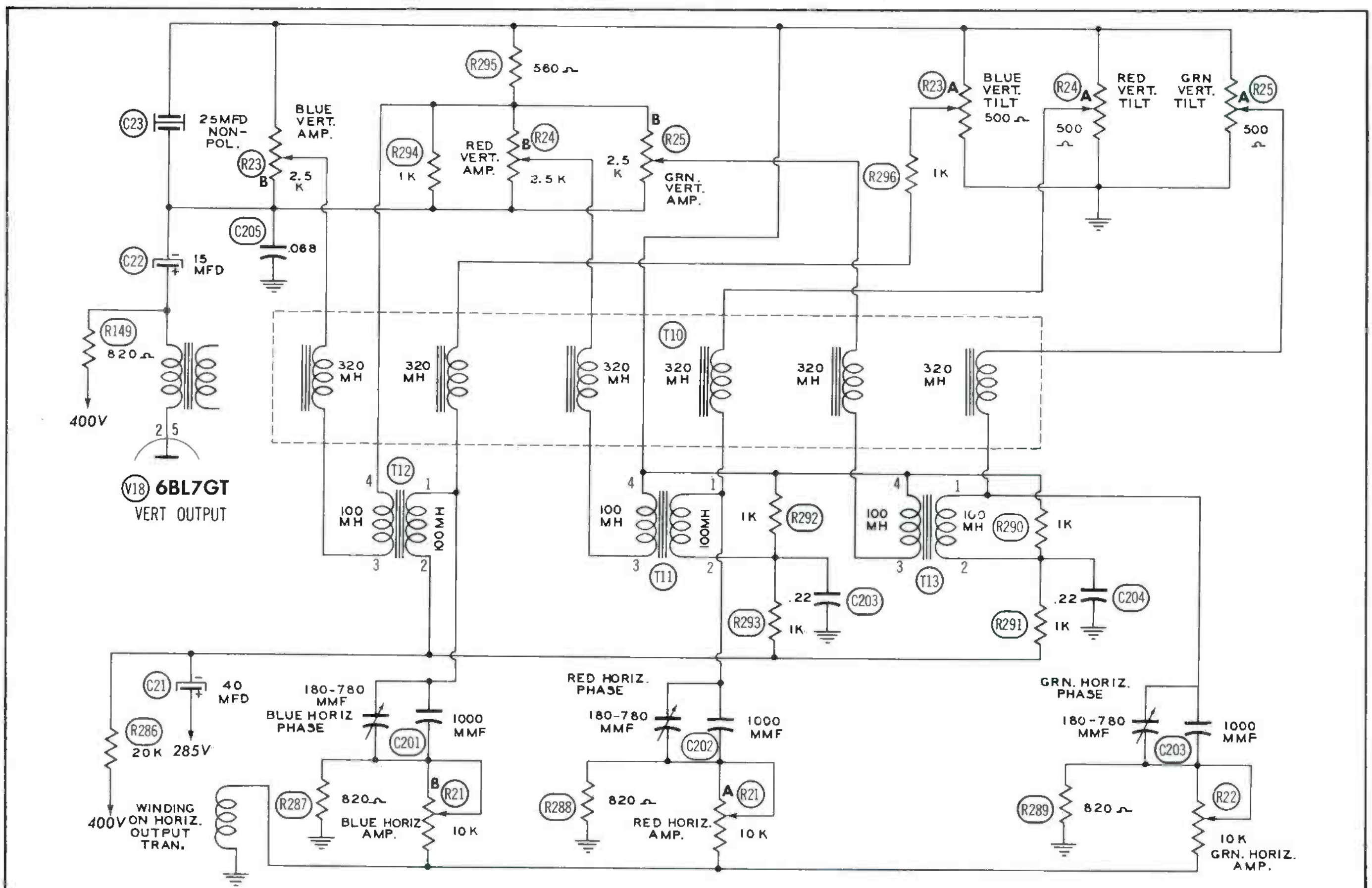

Fig. 12-29. Dynamic-Convergence Circuits Used in RCA Victor Model 21-CT-55 Color Receiver.

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Beam convergence in the electromagnetic type of picture tube is achieved through the use of electromagnets mounted around the neck of the picture tube. By control of the current through the coils associated with the electromagnets, the beams can be made to converge properly.

Shown in Fig. 12-29 is the dynamic-convergence circuit employed in the RCA Victor Model 21-CT-55 color receiver. The setup procedure for obtaining beam convergence in the electromagnetic type of tube was presented in Part XII of this Color TV Training Series in the May 1955 issue.

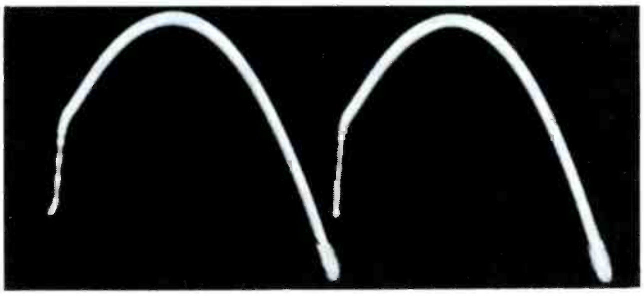


Fig. 12-30. Waveform of Signal at Junction of R149 and C22 in Fig. 12-29.

When trouble shooting the type of convergence circuit shown in Fig. 12-29, the same procedure should be followed as that for the convergence circuit used with the electrostatic type of picture tube.

If it is shown on the screen that misconvergence is present in the vertical direction only, the controls for vertical convergence are first adjusted to see if the trouble can be corrected. When making convergence adjustments, it must be remembered that a signal from a white-dot generator must be used.

If adjustment of the controls for vertical convergence does not cure the trouble, use the oscilloscope to make sure that the pulse from the vertical-output stage is being applied to the input of the circuit. This waveform, shown in Fig. 12-30, can be observed at the junction of R149 and C22 in the circuit of Fig. 12-29.

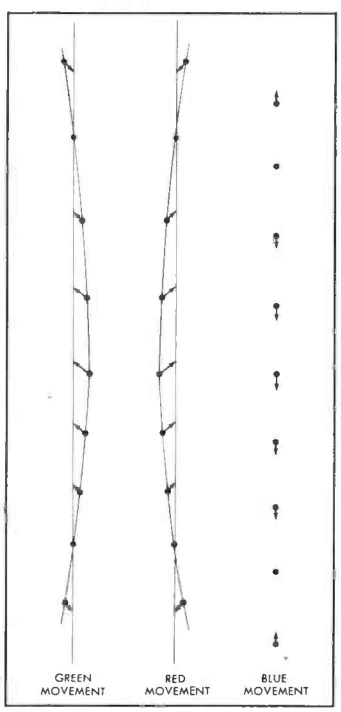


Fig. 12-31 Dot Movements Caused by Adjusting the Vertical-Amplitude Controls.

In the circuit of Fig. 12-29, there is associated with each convergence coil a control for vertical amplitude and one for vertical tilt. By adjusting each control while observing a dot pattern on the screen, the technician can determine which portion of the circuit is not functioning properly. Fig. 12-31 shows the directions in which the vertical center rows of dots should move when the amplitude controls are adjusted. Fig. 12-32 shows the directions in which the dots should move when the tilt controls are adjusted. When it has been determined which control is not functioning properly, a voltage and resistance check of the circuit associated with that particular control should reveal the cause of the trouble.

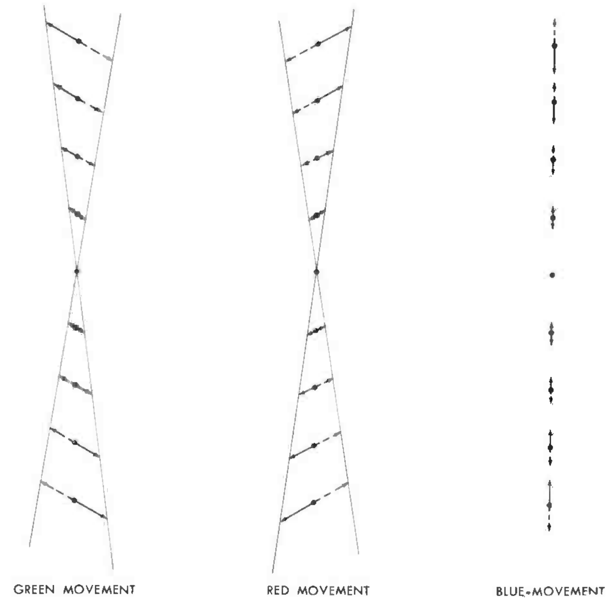


Fig. 12-32. Dot Movements Caused by Adjusting the Vertical-Tilt Controls.

If the beams are misconverged in the horizontal direction but are properly converged in the vertical direction, only the horizontal-convergence circuit needs to be checked. The same trouble-shooting procedure as that for the vertical-convergence circuit can be followed. First, make sure that the horizontal pulse from the horizontal-output transformer is being applied to the convergence circuit. Associated with each convergence coil, there is a control for horizontal amplitude and one for

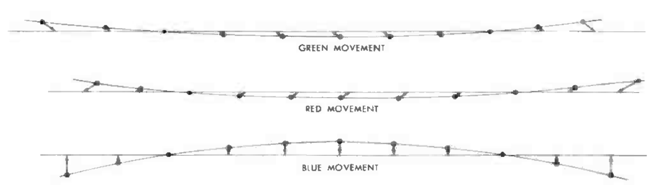


Fig. 12-33. Dot Movements Caused by Adjusting the Horizontal-Amplitude Controls.

horizontal phase. The directions in which the dots should move when the controls for horizontal amplitude are adjusted are shown in Fig. 12-33. If the dots do not move correctly when a control is adjusted, a voltage and resistance check of the circuit associated with that particular control should reveal the cause of the trouble.

In order to give the reader an opportunity to test himself on the material in this issue, we are including on the insert a few questions that are answered in this discussion.

C. P. OLIPHANT

Troubles in Video IF and Detector Systems

(Continued from page 31)

the pattern given in the alignment instructions.

The IF strip should always be clamped with a negative 3-volt battery for these checks. By always clamping the AGC at -3 volts, by always setting the gain control of the oscilloscope at the same point, and by adjusting the output control of the signal generator to produce a pattern of the same height, a basis for obtaining a relative-gain characteristic is reached. That is to say, by noting the difference between the settings of the output control of the signal generator, a relative-gain reading can be obtained. The gain of different IF strips will vary; but after checking several strips, the permissible range of this variation will become apparent.

When replacing a crystal detector, the technician must make sure that it is connected in the proper polarity. The crystals are coded to show the polarity of voltage that should be applied to the terminals in order to obtain maximum current flow. The cathode end of a germanium crystal may be painted green or marked with a negative sign (-). The anode terminal will be coded with a positive sign (+) or in some cases with no marking at all. When the crystal is schematically illustrated, the anode is shown as an arrowhead and the cathode as a bar.

In order to establish a reference for the photographs showing the various trouble symptoms, a normal test pattern is illustrated in Fig. 3.

Common Symptoms

1. **Raster, No Picture, and No Snow.**

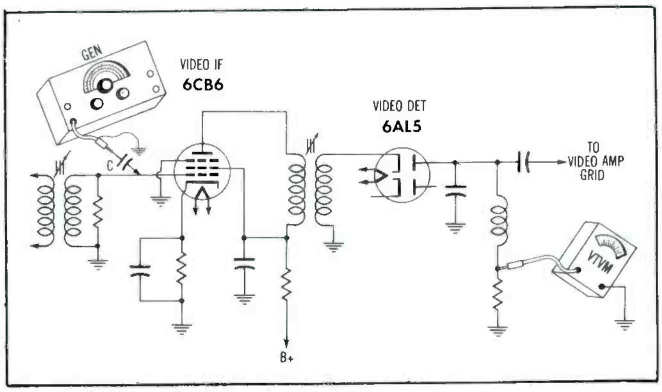


Fig. 5. Setup for Checking Operation of Last Video IF Amplifier and Video Detector.

Fig. 4 shows the condition in which there is a raster on the screen but there is no video signal nor snow reaching the picture tube. This symptom and the loss of sound in receivers employing an intercarrier sound system may be caused by an inoperative video IF or video-detector stage. In the split-sound type of receiver, a trouble in the video IF section may not affect the sound; and the sound can be used as a guide for tuning in a strong operating channel. When the sound is normal in any receiver, it is a good indication that the RF and IF stages up to the sound take-off point are operating.

In the process of isolating the trouble to a certain section of the receiver, the obvious symptoms can often aid in pin-pointing the fault. The absence of snow in the raster usually indicates that the trouble exists somewhere after the mixer stage; however, in a few cases, a faulty tuner could also produce this condition.

In rare instances, receivers of the intercarrier type will produce weak sound with no picture when the trouble is in the video IF or video-detector stages. A small portion of the combined video and sound carriers will be coupled through the defective stage, and the small amount of the 4.5-mc beat frequency developed at the detector will be sufficient to produce some sound from the speaker even though the video frequencies will be too low in amplitude to produce a picture. When trouble shooting for a dead video IF or video-detector stage, the signal-substitution method can prove very helpful. The use of a VTVM and of a signal generator which has an output in the IF range of the receiver can quickly isolate the defective circuits.

The VTVM is placed across the detector load resistor, and the output from the signal generator is connected to the grid of the last video IF amplifier in the manner shown in Fig. 5. By varying the generator frequency through the IF range of the receiver, a frequency will be found that will produce a reading on the VTVM. This reading will be of a relatively low DC voltage of either polarity.

If the signal is able to pass through the last IF stage, the other stages can then be checked by applying the generator signal to the grid of each preceding stage. In some cases, the defective stage may not lie in the IF strip; consequently, a further check of the video-detector circuit is necessary. Trouble in this stage can be located by injecting a strong signal

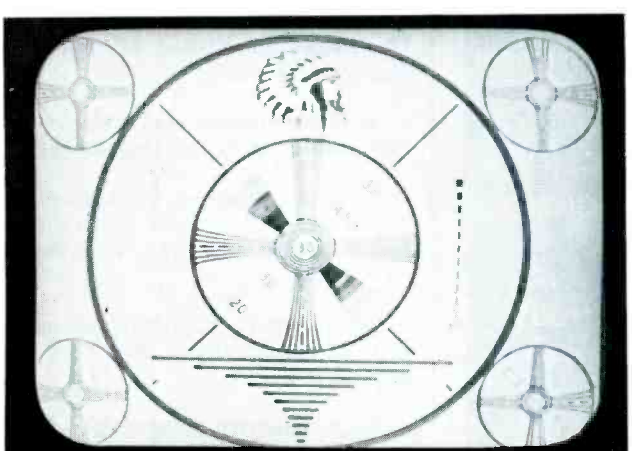


Fig. 3. Normal Test Pattern.

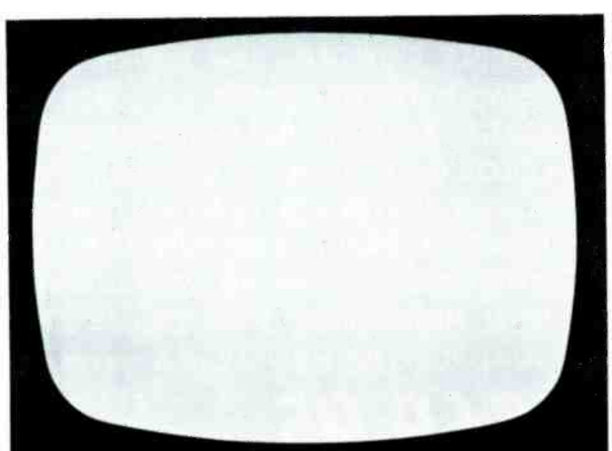


Fig. 4. Raster, No Picture, and No Snow.

from the generator into the receiver at the input to the detector and by observing the indication on the VTVM.

If the signal generator can be internally modulated at 400 cycles or some other audio frequency, a pattern of horizontal bars will appear on the picture-tube screen and the VTVM can be eliminated. The bars serve as an indication of proper operation for each stage tested. A sweep generator can also be used in conjunction with an oscilloscope to isolate a dead video IF stage. First connect the oscilloscope across the video-detector load, and then inject the signal from the generator into each stage, as described in the signal generator and VTVM method. The IF response curve will appear on the scope if the stage under test is functioning.

In the majority of television receivers in the field today, there is little trouble with the video-detector stage, except for tube failure. The reason for this is the fact that in most designs no high supply voltages are required for this circuit, and longer life for the components usually results. Crystal diode detectors, however, are being used to a great extent in many of the new vertical-chassis TV receivers. These crystals are sensitive to heat and moisture; and when one is defective, it may produce an intermittent condition or a complete loss of sound and picture.

Possible causes for a raster with no picture and no snow are:

a. Tube failure.

b. Shorted plate and screen decoupling capacitor. (See C35, C39, C41, or C3B in Fig. 1; C26, C31, C40, or C44 in Fig. 2.)

c. An open decoupling resistor or one of too high a value. (See R28 or R31 in Fig. 1; R26, R30, R36, or R42 in Fig. 2.)

d. Short circuits caused in video IF stages by pieces of solder or foreign material.

e. Tube pins not making good contact with their respective sockets.

f. Open coupling capacitors between video IF stages or to the detector stage. (See C28, C35, or C43 in Fig. 2.)

g. An open primary or secondary of an IF transformer. (See L18, L19, or L20 in Fig. 1.)

h. A defective crystal detector.

i. Shorted bypass capacitor in B+ line.

j. Shorted or leaky coupling capacitor. (See C28, C35, or C43 in Fig. 2.)

k. Open cathode resistor in a video IF stage. (See R26, R30, or R33 in Fig. 1; R25, R29, R34, or R41 in Fig. 2.)

The most common cause of failure in the video IF section is a defective tube. Shorted elements in a tube will often affect other circuit components. In the case of a shorted plate or screen grid within a tube, the decoupling resistor of the stage may become overheated and it may open or increase in value. In a few receivers, heater-to-cathode leakage in the first IF stage may result in no picture, no sound, and no hum bars.

In some strong-signal areas, an open IF transformer or coil will produce a weak picture and a slight amount of sound; however, the same trouble in a weaker-signal area will result in the complete loss of both picture and sound.

The coupling capacitor from the last IF stage to the video-detector input may become leaky because of the B+ voltage present on the IF amplifier plate. This leakage may upset the proper functioning of the detector stage and result in a loss of the video signal.

Crystal detectors may develop a low output because of a change in the ratio between the forward and backward resistance. If a germanium diode becomes defective but it is still able to produce a picture, the picture will have a washed-out appearance and the contrast control will have little or no effect. One quick check of this type of detector is a resistance reading across the disconnected crystal. If the test prods are placed with the proper polarity across the unit, a reading in excess of 10K ohms is normal. By reversing the test prods, a decreased reading that is usually less than 500 ohms should result. If reversal of the test prods reveals no great difference between the two readings, the crystal should be replaced.

2. Snowy Picture.

A snowy picture with weak or noisy sound is caused by a loss of signal amplification in stages that precede the sound take-off point. A test pattern that contains snow content is shown in Fig. 6.

In order to receive weak signals with a minimum of snow, it is very necessary to utilize the maximum available gain of both the IF and tuner sections. Generally speaking, when a snowy picture with weak or noisy sound is caused by trouble within the IF section, it will be more noticeable on the weak signals. This is true since the AGC voltage applied to the IF strip is much higher when the set is receiving a strong signal; thus the IF strip is prevented from operating at maximum gain. The IF strip is not allowed to operate at maximum gain on strong signals because this would cause severe overloading, and distortion of the signal would result.

In receiving a strong signal such as one from a local station, a serious loss of signal amplification in a stage of the IF strip usually causes a degraded picture rather than a snowy one.

Possible causes of a snowy raster with weak or noisy sound are:

a. Defective video IF or detector tubes.

b. Defective detector crystal (if used).

c. Open plate coils in IF stages. (See L18, L19, L20 in Fig. 1; L9, L11, L14, L15 in Fig. 2.)

d. Low plate or screen voltage applied to IF tubes.

e. Open screen-grid bypass capacitors. (See C35, C39, C41 in Fig. 1; or C26, C31, C40, C44 in Fig. 2.)

f. Open cathode-bypass capacitors. (See C42 in Fig. 1; or C32, C45 in Fig. 2.)

g. Open RF bypass capacitor (detector filter network). (See C44 in Fig. 1; or C51 in Fig. 2.)

h. Open input grid coil. (See L8 or L13 in Fig. 2.)

i. Excessive AGC voltage applied to IF strip.

Remember that, in receivers which employ a split-sound system and in which the sound (as well as the picture) is affected, the trouble is located in one of the stages that precede the sound take-off point.

An investigation of the alignment and relative gain (as discussed) can be very helpful in restoring the gain of the receiver. In any alignment procedure, the tubes should be checked and all defective and weak ones should be replaced. All voltages should be normal before the alignment procedure is started.

3. Ringing in Picture.

The distortion that is evident in the picture illustrated in Fig. 7 represents either a severe case of ringing or a condition in which there are multiple images produced by a faulty video IF circuit. A distortion of this nature should not be mistaken for ghosts produced by any condition

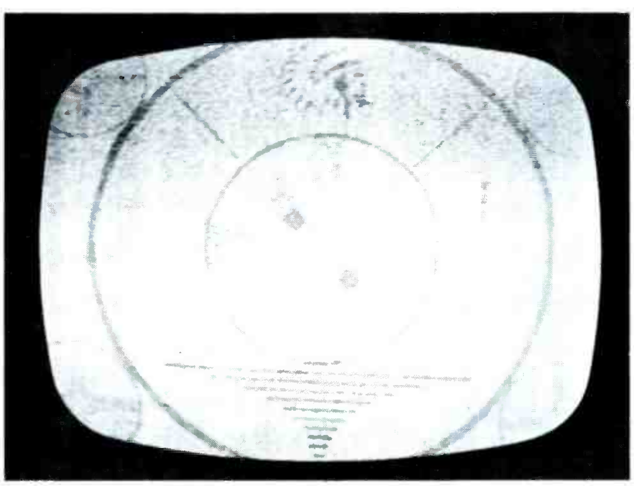


Fig. 6. Snowy Picture.

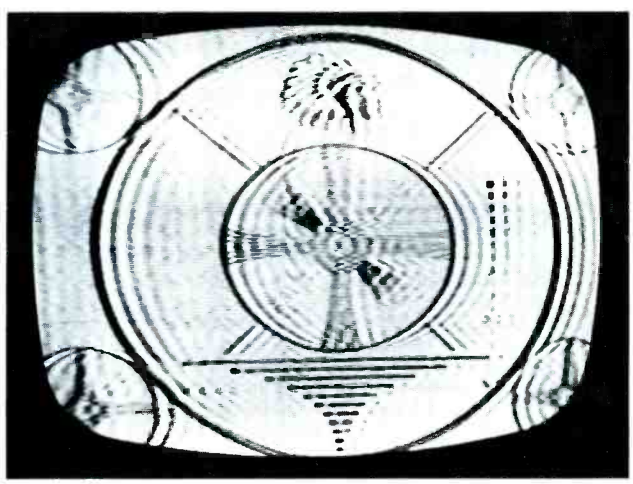


Fig. 7. Ringing in Picture.

external to the receiver. When a trouble within the receiver causes ringing, it should be noticed that the images will appear equally spaced from one another and weaker as they depart from the normal pattern. These multiple images will usually be affected by changing the position of the fine-tuning control. If the control is varied, the images may increase or decrease in number and change from a negative to a positive picture, or vice versa.

Because of the use of high-gain amplifier tubes in the video IF section, only a small amount of stray coupling between stages is sufficient to produce trouble. Coupling between the grid and plate leads can easily produce instability and in some cases can produce oscillation which results in picture ringing.

Misalignment in the video IF section is one of the most common causes that produce ringing in the picture; however, if a receiver is found to be out of alignment, this situation may be a result of some defective component. If the AGC or B+ voltages applied to the video IF stages are not at the proper level, the alignment will appear to be off. It is recommended that a thorough and complete trouble-shooting process should be undertaken before receiver alignment is attempted.

Possible causes of ringing in the picture are:

a. Defective tube in the video IF section.

b. Misalignment.

c. Improper placement of the leads or components in the video IF stages.

d. Open IF plate and screen decoupling capacitor. (C35, C39, or C41 in Fig. 1; C26, C31, C40, or C44 in Fig. 2.)

e. Shorted AGC filter capacitor. (C38 in Fig. 1 or C34 in Fig. 2.)

f. Defective video IF transformer.

g. An open cathode bypass capacitor in one of the video IF stages. (C42 in Fig. 1; C32 or C45 in Fig. 2.)

h. Improper shielding of the IF and detector stages.

i. Defective filament-bypass capacitor. (C36, C40, or C43 in Fig. 1; C27, C33, C41, C46, or C50 in Fig. 2.)

The RC decoupling network in each IF stage isolates each amplifier from the effects of the other stages

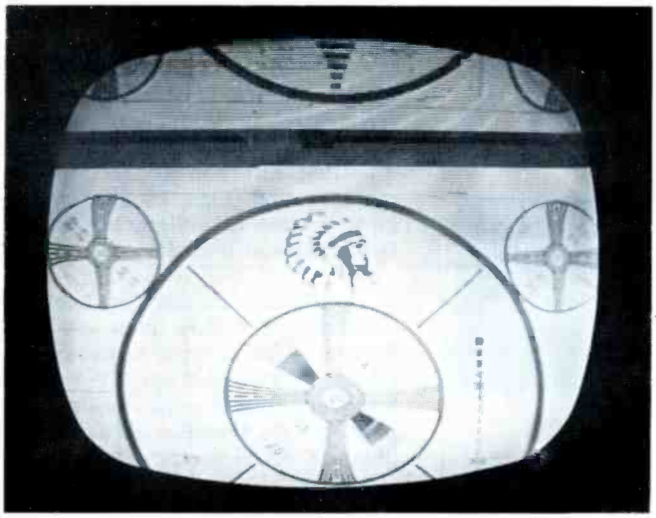


Fig. 8. Poor Vertical Synchronization.

c. Low bias applied to an IF stage.

d. Open screen-grid bypass capacitor. (See C35, C39, C41 in Fig. 1; C26, C31, C40, C44 in Fig. 2.)

e. Overloading caused by excessive signal applied to a stage.

f. Gassy tubes.

Hum caused by heater-to-cathode leakage in an IF amplifier tube can produce a loss of synchronization because the hum has the same frequency that the vertical-sync signal has. This type of trouble most often affects the vertical synchronization; but when the hum is severe enough, it can cause a loss of horizontal synchronization as well.

by eliminating direct connections through the B+ line to the other stages. An open bypass capacitor in either the cathode or screen circuit of an IF stage is capable of producing regeneration or ringing with an accompanying decrease in signal strength. In cases of this kind, the fine-tuning control tends to have little effect on the tuning of the sound signal. A shorted AGC filter capacitor will produce ringing, but it is generally accompanied by an overloading condition which may also disrupt the synchronization. Many receivers employ tube shields for the IF and detector stages and for the IF circuitry under the chassis. If these shields are not in place or grounded properly in an overly critical IF strip, ringing may result.

If any component is replaced in the video IF section, the physical position and lead dress for each wire should be carefully noted. Keep all leads as direct and as short as possible, unless a special lead dress is plainly called for in the original circuit design. By following these servicing hints when replacing a component, such as an IF transformer, a troublesome ringing condition may be prevented.

4. Poor Vertical Synchronization.

Problems concerning vertical synchronization are usually associated with the sync and vertical-oscillator sections. Some of these troubles can, however, be traced to the IF system. When such is the case, it will usually be noted that the receiver has a tendency to synchronize in such a way that the sync bar shows on the screen or the receiver has a tendency to trigger on noise pulses. In Fig. 8, a test pattern with a visible sync bar is shown. Notice also that the contrast is somewhat weak.

Possible causes of poor vertical synchronization are:

a. Hum modulation caused by heater-to-cathode leakage in an IF tube.

b. Low plate or screen voltage applied to an IF stage.

A low value of plate or screen voltage applied to an IF stage would have the same effect on a strong signal that a low value of bias would have. That is to say, a strong signal would overdrive a stage if the stage were operating with low bias, low plate voltage, or low screen voltage. This overdriving action by the large signal may cause distortion or complete elimination of the sync pulses.

Open screen-bypass capacitors can cause poor vertical synchronization because, in cases where the screen-grid bypass capacitor is open, a signal is present on the screen grid. This signal has a degenerating effect on the plate signal and can cause distortion in the sync-pulse portion of the video signal.

By causing a stage to have excessive gain, a gassy tube can be the source of sync trouble. This excessive gain within one stage can amplify the signal to such magnitude that a following stage is overloaded. This signal overloading can cause compression of the sync pulses.

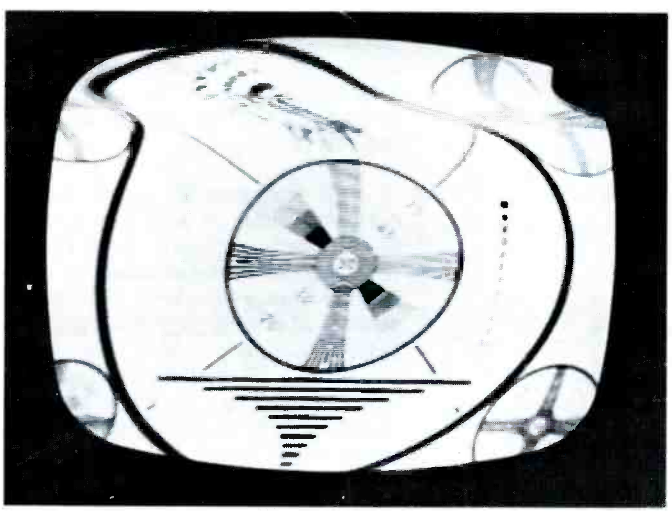


Fig. 9. Pulling in Picture.

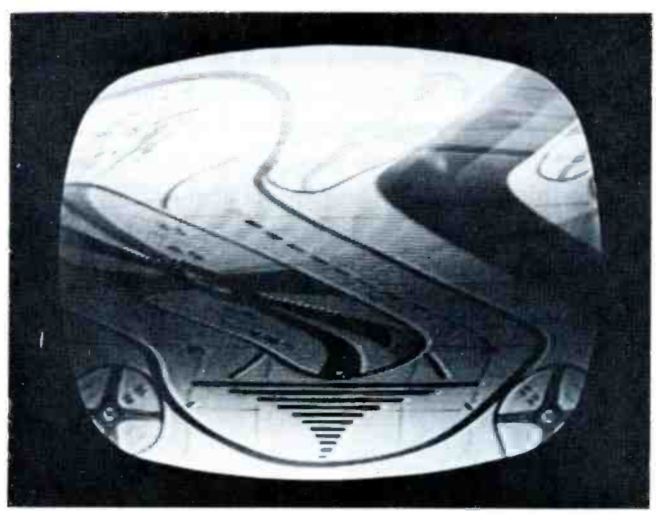


Fig. 10. Pulling in Picture With Brightness Modulation.

5. **Pulling in Picture.**

A pulling or horizontal bending of the picture is encountered very frequently in television servicing. The photograph of Fig. 9 illustrates a pulling effect near the top of the picture, and Fig. 10 represents a severe case of pulling accompanied by brightness modulation.

Picture pulling or horizontal bending can result from any one of a number of defects in several different sections of the TV receiver; however, this discussion deals primarily with troubles situated in the video IF and detector stages.

Two checks are useful in isolating a defect which is causing picture pulling or raster bending. First, observe the edge of the raster by using the centering mechanism to bring it into view. If there is no bending in the raster, the defect is ahead of the horizontal oscillator. In those sets in which the sync take-off point is after the stage employing the contrast control, the amount of picture pulling will vary when the contrast control is varied. If the setting of the contrast control is decreased and if the pulling tends to decrease, the trouble is probably in the video IF section or in the tuner. If the pulling tends to increase, the trouble is in the sync stages or in the video amplifier.

Another symptom which often occurs with picture pulling is brightness modulation. This modulation will appear as a dark area horizontally across the screen. This dark hum bar which may accompany picture pulling usually indicates a defective tube. One of the more common causes of this type of distortion is heater-to-cathode leakage in the RF or IF tubes. The presence of the 60-cycle voltage in the video signal usually results in brightness modulation; however, if only one tube has a very slight amount of leakage, the picture may tend to pull but the modulation will not always be noticeable on the screen.

If the trouble is not due to a defective tube, it will be necessary to remove the chassis from the cabinet in order to determine the reason for the picture pulling. In some instances, unstable vertical synchronization will accompnay the pulling condition. This often indicates that the receiver has a poor low-frequency response. In order to make a quick check of the low-frequency response, turn up the brightness control and adjust the vertical-hold control until the vertical-blanking signal appears on the screen of the picture tube. The vertical sync pulse should be darker than the darkest portion of the picture. If it is not, the sync pulses are too low in amplitude because of poor low-frequency response or the signal is being limited somewhere in the video section.

Fig. 11. Horizontal Blanking Pedestal and Sync Pulse. (A) Normal; (B) Distorted Because of Poor Low-Frequency Response.

The waveform shown in Fig. 11A represents a normal horizontal blanking pedestal and sync pulse. The waveform in Fig. 11B shows the distorted shape of the same signal after passing through an amplifier having a poor low-frequency response. The sync pulse is usually completely lost, and the horizontal oscillator will attempt to synchronize to the leading edge of the blanking pedestal. This condition is often accompanied with poor vertical synchronization because the loss in low-frequency response will also affect the vertical sync pulses. Before attempting any video IF alignment, the adjustment of the local oscillator should be checked to make sure that the picture carrier is properly situated on the video IF response curve.

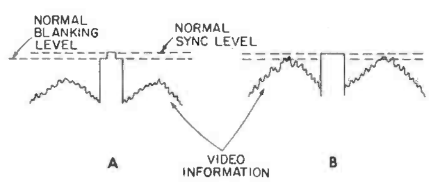


Fig. 12. Composite Video Signal. (A) Normal; (B) Sync Pulse Missing Because of Clipping Action.

Another form of distortion in the horizontal-sync pulse is shown in Fig. 12. A normal video signal in Fig. 12A illustrates the correct sync-pulse amplitude with respect to the video information. Fig. 12B represents the signal after it has undergone a limiting or clipping action in the last IF amplifier or in the video-output stage. In the latter drawing, the top of the sync pulse has been clipped; however, the video information has been amplified and some portions reach the same level as the sync pulses. Under these conditions, the video information tends to trigger the horizontal oscillator and severe picture stretching often occurs.

Excessive gain in the video IF stages may be caused from a defective

AGC circuit. If the AGC voltage is found to be normal, the grid voltage of each IF stage should be checked with a VTVM. A leaky or gassy tube may develop a positive grid voltage and cause the stage to overload.

Possible causes of picture pulling are:

a. Defective IF amplifier tubes.

b. Strong signal applied to the IF section causing an overloading condition.

c. Poor low-frequency response as a result of misalignment.

d. Shorted or open AGC filter capacitor. (C38 in Fig. 1; C34 in Fig. 2.)

e. Open decoupling or bypass capacitor. (C35, C39, C41, or C3B in Fig. 1; C26, C31, C40, or C44 in Fig. 2.)

f. Interference caused by improper shielding of the IF strip.

g. Poor alignment as a result of incorrect component placement or improper lead dress.

If picture pulling is a result of heater-to-cathode leakage in more than one of the video tubes, all of the defective tubes must be replaced to cure the condition completely. In receivers employing a series-filament system, leakage or shorts within a tube can sometimes affect the operation of one or more other tubes in different sections. This situation may result in freak symptoms which are often misleading to the service technician.

When the low-frequency response of a receiver is poor and the trouble is not due to a component failure, a complete RF and IF alignment may be required in order to correct this difficulty; however, adequate alignment data for the receiver should be obtained before attempting this operation.

Symptoms Nos. 6 through 12, which were listed at the beginning of this article, are still to be covered. This will be done in a second installment of "Troubles in Video IF and Detector Systems."

LESLIE D. DEANE
and
CALVIN C. YOUNG, JR.

Dollar and Sense Servicing

(Continued from page 33)

COLOR PROGRAMS. Playing down of color programs, to the extent that the "compatible color television" announcement is made only at the end of the show, has actually resulted in many owners watching a program on their color sets with the controls set for black and white because they didn't know it was in color. Few newspapers list the color programs because of the limited number of color sets that have been sold.

Color TV booster W. C. Moore, large Motorola distributor in Dayton, Ohio, runs co-op ads with restaurant and tavern owners of color sets on the days of big color shows. These help the night spots and promote color TV as well. In addition, he mails printed programs about once a month to all owners of Motorola color sets. These programs can be put up right alongside the sets. On superspectaculars such as the Peter Pan telecast, he used larger advertising space to list the locations of all color sets available to the public.

PAINTING. If you have a favorite dish or cup for painting yet hate to clean it out after each job, try lining it with aluminum foil inside and out. The foil can then be thrown away when you finish, and the dish will be clean. How about trying it on a paint job some cool evening to put new life into the shop. Color is the thing these days. To pick the pair of colors that'll bring your shop in step with the times, just watch the new cars roll by.

FUTURE. Etched-wiring boards mean fewer factory errors and greater reliability of receivers once manufacturers obtain experience in molten-solder dunking to make all joints at once. Time, temperature, solder, and flux are the four factors that must be kept consistently in balance to achieve good dip soldering.

Most users of etched-wiring boards are doing the dip soldering by hand, sometimes with a timer and bell to signal the end of the 8- to 10-second immersion interval. Automatic soldering machines are used by Westinghouse, DuMont, and a few other firms in order to mechanize this operation; but at present, all of these machines are loaded and unloaded by hand.

Automatic assembly machines are already inserting parts in wiring boards at RCA, Admiral, and Emerson plants, though bulky and odd-shaped parts still have to be inserted by hand. When insertion heads have been developed for these, the boards can go right on into the dip-soldering machine, untouched by human hands. Look for this step in mechanization sometime in 1956.

Most plants use a single dip in solder, but RCA consistently uses two solder pots side by side. The operator dunks the board in one for a few seconds, lifts it out, wipes a cake of beeswax across the solder in the second pot, then dunks the board in that pot to complete the job. The wax is claimed to give neater filleted joints and fewer shorts between wiring strips.

DATES. For tax-deductible business trips, consider the National Electronics Conference at the Hotel Sherman in Chicago Oct. 3-5, the Audio Fair at the Hotel New Yorker in New York Oct. 12-15, or the RETMA Radio Fall Meeting at the Hotel Syracuse in Syracuse, New York.

SURPRISES. One nice thing about servicing is its variety of problems. You never know what'll show up next in a TV set. Now we have side and top controls, the vertical chassis, printed circuits, and even flashlight tuning. Next year, there'll be entire stages crammed into little modules or blocks; for replacement of these your bill to the customer may read, "Replace Horizontal Sync Stage . . . . . $9.75."

Both DuMont and Emerson are considering the use of some modules next year. Aerovox just took over a factory for making these things, too. It's the original Project Tinkertoy machine setup of the National Bureau of Standards.

Transistors are still the dark horse in the picture; no one knows yet what they'll do to the appearance of a TV set. Another question is what they'll do to servicing. If some 75 per cent of the troubles today concern tubes, if transistors don't fail in use, if wiring and soldering achieve perfection through printed circuitry, and if resistor and capacitor makers likewise turn out failure-proof products, we'll have a TV set that's as trouble-free as the modern electric refrigerator. But don't start looking for a new business yet — all this is a long long way off, and there's color television coming up fast to put cash in the till.

BOOMERANG. Trapped by the radar that he invented, Sir Robert Watson-Watt recently plunked out $12.50 for a speeding ticket in Canada.

Our local police just bought radar equipment and expect it to pay for itself in a few months, even at special bargain rates of $1 per mile over the speed limit. People have stopped challenging the accuracy of the electronic gadget, and they pay up and shut up to get out of its range.

LOOK — NO SOLDER. Interconnections among the five etched-wiring boards in RCA TV sets are made without solder by using a Keller wire-wrapping tool to wind the stripped wire around each rectangular terminal. Tests show these joints to be electrically and mechanically equal or superior to conventional soldered joints. Once loosened for repair, however, they have to be soldered; human hands just can't wind wire tightly and evenly enough to get the required fusion of metals by pressure.

CASTLE. Human guides have disappeared from the famous castle of Langeais in France. At the entrance to each of the 12 halls through which tourists are conducted is a small knob. When turned by the supervisor accompanying the visitors, it starts a tape recorder that gives carefully worded historical information. At appropriate points in the commentary, pulses recorded on the tape actuate control circuits to turn on special illumination aimed at the piece of furniture or tapestry being described.

FILING. In place of EENY, MEENEY, MINY, MO for your file drawers, reader Eugene Olney suggests RADIO, AUDIO, VIDEO, FIASCO. Take your pick.

SUBMINIATURIZING. Motorola Vice President Dan Noble recently demonstrated a golf ball having a built-in transistorized transmitter and dime-size battery. It puts out a signal strong enough to be picked up by a portable radio receiver used as a direction finder. No more lost balls!

Hearing aids are rapidly approaching invisibility these days. One make is built right into eyeglass frames, and now Philco announces a unit no larger than a packet of matches.

Be assured that these refinements in miniaturizing are also going into military electronic developments. Next thing we know, machine-gun bullets will have built-in electronic target seekers that make every shot count. Our son doesn't agree, so we just read to him those lines from Tennyson:

"For I dipt into the future, far as human eye could see,
Saw the Vision of the world, and all the wonder that would be;
Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales;
Heard the heavens fill with shouting, and there rain'd a ghastly dew
From the nations' airy navies grappling in the central blue; . . ."

The fifth line takes on a new significance this year. Could Tennyson actually have been thinking of radioactive fallout, way back in 1843?

JOHN MARKUS

In the Interest of Quicker Servicing

(Continued from page 17)

2. Output voltage correct — one bulb is lit.

3. Output voltage too high — both bulbs are lit.

A switch is provided to adjust the output voltage to the correct value.

The unit shown in Fig. 2 is representative of a type that has a meter which indicates the output voltage. The unit which is pictured is the Acme T-8394M voltage adjuster made by Acme Electric Corporation. A switch is used to adjust the output voltage to the correct value. Schematic diagrams of two typical voltage regulators, one of each type, are shown in Figs. 3A and 3B.

Adjustable line-voltage transformers are best described as devices which prevent trouble because, through their use, the voltage to the receiver can be maintained at a normal value. This will ensure that the voltages applied throughout the receiver are correct, and component failures which could be caused by excessive voltages will be minimized.

Some indications of a possible need for an adjustable line transformer are as follows:

1. Narrow picture.

2. Short tube life (in the output stages).

3. Filaments that burn out frequently.

4. Lack of focus on some receivers.

A good check to make when trying to determine the need for an adjustable line-voltage transformer is to measure the line voltage during the time of day when the receiver is usually operated the most. A reading that is too high or two low would show a definite need for an adjustable transformer.

For best results in using a variable line-voltage transformer, the voltage should be checked and readjusted each time the receiver is turned on. The indicating device on the transformer should be checked at intervals after that to make sure that the correct voltage is being maintained.

A QUICK CHECK FOR GAS IN PICTURE TUBES

A quick check for shorts or gas in a picture tube can be made by using a clip lead. This test can only be made on receivers that have parallel filaments, because the picture-tube socket must be removed.

To make this check, first remove the picture-tube socket and connect one end of a clip lead to ground; then turn on the receiver,

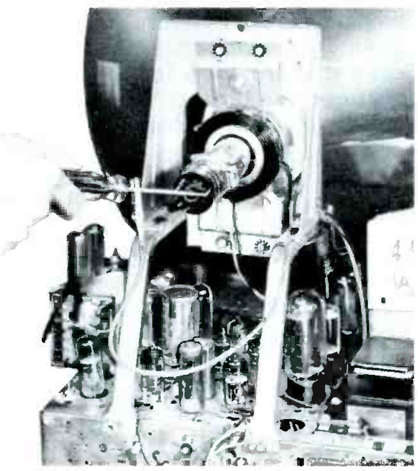


Fig. 4. Quick Gas Check on Picture Tubes.

and touch each pin on the picture tube with the other end of the clip lead. See Fig. 4. The presence of a small arc at any of the pins could indicate an internal short or leakage between the internal coating and a gun element, or it could indicate the presence of gas in the picture tube. In any case, the presence of an arc would indicate a faulty picture tube.

REPLACING TUBES IN THE TUBE CADDY

There is a tendency on the part of service technicians in the busy rush of the average workday to check the tube caddy too infrequently. This has in some cases caused a technician to find himself

Fig. 5. Tear Off Name Flap on Tube Carton for Guide to Replace Tubes.

on a service call without a needed tube. A situation such as this could necessitate either a trip back to the shop for the needed tube or a return call on the next day. Having to do without his television set for an extra day because the technician forgot a tube does not please the average customer; in fact, it sometimes results in the loss of a good customer.

Fig. 5 shows a tube carton from which the flap that bears the tube designation has been removed. If the service technician removes and retains this flap each time he sells a tube, he will be able to determine quickly at the end of each day just which tubes need to be replaced in his tube caddy. Replacing these tubes daily should help to ensure that most tube types will be available on every service call.

ROUTING SERVICE CALLS

Scattered over the country are a great many television service organizations that employ two or more technicians to make home service calls. In some of the larger organizations, a rather complete and efficient system of routing service calls is in use. In some other organizations, however, little or no system may be employed. The latter situation could be due to a lack of understanding on the part of shop managers concerning the way a system is set up or concerning the benefits from the use of such a system.

Information and suggestions relative to the establishment of a routing system will be given in this discussion. By adopting some such system, the shop manager may find that faster and more efficient coverage of his service area is possible.

The chief advantages afforded by a good routing system are:

1. Maximum coverage of a service area with a minimum of travel time.

2. Approximate arrival time predetermined and furnished to the customer for each service call.

3. Whereabouts of each technician known at all times so that he can be located for rush calls or for other reasons.

Dividing the Service Area

One of the first steps in setting up a routing system is to divide the total service area into sections. It is not necessary to have the same number of technicians as there are sections since one technician can be assigned to more than one section. Fig. 6 represents an area that has been divided. Notice how natural barriers were considered in selecting the divisions and how the through streets also act as boundaries between the sections.

The number of potential customers in each section should also be considered when dividing an area. Each section should include territory in which the customers are scattered and should also include territory in which there are many customers.

The allocation of service calls within one area does not have to be

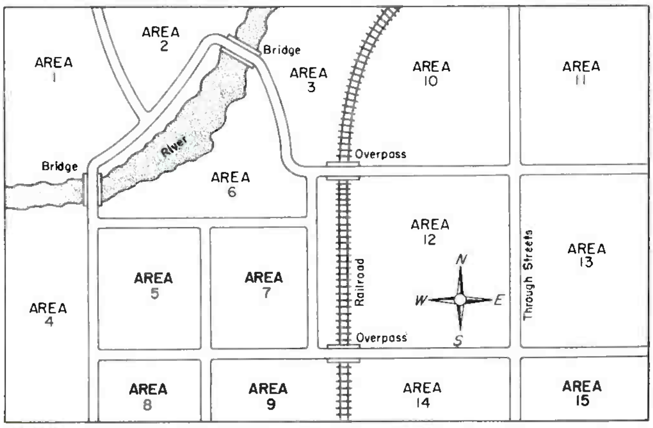


Fig. 6. Divisions for Routing Service Calls.

ROUTE No. 2

CUSTOMER'S NAME	ADDRESS	PHONE No.	MAP LOCATION	TYPE OF CALL	ESTIMATED TIME OF ARRIVAL	SHOP TECHNICIAN	NOTATIONS
J.W. Dokes	125 W. North	BY-6113	1-C	Service	A 9:30 AM	—	set repaired
B. Black	1723 W. Franklin	BY-4151	2-A	Delivery	A 10:00 AM	John	
C Starr	990 N. 10th	ER-5913	7-B	Pickup	B 2:00 PM	—	Customer not there
J. Smith	1620 N. 10th	ER-2165	6-B	Service	B 1:00 PM	—	set pick up
					B= BEFORE A= AFTER		

Fig. 7. Sample Routing Sheet.

reserved to the technician assigned to that area. If that technician is working near one boundary or corner of his area and a call from the opposite side of that area is received, the routing system should be flexible enough so that the technician working the closest to the call should answer it even though he may be assigned to a different area. Obviously, any system that finds two men scheduled to make calls within one or two blocks of one another is not making maximum use of the advantages of a routing system unless both technicians have several calls in the immediate area. Such cases could exist if the dividing line between two sections ran through the center of a heavily populated area.

In all cases, the service calls should be routed in a logical order so that the distance to be traveled by each technician is kept at a minimum. This will ensure that a minimum amount of time will be spent in travel and will therefore make it possible for each technician to make a maximum number of calls. Shown in Fig. 7 is a sample routing sheet. This sheet contains practically all of the data necessary to operate a successful routing system.

The technician assigned to an area should be thoroughly familiar with it if possible. It is very desirable that a man be assigned to an area in which he lives because he may be personally acquainted with many of the people in that area and thus might know better how to deal with them. In fact, assigning a technician to service his own neighborhood may even result in an increase in business from that area.

Deliveries

The delivery of repaired receivers should be interspersed among the service calls. The delivery of the repaired receiver should always be made by the technician who removed the receiver. He will be in a better position to answer to the customer's satisfaction any questions which may be asked. In anticipation of such questions, the technician delivering a repaired receiver should always know exactly what steps were taken in the shop in repairing the receiver. When the technician did not repair the receiver himself, he can get the necessary information by asking the technician who actually performed the work.

Calling the Shop

Some arrangement should be made for the service technician to call the shop for a briefing and to take care of any additional service calls in his area. One way is to have the technician phone after each service call or after every other call. The service technician should phone his shop before leaving one home en route to another in a remote area. A call at this particular time is most important because it could save returning to the same area to service another set.

OTHER WAYS TO IMPROVE SERVICE

Service the Same Day

It is always the best policy to give service as soon as possible. Always complete a call the same day it is received or by the next day at the latest. This is very important, especially if your organization deals in service only. The customer who has to wait three or four days to see a service technician then has to have his receiver taken to the shop for several more days is not going to be too eager to call the same organization for service the next time his receiver needs it.

Customer Not Home

The first thing for the technician to ask himself when he gets no response to his knock is: Is the customer really not at home? Maybe he is upstairs, in the basement, or in the back of the house. In some cases, he may even be in the back yard or in a garage workshop. To avoid having to make a return call, ring the bell for a few seconds to make sure that it could be heard. If there is no doorbell, be sure to knock loud and often enough to be heard. A walk to the side of the house or along the driveway should reveal if the customer is in the yard or garage. In any case, a period of 2 or 3 minutes should be given the customer to appear. In some cases, an even longer wait is advisable.

Not-Home Card

If it is finally determined that the customer is definitely not at home, a "Not-Home Card" should be left. This card should be in the form of a tag that is fastened to the doorknob so that the customer will be sure to get it. A sample card is shown in Fig. 8. It has most of the pertinent data which should be included on such a card. Notice that the time of the call is very bold and prominent. Also notice that the "NOT AT HOME" is in the largest lettering on the card so that there will be no possibility of missing it. The entire card should be a bright

Fig. 8. Example of Not-Home Card.

color, or the letters should be a bright color so that the customer will be sure to see it when he returns. In size, the card should be large enough to be seen easily and to contain the necessary data. The printer can help in the determination of the size because it may be less expensive to have certain sizes printed.

Free Return Calls

There are several factors which may have caused the customer to be away from the home when the technician called, and not all of them are the customer's fault. Some of these are:

1. Technician arriving later than the appointed time.

2. Emergency trip to a doctor's office.

3. Unexpected business in town.

4. Washing clothes in the basement and did not hear the knock or doorbell.

5. In the back yard and did not hear the knock or doorbell.

6. Forgot service technician was coming.

In any case, a return call results in a loss of time which means fewer calls can be made, a fact which means that less money will be taken in by the technician that day. Therefore, anything which can be done to eliminate a call back is desirable. There are two things that the technician and service organization can do to help eliminate these return calls which become necessary because the customer is away from home:

1. Give the customer a good idea of the time the service technician will arrive; then be there at the appointed time.

2. Make an honest effort to locate the customer after ringing the doorbell.

The technician can also reduce the number of return calls by making sure that he has sufficient money to cash the largest denomination of bill which he may expect to receive.

Speed and Traffic

Besides being a violation of the law, speeding or any form of reckless driving is not the way to give fast efficient service. It may also cause the customer to take his service elsewhere. This is caused by the fact that people resent having their children endangered by speeding vehicles, and rightly so. Another thing to be considered is that being picked up for traffic violations is a gross waste of time. It could also result in having the police on a constant lookout for any type of violation by your service vehicles, and this can be harrassing.

Day and Evening Service Calls

It is a common practice for most service organizations to make both day and evening service calls. This was made necessary by the fact that many people work and can only be at home in the evening. In addition to this, the television receiver is in use mostly during the evening; and therefore more troubles develop then.

It is good business to give service as soon as possible after the customer calls, preferably on the same day or evening. This type of same-day service is the best advertising a TV service company can get.

Some special problems must be considered if evenings calls are to be made with the same efficient dispatch with which day calls are made. Parking is one of the prime problems, especially in areas where there are large apartment buildings. Whenever possible, the service vehicle should be parked in the customer's driveway since it may be necessary to remove the TV chassis and take it to the shop for repair.

Locating the correct address also poses a problem because house numbers that are visible in daylight sometimes are almost impossible to see at night. In addition, it is often difficult to see the street signs even with the help of a spotlight. For this reason, it is important that the service technician be thoroughly familiar with the area. Directions are very important in routing evening calls because it is much easier to become confused after dark. The directions should route each call via the nearest through street.

Uniforms

In making calls after dark, technicians wearing uniforms which have the company's name on them will usually have less trouble gaining entrance to the customer's home when the customer has never seen the technician before. If it becomes necessary to remove the chassis for shop service, less difficulty is met in getting the customer's permission. This problem of customer distrust has arisen from the actions of a few unscrupulous operators; consequently, uniforms can help somewhat. Fair dealing, good service, and courteous manners complete the picture for obtaining good customer relations.

The major objective of any service organization should be the improvement of its service to the customer. Some of the ways to do this are as follows:

1. Establish a fast and efficient routing system.

2. Return repaired chassis immediately.

3. Make a service call the same day that the customer calls in.

4. Notify the customer the approximate time that the service technician will arrive.

   a. When the customer is not at home, use a not-home card.

   b. Make efforts to reduce the number of free return calls.

5. Technicians should drive carefully to avoid loss of time.

6. A proper uniform should be worn.

If the many different phases of these main ideas are kept in mind, an efficient and fast servicing system can be maintained.

CALVIN C. YOUNG, JR.

Examining Design Features

(Continued from page 25)

the emitters in the IF transistors. Resistor R13 returns to a negative 1.5-volt DC source; whereas, R18 is returned to chassis ground.

The detector stage also utilizes a CK760 transistor having a grounded emitter. The AVC voltage is tapped off at the detector output where it is filtered by C1 and is reduced to the proper DC level by R23. The audio signal from the detector stage is coupled to the volume control through the electrolytic capacitor C2. The resistors R24 and R30 have been added in later productions to improve the quality of the audio system in the receiver.

The audio amplifier stage employs a CK721 or a CK722 transistor connected in a grounded-emitter circuit. Bias for the emitter circuit is derived from the series resistor R27, and capacitor C4 acts as an RF bypass. The base connection of the AF amplifier transistor obtains bias from a divider network formed by resistors R25 and R26. The audio output from the collector circuit of this stage goes into the primary of transformer T1. The secondary of this interstage transformer is center tapped and develops two out-of-phase signals which are required for the operation of the push-pull output circuit.

The output stage consists of two CK721 or two CK722 transistors connected as push-pull amplifiers. These units are connected in grounded-emitter circuits. The bias for the base connections is provided by the voltage dividers R28 and R29, and C5 serves as a decoupling capacitor. The impedance of the center-tapped primary of the audio output transformer T2 matches the collector impedance of the output transistors. A .15-mfd capacitor C25 has been connected across the primary of this transformer in later productions in order to improve the impedance match and thus reduce audio distortion. The secondary of the output transformer drives a 3 1/2-inch PM speaker. The secondary of the transformer and the voice coil of the speaker are matched in impedance. The impedance is 16.8 ohms. The small speaker employed in this radio provides a reasonable amount of volume and fidelity. The manufacturer of the receiver rates the power output at 100 milliwatts.

All input power required to operate this relatively small receiver is furnished by four 1 1/2-volt, size D batteries connected in series. The current drain from this power supply is approximately 15 milliamperes, and the life expectancy of ordinary flashlight batteries in this application is about 500 hours. If mercuric-oxide batteries are employed, their life expectancy will be as much as 2,500 hours depending upon the duration and frequency of operation.

The transistors used in the circuit are of the p-n-p type; therefore, the positive terminal of the battery series is connected to the chassis, and the supply voltage becomes a negative 6 volts DC. The transistor pictured in Fig. 4A has the pins keyed to fit the socket, and the middle pin is placed closer to one end than it is to the other. The transistor in Fig. 4B has the pins equally spaced; however, they may be bent to fit the socket, as shown in this photograph. If a transistor is suspected of being faulty, the only reliable check is by means of substitution. When replacing the type shown in Fig. 4B, it may be noticed that one end is coded with a red dot. This indicates that the collector pin is located near the dot end of the transistor. The drawing of Fig. 5 illustrates the connections of a transistor socket.

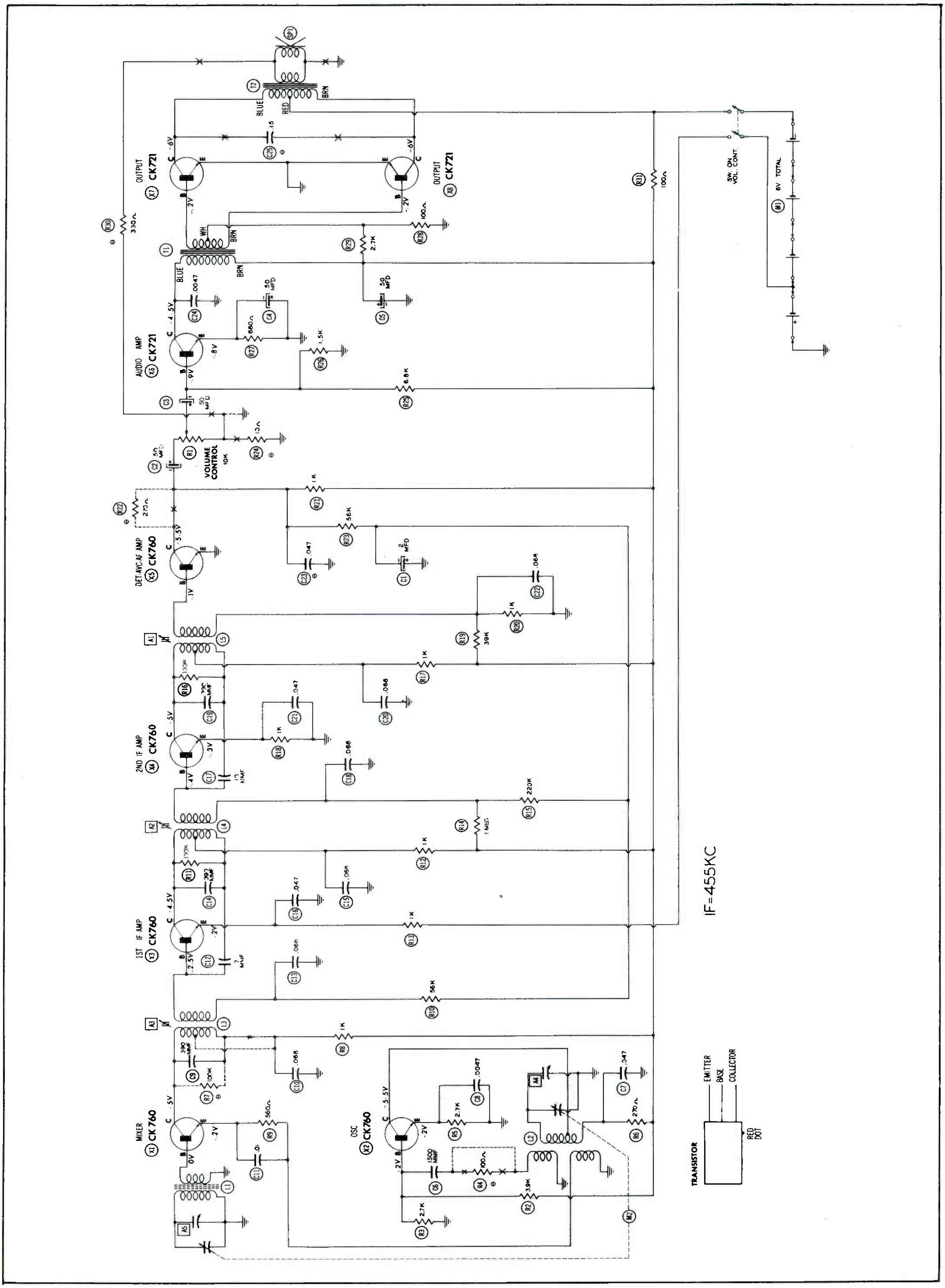
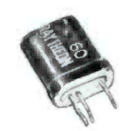


Fig. 3. Schematic Diagram of Raytheon Chassis 8RT1.

In order to simplify the replacement of this type of transistor, note the location of the red dot and bend the pins of the new unit to duplicate those of the original. In some later production runs of this chassis, the manufacturer has wired and soldered the transistors directly to their respective circuits.



(A) For RF, IF, and Detector Stages.

(B) For Audio Stages.

Fig. 4. Plug-in Type Transistors Employed in Raytheon Chassis 8RT1.

Interchanging the transistors from one stage to another in the receiver is not recommended. In some instances, realignment will be required after substituting a new transistor unit in the RF stages.

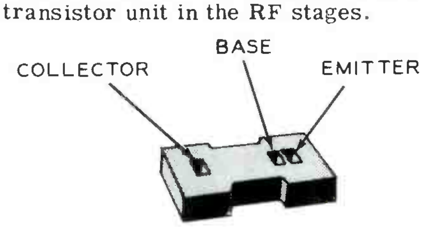


Fig. 5. Transistor Socket Showing Connections.

The transistor should always be removed before replacing a component which is soldered to its socket because excessive heat is capable of damaging the transistor permanently. When servicing a receiver of this design, remember that transistors should be removed before accurate readings of resistance through other components can be made and that the voltage at the terminals of the meter leads should not exceed the normal operating voltage of the circuit under test.

LESLIE D. DEANE

Audio Facts

(Continued from page 21)

is important, and certain precautions should be taken. As shown in Fig. 1, a record jacket should be pressed on its edges so its sides will be bowed away from the playing surfaces of the record. The record is then grasped with the thumb at the edges and with the finger tips on the label surface and withdrawn from the jacket. In this way, dust or grit that might be clinging to the inner surfaces of the jacket or to the surface of the record will not be rubbed across the record and will not damage the playing surfaces of the record.

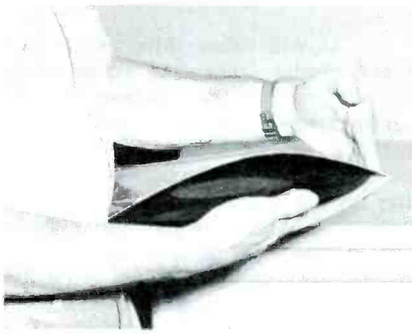


Fig. 1. Removing Record From Jacket.

The record should only be handled by the edge and the label surfaces. The fingers should never be placed on a playing surface. Fingers will usually leave prints which will at the least have a tendency to hold dust. Of course, if any dust, grit, or other foreign material is present on the fingers, it will be deposited in the grooves where it can cause damage eventually, if not at the time of handling.

The important things to remember are that records should never be handled by the playing surfaces and should never be laid on any surface that might scratch them or deposit dirt on them. Keep them in their protective containers when not in use, and keep them clean.

We must not forget that the turntable must also be kept clean and free of dust.

Importance of Stylus

Before proceeding further, we should mention that one of the most common causes of damage to records is the use of a worn, damaged, or improperly used stylus. A stylus which has become worn from normal usage or has been broken can do great damage to the grooves subjected to its cutting and gouging action. If the stylus is not aligned properly and leans to one side or the other or if the turntable is not level, the grooves can be distorted and damaged. Excessive stylus pressure or the use of the wrong stylus, such as a 3-mil stylus for a microgroove record, can cause irreparable damage.

Cleaning Records

Dust has a tendency to settle on all surfaces; but since microgroove records are made of plastic, they accumulate a static charge and attract dust to their surfaces. When dust settles on a record, the record should be cleaned before it is played or returned to its protective container.

As with other things connected with audio, there is no absolute agreement on the virtues of the methods used to clean records. Most methods are both recommended and condemned, with the opinion depending on the individual. Some claims are made that the damage done to the record during cleaning exceeds by far any good derived from the process. These claims may be valid in cases in which proper precautions are not taken and in which the cleaning is not done with care, but any reasonable method which will at least remove the most of the grit and foreign material should prove worth while. It would seem that a knowledge of how and what to do and the use of some common sense could be the answer to any controversy on the subject.

Included among the notes on some record jackets is the suggestion that "before the enclosed record is played, it should be wiped carefully with a moist soft cloth to remove any accumulation of dust." This seems to be a reasonable suggestion because a lint-free soft cloth when moistened and used with a gentle circular motion on the surface of the record will pick up dust and also dissipate some of the static charge on the record for at least a short time.

Microgrooves are very small and narrow but do have depth, consequently some difficulty is encountered when attempts are made to remove dust, grit, or any other foreign particles from them. The opinion that such material will be pushed deeper into the grooves rather than be removed appears logical. For this reason, the use of a suitable brush seems appropriate.

A two-inch paint brush with very fine soft bristles was used by the writer for many years to remove

Fig. 2. Kral Rek O Kleen Brush in Use.

Fig. 3. Staticmaster (Hi-Fi Model) Record Brush.

dust from 78-rpm records while they were spinning on the turntable prior to being played. This practice was carried over to microgroove records and seemed to be very satisfactory. The brush had to be kept clean because it certainly did pick up a great deal of dust and lint.

Several styles of brushes are supplied for this purpose. Some very small ones are designed for mounting on the pickup arm with the bristles riding in the record grooves in front of or adjacent to the stylus. This type is not so popular at the present time, probably because of the lightweight pickups used with microgroove recordings. A larger brush which mounts or stands on the turntable mounting board is adjusted to allow the tips of the bristles to ride on the playing surfaces of the record. One is shown in Fig. 2. This type can only be used with a single-play turntable and must be moved aside when a record is changed. This model will automatically return to its correct position on the record. A special brush which neutralizes the static charge as it cleans the record will be discussed in a later paragraph.

A record can also be cleaned by washing it in a stream of running water from a tap. Of course, this cannot be done recklessly. Hot water and too much force cannot be used because labels can be washed off very easily.

Removing Static Charge From Records

Dust can be removed from the playing surfaces of a record; but if the static charge is not removed from the disk, more dust will soon collect on the surfaces again. This static condition is more severe when the humidity is low and is aggravated by motion and friction. A spinning record can accumulate a heavy charge, and rubbing with a cloth or using a brush can increase the charge to a degree that will attract additional dust and lint.

Various static removers have been developed for use with records. These are available in the form of liquids, sprays, prepared cloths, and special brushes all of which are to be used directly on the records. There are also some small attachments that mount on the pickup arm near the stylus and never touch the record.

Several manufacturers supply liquid antistatic solutions. The liquid is applied and used according to the directions accompanying that particular brand. In most cases, a few drops are applied to the playing surface of the record and then spread with a soft clean cloth. Manufacturers of certain brands of records recommend that enough liquid should be applied to saturate the surface of the record; whereas, others say that only a very small amount is required. In any event, a clean cloth must be used and the record should be clean. If the record is not clean when the liquid is applied, even though the static is eliminated, the dirt and foreign particles will be rubbed into the grooves. An antistatic solution can also be sprayed on the record instead of being poured.

Antistatic cloths are impregnated and prepared in such a way that they dissipate the static when they are rubbed over the record in a prescribed manner. These are convenient because no liquid is required. The same rules of cleanliness must be observed; and of course, the cloth must be kept clean.

The static-eliminating brush (Fig. 3) derives its powers from the polonium strip located in its ferrule. When the record is brushed, the dust is removed and at the same time the static charge is neutralized by the radioactive polonium in the strip. The polonium strip is effective for one or two years. When necessary, the brush can be returned to the manufacturer for replacement of the strip to renew its static-neutralizing properties.

Some small, very lightweight attachments which clip to the pickup arm near the stylus, as shown in Fig. 4, remove the static charge by the neutralizing action of a small bit of radioactive material held close to the record surface. As the record revolves, the radiation scans the record grooves and removes the static charge. If any particles of dust or grit have been clinging to the record, they will be released and be free on the surface. These small attachments seem to do a good job of keeping the records uncharged so that the records would apparently remain neutralized for an indefinite period.

How long records will remain in the uncharged state will depend on how often they are played, how they are handled, and how and where they are stored. If a record is static free and clean when it is returned to its protective container, it should be in excellent condition when removed to be played in the future.

We read and hear objections to the application of any kind of solution to the playing surfaces of a record. One objection is that if the solution is allowed to accumulate, the grooves might have a tendency to become filled with a sludge. We have also heard the opinion expressed that an excess amount of some of the solutions would have a deteriorating effect upon damping material and protective membranes associated with the stylus of certain cartridges. No doubt there is some truth to these claims if some solutions are used in excessive amounts; but if discretion and common sense are used in following specified procedures, the benefits should outweight any damage.

Fig. 4. Eby Stati-Mute Installed on General Electric "Baton" Arm.

We must admit that there is a wide disparity between the recommendation that enough of a certain brand of solution should be used to saturate the surface of the record because of the lubrication afforded the grooves and the one that warns against using any type of fluid including water. Probably the moral to be gained from all this is that a record should be kept clean and static free with a minimum of manipulation.

Storage of Records

The storage of records involves only a few basic precautions. The most troublesome problem encountered when large numbers of records are to be stored seems to be the difficulty of finding a suitable cabinet shelf or some such container which will fit into the surroundings.

Records should be clean and stored vertically (on edge) in their original jackets. Suitable plastic envelopes that afford added protection from dust and handling are available from several suppliers. If the jacket or container is flat, if no distorting pressure is applied, and if the temperature is not excessively high, the stored records should remain flat and not become warped. Because of the accumulated weight, records can become warped and deformed in a very short time if they are stored horizontally (flat), particularly if they are placed in stacks of many records.

Records should be clean, should be stored in a vertical position in protective jackets, and should not be subjected to excessive pressure or high temperature. This seems to cover the story of record storage.

ROBERT B. DUNHAM

Notes on Test Equipment

(Continued from page 19)

caused by application of too great a sync signal.

A calibration voltage is provided internally. When the CAL (calibrate) button on the front panel is pressed, a square-wave signal with an amplitude of .05 volt peak to peak is applied to the vertical section of the oscilloscope. The calibrating voltage is kept constant by means of a voltage-regulating circuit.

This voltage is applied at a point after the step-attenuator section so that the calibration may be used for all positions of the step attenuator once the calibration has been made. To calibrate the oscilloscope, the operator presses the CAL button; then he adjusts the V-GAIN (vertical-amplifier gain) control until the height of the square wave is equal to the distance between the two horizontal calibration lines on the screen. The switch of the vertical attenuator is marked at each position with the peak-to-peak voltage that is represented by the distance between the calibration lines when the oscilloscope has been set up in this manner.

Two input connections to the vertical amplifier are provided on the front panel of the oscilloscope. One is a binding post, and the other is an Amphenol connector for cables such as the one shown in Fig. 1. The probe and cable assembly shown is the Hycon Model 6211 oscilloscope probe having an impedance of 10 megohms and 15 micromicrofarads. Two binding posts for ground connections are provided, and there is one for horizontal input and another for Z-axis modulation. All of the binding posts will accept banana plugs, and they are also spaced on 3/4-inch centers to accommodate General Radio 274-MB plugs. The vertical and horizontal step attenuators are frequency compensated for best frequency response at all positions.

HYCON MODEL 614 VTVM

Another Hycon test instrument which we have had an opportunity to use is the Model 614 VTVM pictured in Fig. 2. This meter is designed to measure a wide range of resistances and voltages (both AC and DC). DC voltages are measured with the use of a probe having a built-in isolating resistor. AC measurements are made with the use of a low-impedance probe or a crystal-diode probe.

The Hycon Model 614 VTVM matches other Hycon equipment in outward appearance. The meter is housed in a green steel case, and the instrument can be stacked vertically with other Hycon instruments. An interesting and convenient feature is that storage compartments are provided in one side of the case where the cables and probes that are permanently attached may be kept when not in use.

A small circular groove has been cut around the tips of both the AC-OHMS probe and the DC probe. It was noticed during the use of this VTVM in our laboratories that this groove was of great aid in keeping the probe from slipping off the test point.

The size of the case is 8 1/2 inches wide, 11 inches high, and 7 1/2 inches deep. Weight of the instrument is approximately 10 pounds. The large 6 1/2-inch meter dial contains seven photo-printed scales and is illuminated by dial lamps.

There are four front-panel controls: (1) an input-selector switch, (2) a range-selector switch, (3) a zero-adjust control, and (4) an ohms-adjust control. The input-selector switch has five positions:

Fig. 2. Hycon Model 614 VTVM.

OFF, -VOLTS, +VOLTS, AC VOLTS, and OHMS. The range-selector switch has seven positions. For voltages, the positions are marked as follows: 1.5V, 5V, 15V, 150V, 500V, and 1500V. For resistances, the positions are marked as follows: R x 1, R x 10, R x 100, R x 1K, R x 10K, R x 100K, and R x 1MEG.

The meter dial is calibrated so that DC and AC rms voltages may be read for the voltage ranges just mentioned. The instrument responds to peak-to-peak AC voltages, and separate scales that are marked in red are provided for these ranges.

The input impedance is 11 megohms for all DC ranges, and the accuracy is ±3 per cent of full scale. The input impedance on AC ranges is 1 megohm shunted by 60 micromicrofarads. The frequency response is 30 cycles per second to 3 megacycles with the direct probe, and it is 50 kilocycles to 250 megacycles with a crystal probe. Accuracy is ±5 per cent of full scale on all AC ranges.

AUTHORIZED MODEL 101F CATHODE-RAY TUBE TESTER AND REJUVENATOR

In the February 1955 issue of the PF REPORTER, mention was made in this column of the Authorized Model 101 cathode-ray tube tester. A more recent model, the Authorized Model 101F, has some added features to increase its range of applications over that of the previous model.

The general appearance of both instruments is similar. The Model 101F is shown in Fig. 3. The push button which was in the lower left corner of the earlier model has been replaced by a three-position switch marked READ - SET - REJUVENATE.

Fig. 3. Authorized Model 101F Cathode-Ray Tube Tester and Rejuvenator.

This switch adapts the instrument for use in rejuvenating cathode-ray tubes which give a low emission reading on the tester. It is claimed that the rejuvenation process will not injure grid structures and that the instrument will indicate whether or not the rejuvenation has proceeded to the necessary degree.

In addition, the emission scale has been recalibrated to give a true indication of beam current in microamperes.

HICKOCK MODEL 770 OSCILLOSCOPE

A new addition to the line of test instruments manufactured by the Hickok Electrical Instrument Co., Cleveland, Ohio, is the Model 770 oscilloscope which is shown in Fig. 4.

The Model 770 is a general-purpose oscilloscope having high deflection sensitivity and a wide-band frequency response. It is suitable for a great number of applications by the service technician. Although this oscilloscope is classed by the manufacturer as a general-purpose type, its appearance suggests that it is more of a laboratory type because of the number and variety of functions which it offers.

Some of the features of the Hickok Model 770 are not usually found in general-purpose oscilloscopes. These features are: DC amplifiers for both vertical- and horizontal-deflection circuits, balanced input to the vertical amplifier, and a driven sweep.

A driven sweep (sometimes called "triggered sweep") depends upon an applied signal to initiate the trace, whereas the usual recurrent sweep does not depend upon such a signal. The recurrent sweep will operate at a free-running rate if no sync signal is applied; however, if no sync signal is applied to the driven sweep, it will not operate at all. In the Model 770, the triggering signal can be taken from the vertical-input signal if the sync selector is in the INT (internal) position; or it can be taken from some external source if the sync selector is in the EXT (external) position.

We have had occasion to use a driven sweep at various times in our laboratories; and we find that under

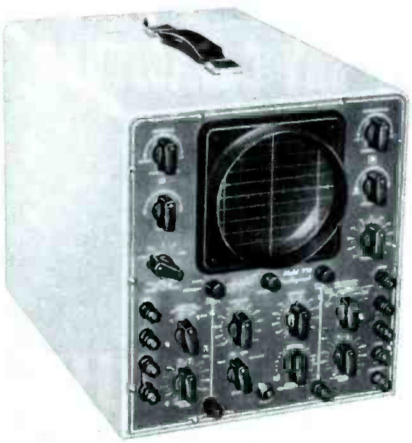


Fig. 4. Hickok Model 770 Oscilloscope.

difficult synchronization conditions, it may offer a more stable synchronization than the use of a recurrent sweep. A change of setting of the vernier sweep control does not appear to disturb the synchronization greatly. A driven sweep may be used in such a manner as to result in a greatly expanded sweep if the sweep is set to a much higher rate than the repetition rate of the observed signal and if a synchronization signal of the same rate as the observed signal is used. In this manner only a portion of a cycle will be observed; but the detail of that portion will be shown in a stretched or expanded form.

Front-panel controls and switches are provided for the following functions: focusing; phasing; calibration; sync selection; adjustment of beam intensity, sweep stability, scale illumination, and sync amplitude; selection of type of sweep and vertical-amplifier bandwidth; coarse and fine adjustment of sweep rate; vertical and horizontal positioning and attenuation.

The calibration signal may be .1, 1, 10, or 100 volts peak to peak, depending upon the position of the calibration switch.

The vertical- and horizontal-gain controls are vernier controls, and the vertical attenuator is governed by a four-position switch. The vertical attenuator is frequency compensated. The LOCKING (or sync-amplitude) control will select either polarity of the sync signal.

A sweep range of 2 cycles to 30 kilocycles is covered by the coarse-frequency switch and is obtained by means of six of the switch positions. Two other positions are for frequencies of 30 and 7,875 cycles per second. These positions are useful when viewing vertical and horizontal signals in TV receivers. Another switch position is marked EXT. CAP.; and when this position is used, an external capacitor can be connected between the ground and the horizontal DC terminals in order to extend the sweep rate below 2 cycles per second.

The type of sweep used is governed by the position of the horizontal selector switch. This is a five-position switch. Two of the positions provide for feeding an external deflection signal to the input of the horizontal amplifier. The signal is fed directly to the amplifier when the switch is in the X1 position, and it is fed through an attenuator in the X10 position. The third position is for a recurrent sweep, the fourth is for a driven sweep, and the fifth is for a sine-wave sweep at line frequency.

The sync-selector switch is a four-position switch marked EXT, INT, LINE, and 2X LINE.

The DC balance controls for the vertical and horizontal amplifiers are accessible through the front panel as screwdriver adjustments. Binding posts are provided for:

All input signals to the horizontal and vertical amplifiers.

An output signal at line frequency.

A sawtooth output signal.

An input signal for intensity modulation.

An external sync signal.

The manufacturer's specifications for the deflection sensitivity and frequency range of the Hickok Model 770 are as follows:

Deflection Sensitivity

First vertical amplifier — .010 volt rms per inch with the bandwidth switch in NARROW position.

Second vertical amplifier — .035 volt rms per inch with the bandwidth switch in WIDE position.

Horizontal amplifier — .075 volt rms per inch.

Frequency Ranges

First vertical amplifier — 0 to 2.5 megacycles (flat within 3 decibels) with the bandwidth switch in NARROW position.

Second vertical amplifier — 0 to 5 megacycles (flat within 3 decibels) with the bandwidth switch in WIDE position.

Horizontal amplifier — 0 to 500 kilocycles (flat within 3 decibels).

The size of the Hickok Model 770 is 12 by 14 by 18 inches. The weight is 50 pounds.

RCP MODEL 780 SWEEP GENERATOR

The RCP Model 780 electronic sweep generator is made by the Radio City Products Company and is pictured in Fig. 5. This sweep generator is designed to provide a sweep signal within a frequency range from 3 to 1200 megacycles. Six frequency bands are employed to cover this range. The signals on bands A, B, C, and D are at fundamental frequencies; and the signals on bands D_1 and D_2 are harmonics.

The sweep-generating portion of the instrument is entirely electronic in operation, depending for its action upon a tank circuit which has the property of variable reluctance. The sweep action is in one direction only and starts at the frequency indicated on the dial, sweeping upward in frequency an amount that is dependent upon the setting of the width control and upon the band selected.

According to the manufacturer, the sweep width may be as high as 30 megacycles on band D. The WIDTH control is calibrated with 90 equal divisions from 10 to 100, and a table in the instruction manual gives the different sweep widths obtained for various settings of the WIDTH control, BAND switch, and TUNING control.

The six ranges provided by the BAND switch are as follows (in megacycles):

Band A — 3.0 to 8.4.

Band B — 9 to 25.

Band C — 28 to 72.

Band D — 72 to 200.

Band D_1 — 216 to 600.

Band D_2 — 435 to 1200.

No external blanking signal is required inasmuch as blanking is provided internally by the action of a gating signal.

A HORZ SCOPE OUTPUT jack is provided so that a horizontal-deflection voltage may be applied to the horizontal-input terminals of an oscilloscope when it is desired to view a response curve. The phase of the horizontal-deflection voltage may be varied through 180 degrees by means of the PHASING control of the generator. The knob of this control also operates the ON-OFF switch of the instrument.

The SWEEP OUTPUT cable is permanently attached to the instrument and is terminated at the opposite end with a 50-ohm resistor. An unusual feature of the instrument is the attenuator system that is operated by five push buttons. The attenuator is of the step or ladder type and is calibrated directly in decibels. The attenuation range is from 0 to 78 decibels. It is obtained in 32 steps, and no two successive steps are separated by an amount greater than 3 decibels. Any attenuation ratio within the range can be selected by the proper combination of push buttons. Each section of the attenuator is completely shielded and terminated for low leakage and constant impedance over the entire range of attenuation.

An internal detector circuit is connected to the DET/COMP (detector/comparator) OUTPUT jack, and

Fig. 5. Radio City Products Model 780 Sweep Generator.

this circuit provides a means for checking the output signal of the sweep generator. A marker can be applied to the MARKER INPUT jack, and this marker will appear in the detector-comparator output. The sweep limits can be determined in this manner. The marker will also be present in the SWEEP-OUTPUT signal fed to the circuit under observation.

An AGC circuit is used to provide a regulated output signal.

The RCP Model 780 is supplied with three cables — one for sweep output, one for horizontal output, and one for detector-comparator output. The size of the instrument is 9 1/2 by 9 1/4 by 12 1/2 inches. The weight is 16 1/2 pounds.

GAS TEST WITH RAYTRONIC CATHODE BEAMER

The Raytronic Laboratories,Inc., of Cincinnati, Ohio, have included facilities for a critical gas test in their latest model of the Raytronic Beamer CB-54A. Other testing and repair operations remain the same as in previous models except for the removal of the toggle switch which controlled the burn current during removal of a cathode-to-grid short. The space formerly occupied by this switch is now occupied by the gas-test switch. This gas-test feature is designed to provide the service technician with a means for accurate determination of the gas content of a picture tube. Knowing this content, the technician will then be better able to advise either replacement or repair of the picture tube as he sees fit.

The manufacturer of the Raytronic Beamer states that no attempt should be made to rejuvenate a tube showing indications of more than 1 microampere of ion current (gas) per milliampere of beam current.

Their field tests indicate that a gas content in excess of this amount will lower the life expectancy of the tube even though the emission can be increased by rejuvenation. If the gas content is less than this amount (1 microampere),then other factors such as the thickness of the barium coating on the cathode will govern the life expectancy of the tube.

The action of the Cum-A-Tron circuit, as it is called by the manufacturer, will be described briefly. The gas test is made with the master selector switch of the Raytronic Beamer in the GRID position. (The technician should first make sure that the tube is not defective. This means that the tube should have grid control, good emission characteristics, and should not be shorted.) The GAS-TEST switch is then set to the METER SET position, and the grid-control potentiometer is adjusted until the meter needle is at the red calibration mark. Then the GAS-TEST switch is set to GAS CONTENT, POS 1; and the position of the meter needle is noted. At this setting of the controls of the instrument, the meter is registering a current which is the sum of the plate current in the amplifier tube of the instrument, the ion current (gas) in the picture tube, and the interelement leakage.

In the next position, GAS CONTENT, POS 2, the cathode-ray tube is biased to cutoff so that the meter indicates the sum of the plate current and the interelement leakage. The difference between these two readings for POS 1 and POS 2 is the indication of gas content. This difference can be measured in the number of the smallest scale divisions between the two meter-needle positions. If this number exceeds 10 (15 in some models of the instrument), the tube should be rejected as too gassy for rejuvenation. At these control settings, 10 divisions (or 15 in some models) indicate a gas-ion current of 1 microampere which is the limit previously mentioned.

An accurate indication of the gas content of a picture tube will help the technician to decide whether to repair or replace. This will save him some wasted time in repairing tubes which would fail at an early date because of high gas content. It will also do much to prevent customer dissatisfaction from cases of early failure after rejuvenation.

PAUL C. SMITH

URANIUM. A small California appliance shop reports selling $3,200 worth of Geiger counters in less than a month. A big department chain expects to sell $2,000,000 worth of uranium-finding equipment this year, 40 per cent of it east of the Mississippi. Yes, uranium hunting is becoming big business.

Radio and television shops are logical market places for this equipment, because of its technical nature. Because so many dealers are showing interest, one manufacturer of radiation instruments (Technical Associates, Burbank, California) has issued a brochure of advice: "Cashing In on the Big Uranium Boom."

They say, among other things, that Geiger counters are fine for pinpoint prospecting and for making rough ore assays but are strictly for shoe-leather prospecting. The more expensive scintillation counters, on the other hand, have much higher sensitivity and are nondirectional; they can easily detect bodies of hidden ore and can be used while moving at good speeds on a jeep or other vehicle.

For information about prospecting areas in your vicinity, write the Atomic Energy Commission in Grand Junction, Colo. For a good booklet, order "Prospecting for Uranium" from the Supt. of Documents, U.S. Govt. Printing Office, Washington 25, D. C., at 25 cents.

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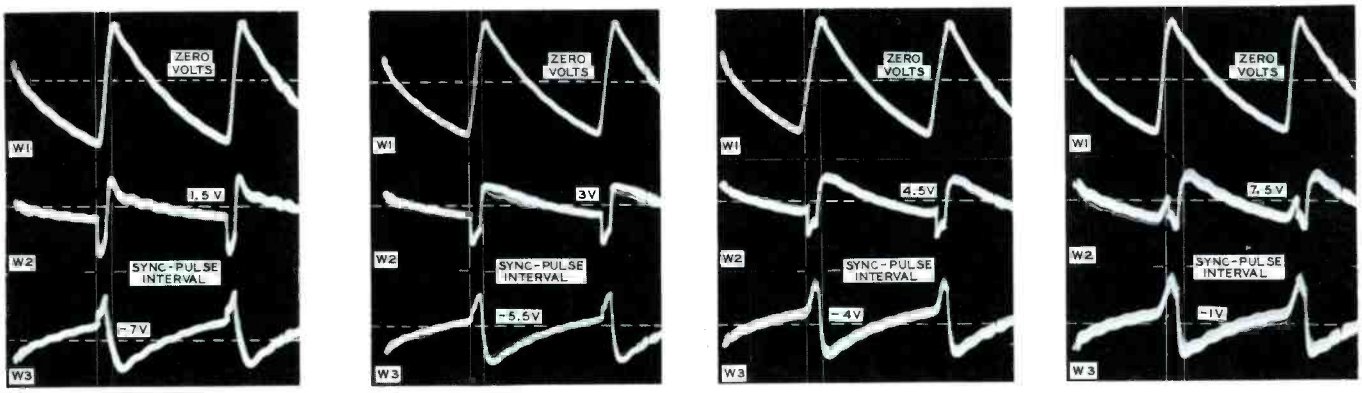
The Triode Phase Detector

(Continued from page 23)



(A) With Oscillator Tending to Run at a Reduced Rate.

(B) With Oscillator Tending to Run at a Slightly Reduced Rate.

(C) With Oscillator Tending to Run at Correct Frequency.

(D) With Oscillator Tending to Run Fast.

• Fig. 2 Waveforms Observed in Circuit of Fig. 1B.

nals as the dual diode; but the negative sync pulse is applied to the cathode, the positive pulse goes to the grid, and the sawtooth wave is fed to the plate of the triode. The correction voltage is taken from the junction of two equal resistors, R79 and R80. These resistors form a voltage-divider network so that the value of the correction voltage is midway between the grid and cathode potentials.

The series of waveforms in Fig. 2 shows how the voltage relationships in the Motorola phase detector change when the horizontal oscillator tends to drift off frequency. In each group of pictures, W1 is the sawtooth waveform on the plate; W2 is the negative pulse on the cathode; and W3 is the positive pulse on the grid.

While the waveforms were being taken, the oscilloscope was synchronized externally to a voltage obtained by clipping a lead to the insulation on one of the leads to the horizontal windings of the yoke. In this manner, the true phase relationships between each of the waveforms could be observed. The distance between the two vertical lines in each group of waveforms represents the duration of the sync pulse. The sawtooth voltage W1 applied to the plate maintains an average value of approximately zero volts with respect to ground at all times.

In Fig. 2C, the free-running frequency of the horizontal oscillator is about the same as the frequency of the sync pulses. Note that the sawtooth voltage crosses its AC axis during the sync-pulse interval. The sync pulses are negative on the cathode and positive on the grid; and there is a flow of grid current from the cathode side of C77, through the tube, and on to the grid side of C76. Capacitors C76 and C77 become charged in the polarities shown in Fig. 1B. The charges leak off slightly between pulses but are re-established during every sync-pulse interval.

Because of the flow of grid current during each sync pulse, the potential on the grid side of C76 with respect to the potential on the cathode side of C77 is dependent upon the sync amplitude which is almost constant for a given signal. Since the difference between these potentials is essentially the bias on the tube, the bias remains practically constant.

The cathode voltage with respect to ground will vary, however, depending upon the average amount of tube conduction; and the tube conduction will vary depending upon the instantaneous plate voltage during the sync-pulse interval. The voltage at the junction of R79 and R80 together with the grid voltage on the tube will vary in step with the cathode voltage.

The DC levels which were observed in the Motorola circuit under the conditions of Fig. 2 are given in Table I. It can be observed in Table I that the difference of DC potential between the cathode and the grid stays constant regardless of the amount of conduction through the tube; therefore, the potential across R79 maintains a steady value. The output voltage measured from the junction of R80 and R79 to ground is really the result of the combined voltages across R77 and R79. Since the average potential of the grid is more negative than the cathode voltage, the grid end of R79 is negative with respect to the cathode. The cathode, however, is positive with respect to ground. The circuit is designed in such a way that the voltage developed across R77 is equal to that which appears across R79 when the free-running frequency of the oscillator is approximately the same as the frequency of the sync pulses. Cancellation takes place, and no correction voltage is produced.

If the oscillator tends to run fast, the sawtooth voltage reaches a positive value by the time the sync pulses arrive. See waveform W1 in Fig. 2D. Since the plate voltage is positive, conduction is heavier through the tube during the pulse time and the average cathode voltage becomes more positive. The grid voltage is also less negative than it was in Fig. 2C, but the grid constantly maintains the same DC potential with respect to the cathode.

Since the negative voltage across R79 has not changed and the positive voltage across R77 has increased, the correction voltage from the phase detector is positive. This correction voltage serves to decrease the frequency of the cathode-coupled multivibrator which is used as the horizontal oscillator.

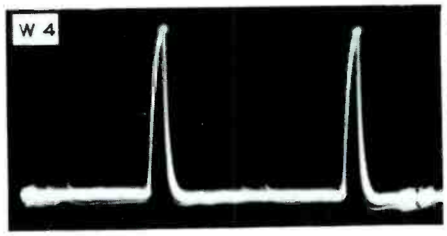
If the oscillator tends to run at a reduced rate, the sawtooth voltage on the plate of the triode is negative during pulse time and conduction through the tube is reduced. See Figs. 2A and 2B. The voltage across R77 is lower, and the potential across R79 is as great as before. The output, which is the algebraic sum of these two voltages, is negative.

The incoming sync pulse shown in waveform W4 of Fig. 3 is distorted

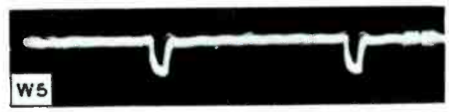
TABLE I

DC LEVELS IN MOTOROLA CIRCUIT

Figure No.	On Cathode (volts DC)	On Grid (volts DC)	At Junction of R79 and R80 (volts DC)
2A	1.5	-7.0	-3.0
2B	3.0	-5.5	-1.5
2C	4.5	-4.0	0.0
2D	7.5	-1.0	3.0



(A) Positive Pulse to the Grid.



(B) Negative Pulse to the Cathode.

Fig. 3. Input Pulses to the Phase Detector of Fig. 1B.

into the shape of waveform W3 of Fig. 2. The incoming sync pulse shown in W5 of Fig. 3 is distorted into the shape of W2 of Fig. 2. This distortion is caused by the action of the circuit of the phase detector. The gradual rise in grid voltage and the gradual fall in cathode voltage between pulses are caused by the discharge of C76 and C77.

Triode in General Electric Model 21T17

Fig. 4 is a schematic diagram of another phase detector using a triode. This circuit, which is found in the General Electric Model 21T17, requires only one sync pulse — a negative one from the cathode of the phase-inverter stage. A sawtooth voltage taken from the output of the horizontal-deflection system is applied to the plate of the phase detector.

The output voltage of the phase detector is developed across R71, R73, and R75 in series and is measured between ground and the junction of R71 and R78. This voltage is applied to one grid of a cathode-coupled multivibrator where it is superimposed upon a small negative bias which is already present on that grid. A more detailed description of this same multivibrator is included in the article, "Grid Emission and Gas in Vacuum Tubes" in the August 1955 issue of the PF REPORTER.

Fig. 5A shows the waveform W6 which appears on the cathode of the phase detector, Fig. 5B shows the amplified view of the waveform W7 produced on the grid of the phase detector by conduction through the tube, and Fig. 5C shows the sawtooth waveform W8 which appears on the plate.

The sync pulse is much greater in amplitude than the sawtooth wave.

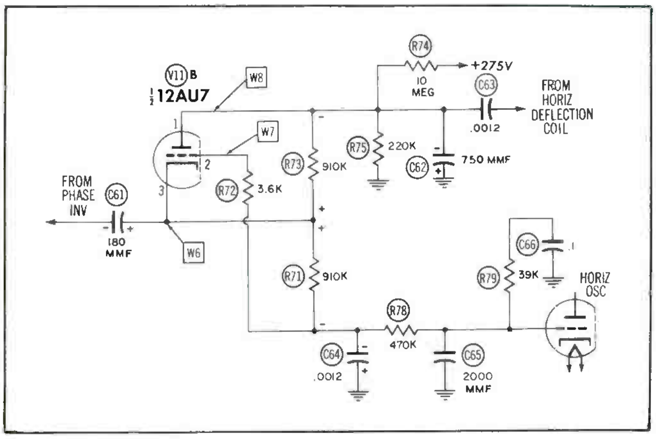


Fig. 4. Phase Detector in General Electric Model 21T17.

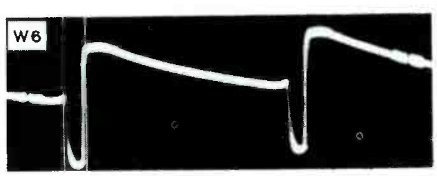
When this strong negative pulse is applied to the cathode of the phase detector, the tube conducts. During pulse time, both the grid and plate are positive with respect to the cathode; and both draw current. The operation of this circuit depends upon the proportion between the current drawn by the grid circuit and that drawn by the plate circuit.

At the end of the pulse, C62 and C64 are charged in the polarity shown in Fig. 4. The cathode side of C61 is positively charged. Between pulses, the capacitors discharge as follows. The discharge path in the plate circuit is from the top of C62 through R73, C61, the phase inverter, ground, and back to the bottom of C62. The discharge path in the grid circuit is from the top of C64 through R71, C61, the phase inverter, ground, and back to the bottom of C64. The time constant of each discharge path is long.

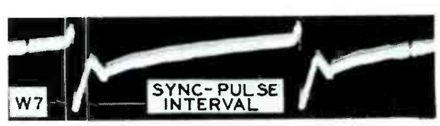
Between pulses, the voltage developed across R71 is opposite in polarity to that across R73; and the values of the components in the phase detector are chosen so that these voltages will be equal if the free-running frequency of the oscillator is the same as that of the sync signal.

When the oscillator frequency is too low, the sawtooth wave lags behind the sync pulses. The tube conducts at a time when the sawtooth wave is at a value more negative than normal. The grid voltage during the sync pulse is approximately the same as normal. Since plate current in a triode is proportional to plate voltage, provided that the grid voltage is constant, the proportion of cathode current going to the plate is reduced. The charge on C62 is lower than it is when the oscillator frequency is correct. The voltage developed across R73 between pulses is lower than that across R71; therefore, the resultant correction voltage is negative, and the speed of the multivibrator increases.

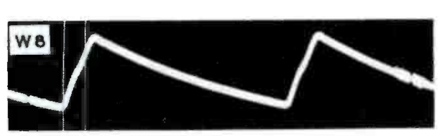
The sequence of events is exactly the opposite when the oscil-



(A) On Cathode.



(B) On Grid.



(C) On Plate.

Fig. 5. Waveforms Observed in the Circuit of Fig. 4.

lator tends to run at a frequency faster than that of the sync signal. The charge on C62 is higher than usual, the voltage across R73 is greater than that across R71, and the correction voltage is positive.

The value of the positive correction voltage that can be supplied is limited because the grid of the multivibrator will draw current and some of the positive voltage will be neutralized when the bias of the multivibrator is reduced beyond a certain point.

The circuit found in the General Electric Model 21C106 has a phase detector which includes a slight modification of the system used in the Model 21T17. Resistor R72 has been removed, and R71 has been replaced with a potentiometer and a small fixed resistor. The circuit has been modified to accommodate the characteristics of the 5U8 tube used as the phase detector and to permit the inclusion of the potentiometer which is called the phase-balance control.

If there is synchronization at only one extreme of the horizontal-hold control or if there is unstable horizontal synchronization, the technician should not immediately look for defective components in the phase detector and horizontal oscillator. The input signals to the phase detector should be checked first with an oscilloscope to make sure that the proper waveforms are arriving and that stray noise pulses are being kept out.

The horizontal-oscillator coil may need adjustment, especially if a new tube has been installed. To make this adjustment, the technician should follow the instructions given in the service notes for the set concerned.

Component deterioration short of actual failure will tend to have a considerable effect on phase detectors. Leakage in a capacitor, gas in a tube, or any change in the value of a resistor will have a more marked effect in phase-detector circuits than in many other applications.

THOMAS A. LESH

MASKS. In a Dick Rogers cartoon in Electrical Merchandising, one lady has just taken a 7-inch mask off a TV console to reveal a 10-inch mask framing the picture while explaining to the other lady, "I bought a 21-inch set last week and I'm breaking the news to my husband gradually."

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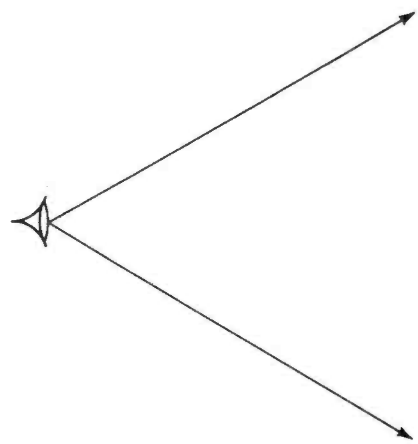
Antennas— the Eyes of TV Receivers

(Continued from page 5)

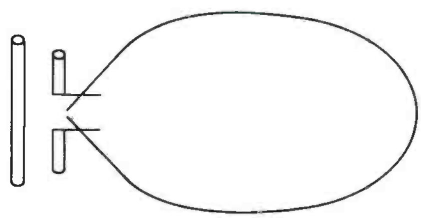
to respond to a wider range of frequencies if the diameter of the receiving elements is increased. See Fig. 1B.

A cone-shaped receiving element like that shown in Fig. 1C will also increase the frequency coverage, but this shape presents a high resistance to wind; therefore, it has been supplanted by the fan shape shown in Fig. 1D. An antenna with the latter shape is referred to as a conical antenna.

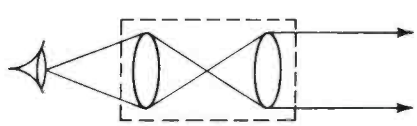
Still another method of obtaining wide-band operation is by using multiple receiving elements. See Fig. 1E. This antenna makes use of more than one receiving element, each tuned



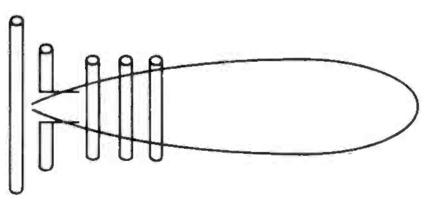
(A) Field of Vision With Unaided Eye.



(B) Field Pattern of Antenna Without Directors.



(C) Field of Vision With Telescope.



(D) Field Pattern of Antenna With Directors.

Fig. 2. Fields of Vision Compared to Field Patterns of Television Antennas.

to a different frequency range and connected or coupled in such a manner that signals can be received over a wide range of frequencies.

The human eye, by reason of its unchangeable design, responds only to a limited range of light frequencies from red to violet. On the other hand, the frequencies to which an antenna responds can be changed by lengthening or shortening the elements. As the element length is increased, the frequencies to which an antenna responds become lower; and as the element length is decreased, the frequencies to which it responds become higher. For this reason, we can choose an antenna which will respond to any frequencies we wish to receive.

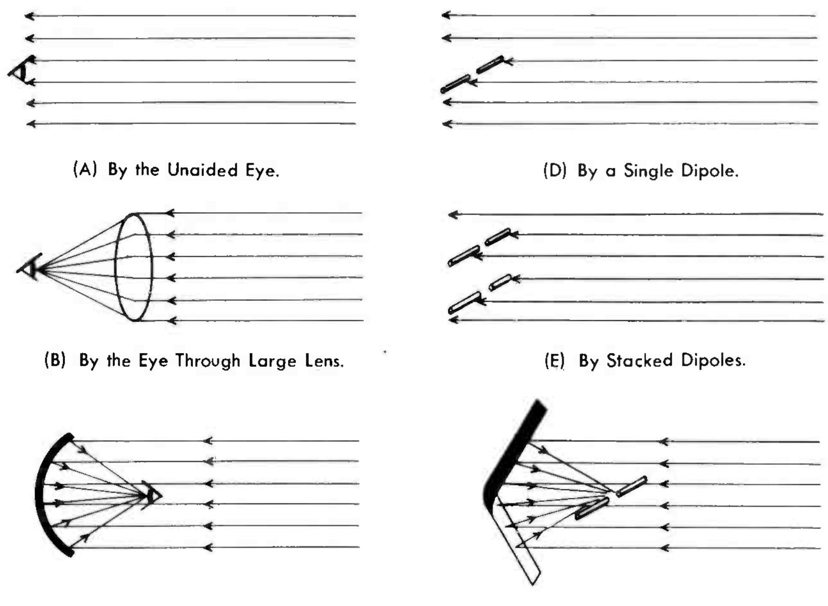
Improving Performance

Once the receiving element has been decided upon for a particular range of frequencies, we then have a similarity to the human eye. In the case of the human eye, improvements upon its operation depend upon the addition of a system of lenses and mirrors; whereas, improvements upon the abilities of the receiving element of the antenna are dependent upon the addition of directors and reflectors.

When directors and reflectors are used in a manner similar to the use of lenses and mirrors, they are sometimes referred to as parasitic elements. These elements are not electrically connected to the receiving element, and their action is dependent entirely upon mutually induced fields created by the incoming radio wave. Hence, the name "parasitic" elements is derived. The parasitic elements play a large part in shaping the field pattern of the television antenna.

The normal field of vision of the human eye is changed when lenses are placed in front of the eye, as shown in Figs. 2A and 2C. An example is the telescope which creates a narrow field of vision. Directors can be thought of as lenses which act upon the radio waves arriving from the forward direction to a greater degree than on signals arriving from other angles. The director is placed in front of and parallel to the receiving element. The receiving element then makes use of the director to look down a narrow field of receptivity in much the same manner that a telescope is used by the eye to look at a distant point. Figs. 2B and 2D show field patterns of antennas with and without directors.

Let us refer back to the example of strong surrounding light



(A) By the Unaided Eye.

(D) By a Single Dipole.

(B) By the Eye Through Large Lens.

(E) By Stacked Dipoles.

(C) By the Eye Using Curved Mirror.

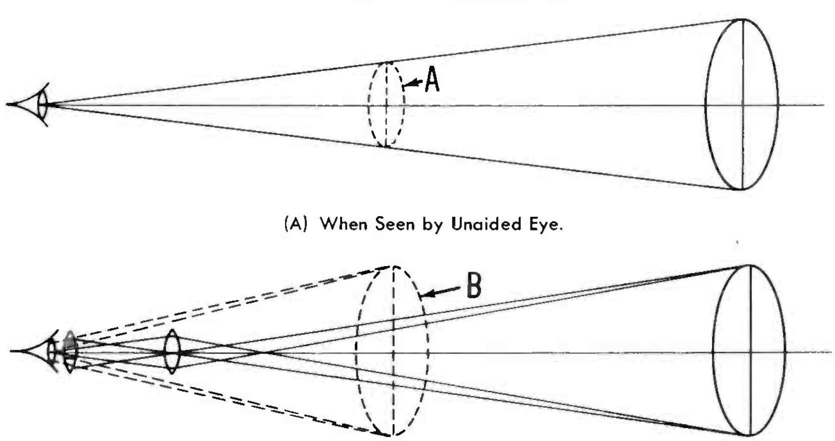
(F) By a Dipole and Reflector.

Fig. 3. Amounts of Energy That Are Intercepted.

blinding the eye. One method of looking at a neon sign in the daylight would be to cup the hands over the eyes to shield them from the bright light. The antenna cannot be shielded in the same manner from interference, but a large screen can be mounted in back of the receiving element. This screen will reduce the interference from the back side. In addition, a system of directors will narrow the field pattern and reduce the amount of interference picked up by the receiving element. The reflector and directors will allow clearer reception of the television signal. This is similar to using a telescope or long tube to narrow the field of vision and to reduce the strong interfering light so that a distant neon sign will appear clearer and brighter.

The problem of the limited receiving area of the human eye, as shown in Fig. 3A, has been solved by increasing the sizes of the lenses and mirrors that are used with the eye. In Fig. 3B, a large lens intercepts more of the arriving light waves for the eye to use. In Fig. 3C, a large curved mirror collects light and directs it upon the eye. The 200-inch mirror used at the observatory on Mt. Palomar to collect light from the stars is the best example of this method of increasing the amount of light available to the eye.

Fig. 3E shows an array of stacked antennas which present a large receiving area and intercept more of the incoming radio waves in comparison with the amount intercepted by the single antenna in Fig. 3D. The broadside and collinear arrays are examples of this method of increasing the receiving area presented to radio waves. A curved reflector is used in Fig. 3F. The radio waves striking the large area of the reflector are directed back upon the receiving element, and the strength of the received signal is increased.



(A) When Seen by Unaided Eye.

(B) When Seen Through a Telescope Having a Magnification of Two.

Fig. 4. Apparent Size of an Object.

Directors and reflectors may be combined with the receiving element to produce a variety of antenna arrays which can then be used singly or grouped together to form more complex arrays.

In any antenna array, there are three important characteristics to be considered. These are the directivity, the gain, and the terminal impedance. Similarly, in an optical system, three factors are of importance: the field of vision, the amount of amplification, and the ability to focus over the entire visible frequency spectrum.

Directivity

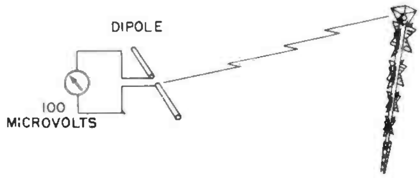
Let us consider the field of vision of a pair of binoculars. A pair with a very narrow field angle would be used to look at a single distant object. If these binoculars were used to watch a number of objects, the narrow angle would cut off some of the objects from view. A wide-angle pair of binoculars might allow you to see all of the objects.

An analogy to this would be a highly directive antenna being used in a location where signals are to be received from more than one direction. A highly directive antenna has the ability to receive a signal from one direction while rejecting signals from others. In this case, the signal arriving from a direction other than from the front would be rejected or at best would be received very poorly.

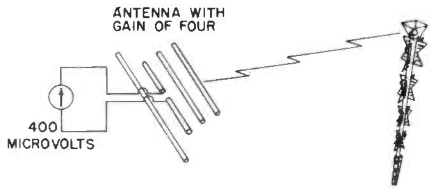
Gain

The second characteristic to be considered is gain. In a telescope, this is rated according to the amount of image amplification realized. Fig. 4 shows a comparison between the image A as seen by the eye and the enlarged image B as seen through a telescope. A magnification of two has the effect of bringing the object halfway toward you. The area of the object will then appear four times as big. The latter effect is analogous to antenna gain.

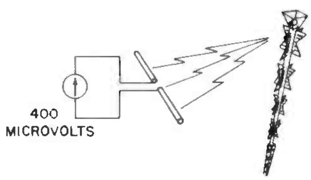
To describe the gain of an antenna, a reference point must be established. In most cases, the signal strength measured at the terminals of a dipole is used for this reference point. This dipole is called a reference dipole and is designed to be resonant at the frequency of the test signal. Assume that a signal strength of 100 microvolts is measured at the terminals of the dipole receiving element, as in Fig. 5A. The dipole is then replaced by an antenna array. The signal present at the terminals of the receiving element of the array is 400 microvolts. Refer to Fig. 5B. This is four times the signal received on the dipole, or the gain of the antenna array is four.



(A) Signal Received by Single Dipole.



(B) Signal Received by Antenna Array at Same Distance As in A Shows Gain of Four.



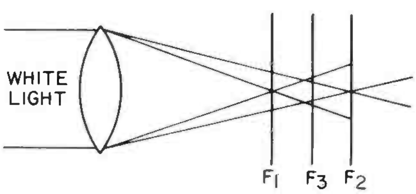
(C) Signal Received by Single Dipole With Source at Half the Distance of A.

Fig. 5. Drawings Which Illustrate Antenna Gain.

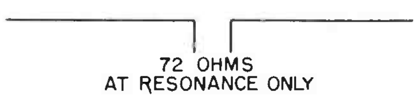
The signal of 100 microvolts is received on the dipole from the signal source. If the signal source were closer by one half the distance, a signal of 400 microvolts would be received. Refer to Fig. 5C. This is the same amount of signal received on the antenna array. The addition of parasitic elements to the receiving element has effectively brought the transmitter closer to the receiving element.

Impedance

The third important factor to consider is impedance. This is the most difificult of the antenna characteristics to explain. To form an analogy to antenna impedance, we will consider the ability of a lens to focus properly throughout the visible frequency spectrum.



(A) Focus Points Have Different Positions for Different Light Frequencies.



(B) Impedance Values Are Different for Different Radio Frequencies.

Fig. 6. Plain Lens Compared to Dipole With Small-Diameter Elements.

A plain glass lens bends the high-frequency or violet light to a greater degree than it bends the low-frequency or red light. A beam of white light is directed through this lens in Fig. 6A. The violet light or high frequencies will focus at point F_1; the red light or low frequencies will focus at point F_2. A compromise point at F_3 can be used for the focal plane, and both red and violet light will be slightly out of focus. At one frequency between the red and violet, the focus will be correct. The condition is known as chromatic aberration.

A similar situation exists in an antenna with a small-diameter receiving element. See Fig. 6B. At the resonant frequency, the impedance will be 72 ohms; and at frequencies off resonance, it will be more than 72 ohms. The maximum transfer of energy to a 72-ohm transmission line takes place when the terminal impedance of the dipole is 72 ohms; therefore, at frequencies other than the resonant frequency, the transfer of energy to the transmission line will be less.

Fig. 7A shows two lenses composed of two types of glass cemented together to form a single lens which causes all light frequencies in the visible spectrum to focus at point F_3. Similarly, the dipole can be made to retain an impedance match of 72 ohms over a given frequency band by increasing the diameter of the receiving elements, as in Fig. 7B.

In the design of a broad-band antenna, it is important that the impedance variation be as small as possible over the entire range of frequencies being received. A large variation in impedance at any frequency will result in a signal reduction at that frequency.

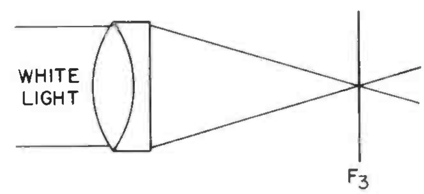
Let us review the three important characteristics of television antennas.

1. Directivity of an antenna is its ability to receive a signal from one direction and to reject simultaneously signals arriving from other directions.

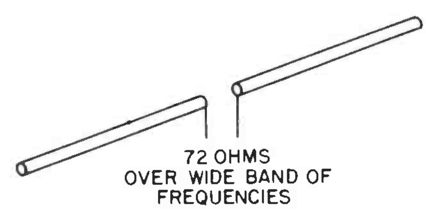
2. The gain of an antenna is the ratio between the signal voltage

available at the terminals of the test antenna and the signal voltage which would be developed at the terminals of a reference dipole.

3. The terminal impedance of an antenna is the reactance in ohms at the antenna terminals. When the antenna is connected to a resistor having a resistance equal to the terminal impedance, maximum energy will be transferred from the antenna to the resistor. This maximum transfer of energy will also occur if the antenna is connected to a transmission line having a characteristic impedance equal to the terminal impedance of the antenna.



(A) Focus Point Is Fixed for All Visible Light Frequencies.



(B) Impedance Value Is Constant for Wide Band of Radio Frequencies.

Fig. 7. Composite Lens Compared to a Dipole With Large-Diameter Elements.

In presenting the analogy between antennas and the human eye, we have attempted to create a different viewpoint from which to look at the television antenna and its characteristics.

The television antenna plays an important part in television reception. Its application and installation should be given the consideration that a person gives his own eyes when he purchases a pair of eyeglasses.

All types of television antennas will receive a television signal. Many types will give good results, but one antenna which is chosen for a particular area and properly installed will give the best results.

GEORGE B. MANN

PF REPORTER

CATALOG and LITERATURE SERVICE

valuable manufacturers' data available to our readers

1J. B & K (B & K Manufacturing Co.)
Bulletin No. 500 describing DYNA-QUIK, Model 500, a new dynamic mutual conductance tube tester that completely tests, with laboratory accuracy, 99% of all tubes; and Bulletin 104 describing two new B & K Cathode Rejuvenator Testers—the CRT 400 and the CRT 200. *See advertisements pages* 68, 69.

2J. CBS (CBS-Hytron, a Division of CBS, Inc.)
Flyer describing CBS tube promotion kit tying in with advertising on Arthur Godfrey's Talent Scouts and in Good Housekeeping Magazine. *See advertisement page* 16.

3J. CENTRALAB (Centralab, a Division of Globe-Union, Inc.)
Information on how to obtain the Centralab "Pick-Ur-Pak" 4-drawer metal cabinet for storing capacitors and other small parts. *See advertisement page* 62.

4J. CLAROSTAT (Clarostat Manufacturing Co., Inc.)
Precision Potentiometer, Series 42-900, Form No. 753793010. *See advertisement page* 4.

5J. CORNELL-DUBILIER (Cornell-Dubilier Electric Corp.)
Vibrator Replacement Guide (VC). *See advertisement page* 71.

6J. EICO (Electronic Instrument Co., Inc.)
Free EICO Catalog HS-9 describes complete line of 46 Kits and Wired Instruments, including oscilloscope, VTVM's, signal generators, tube testers, flyback testers, etc. *See advertisement page* 78.

7J. ELECTRONIC TEST (Electronic Test Instrument Corp.)
Brochure on Vitameter. *See advertisement page* 82.

8J. FINNEY (The Finney Co.)
Combined catalog and technical data sheet; engineering data folder; both on new GEOMATIC series antenna. *See advertisement page* 34.

9J. GENERAL CEMENT (General Cement Mfg. Co.)
G-C No. S-57 New Products Supplement and Printed Circuit Service Manual. *See advertisement page* 24.

10J. GERNSBACK (Gernsback Publications, Inc.)
Descriptive literature on the Gernsback Library Books. *See advertisement page* 78.

11J. HICKOK (The Hickok Electrical Instrument Co.)
New 8-page Radio-TV Test Equipment catalog. *See advertisement page* 65.

12J. HYCON (Hycon Mfg. Co.)
Catalog sheets on 616 Color Bar Generator, Model 622 5" Oscilloscope, 614 VTVM, and Model 617 3" Oscilloscope. *See advertisement page* 56.

13J. IRC (International Resistance Company)
Form S-031, Auto Radio Control Replacements. *See advertisement* 2nd cover.

14J. JENSEN (Jensen Industries, Inc.)
Jenselector (guide to correct needle) Wall Chart, (list of needles and cartridges); Catalog; Jenseneedler, (guide to salespeople new in the needle field). *See advertisement page* 80.

15J. OHMITE (Ohmite Mfg. Co.)
Bulletin No. 147 describes the line of Ohmite Axial Lead Vitreous Enameled All-Welded Construction Resistors. Includes tables of resistance values carried in stock with list prices. *See advertisement page* 66.

16J. PHAOSTRON (Phaostron Company)
"777" VTVM. *See advertisement page* 48.

17J. RADIART (The Radiart Corp.)
F-925 Vipower Catalog. *See advertisement insert.*

18J. SOUTH RIVER (South River Metal Products Co.)
Complete catalog of Antenna Mounting Accessories. *See advertisement page* 81.

19J. SYLVANIA (Sylvania Electric Products, Inc.)
Test Equipment Free Trial and Time Payment Plan. *See advertisement pages* 26, 27, and 42.

20J. TACO (Technical Appliance Corp.)
Catalog 5010 on "Heavy-Duty" fully welded broad-band Yagi Antennas for communications. *See advertisement page* 53.

21J. TRANSVISION (Transvision, Inc.)
Electronic Components Catalog (instruments, parts, kits, master antennas); "Hi-Fi" Catalog (speakers, cabinets, etc.). *See advertisement page* 82.

22J. TRIAD (Triad Transformer Corp.)
New Triad TV Replacement Guide, TV-155, listing Triad correct replacement transformers for television use showing recommended Triad items for more than 100 television manufacturers and over 5800 models. *See advertisement page* 81.

23J. TURNER (The Turner Co.)
Bulletin No. 969 describing the Turner Chief crystal, ceramic or magnetic microphone. *See advertisement page* 83.

24J. XCELITE (Xcelite, Inc.)
Folder describing new, larger chrome plated hand reamers; also catalog on complete line of screwdrivers, nut drivers, pliers, kits. *See advertisement page* 76.

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COLOR TV TRAINING SERIES

QUESTIONS ON PART XVI

Part XVI of the Color TV Training Series appears in this issue and should be studied prior to reading the following questions.

These questions are presented to give the reader an opportunity to test himself on the color-television material discussed in this part.

1. What is the appearance of the screen when color synchronization is lost?
2. What is the best stage in which to begin the trouble-shooting procedure for the loss of color synchronization?
3. If the receiver employs a color killer, which tube is the only one that can cause loss of color synchronization?
4. What would be the result if the DC correction voltage applied tc the oscillator-control stage were lost or had an incorrect value?
5. What indication on the screen points to improper color purity?
6. What circuits and components should be checked when improper color purity is present?
7. What indications in a monochrome picture point to misconvergence of the beams?
8. If the beams converge properly in the horizontal direction but not in the vertical direction, what is the procedure to follow for finding the cause of the trouble?

C.P.O. & V.M.R,

Howard W. Sams
PF REPORTER

INDEX TO ADVERTISERS
September, 1955

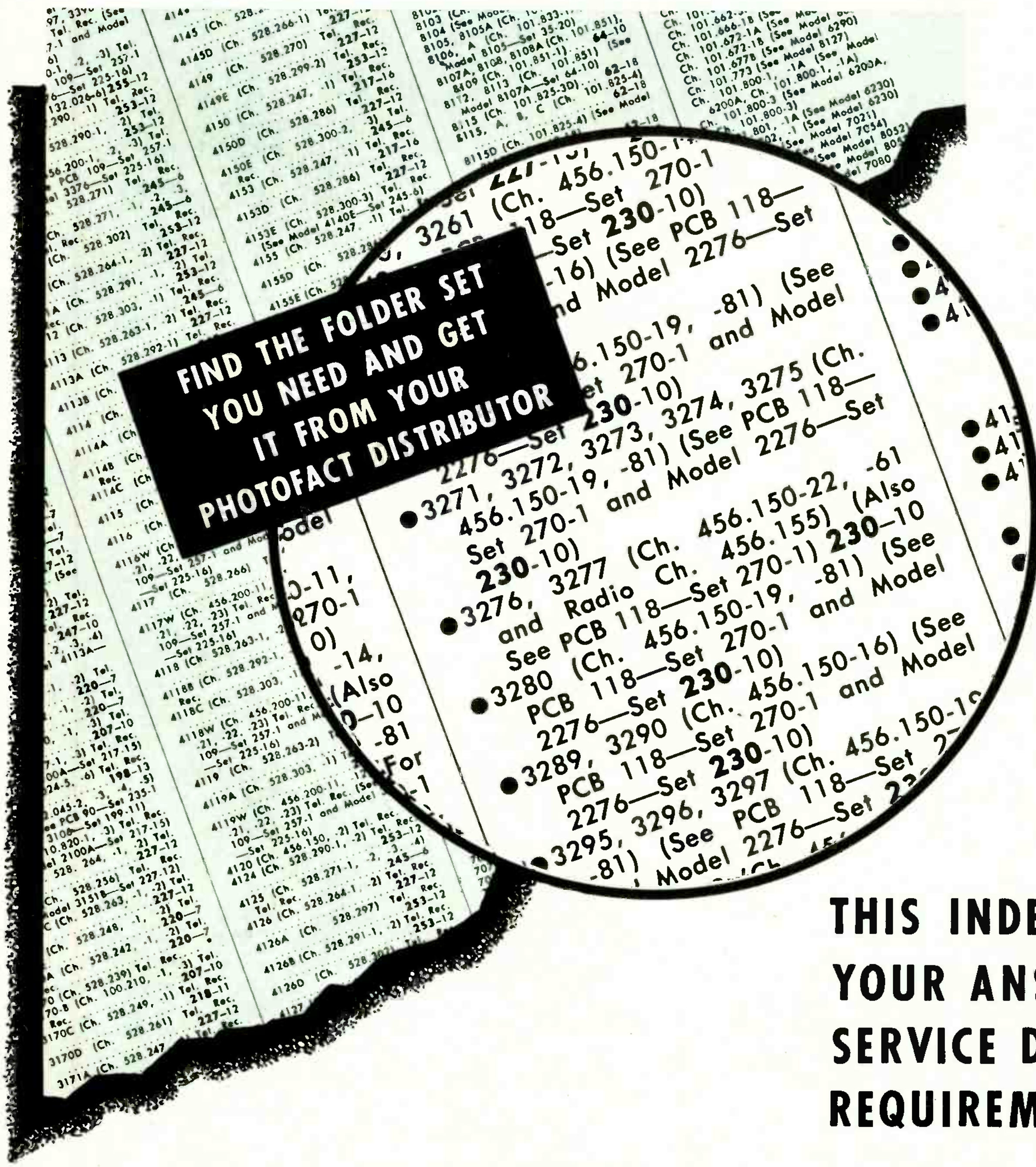
While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of the REPORTER.

Cumulative Index

No. 52

SEPT.-OCT. 1955

COVERING **PHOTOFACT FOLDER** SETS 1 THRU 289



THIS INDEX IS YOUR ANSWER TO SERVICE DATA REQUIREMENTS

THIS INDEX CURRENT ONLY UNTIL NOV. 15th, 1955

Cumulative Index to PHOTOFACT FOLDERS

No. 52 · Covering Folder Sets Nos. 1 through 289 · World's Finest Electronic Service Data

HOW TO USE THIS INDEX

To find the PHOTOFACT Folder you need, first look for the name of the receiver (listed alphabetically below), and then find the required model number. Opposite the model, you will find the number of the PHOTOFACT Set in which the required Folder appears, and the number of that Folder. The PHOTOFACT Set number is shown in bold-face type; the Folder number is in the regular light-face type.

IMPORTANT—1. The letter "A" following a set number in the Index listing, indicates a "Preliminary Data Folder." These folders were designed to provide immediate basic data on TV receivers. Many of these were later superseded by regular Photofact Folders. In those cases where short production runs and/or limited distribution prevented availability of a sample chassis the "A" designation has been retained.

2. Models marked by an asterisk (*) have not yet been covered in a standard Folder. However, regular PHOTOFACT Subscribers may obtain Schematic, Alignment Data or other required information on these models without charge by supplying make, model or chassis number and serial number. (When requesting such data, mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.)

3. Production Change Bulletins contain data supplementary to certain models covered in previously issued PHOTOFACT Folders, and are listed in this Index immediately preceding the listing of the original coverage of the model or chassis. These Bulletins should be filed with the Folders covering the models to which the changes apply.

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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●7H214B (Ch. CT-121) (Ch. Series CX-37) (See PCB 113—Set 264-1 and Ch. CT-77—Set 203-4)
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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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●11F244M (Ch. CT-95) (Ch. Series CX-37) (See PCB 113—Set 264-1 and Ch. CT-75—Set **203**-4)
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●320BX, MX (Ch. CT-27) (Ch. Series CX-33DX) (See Ch. CT-27—Set **160**-2)
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●328 (Ch. C-299) (Ch. Series CX-33) (For TV Ch. only see PCB 13—Set 122-1, PCB 24—Set 142-1 and Model 323M—Set **112**-3)
●328CX, X (Ch. CT-37) (Ch. Series CX-33DX) (See Ch. CT-27—Set **160**-2)
●331B, M (Ch. C-303) (Ch. Series X-33) (See PCB 13—Set 122-1, PCB 24—Set 142-1 and Model 323M—Set **112**-2)
●331BX, MX (Ch. CT-38) (Ch. Series CX-33DX) (See Ch. CT-38—Set **160**-2)
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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250 ● Denotes Television Receiver.

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●A-T2292, L (Code 128) (Ch. 94, A, J-5 and Radio Ch. RT-10) (For TV Ch. Only See PCB 85—Set 226-1 and Model 53-T2285—Set **213**-5)
●A-T2294 (Code 128) (Ch. 94, J-5 and Radio Ch. RT-11) (For TV Ch. Only See PCB 85—Set **226**-1 and Model 53-T2285—Set **213**-5)
●A-UT1816, L, A-UT1817 (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. See PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, For UHF Tuner See Model UT21B—Set **223**-9)
●A-UT1818 (Code 128) (Ch. 91A, J-2) (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T-1853—Set **185**-10)
●A-UT1856, HM, L, W (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, for UHF Tuner see Model UT21B—Set **223**-9)
●A-UT1858 (Code 128) (Ch. 91A, J-2) (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set **185**-10)
●A-UT2230, A-UT2232 (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. See PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, For UHF Tuner See Model UT21B—Set **223**-9)
●A-UT2233, A-UT2234, A-UT2266 (Code 128) (Ch. 91A, J-2) (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set **185**-10)
●A-UT2272 (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, for UHF Tuner see Model UT21B—Set **223**-9)
●A-UT2272 (Code 129) (Ch. 81A, D-81) (Also See PCB 115—Set 267-1) ... **227**–10
●A-UT2274, W (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, for UHF Tuner see Model UT21B—Set **223**-9)
●A-UT2277, A-UT2279 (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. See PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, For UHF Tuner See Model UT21B—Set **223**-9)
●A-UT2280, A-UT2281 (Code 128) (Ch. 91A, J-2) (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set **185**-10)
●A-UT2288 (Code 123) (Ch. 81, H-1, H-1A) (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set **201**-7, for UHF Tuner see Model UT21B—Set **223**-9)
●A-UT2289 (Code 128) (Ch. 91A, J-2) (See PCB 66—Set 203-1, PCB 82—Set 223-1, and Model 53-T1853—Set **185**-10)
●A-UT2292L (Code 128) (Ch. 94A, J-5 and Radio Ch. RT-10) (For TV Ch. Only See PCB 85—Set 226-1 and Model 53-T2285—Set **213**-5)
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C-4908 (See Mopar Model 805—Set **71**-11)
C-5009 (See Mopar Model 809—Set **71**-11)
C-5010 (See Mopar Model 805—Set **71**-11)
C-5109 (See Mopar Model 815—Set **139**-8)
C-5110 (See Mopar Model 816—Set **139**-8)
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S-5123 (See Studebaker Model AC2113—Set **172**-11)
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UT25 Tel. UHF Tuner (See PCB 115—Set **267**-1)
●18B 3000 (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) ... **227**–10
●18B 3001 (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) ... **227**–10
●18B3002 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) ... **231**–12
●18B 3100, HM, L (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) ... **227**–10
●18B3100W (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 18B3100—Set **227**-10)
●18B3102, L (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) ... **231**–12

NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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●18B3103 (Code 140) Ch. R-191, D-191) (See PCB 111—Set 260-1 and Model 18B3002—Set **231**-12)
●18B3104 (Code 150) (Ch. R-201, D-201) **241**-11
●18BU3000 (Code 130) (Ch. R-181U, D-181) (Also see PCB 115—Set 267-1) **227**-10
●18BU3001 (Code 130) (Ch. R-181U, D-181) (Also See PCB 115—Set 267-1) **227**-10
●18BU3002 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
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●18BU3100W (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 18BU3100—Set **227**-10)
●18BU3102, L (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●18BU3102, L (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 18B3002—Set **231**-12)
●18BU3103 (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 18B3002—Set **231**-12)
●18BU3104 (Code 150) (Ch. R-201, D-201) **241**-11
●22B4000 (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22B4000X, XD (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22B4001, E, L (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22B4002 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4002G (Code 140) (Ch. R-191, D-191) (See PCB 111—Set 260-1 and Model 22B4002—Set **231**-12)
●22B4002L (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4003 (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22B4004 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
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●22B4007, L (Code 140) (Ch. R-191, D-191) (See Model 18B3002—Set **231**-12)
●22B4008, 22B4009 (Code 150) (Ch. R-201, D-201) **241**-11
●22B4100 (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22B4100A (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4100—Set **227**-10)
●22B4100L (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22B4100X (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4100—Set **227**-10)
●22B4101 (Code 129) (Ch. R-81B, D-81) (Also See PCB 115—Set 267-1) **227**-10
●22B4101 (Code 130) (Ch. R-181, D-181) **227**-10
●22B4102, L (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4103, L (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4100—Set **227**-10)
●22B4105, L (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4100—Set **227**-10)
●22B4106 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4107, L (Code 140) (Ch. R-191, D-191) (See Model 18B3002—Set **231**-12)
●22B4108 (Code 150) (Ch. R-201, D-201) **241**-11
●22B4109HM (Code 141) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4110, L (Code 150) (Ch. R-201, D-201) **241**-11
●22B4112, L (Code 140) (Ch. R-191, D-191) (See Model 18B3002—Set **231**-12)
●22B4150 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4150L (Code 140) (Ch. R-191, D-191) (See PCB 111—Set 260-1 and Model 22B4150—Set **231**-12)
●22B4301 (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22B4302 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4303 (Code 130) (Ch. R-181, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22B4304 (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4306, L (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4307HM (Code 140) (Ch. R-191, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22B4308 (Code 150) (Ch. R-201, D-201) **241**-11

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●22BU4000 (Code 130) (Ch. R-181U, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22BU4000X, XD (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22BU4001, E, L (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22BU4002, L (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4002, L (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4002—Set **231**-12)
●22BU4003 (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22BU4004 (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4004 (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4004—Set **231**-12)
●22BU4008, 22BU4009 (Code 150) (Ch. R-201, D-201) **241**-11
●22BU4100 (Code 130) (Ch. R-181U, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22BU4100A (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
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●22BU4100X (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22BU4101 (Code 129) (Ch. R-81B, D-81) (Also See PCB 115—Set 267-1) **227**-10
●22BU4101 (Code 130) (Ch. R-181U, D-181) **227**-10
●22BU4102, L (Code 140) (Ch. R-191U, D-191) (Also see PCB 111 Set 260-1) **231**-12
●22BU4102, L (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4102—Set **231**-12)
●22BU4103, L (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22BU4105, L (Code 130) (Ch. R-181U, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22BU4106 (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4106 (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4106—Set **231**-12)
●22BU4108 (Code 150) (Ch. R-201, D-201) **241**-11
●22BU4109HM (Code 140) (Ch. R-191U, D-191) (Also see PCB 111 —Set 260-1) **231**-12
●22BU4109HM (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4109HM—Set **231**-12)
●22BU4110, L (Code 150) (Ch. R-201, D-201) **241**-11
●22BU4150, L (Code 140) (Ch. R-191U, D-191) (See PCB 111—Set 260-1 and Model 18BU3002—Set **231**-12)
●22BU4150, L (Code 141) Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 18BU3002—Set **231**-12)
●22BU4302 (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4302 (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4302—Set **231**-12)
●22BU4303 (Code 130) (Ch. R-181U, D-181) (Also See PCB 115—Set 267-1) **227**-10
●22BU4304 (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4304 (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4304—Set **231**-12)
●22BU4306, L (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4306, L (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4306—Set **231**-12)
●22BU4307HM (Code 140) (Ch. R-191U, D-191) (Also see PCB 111—Set 260-1) **231**-12
●22BU4307HM (Code 141) (Ch. R-192U, D-191) (See PCB 111—Set 260-1 and Model 22BU4307HM —Set **231**-12)
●22BU4308 (Code 150) (Ch. R-201, D-201) **241**-11
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●22C4010, L (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22C4010, L (Code 131) (Ch. R-181, D-182) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
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●22C4012 (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22C4012 (Code 131) (Ch. R-181, D-182) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)

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●22C4013, L, X (Ch. 300, 301) .... **276**—7
●22C4014 (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22C4014 (Code 131) (Ch. R-181, D-182) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
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●22C4020 (Ch. TV400) .... **280**—8
●22C4113 (Ch. TV-301) (See Model 22C4011—Set **276**-7)
●22C4118, 22C4119, X, 22C4120, L, X, 22C4121, L (Ch. 300, 301) .... **276**—7
●22C4122 (Code 130) (Ch. R-181, D-181) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
●22C4122 (Code 131) (Ch. R-181, D-182) (See PCB 115—Set 267-1 and Model 22B4000—Set **227**-10)
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●22C4132L (Ch. TV400) ... **280**—8
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NOTE: PCB Denotes **P**roduction **C**hange **B**ulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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●52-T2244 (Code 121) (Ch 41, D1, D1A) (Also see PCB 56—Set 190-1) ....171—9
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●52-T2258 (Code 121) (Ch. 41, D1, D1A) (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
●52-T2259 (Code 121) (Ch. 41, D1, D1A) (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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NOTE: PCB Denotes **Production Change Bulletin.** Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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SHERIDAN ELECTRONICS (See Vogue)

NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

SIGNAL

SILVERLINE (See General Instrument)

SILVERTONE (Also see Changer and Recorder Listing)

NOTE: PCB Denotes **P**roduction **C**hange **B**ulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200 Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250 ● Denotes Television Receiver.

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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NOTE: PCB Denotes **P**roduction **C**hange **B**ulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200 ● Denotes Television Receiver.
Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250

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H-451T5, H-452T5, H-453T5, H-454T5 (Ch. V-2184-1) (See Model H-378T5—Set **211**-17)
H-457T6, H-458T6, H-459T6, H-460T6 (Ch. V-2229-1) **269**-16
H-461P4, H-462P4, H-463P4, H-464P4 (Ch. V-2182-2) **257**-19
H-465R6, H-466R6 (Ch. V-2229-2) **269**-16
H-467R6, H-468R6 (Ch. V-2229-3) **269**-16
H-469R12, H-470R12 (Ch. V-2180-13 and V-2235-1) **271**-17
H-471T5, H-472T5, H-473T5, H-474T5 (Ch. V-2184-5)...**279**-15
H-475T5, H-476T5, H-477T5, H-478T5 (Ch. V-2236-1) **266**-20
H-479P4 (Ch. V-2182-2)...**257**-19
H-480C12 (Ch. V-2180-13 and V-2235-1) **271**-17
H-482PR5 (Ch. V-2229-5). **286**-12
H-486T5, H-487T5, H-488T5, H-489T5 (Ch. V-2236-2)...**282**-16
H-499T5, H-500T5, H-501T5, H-502T5, H-503T5 (Ch. V-2184-6) **283**-15
●H-600T16 (Ch. V-2150-61, A, B) **98**-14
●H-601K12, H-602K12 (Ch. V-2150-41) **98**-14
●H-603C12 (Ch. V-2152-01 and V-2149-3) **100**-14
●H-604T10, A (Ch. V-2150-91A, -94, -94A) (See Set 99A-14 and Model H-609T10—Set **95**-7)
●H-605T12 (Ch. V-2150-101) **97**-19
●H-606K12 (Ch. V-2150-111, A) **120**-12
●H-607K12 (Ch. V-2150-111, A) **120**-12
●H-608C12 (Ch. V-2152-01, V-2149-3) (See Model H-603C-12—Set **100**-14)
●H-609T10 (Ch. V-2150-94C) **95**—7
●H-610T12 (Ch. V-2150-136) **105**-13
●H-611C12 (Ch. V-2152-16) **112**-14
●H-613K16 (Ch. V-2150-146) **107**-12
●H-614T12 (Ch. V-2150-136) **105**-13
●H-615C12 (Ch. V-2152-16) **112**-14
●H-617T12 (Ch. V-2150-176, U, -177U) (Also see PCB 10—Set 116-1) **103**-17
●H-618T16 (Ch. V-2150-186, A, C, CA) (Also see PCB 10—Set 116-1) **103**-17
●H-619T12, U (Ch. V-2150-176, U, -177U) (Also see PCB 10—Set 116-1) **103**-17
●H-620K16 (Ch. V-2150-186, A, C, CA) (Also see PCB 10—Set 116-1) **103**-17
●H-622K16 (Ch. V-2150-186, A, C, CA) (See PCB 10—Set 116-1 and Model H-617T12—Set **103**-17)
●H-625T12 (Ch. V-2150-197) **114**-11
●H-626T16 (Ch. V-2172) ...**116**-13
●H-627K16 (Ch. V-2171) ...**116**-13
●H-628K16, H-629K16 (Ch. V-2171) **116**-13
●H-630T14 (Ch. V-2176) ...**116**-13
●H-633C17, H-634C17 (Ch. V-2173) **122**-11
●H-636T17 (Ch. V-2175) ...**116**-13
●H-637T14 (Ch. V-2177) ...**116**-13
●H-638K20 (Ch. V-2178) ...**129**-13
●H-639T17 (Ch. V-2192, -1) **133**-15
●H-640T17 (Ch. V-2175-3, -4), H-640T17A (Ch. V-2192, -1, -2, -3, -4, -5, -6) (Also see PCB 28—Set 150-1) **133**-15
●H-641K17 (Ch. V-2175-1, -5), H-641K17A (Ch. V-2192, -1, -2, -3, -4, -5, -6) (Also see PCB 28—Set 150-1) **133**-15
●H-642K20 (Ch. V-2178-1, -3) **129**-13
●H-642K20A (Ch. V-2194, V-2194A, V-2194-1) **137**-16
●H-643K16 (Ch. V-2179, V-2179-1) **127**-13
●H-646K17 (Ch. V-2192) ...**133**-15
●H-647K17 (Ch. V-2175-3)..**133**-15
●H-648T20 (Ch. V-2201-1) (Also see PCB 42—Set 176-1) **154**-15

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●H-649T17 (Ch. V-2200-1) (Also see PCB 42—Set 176-1) **154**-15
●H-649T17 (Ch. V-2192-4) (See Model H-639T17—Set **133**-15)
●H-650K21 (Ch. V-2192-4) (See Model H-639T17—Set **133**-15)
●H-650T17 (Ch. V-2200-1) (Also see PCB 42—Set 176-1) **154**-15
●H-651K17 (Ch. V-2192) (See Model H-639T17—Set **133**-15)
●H-651K17 (Ch. V-2200-1) (Also see PCB 42—Set 176-1) **154**-15
●H-652K20 (Ch. V-2194-2, -3) (See PCB 31—Set 157-3 and Model H-642K20A—Set **137**-16)
●H-652K20 (Ch. V-2201-1) (Also see PCB 42—Set 176-1) **154**-15
●H-653K24 (Ch. V-2202-2, V-2210-1) (Also see PCB 35—Set 164-1) **160**-13
●H-654T17 (Ch. V-2175-3, -4, V-2192, -1) **133**-15
●H-655K17, H-656K17, H-657K17 (Ch. V-2200-1) (Also see PCB 42—Set 176-1) **154**-15
●H-657K17 (Ch. V-2192-4, -5, -6) (See PCB 28—Set 150-1 and Model H-639T17—Set **133**-15)
●H-658T17 (Ch. V-2192, -1) (See PCB 28—Set 150-1 and Model H-639T17—Set **133**-15)
●H-659T17 (Ch. V-2204-1) (Also see PCB 42—Set 176-1) **154**-15
●H-660C17, H-661C17 (Ch. V-2203-1 and Radio Ch. V-2180-3) (Also see PCB 46—Set 180-1)..**157**-12
●H-662K20 (Ch. V-2201-1) (Also see PCB 42—Set 176-1) **154**-15
●H-663T17 (Ch. V-2192-2) (See PCB 28—Set 150-1 and Model H-639T17—Set **133**-15)
●H-663T17 (Ch. V-2204) (Also see PCB 42—Set 177-1) **154**-15
●H-664K17 (Ch. V-2200-1) (Also see PCB 42—Set 176-1) **154**-15
●H-665T16 (Ch. V-2206-1) (See PCB 42—Set 176-1 and Model H-648T20—Set **154**-15)
●H-667T17, H-668T17 (Ch. V-2216) (Also see PCB 40—Set 172-1) **167**-15
●H-673K21 (Ch. V-2217-1) (See Model H-667T17—Set **167**-15)
●H-676T21 (Ch. V-2217-1) (See Model H-667T17—Set **167**-15)
●H-678K17, H-679K17 (Ch. V-2216-1, -2, -3) (Also see PCB 40—Set 172-1, PCB 45—Set 179-1 and PCB 52—Set 186-1) **167**-15
●H-681T17 (Ch. V-2215-1) (See PCB 45—Set 179-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-688K24 (Ch. V-2219-1) (Also see PCB 52—Set 186-1)....**174**-14
●H-689T16 (Ch. V-2214-1) (See PCB 40—Set 172-1, PCB 58—Set 192-1 and Model H-667T17—Set **167**-15)
●H-690K21, H-691K21 (Ch. V-2217-1) (See Model H-667T17—Set **167**-15)
●H-692T21 (Ch. V-2217-2, -3) (See PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-695K21 (Ch. V-2217-2, -3) (See PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-699K17 (Ch. V-2216-2, -3) (See PCB 40—Set 172-1, PCB 45—Set 179-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-700T17, H701T17 (Ch. V-2216-2, -3) (See PCB 40—Set 172-1, PCB 45—Set 179-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-701K21 (Ch. V-2217-2) (See PCB 43—Set 177-1 and Model H-667T17—Set **167**-15)
●H-702K17, H-703K17 (Ch. V-2216-2, -3) (See PCB 40—Set 172-1, PCB 45—Set 179-1, PCB 52—Set 186-1 and Model H-767T17—Set **167**-15)
●H-704T17 (Ch. V-2216-2) (See PCB 40—Set 172-1, PCB 45—Set 179-1, PCB 51—Set 185-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-704T17 (Ch. V-2216-4, -5) **202**-10
●H-705K17 (Ch. V-2216-2, -3) (See PCB 40—Set 172-1, PCB 45—Set 179-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-706T16 (Ch. V-2207-1). **193**-12
●H-708T20 (Ch. V-2220-1, -3, -11) **193**-12
●H-710T21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-710T21 (Ch. V-2217-4, -5) **202**-10
●H-711T21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-711T21 (Ch. V-2217-4, -5) **202**-10
●H-713K21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-714K21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-714K21 (Ch. V-2217-4, -5) **202**-10
●H-715K21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)

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●H-715K21 (Ch. V-2217-4, -5) **202**-10
●H-718K20 (Ch. V-2220-2) .**193**-12
●H-720K21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-720K21 (Ch. V-2217-4, -5) **202**-10
●H-721K21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-721K21 (Ch. V-2217-4, -5) **202**-10
●H-722K21 (Ch. V-2217-2, -3) (See PCB 40—Set 172-1, PCB 43—Set 177-1, PCB 52—Set 186-1 and Model H-667T17—Set **167**-15)
●H-722K21 (Ch. V-2217-4, -5) **202**-10
●H-723K21 (Ch. V-2217-5) .**202**-10
●H-724T20, H-725T20 (Ch. V2220-2) **193**-12
●H-730C21 (Ch. V-2218-1 and Radio Ch. V-2180-9, -10) **190**-16
●H-730C21 (Ch. V-2218-2 and Radio Ch. V-2180-9, -10) (Also see PCB 59—Set 193-1 and PCB 68—Set 205-1) **190**-16
●H-730C21 (Ch. V-2218-11 and Radio Ch. V-2180-9, -10) (Also see PCB 59—Set 193-1) **190**-16
●H-732C21 (Ch. V-2218-1 and Radio Ch. V-2180-9, -10) **190**-16
●H-732C21 (Ch. V-2218-11 and Radio Ch. V-2180-9, -10) (Also see PCB 59—Set 193-1) **190**-16
●H-733C21 (Ch. V-2218-1 and Radio Ch. V-2180-9, -10) **190**-16
●H-733C21 (Ch. V-2218-11 and Radio Ch. V-2180-9, -10) (Also see PCB 59—Set 193-1) **190**-16
●H-736T17 (Ch. V-2227-1) (Also see PCB 89—Set 233-1) **214**-10
●H-737T17 (Ch. V-2216-5) .**202**-10
●H-737T17 (Ch. V-2232-2) .**212**—9
●H-738T17 (Ch. V-2227-1) (Also see PCB 89—Set 233-1) **214**-10
●H-739T17, H-739TU17 (Ch. V-2227-2) **214**-10
●H-740T21, H-742K21, H-743K21 (Ch. V-2233-1) (Also See PCB 99—Set 244-1) ...... **212**—9
●H-746K21, H-746KU21, H-747K21, H-747KU21 (Ch. V-2233-4) **215**-16
●H-750T21 (Ch. V-2233-3) .**212**—9
●H-751T21 (Ch. V-2217-4, -5) **202**-10
●H-751T21 (Ch. V-2233-2) .**212**—9
●H-752T21 (Ch. V-2233-2) .**212**—9
●H-753K21 (Ch. V-2233-3) .**212**—9
●H-754K21 (Ch. V-2217-4, -5) **202**-10
●H-754K21 (Ch. V-2233-2) .**212**—9
●H-755K21 (Ch. V-2233-2) .**212**—9
●H-756K21 (Ch. V-2217-4, -5) **202**-10
●H-756K21 (Ch. V-2233-2) .**212**—9
●H-757K21 (Ch. V-2217-4, -5) **202**-10
●H-757K21 (Ch. V-2233-2) .**212**—9
●H-758K21 (Ch. V-2217-4, -5) **202**-10
●H-758K21 (Ch. V-2233-2) .**212**—9
●H-759K21 (Ch. V-2217-4, -5) **202**-10
●H-759K21 (Ch. V-2233-2) .**212**—9
●H-760T21 (Ch. V-2233-2) .**212**—9
●H-760TU21 (Ch. V-2233-2) **212**—9
●H-761T21 (Ch. V-2233-2) .**212**—9
●H-761TU21 (Ch. V-2233-2) **212**—9
●H-769T21 (Ch. V-2263-12, -14) **253**-17
●H-769TU21 (Ch. V-2273-122) **253**-17
●H-770T21A (Ch. V-2263-12) **253**-17
●H-770TU21A (Ch. V-2273-122) **253**-17
●H-771T21A (Ch. V-2263-12) **253**-17
●H-771TU21A (Ch. V-2273-122) **253**-17
●H-786K21 (Ch. V-2263-12) **253**-17
●H-786KU21 (Ch. V-2273-122) **253**-17
●H-787K21 (Ch. V-2263-12) **253**-17
●H-787KU21 (Ch. V-2273-122) **253**-17
●H-795T27, H-795TU27 (Ch. V-2250-1) (Also see PCB 105—Set 252-1) **241**-12
●H-798T17 (Ch. V-2260-12, -14) **255**-17
●H-798TU17 (Ch. V-2270-122, -124) **255**-17
●H-799T17 (Ch. V-2260-12, -14) **255**-17
●H-799T17, B (Ch. V-2310). **281**-10
●H-799TU17 (Ch. V-2270-122, -124) **255**-17
●H-799TU17, B (Ch. V-2320) **281**-10
H-802 (Ch. V-11900-1, -2, -3, -4, -5, V-11213) Tel. UHF Conv. **209**-13
●H-815T24, H-815TU24 (Ch. V-2250-1, -4) (Also see PCB 105—Set 252-1) **241**-12
●H-817K24, H-817KU24 (Ch. V-2250-1, -4) (Also see PCB 105—Set 252-1) **241**-12
●H-822K21 (Ch. V-2263-12) **253**-17
●H-822KU21 (Ch. V-2273-122) **253**-17
●H-823K21 (Ch. V-2263-12) **253**-17
●H-823KU21 (Ch. V-2273-122) **253**-17
●H-827T21 (Ch. V-2263-12, -13, -14, -15) **253**-17
●H-827TU21 (Ch. V-2273-122, -134) **253**-17
●H-828T21 (Ch. V-2263-12, -13, -14, -15) **253**-17
●H-828TU21 (Ch. V-2273-122, -134) **253**-17
●H-829T21 (Ch. V-2263-12, -13, -14, -15) **253**-17

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●H-829TU21 (Ch. V-2273-122, -134) **253**-17
●H-830K21 (Ch. V-2263-11, -12, -13, -14) **253**-17
●H-830KU21 (Ch. V-2273-111, -122, -124, -132, -134) **253**-17
●H-831K21 (Ch. V-2263-11, -12, -13, -14) **253**-17
●H-831KU21 (Ch. V-2273-111, -122, -124, -132, -134) **253**-17
●H-834K21 (Ch. V-2263-22) **253**-17
●H-834KU21 (Ch. V-2273-222) **253**-17
●H-835K21 (Ch. V-2263-22) **253**-17
●H-835KU21 (Ch. V-2273-222) **253**-17
●H-836T21 (Ch. V-2263-35) **253**-17
●H-836TU21 (Ch. V-2273-322) **253**-17
●H-838K21 (Ch. V-2263-15) **253**-17
●H-838K21A (Ch. V-2263-15) (See Model H-769T21—Set **253**-17)
●H-838K21B (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-838KU21 (Ch. V-2273-122) **253**-17
●H-838KU21A (Ch. V-2273-124) (See Model H-769TU21—Set **253**-17)
●H-838KU21B (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-839K21 (Ch. V-2263-15) **253**-17
●H-839KU21 (Ch. V-2273-122) **253**-17
●H-840CK15 (Ch. V-2284-15) **259**-15
●H-841T21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-841TU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-842T21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-842TU21 (Ch. V2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-843K21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-843KU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-844K21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-844KU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-847K21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-847KU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-848K21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-848KU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-853K24 (Ch. V-2314-15, -25) **274**-16
●H-853KU24 (Ch. V-2324-203) **274**-16
●H-854K24 (Ch. V-2314-15, -25) **274**-16
●H-854KU24 (Ch. V-2324-203) **274**-16
●H-861T21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-861TU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-862T21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-862TU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-863T21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-863T21A (Ch. V-2263-35) (See Model H-769T21—Set **253**-17)
●H-863TU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-863TU21A (Ch. V-2273-324) (See Model H-769TU21—Set **253**-17)
●H-864T21 (Ch. V-2313-15, -25, -35) **270**-18
●H-864T21A (Ch. V-2263-35) (See Model H-769T21—Set **253**-17)
●H-864T21, B (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-864TU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-864TU21A (Ch. V-2273-324) (See Model H-769TU21—Set **253**-17)
●H-864TU21B (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-865T21 (Ch. V-2313-15, -25, -35) **270**-18
●H-865T21A (Ch. V-2263-35) (See Model H-769T21—Set **253**-17)
●H-865T21, B (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-865TU21A (Ch. V-2273-324) (See Model H-769TU21—Set **253**-17)
●H-865TU21 (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-865TU21B (Ch. V-2323-101, -122, -124, -201, -301) (Also See PCB 127—Set 286-1) **270**-18
●H-866T21 (Ch. V-2313-15, -25, -35) (Also See PCB 127—Set 286-1) **270**-18
●H-866T21A (Ch. V-2263-35) (See Model H-769T21—Set **253**-17)

NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200 ● Denotes Television Receiver.
Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250. ● Denotes Television Receiver.

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NOTE: PCB Denotes **P**roduction **C**hange **B**ulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200 Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250 ● Denotes Television Receiver.

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(CM-1) indicates service data *also* available in Howard W. Sams 1947 Record Changer Manual. (CM-2) indicates service data available in Howard W. Sams 1948 Record Changer Manual. (CM-3) indicates service data available in Howard W. Sams 1949, 1950 Record Changer Manual. (CM-4) indicates service data available in Howard W. Sams 1951, 1952 Record Changer Manual. (CM-5) indicates service data available in Howard W. Sams 1953 Record Changer Manual.

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Production Change Bulletin Nos. 64 Through 104 Are All Contained in Set No. A-250
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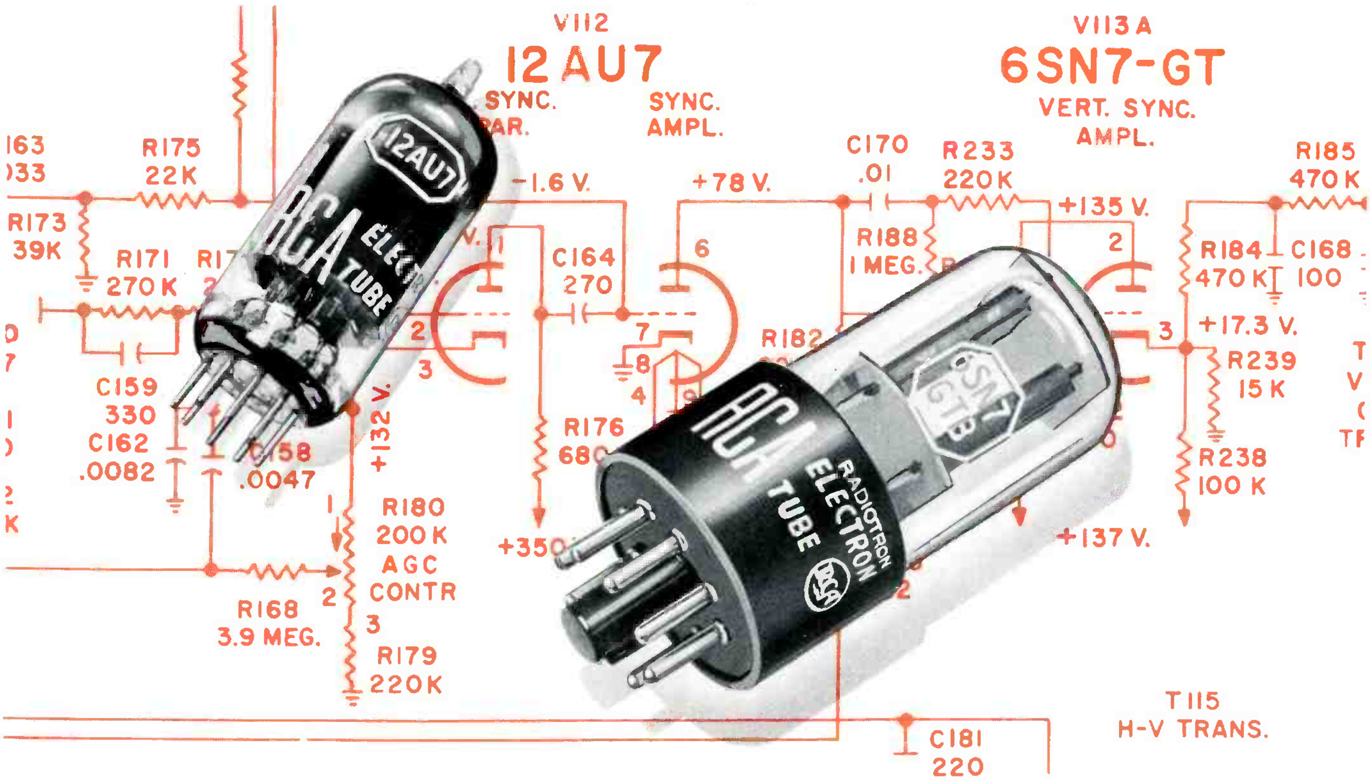

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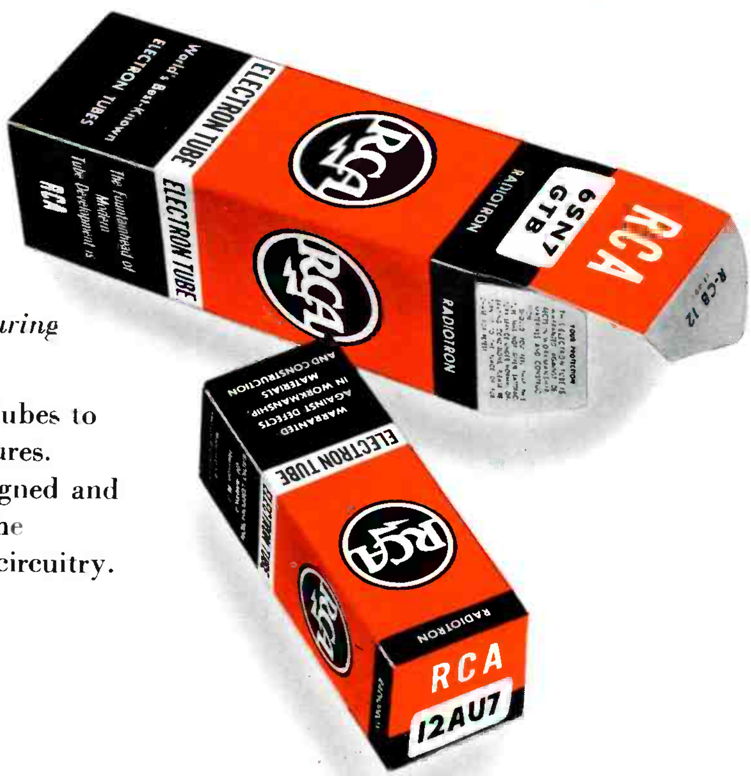

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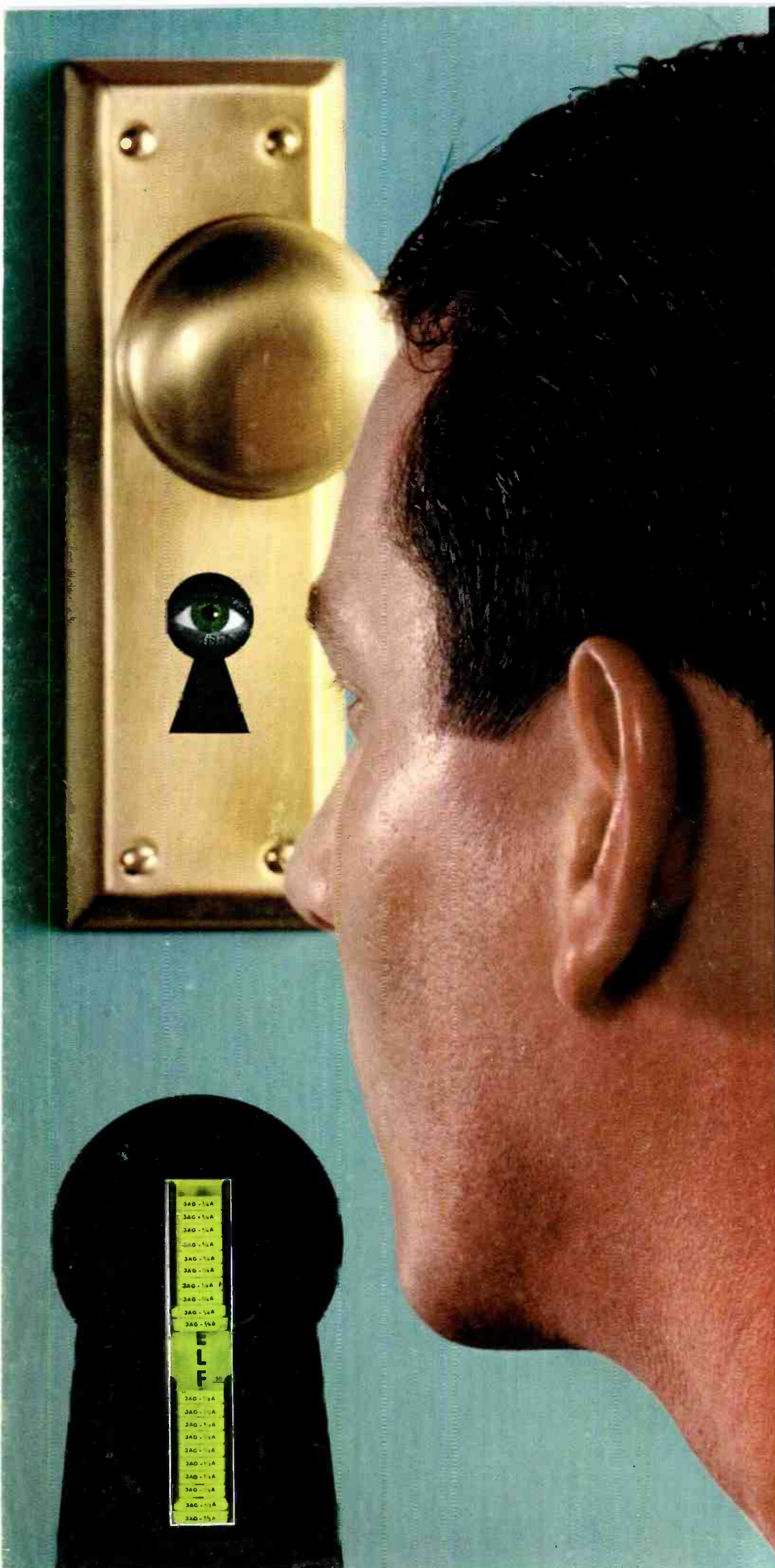

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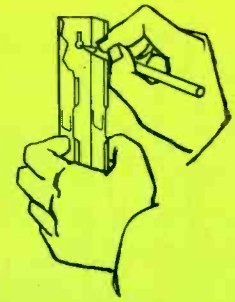
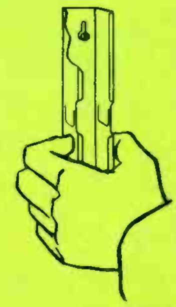
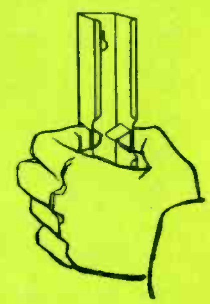


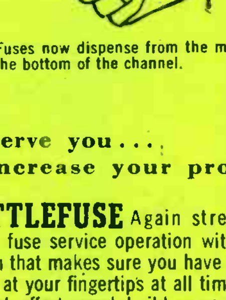
1. Determine the most handy location above or near your work bench. Using one channel as a guide locate the position of the screws for the number of channels required — single, double or triple bank.



2. Insert screws in position—do not turn all the way down. Slide channel down, letting screw head come through large part of keyhole slot. Slip narrow part of slot behind the screw head and tighten.



3. Each channel can be made to dispense two types of fuses simply by folding in the tabs cut out in the middle of the channel.



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