PF REPORTER

for the Electronic Service Industry

AUGUST • 1955

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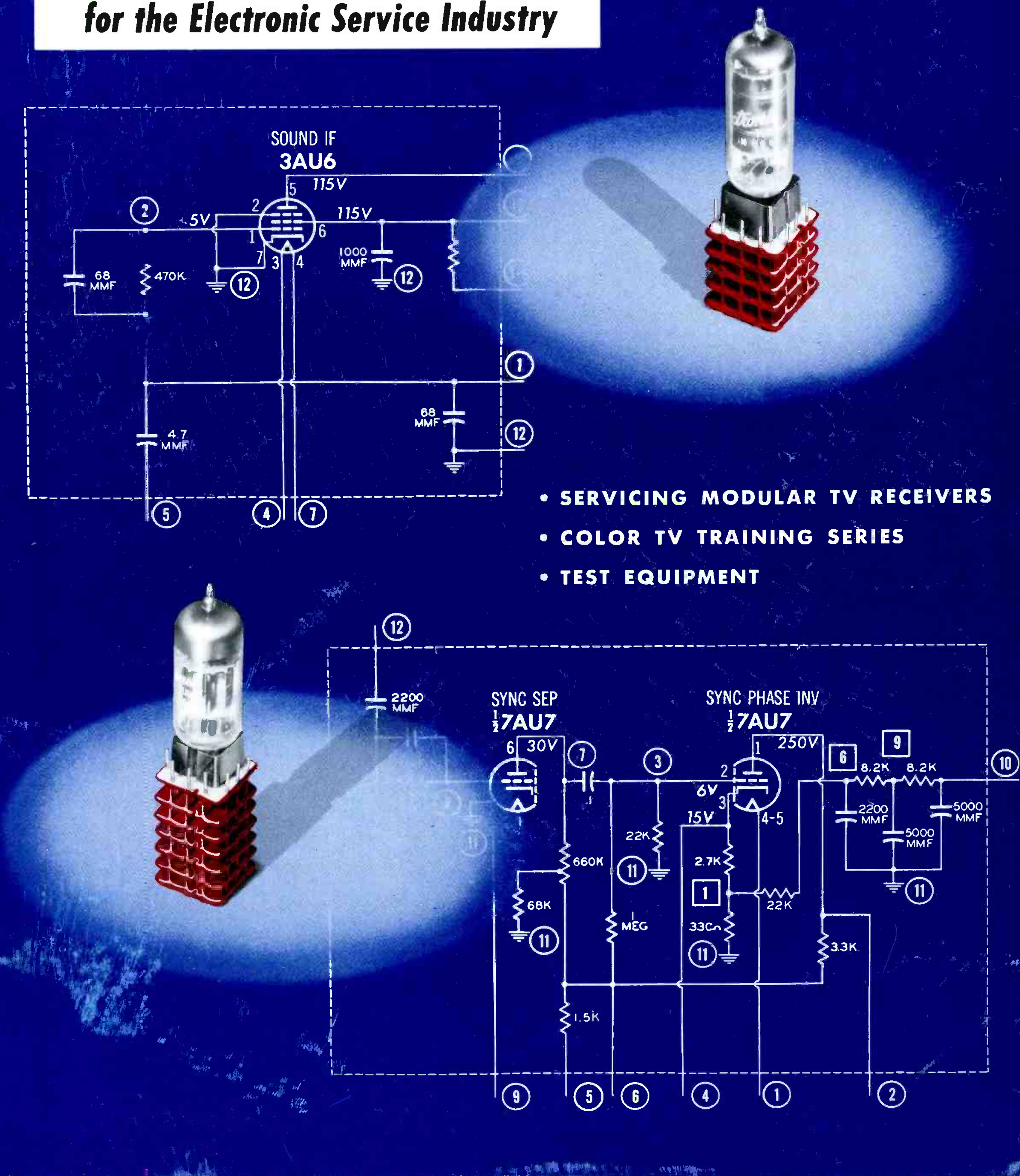

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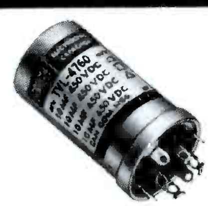

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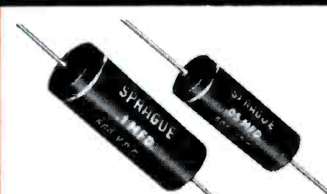

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Howard W. Sams

PF REPORTER
for the Electronic Service Industry

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SUBJECT REFERENCE

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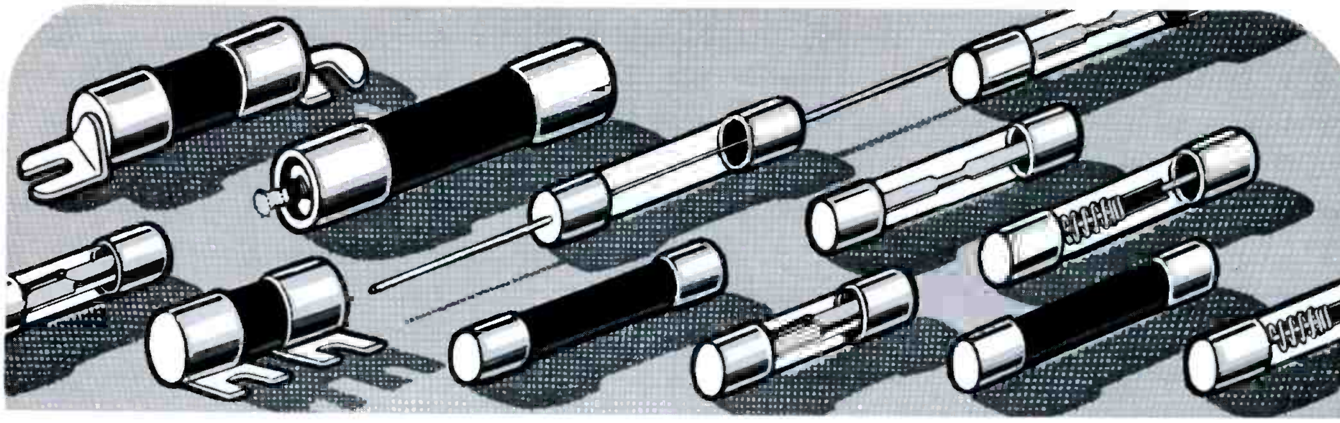

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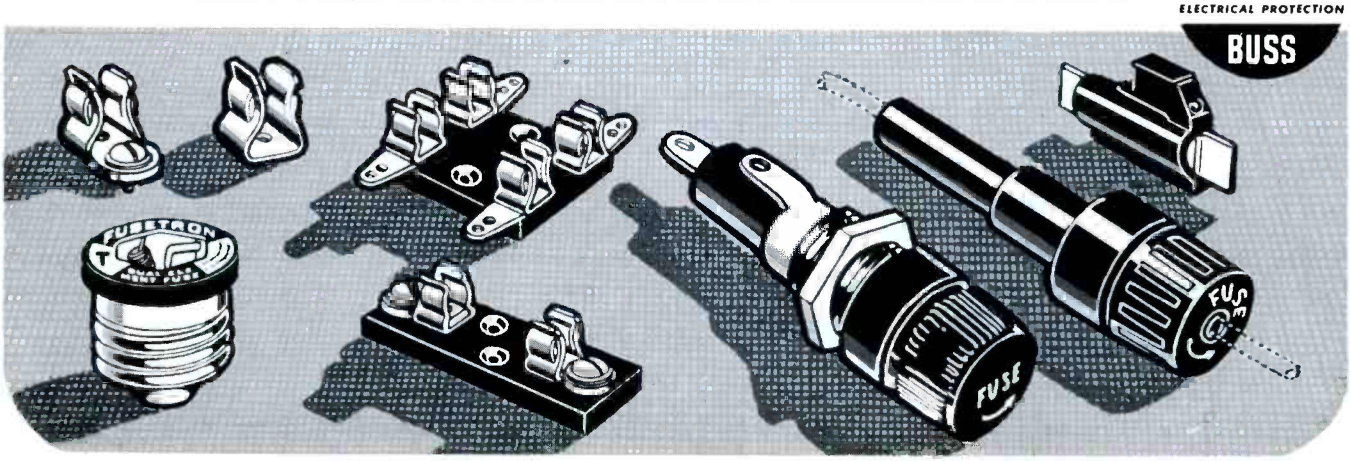


Shop Talk

MILTON S. KIVER
President, Television Communications Institute

INCREASED SIGNAL CAPACITY OF TV RECEIVERS

Television receivers must operate over a wide range of input signals. For the vast majority of sets, this range can be placed between 20 microvolts at the low end and 100,000 microvolts at the high end. It is the function of the AGC system to regulate the bias of the RF and IF stages so that signals within this range will be handled without distortion and without overloading.

The biggest single problem in securing satisfactory operation of the AGC system results from the fact that there is considerable variation in the cutoff values of the tubes it controls. In the case of the IF system, this refers to the cutoff values of 6CB6 tubes because these are the ones used most extensively for this purpose.

Experiments with groups of 6CB6 tubes have been conducted, and it has been found that the bias voltage needed to cut off the current through these tubes will be different for different tubes. With plate and screen voltages set at approximately 150 volts, the cutoff voltages ranged anywhere between -5.5 volts and -11.5 volts. It is reasonable to expect that a similar pattern exists for other types of tubes.

Applying These Facts to Servicing

Now let us see how this variation in cutoff voltage affects receiver performance. Suppose we have a receiver with three IF stages in which three 6CB6 tubes are used. Assume further that one 6CB6 requires a bias value of -5.5 volts for cutoff, another requires -8 volts, and the third requires -10 volts. If we distribute these tubes so that the one with the cutoff value of -10 volts is placed in the first IF stage, the one with the value of -8 volts is placed in the second IF stage, and the one with the value of -5.5 volts is placed in the third IF stage, then it will be found that the range of signal levels to which the set can respond linearly is at a minimum. This is because the signal is strongest at the third IF stage; yet this tube possesses the lowest cutoff value. Hence, this tube will reach the cutoff point and start clipping the signal long before the same thing happens in the other two stages. On the other hand, if we had reversed the order of placement so that the tube with the lowest cutoff value had been positioned in the stage where the signal level was weakest, then we would have obtained linear operation over a wider range of signal levels.

Checking Tube Cutoff

The next question is, "How can I check the cutoff bias of the tubes in a receiver?" We are primarily concerned with the video IF tubes because these are the ones which will most markedly affect set operation. One approach is through the use of a tube tester. There are on the market some tube testers which provide for measurement of the actual cutoff bias of a tube; therefore, if you have a tester of this type, simply pull out the video IF tubes from the receiver and measure their cutoff values. The tubes then would be reinserted in accordance with these values — with the ones with the smallest cutoff values in the stages that handle the smallest signals.

If your tube tester does not enable you to measure the cutoff bias directly but is instead a mutual-conductance tester, then it will probably have a knob marked BIAS. Insert the tube into its socket in the tester, and set all of the controls as instructed on the roll chart for that tube. With the test button depressed, rotate the BIAS knob until the meter pointer is brought to zero. This indicates that there is no plate current. Note the setting of the bias control.

Check all other tubes in the same way, each time noting the position of the BIAS knob at current cutoff. The tube that requires the greatest rotation of the BIAS knob has the highest cutoff value; the tube that cuts off with the smallest rotation of the control has the smallest cutoff value. Note that we are concerned with relative values because the markings on the bias control do not generally represent specific voltage values.

If your tube tester does not permit either of these methods to be used, then you may attempt the following approach.

Connect an oscilloscope across the load resistor at the output of the video detector through a 10,000-ohm isolating resistor. Apply to the input terminals of the antenna an RF signal that is amplitude modulated. Choose a mid-channel frequency, and adjust the fine-tuning control until reception of the signal is best, as indicated by the amplitude of the sine-wave pattern on the oscilloscope screen. Gradually increase the output from the signal generator until the signal shows distortion. Note this setting of the output control.

Next, interchange the various video IF tubes, and perform the same test. For a three-tube IF system, there are six different ways in which the tubes may be inserted. See Table I.

The tube arrangement that allows the greatest input signal before distortion occurs would be the best one to use. Note that we are simply rearranging the tubes existing in the set; we are not replacing any of them with other 6CB6 tubes which might possess more desirable cutoff

* * Please turn to page 43 * *

COLOR TV TRAINING SERIES

PART XV TROUBLE SHOOTING

by C. P. Oliphant and Verne M. Ray

Part XIV of this Color TV Training Series dealt with causes of improper monochrome operation and complete loss of color. This section will discuss some additional causes of improper monochrome operation and also some probable causes of wrong colors.

A Color Plate has been included to show what happens to the picture on the screen when specific troubles occur in the receiver. It should be mentioned that the signal used during the photographing of the color-bar patterns and the waveforms used in this section can be obtained from either the Jackson Model 700 or Model 712 color-bar generator.

EFFECT OF HUM ON MONOCHROME PICTURES

Normally, the color circuits do not contribute any signals to the picture tube during the reproduction of a monochrome scene. For this reason, the cause of improper monochrome operation is generally confined to a section of the receiver through which the luminance signal must pass. Troubles of this type were discussed in the preceding section of this series.

In addition, certain troubles in the color circuits of a receiver may occasionally affect monochrome reproduction. One such trouble can be defined as hum. Hum is usually of the 60-cycle variety and is commonly caused by a short or leakage between the filament and cathode of a tube. Fig. D1 of the Color Plate shows the effect of 60-cycle hum on a color-bar pattern.

Hum which develops in one of the stages of the color circuits is not difficult to isolate. This is because the hum bars produced on the screen will appear in two specific colors when the receiver is tuned to a monochrome signal. These colors will be those associated with the receiver section which introduces the hum. For example, if a 60-cycle hum originates in the I channel, the hum will appear on the screen as wide horizontal bars of orange and cyan like those shown in Fig. D2 of the Color Plate. If the hum originates in the Q channel, the modulation will appear on the screen as green and magenta bars like those in Fig. D3 of the Color Plate.

It is also possible that the hum may develop in the matrix section and cause the modulation to appear at the control grid of only one of the guns in the picture tube. In such cases, the hues produced on the screen will be the primary and complementary colors associated with the gun receiving the hum modulation. Hum which modulates the red gun will cause the red and cyan bars to appear on the screen, as shown in Fig. D4 of the Color Plate. Figs. D5 and D6 show the result of hum which modulates the green and blue guns, respectively.

When 60-cycle hum is caused by a defective tube, the trouble can be readily corrected. For instance, if the colors which appear on the screen during the reproduction of a monochrome picture indicate that the hum originates in the I channel, the tubes in this section, beginning with the demodulator, should be removed from their sockets one at a time until the hum disappears. Replacement of the last tube removed will generally correct the trouble. If not, the chassis should be removed and an oscilloscope used to trace the hum in the conventional manner.

Sometimes the hum modulation may not be very strong, and the colors which contaminate the monochrome picture will be pale. This may make it difficult to determine whether the hum originates in the I channel or in the red-matrix section, because the hues produced in one case closely resemble the hues produced in the other. It may also be difficult to differentiate between hum in the Q channel and hum in the green-matrix section for the same reason. In many instances, removing the last tube in either the I or Q channel will help to isolate the defective circuit. For example, let us suppose that it cannot be determined whether the trouble is confined to the I channel or to the red-matrix section. If the hum is still in evidence after the last tube in the I channel has been removed, the trouble should be in the red-matrix section. If the modulation is no longer apparent when this tube has been removed, the trouble must be confined to the I channel.

WRONG COLORS

If monochrome operation is normal but improper colors are produced during a color transmission, the trouble can be classified as reproduction of wrong colors. A color can be defined by its hue, saturation, and brightness. A change in any one of these characteristics will cause improper color reproduction.

A color receiver determines the hue represented by the chrominance signal by comparing the phase of this signal with the phases of two reference signals. If the phase relationship between any two of these signals is incorrect, the hues represented by the chrominance signal will be reproduced incorrectly. Saturation is determined by the amplitude ratio between the chrominance and luminance signals. If this ratio is altered in the receiver, color saturation will be affected.

In this discussion, the luminance signal is considered to be normal. Although a serious change in the amplitude of the luminance signal would affect color saturation, the symptoms in such a case should be classified as improper monochrome operation rather than wrong colors.

A number of indications that will help to isolate a trouble in a color receiver can be obtained before the back cover is removed. After making sure that the receiver operates satisfactorily when tuned to a monochrome signal, the receiver performance should be checked when tuned to a color signal. A good source for such a signal is a color-bar generator. By observing the picture produced on the screen when the receiver is tuned to a sig-

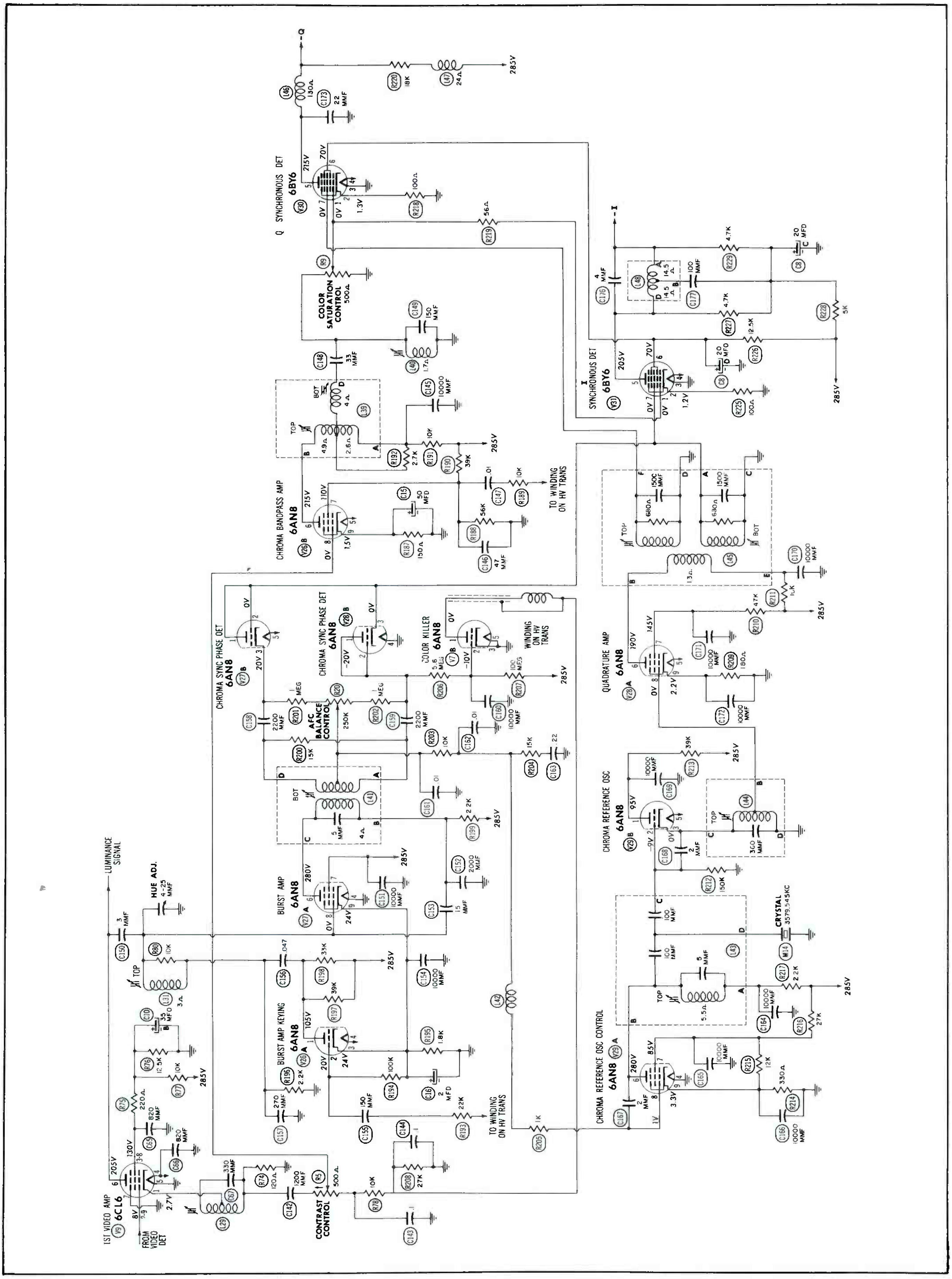


Fig. 12-13. Chrominance and Color-Sync Circuits Used in the RCA Victor Model CT-100 Color Receiver.

REFERENCE PATTERNS FOR TROUBLE SHOOTING

COLOR TV TRAINING SERIES

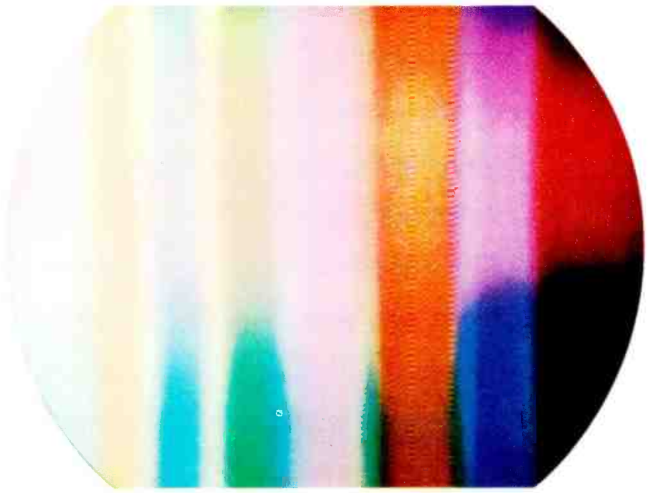


Fig. D1. Color-Bar Pattern Showing Presence of 60-Cycle Hum.

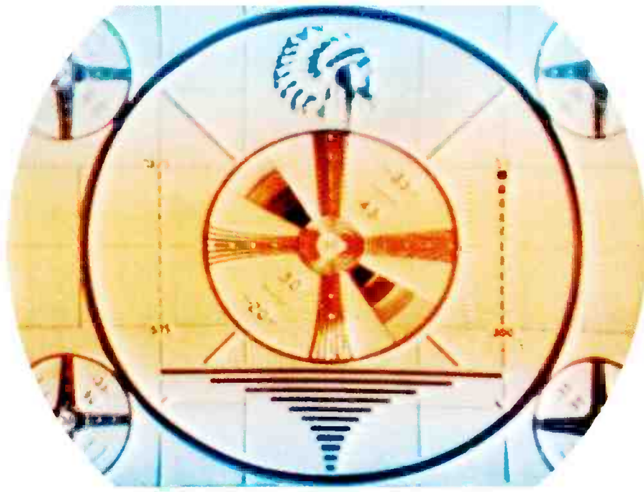


Fig. D2. Colors Produced by Hum in the I Channel During Monochrome Reception.

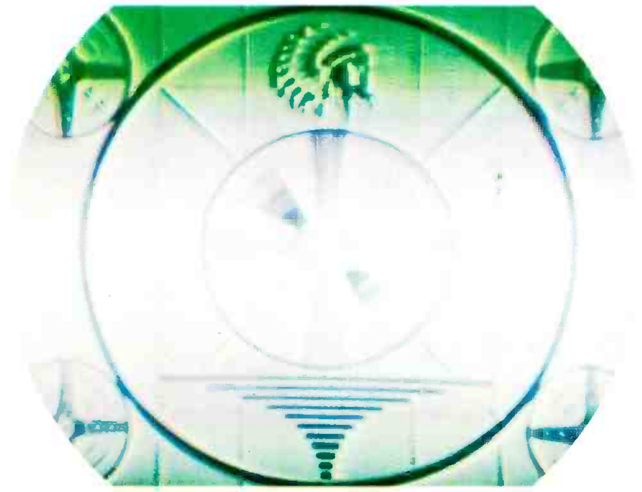


Fig. D3. Colors Produced by Hum in the Q Channel During Monochrome Reception.

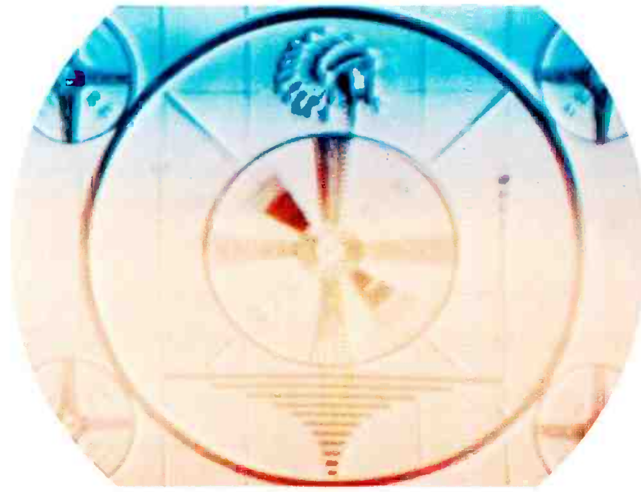


Fig. D4. Colors Produced by Hum in the Red-Matrix Section During Monochrome Reception.

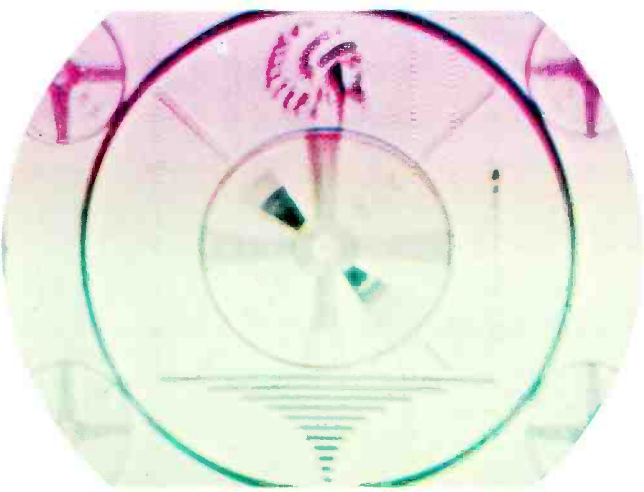


Fig. D5. Colors Produced by Hum in the Green-Matrix Section During Monochrome Reception.

Fig. D6. Colors Produced by Hum in the Blue-Matrix Section During Monochrome Reception.

REFERENCE PATTERNS FOR TROUBLE SHOOTING

COLOR TV TRAINING SERIES

Fig. D7. Color-Bar Pattern in Which Colors Are Normal.

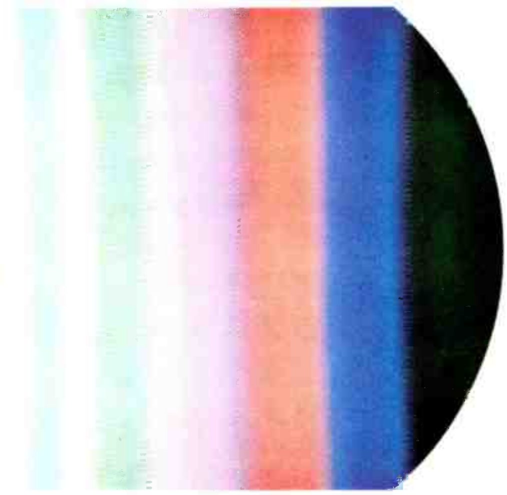


Fig. D8. Color-Bar Pattern in Which Colors Lack Saturation.

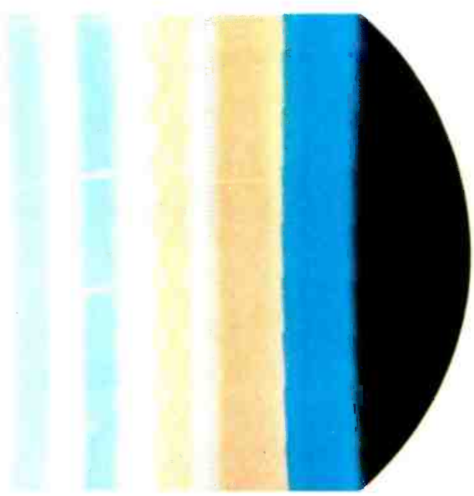


Fig. D9. Colors Produced in the Absence of the Q Signal.

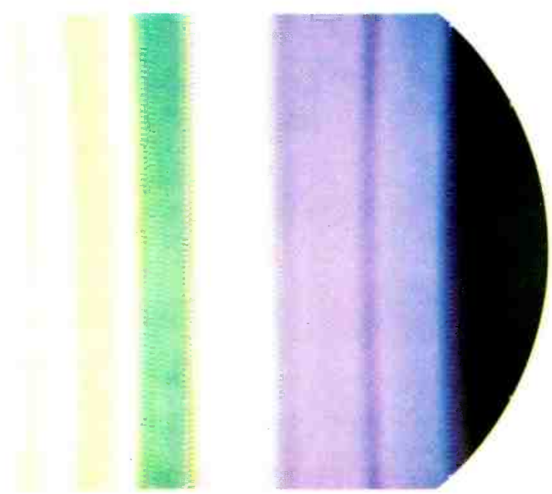
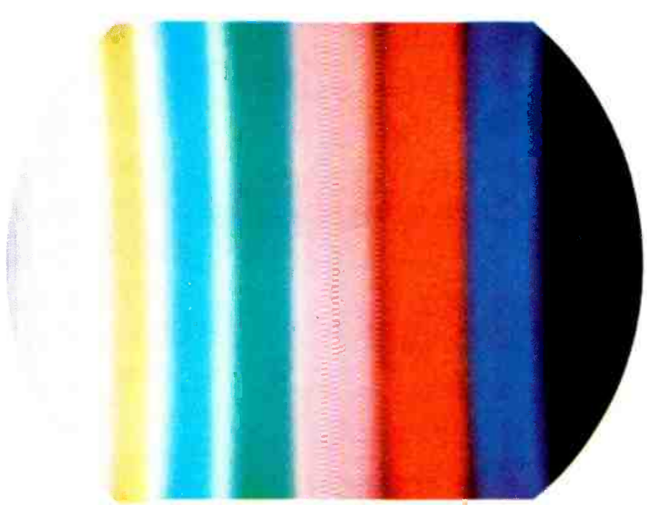


Fig. D10. Colors Produced in the Absence of the I Signal.



Dig. D11. Colors Produced in the Absence of the Minus-Q Signal.

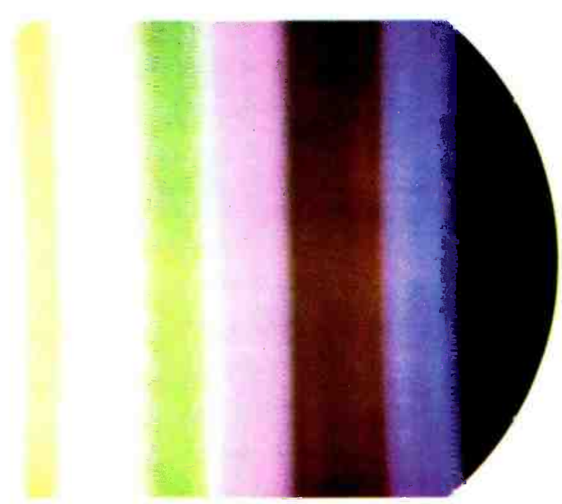


Fig. D12. Colors Produced in the Absence of the Plus-I Signal.

nal from this instrument, several indications may be obtained to help isolate the trouble to a particular section of the receiver.

The first step toward restoring normal receiver operation is to check for a misadjustment of any front- or rear-panel controls that might be causing the trouble. The misadjustment of any one of three controls in particular may cause the hues represented by a color signal to be reproduced incorrectly. These controls are the hue, saturation, and fine-tuning controls.

A misadjusted hue control will cause the phase relationships between the chrominance signal and the two reference signals to be incorrect. A misadjusted saturation control will cause the amplitude ratio between the chrominance and luminance signals to be incorrect. A misadjusted fine-tuning control may cause the signal to be distorted so that either or both of these troubles will occur. The setting of all three of these controls should be checked before it is assumed that the trouble is due to a defective tube or component.

If normal receiver operation cannot be restored by the adjustment of controls, the tubes employed in the section suspected of causing the trouble should be checked. A good method of finding faulty tubes is to substitute one known to be good for each one in the suspected section. Removal of the back cover will provide access to many of the tubes. A number of cabinets have removable tops, a feature which makes it easier to get to all of the tubes. In the event that proper operation cannot be restored by the adjustment of controls or the replacement of tubes, the chassis will have to be removed from the cabinet for further analysis.

Loss of Saturation

One specific case in which the colors represented by a signal are reproduced incorrectly can be defined as a loss of saturation. This condition is shown by the colors in the pattern in Fig. D8 of the Color Plate. By comparing this photograph with the normal color-bar pattern in Fig. D7, it may be noted that the colors in the bars in Fig. D8 appear as pastels instead of saturated colors.

A pastel is produced by a mixture of white light and a fully saturated color. Since white light contains all colors, all three of the phosphors must be emitting a percentage of the total light output during the scanning of each color bar. This means that the bars which represent the primary colors contain some amount of light from the other two primaries, and each secondary color contains some amount of light from its complementary primary. For example, the red bar normally contains only light from the red phosphor. When this bar becomes desaturated, it will also contain some light from both the green and the blue phosphors. The cyan bar normally contains only light from the green and blue phosphors. It becomes desaturated when light from the red phosphor is added.

Such a condition is caused by the fact that the signals applied to the picture tube are unable to cut off each beam at the proper time. The luminance signal is known to be normal; therefore, it may be assumed that the desaturation of colors is caused by a deficiency in the color-difference signals. It may be further assumed that the inability of these signals to cause proper beam cutoff is due to insufficient signal amplitude. Since all of the colors are desaturated, the signals from both of the demodulator sections must be lacking in amplitude.

In some instance, it may be possible to remedy a condition of desaturated colors by advancing the saturation control because the setting of this control determines the amount of signal applied to the demodulator stages; however, if it becomes necessary to advance this control beyond its normal setting in order to obtain sufficient color saturation, a definite trouble is indicated.

There are two possible causes for this trouble. Either the chrominance signal applied to the demodulator stages is lacking in amplitude or the CW reference signals applied to these stages are lacking in amplitude.

Fig. 12-13 shows the color circuits used in the RCA Victor Model CT-100 color receiver. In this receiver the tubes which might cause a loss of saturation are the bandpass amplifier, the quadrature amplifier, and the burst amplifier. A weak tube in the bandpass-amplifier stage will not provide the proper amplification of the chrominance signal, and a weak tube in the quadrature-amplifier stage will not provide the proper amplification of the 3.58-mc reference signal. A weak tube in the burst-amplifier stage may not amplify the burst signal a sufficient amount to cut off the color killer completely. This would increase the bias on the bandpass amplifier and reduce the amount of amplification provided by this stage.

Chrominance Signal Lacks Amplitude

If replacement of the bandpass amplifier, quadrature amplifier, or the burst amplifier does not correct the loss in saturation, the chassis should be removed and the signals at the input of the demodulator stages should be observed on an oscilloscope. The chrominance signal should appear as shown by the waveform in Fig. 12-14.

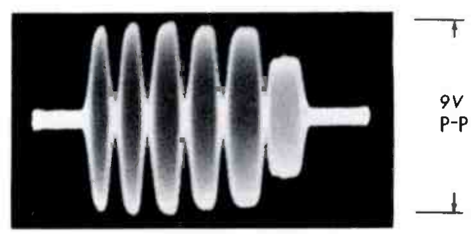


Fig. 12-14. Normal Waveform of the Chrominance Signal at the Input of the Demodulator Stages.

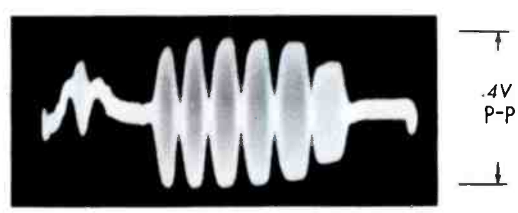


Fig. 12-15. Normal Waveform of the Signal at the Grid of the Bandpass Amplifier.

If the chrominance signal is lacking in amplitude at this point, the signal should be observed at the grid of the bandpass amplifier. The normal waveform of this signal is shown in Fig. 12-15. A lack of signal amplitude at this point is an indication that the 4.5-mc trap in the cathode circuit of the first video amplifier may be detuned and is presenting a high impedance at the frequency of the chrominance signal.

If a normal signal can be observed at the input of the first video amplifier, the adjustment of the 4.5-mc trap should be checked. Normally, the signal at the grid of the first video amplifier will appear as shown by the waveform in Fig. 12-16. If the signal at the input of the video amplifier is not normal, the passband of the video

* * Please turn to page 31 * *

TRANSPORT MECHANISM in AMPEX Model 600 TAPE RECORDER

The Seventh in a Series of Articles Devoted to the Principles of Magnetic Recording

by ROBERT B. DUNHAM

The mechanical section of the Ampex Model 600 magnetic-tape recorder is an example of a professional quality of tape-transport mechanism which is driven in all operating modes by a single one-speed motor. It is designed to handle 7-inch or smaller tape reels and to operate at a tape speed of 7 1/2 inches per second.

Specifications

Some of the operating specifications of the Ampex Model 600 are:

Flutter and Wow -- below 0.25 per cent.

Starting Time — instantaneous (tape accelerates to full play-record speed in less than one second).

Stopping Time — less than one second.

Fast-Forward or Rewind Time — 90 seconds for full 1200-foot reel.

Playback Timing Accuracy — ±0.2 per cent (±3.6 seconds in a 30-minute recording).

Operation

Operating modes of STANDBY, PLAY, RECORD, REWIND, and FAST FORWARD are accomplished in this compact unit (shown in Fig. 1) through a system of pulleys, belts, and clutches driven by the single-speed synchronous motor. The correct sequence of movements is maintained when the mechanism is started or stopped in any one of the operating modes. Interlocks are provided to prevent the turning of either of the two controls when the other is in an operating position. Such interlocks prevent the accidental erasing of a recorded signal and prevent the accidental breaking or spilling of the tape because of mishandling of the controls.

As can be seen in Fig. 2, no pressure pads are used in the Model 600. Consequently, correct tape tension must be maintained during the play and record modes so that the tape will make constant and uniform contact with the faces of the erase head, record head, and playback-monitor head. This tension must also be relaxed during the rewind and fast-forward modes to avoid unnecessary wear on the tape and heads.

It is difficult to explain and show how the tape-transport mechanism accomplishes the desired results because of the number of parts and the manner in which they must be hidden in the small space they occupy. But with the aid of the photographs in Fig. 3

* * Please turn to page 36 * *

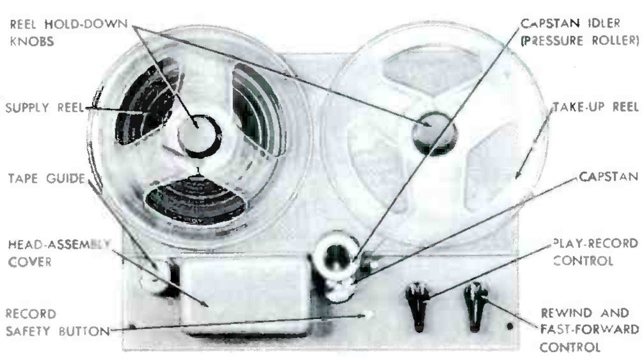


Fig. 1. Front View of Tape-Transport Mechanism of Ampex Model 600 Magnetic-Tape Recorder With 7-Inch Reels in Place and Tape Threaded.

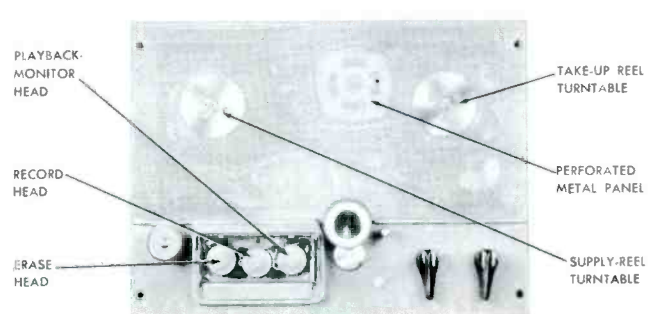


Fig. 2. Front View of Transport Mechanism With Cover Removed From Head Assembly.

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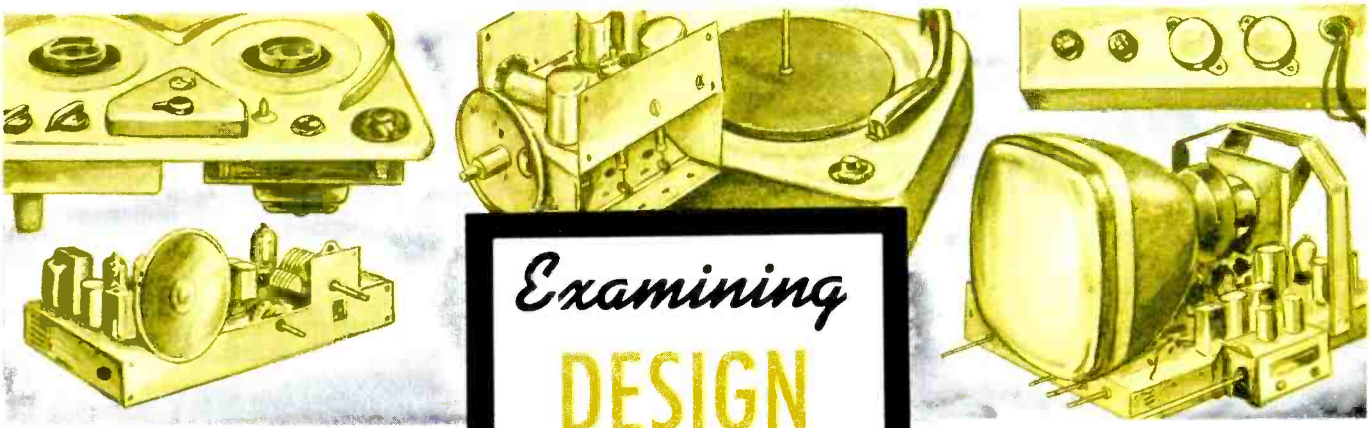

Examining DESIGN *Features*

by LESLIE D. DEANE

Standard Coil T-Series Tuners

Many manufacturers are incorporating in their new lines of television receivers a new T-Series of Standard Coil tuners. One of the T-Series tuners is shown in the photograph of Fig. 1. It can be seen from this picture that the outward appearance of the tuner resembles that of a majority of the earlier turret designs.

These new tuners are available in four basic types that differ in their electrical characteristics:

1. Tuners coded TA use a pentode RF amplifier and are designed for receivers having 21-mc IF systems.

2. Tuners coded TB also employ pentode RF amplifiers but are built to be used with 41-mc IF systems.

3. Tuners coded TC have cascode RF amplifier stages and are intended for 21-mc IF systems.

4. Tuners coded TD also employ cascode RF amplifiers but are designed to be used with 41-mc IF systems.

There are a few variations in these four basic styles. They have provisions so that they will operate with either a 6.3-volt parallel-filament system or with the newer

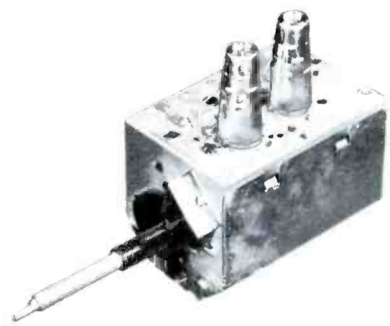

Fig. 1. Standard Coil T-Series Tuner.

600-milliampere series-filament strings. The Standard Coil Company is also producing these units with 12-position or 13-position turrets and with metallic or insulated tuning shafts, whichever the receiver manufacturer desires.

In the many different receivers employing this type of tuner, the service technician may find a wide variety of antenna-input circuits and IF output circuits. Various filter networks may have been added to the basic design by the receiver manufacturer, and various coupling circuits may have been added between the mixer and the first IF amplifier.

The most noticeable difference in appearance between the newer and the previous Standard Coil tuners is in the turret and its channel insert strips. The contrast in appearance between the two turret assemblies is apparent in Fig. 2. In the new unit, the coils required for each individual channel are all mounted on a single insert strip. Each strip is held in position by spring tension at point A, and the opposite end of the strip is inserted into a slot in the detent plate at point B. The detent plate in the T-Series of tuners is very similar to the detent plate in earlier models except that it is located in a different position, indicated in Fig. 2. The turrets in the new tuners are also lighter in weight and shorter in length than those employed in the earlier designs.

The channel insert strips may be easily removed by exerting pressure on the retaining spring and by lifting outward on the strip. When removing the strips from the turret, care should be taken to avoid damaging the antenna coil which is located at the rear of each strip. The

* * Please turn to page 53 * *

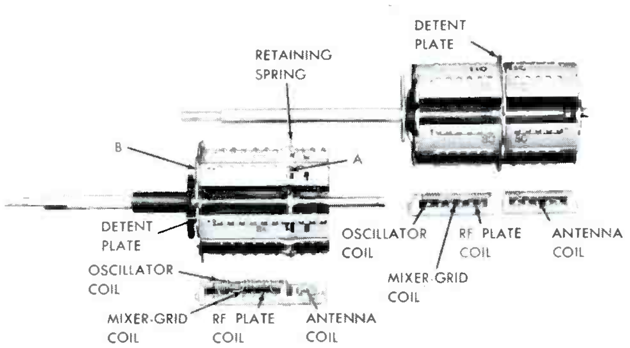

Fig. 2. Turrets and Strips From Standard Coil Tuners of the New T-Series (*at left*) and an Earlier Type (*at right*).

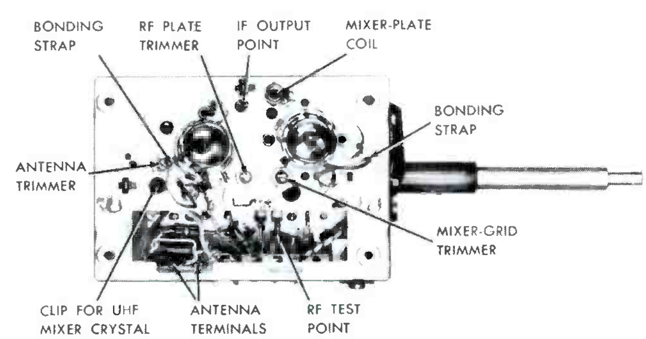

Fig. 3. Top View of T-Series Tuner With Cover Plate Removed.

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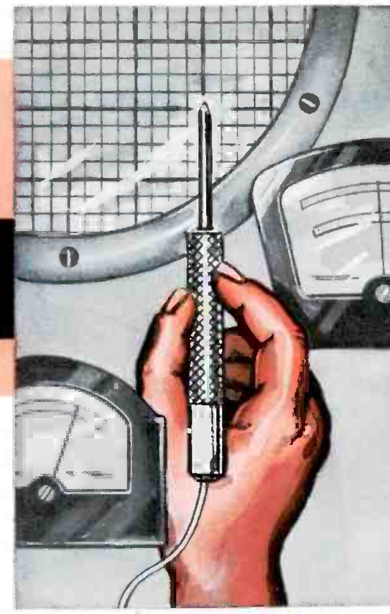


Presenting Information on Application, Maintenance, and Adaptability of Service Instruments

by Paul C. Smith

Fig. 1. Probescope Model PO-1 Oscilloscope.

Probescope Model PO-1

The Probescope Model PO-1 is a compact and portable oscilloscope designed for convenience, speed, and ease of operation. It is made by the Probescope Co., Long Island City, New York and is shown in Fig. 1.

The main feature of the instrument is the probe which consists of a 1CP1 cathode-ray tube mounted in a mu-metal shield. The entire probe is then covered with insulating material of black phenolyte. The entire probe assembly measures 7 1/2 inches long and 1 1/2 inches in diameter and is permanently connected to the body of the Probescope by a 3 1/2-foot cable.

Fig. 2. Probe Assembly of the Probescope Model PO-1.

Fig. 2 shows the comparative size of the probe as it is held in the hand. Fig. 3 shows the Probescope being used to view the waveforms in the horizontal-oscillator circuits of a television receiver. It can be seen from these illustrations that the instrument occupies very little bench space. The cabinet size is 6 inches high, 9 inches wide, and 5 inches deep.

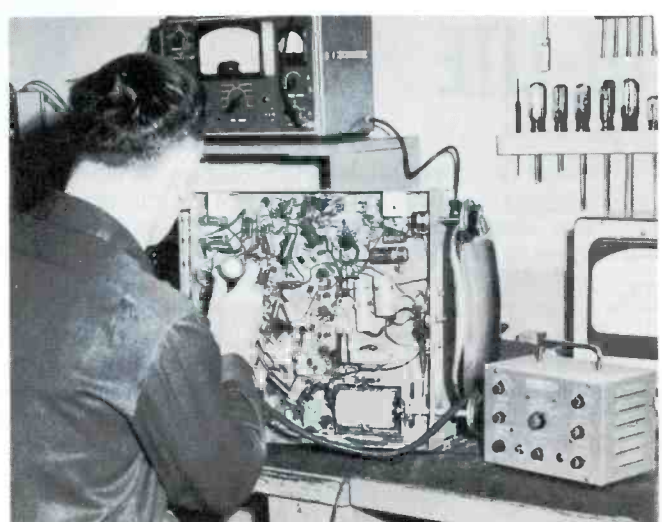
Adjustments can be made by means of the following front-panel controls: vertical gain, horizontal gain, vertical positioning, horizontal positioning, intensity, sync amplitude, vernier frequency, and sweep rate. The sweep-rate control is a five-position switch calibrated from 20 cycles to 30 kilocycles.

No focus adjustment is provided inasmuch as the focus is sharp for all positions of the intensity control. The trace obtained is very brilliant and can be easily seen under any normal viewing conditions.

The probe is equipped with a banana type of tip. A sharp-pointed, conical tip which may be slipped over the banana tip is also supplied.

The deflection sensitivity of the vertical amplifier is stated as being 100 millivolts for full-scale deflection. Other specifications from the manufacturer are: a frequency response in the vertical amplifier of 7 cycles to 70 kilocycles between

Fig. 3. Probescope Model PO-1 Being Used to View Waveforms in a TV Receiver.



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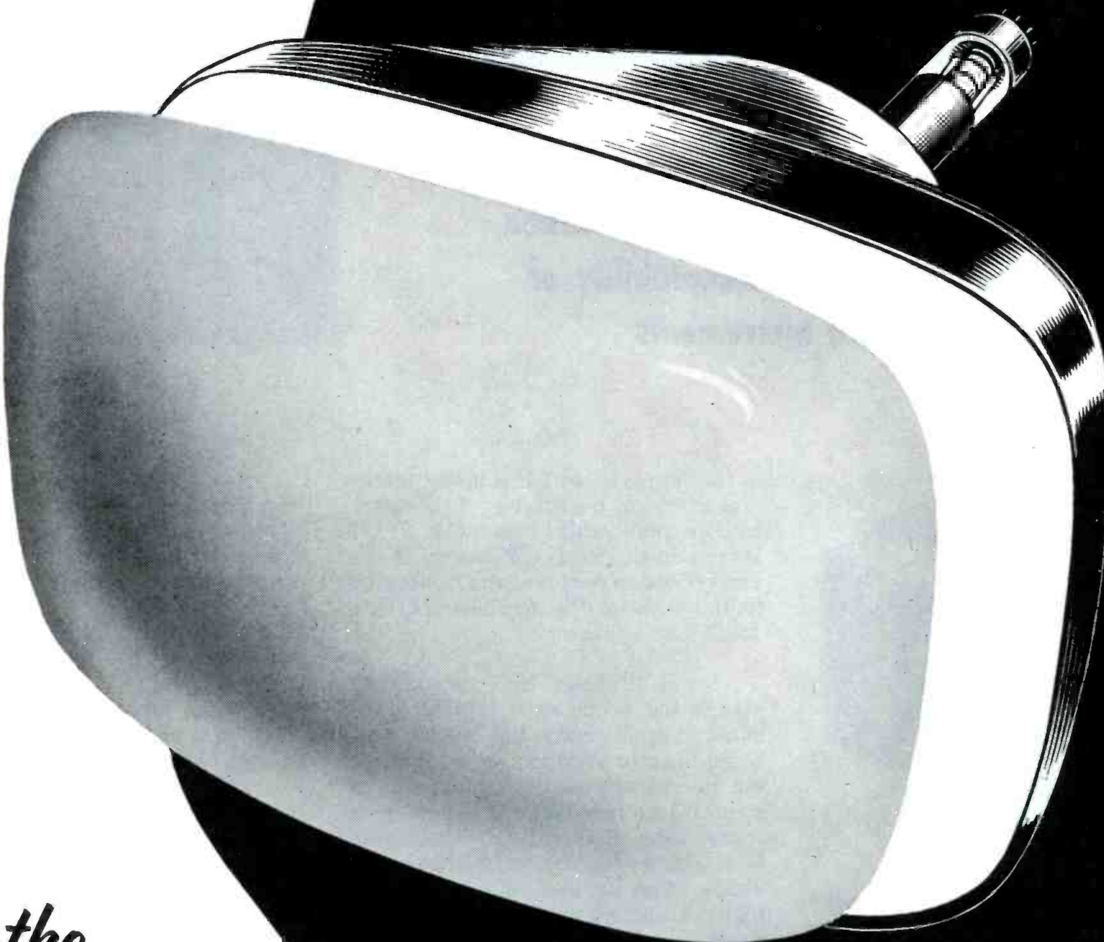

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New Features Recently Added to the Triplett Model 3423 Tube Tester

A number of new features have been added to the Triplett Model 3423 tube tester, thus increasing the number of tests that may be performed with the instrument.

The tester may be set up to check transistors and crystal diodes. Because of rapid changes in transistor data, a separate instruction sheet is included with the manual, and it lists settings for testing 23 types of transistors and 24 types of crystal diodes.

Very comprehensive tests for leakage and shorts may be made. Shorts and leaks of less than 250,000 ohms will be indicated by a glow on the neon indicator. Leakages of higher value may be measured directly by means of a leakage scale on the meter of the instrument. This meter is calibrated for a range up to 10 megohms. The full-scale deflection of the meter is just past the 10-megohm mark.

Checks for open elements may be performed in connection with the shorts test. If the shorts test for any element indicates that no short is present, the element can then be tested for an open condition by pressing a button. An up-scale movement of the pointer when the button is pressed indicates that the element is functioning.

A sensitive test for noise may be performed through the use of two pin jacks on the tester panel. Ordinary headphones may be connected across these terminals, or the output from the jacks may be fed to the antenna input of a radio receiver for amplification of the noise pulses. If desired, the noise pulses can be viewed by feeding them to the vertical input of an oscilloscope.

WIN-TRONIX Model 150 Rainbow Generator

The WIN-TRONIX Model 150 rainbow generator pictured in Fig. 4 furnishes a signal which, according to the manufacturer, may be used in adjustment or alignment of the following color circuits:

1. The 3.58-mc burst-amplifier circuit.

2. The 3.58-mc reference-oscillator circuit.

3. The 3.58-mc phase-comparator circuit.

4. The circuit associated with the master phase control (or hue control).

5. The demodulator circuits.

6. The quadrature-phase circuits.

7. The matrix (or adder) circuits.

8. The color-killer circuit.

The instrument will provide checks of over-all receiver performance and of demodulation gain. WIN-TRONIX equipment is manufactured by Winston Electronics, Inc. 4312 Main Street, Philadelphia 27, Pa.

The Model 150 generator provides an RF signal tunable from channels 2 through 6 on fundamental frequencies. This signal is modulated 30 per cent by the 3.58-mc color subcarrier. The color subcarrier is made to scan all color phases from 0 to 360 degrees when the generator is set at +1 on the RAINBOWS dial. Any number of rainbow patterns from 1 to 8 may be obtained by adjusting the RAINBOWS dial. With the dial set at zero, a 3.58-mc reference signal is obtained. (A 3.579545-mc crystal may be installed for crystal control of this frequency reference.) When the RAINBOWS dial is set at -1, the order of the colors in the pattern is reversed.

Each rainbow pattern contains bars of red, magenta, blue, cyan, and green. To the average observer, the red, blue, and green colors will probably be most evident. The magenta bar will appear as a narrow transition bar between the red and blue bars, and the cyan bar will appear as a narrow transition bar between the blue and green bars. As the contrast and color-saturation controls of the receiver are advanced until the receiver is overloaded, all the color bars become more distinct and the transition between each bar is more definite.

A 60-cycle luminance signal may be obtained by moving the function switch from CHROMA to LUMINANCE. At this setting, the receiver screen will be divided horizontally by one dark bar and one light bar. This type of signal may be used for matrix and adder checks or adjustments.

All signals are produced as RF modulation at the particular channel frequency selected. The output cable is a 300-ohm twin lead for connecting to the 300-ohm antenna terminals of the receiver.

Fig. 4. WIN-TRONIX Model 150 Rainbow Generator.

The instrument is quite compact, measuring 8 by 5 by 4 inches and weighing 3 1/2 pounds.

The instruction manual accompanying the Model 150 rainbow generator contains examples of a number of applications of the instrument. Illustrative diagrams are provided to show bar patterns obtained under normal and abnormal receiver operation.

The waveforms developed by the generator signal at important points in a color receiver are also shown, together with instructions in the text for proper interpretation and any necessary adjustments.

In our laboratories, a few observations were made using the Model 150 rainbow generator with a color receiver having I and Q demodulators. Fig. 5 is the waveform that was observed in the I demodulator circuits. The waveform consists of a sine wave with a square-wave pulse superimposed upon it. The position of the square-wave pulse with respect to the phase of the sine wave depends upon the particular setting of the hue phase control, and this fact is used as an aid to proper setting of this control.

Once it has been determined that the hue control is correctly adjusted, the oscilloscope probe is moved to the Q channel where an indication of correct or incorrect adjustment of the quadrature trans-

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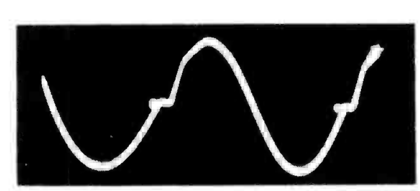
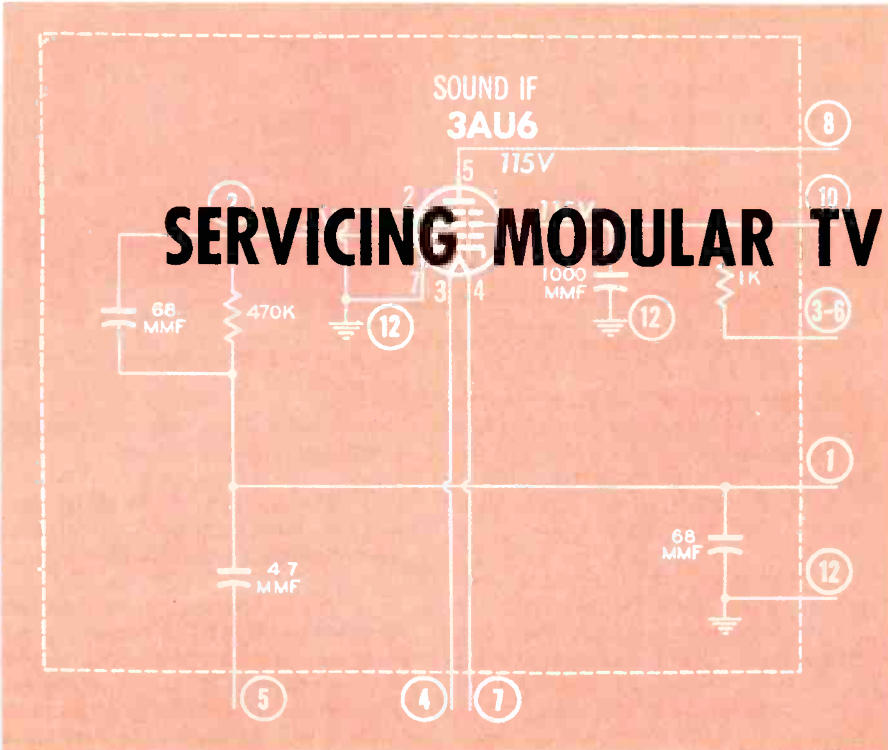
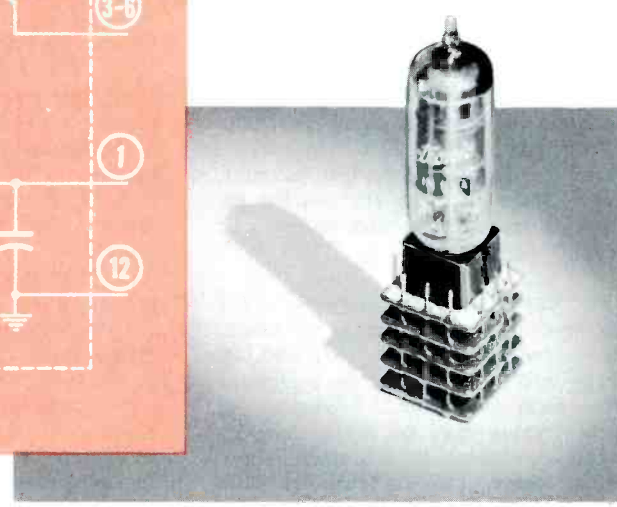


Fig. 5. Waveform of the I Signal in a Color Receiver Using the WIN-TRONIX Model 150 Rainbow Generator.



SERVICING MODULAR TV RECEIVERS



Advance Information on Service and Replacement

by William E. Burke and W. W. Hensler

What is a modular TV receiver? This question might be asked by anyone reading the title. A modular TV receiver is one which uses modules as a part of its circuitry. Such a statement is like answering a question with a question because the normal reaction is now to ask, "What's a module?" According to Webster, a module is "a plan or design on a small scale." This definition applies very well to the modules which have been designed for use in TV receivers.

Before we get into the technical discussion of modules, it should be pointed out that modules were designed in an effort to reduce the cost of the assembled receiver and to provide longer and more consistent receiver operation. Modules were not specifically designed to make servicing easier. Those of us in the service industry may jump to the conclusion that we are again the forgotten men. Before doing so, we should keep in mind that nearly all design work is done with two main aims in view: (1) minimum cost and (2) customer satisfaction. The first point is self-explanatory. The second point is intended to cover all phases of customer reaction from the first moment he sees the product until it is removed from service. Although many designs are steps forward as far as these aims are concerned, they may present some difficulties to the service technicians.

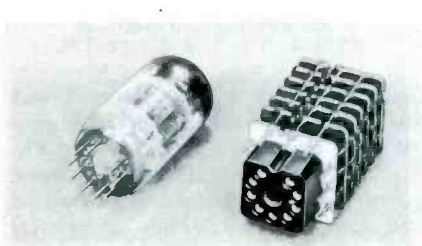


Fig. 1. Typical Module Unit for use in TV Receivers.

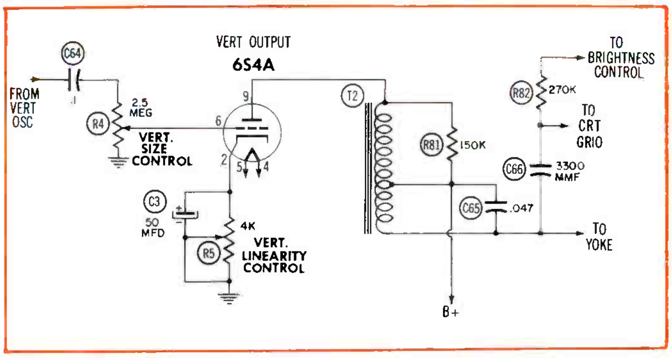
There is a natural tendency for the service technician to suspect that in the over-all design of TV receivers very little consideration has been given to servicing requirements, but such is not the case. On the contrary, many receiver features have been incorporated in order to make servicing easier. For example, in most receivers, sockets and plugs are used to connect such things as the speaker and the deflection yoke to the chassis. Many table models are designed so that the cabinets can be removed from above to give easy access to the chassis.

The use of modules in TV receivers will also afford certain advantages in servicing; but at the same time, their use may present some problems that would not be encountered in a receiver that is wired conventionally. Most of these problems, however, can be overcome if the service technician keeps himself informed of developments in this new field. This article is intended to be instrumental in providing the service industry with information about the construction of modules, the technique of servicing receivers using modules, and the correct procedure in replacing modules. With this information, the service technician should be able to approach a service job on a modular receiver with confidence.

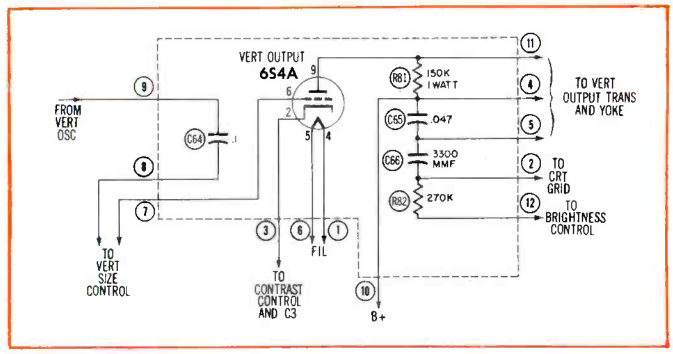
What Is a Module?

A module is a component. It possesses certain electrical characteristics and may be wired into a TV receiver as a single unit. Just as a resistor is used to provide a certain resistance to electron flow and just as a capacitor is used to present an impedance to alternating current, several resistors and capacitors can be combined into a single unit which will perform a specific function. A module is so designed that a combination of resistors, capacitors, and coils is contained within a small compact unit.

A representative module is made up of several ceramic wafers



(A) Conventional Schematic Diagram of Vertical-Output Circuit.



(B) Vertical-Output Circuit Adapted for Modular Construction.

which are held in position with twelve wires called risers. These wires serve as electrical connections between wafers and as mechanical supports for the wafers. The resistive, capacitive, and inductive elements can be placed on either side of each wafer. The leads of these elements are connected to the riser wires which provide continuity to the chassis wiring. If a tube is required in the circuit, a tube socket may be mounted on the top of the first wafer; then the terminals of the tube socket are connected to the proper riser wires.

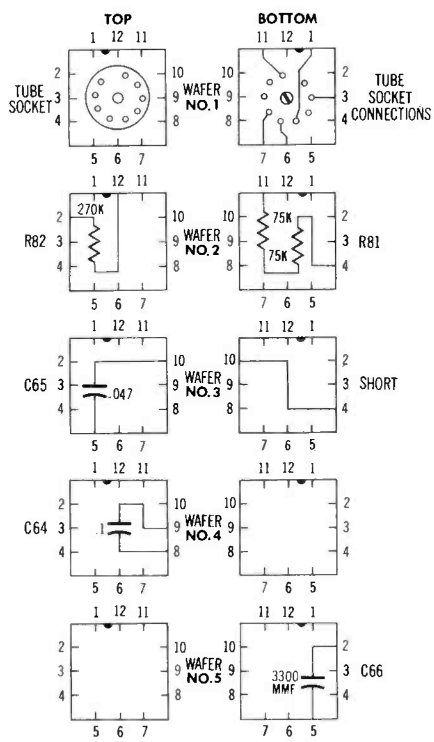
A typical module unit is shown in Fig. 1. The wafers are square, and the riser wires are brought out around the socket. The unit is designed to mount in a square hole in the chassis board. The particular module in Fig. 1 contains a complete sync-separator circuit and a vertical-integrator circuit. These circuits are made up of a tube socket, six capacitive elements, and thirteen resistive elements. When this module is incorporated in a receiver, B+ and filament voltages and the composite video signal are applied to the proper riser wires. Horizontal-sync pulses of both polarities and a completely integrated vertical-sync signal are available at the output risers. Thus, this single module unit performs the complete function required of a section of the receiver.

By checking the input signal and the three output signals, the technician can determine whether the module is operating properly. If it is not, he does not need to be concerned with the element in the module that failed. His only concern is whether the component as a unit is bad and needs replacement. Before continuing with the discussion about servicing, let us examine more closely the construction details of modules and their mounting arrangements.

Construction Details of Modules

One point that should be understood about modules is that they do not contain circuits which are pe-

(C) Complete Module for Vertical-Output Circuit.



(D) Pictorial Diagram of Element Layout in Wafers.

Fig. 2. A Module and Its Circuitry.

culiar only to modules. Most any circuit or portion of a circuit can be built into a module. To understand how this is done, refer to Fig. 2. A schematic diagram of a typical vertical-output circuit is shown in Fig. 2A. The same circuit is shown in Fig. 2B, but note that encircled numbers are shown next to the lines at the points where they enter the dotted box. The dotted box is used to enclose the parts which are contained within the module. Each encircled number indicates the number of the riser wire which is used to make a particular connection.

Fig. 2C is a photograph of a module into which the circuit of Fig. 2B has been incorporated. Five wafers are used. The three capacitors and two resistors shown in the schematic of Fig. 2B are contained within this module. These five parts, plus the tube socket and all interconnections, are thus included in a single component.

A module should not be considered as merely a new type terminal strip because conventional resistors, coils, or capacitors are not mounted on modules. Instead, the elements are either of the printed-circuit type or are specially designed to facilitate their mounting on the wafers. Fig. 2D illustrates the layout of the resistors and capacitors employed in the module of Fig. 2C. The socket is mounted on the top of wafer No. 1, and all connections from the socket to the riser wires are made on the bottom of the wafer. On some modules, connections from the socket to the riser wires may also be made on the top side of wafer No. 1. Note that the connections from the socket terminals to the riser wires correspond to those shown on the schematic of Fig. 2B as follows: pin 2 to riser 3, pin 4 to riser 1, pin 5 to riser 6, pin 6 to riser 7, and pin 9 to riser 11. Measurements of signals at all socket terminals can be made at the appropriate riser wires which are identified on the schematic diagram.

Wafer No. 2 contains R81 and R82. R81 is specified on the schematic as being a 150K-ohm, 1-watt resistor; and it is connected between risers 4 and 11. The drawing in Fig. 2D shows that R81 is actually made up of two 75K-ohm resistors which are connected in series to provide the required resistance. Each of these resistive elements is rated at

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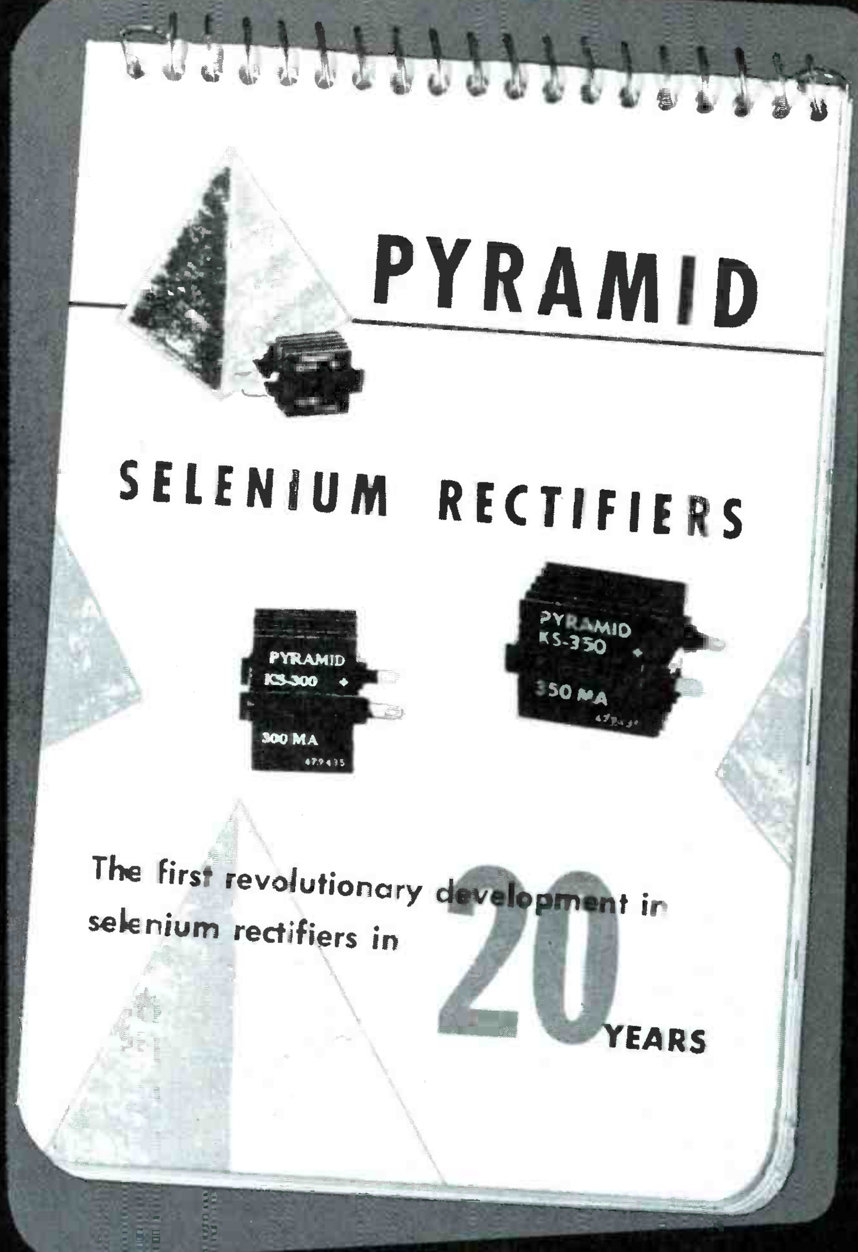

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Audio-Facts

CABLES and CONNECTORS

by ROBERT B. DUNHAM

Most high quality home music systems are composed of three or more separate pieces of audio equipment. As an example, we can point out that the basic system usually consists of a phonograph pickup, an amplifier, and a loudspeaker. Since these are separate and isolated units, cables must be employed to feed the signal from one to the other. Power and control cables, in addition to those carrying the signal, are required in the more elaborate audio systems in which tuners, recorders, preamplifiers, amplifiers, and large loudspeaker systems are used.

Cables and the connectors, plugs, and receptacles used with them are so important and are used in such large numbers in audio work that they deserve some discussion. In the commercial and professional audio fields, cables and connectors are considered to be so important that much effort has been put into their design and construction to ensure consistent and uninterrupted service.

Experience shows that maintenance and repairs are required sooner or later on cables and connectors which are subjected to rough usage and on those which are handled and used in continuous service. Care must be taken to attach a plug or receptacle in the proper manner; otherwise, there is a possibility that trouble will develop at some inopportune time.

Assembling and making cables is an old familiar procedure to an experienced audio technician; but with cables and connectors available in such a wide variety of types and sizes, the inexperienced man can encounter difficulties. Anyone will have to admit that some connectors are complicated and require detailed instructions when assembled for the first time. It might be well to point out that when the term cable is mentioned, a complete cable fitted with necessary connectors is implied in many instances, particularly when the specific use of the cable is also mentioned as in the case of a microphone cable, for example.

Suitable power and control cables are usually supplied with the major pieces of audio equipment used in a home music system. Sometimes, if the complete cables are not supplied, appropriate connectors are furnished so that suitable cables can be assembled. In cases in which units of different manufacture are combined to form an audio system, the cables furnished with the equipment may have to be modified or new and special cables may have to be made.

Plugs and connectors suitable for use on signal cables are sometimes supplied with equipment, but complete cables of this type are seldom furnished. Therefore, it is usually necessary to make the proper type of shielded cables to carry the signal from one unit to the other.

Phono-Pickup Cables

Of all the many cables and connectors used in home music systems, the most familiar ones are probably the phono plug and cable used to connect the pickup cartridge to the input of the preamplifier or amplifier. Two examples are shown in Fig. 1.

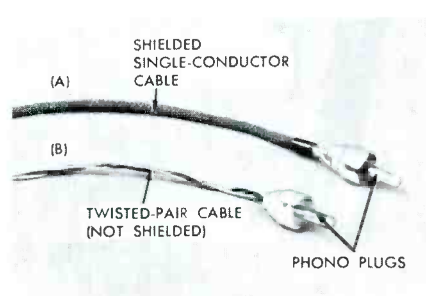

Fig. 1. Two Types of Phono-Pickup Cables.

Very flexible, single-conductor, shielded cables (Figs. 1A and 2A) are normally used with most pickups — particularly with crystal, ceramic, and high-impedance magnetic types such as those made by General Electric and the Audak Company. A twisted pair with no shield is sometimes used with low-impedance, magnetic cartridges such as those made by the Fairchild Recording Equipment Corporation and the Electro-Sonic Laboratories because hum pickup is not so bothersome in low-impedance circuits.

Interconnecting Signal Cables

Cables of the same general construction as the phono-pickup cable, but larger and heavier, are used to connect the output of a tuner or recorder to the input of a preamplifier or control unit and to connect the output of the preamplifier or control unit to the input of the amplifier.

Four types of shielded single-conductor cables are shown in Fig. 2. These are cables manufactured by the Belden Manufacturing Company, and they are similar to types supplied by several manufacturers.

Fig. 2A is a Belden No. 8431 phono-pickup cable featuring flexibility and a small over-all diameter of approximately .095 inch. The conductor is made up of 16 strands of No. 36 tinned-copper wire and is

* * Please turn to page 58 * *

YOU MUST PLEASE YOUR *women* CUSTOMERS IF YOU WANT TO MAKE YOUR BUSINESS GROW

It's a woman you have to please in 76.9% of your service calls.

You'll please more women when you use tubes with the Good Housekeeping Guaranty Seal . . . CBS tubes.

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More and more women will have greater confidence in you and your service when you use tubes with the Good Housekeeping Seal . . . tubes with the respected name — CBS.

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Danvers, Massachusetts
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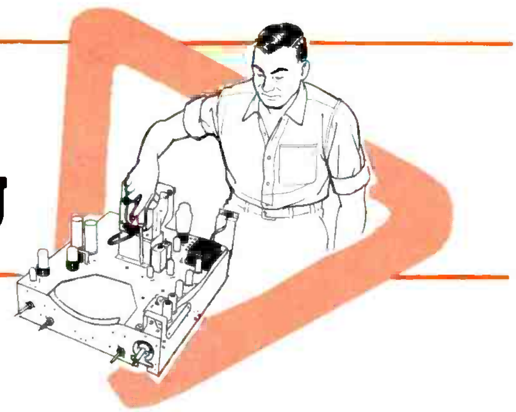

In the Interest of . . .

Quicker Servicing

by **Henry A. Carter** *and* **Calvin C. Young, Jr.**

IN THE SHOP

Lightning Damage in a Tuner

It has been said many times that most customers expect too much of their TV receivers and that they often think there is something wrong when there is not. If this is true, then the following case is an exception.

A certain receiver was not operating properly, yet the owner was completely unaware that anything was wrong. The trouble was not found until the service technician was called in to repair the fine-tuning mechanism which was loose. When he removed the bottom cover in order to repair the fine tuning, he found that the contacts on the RF strip for channel 6 were badly burned and pitted. He could think of only one thing that could cause this, so he asked the customer if the set had been struck by lightning. The answer was that the antenna had been hit almost a year before and that the lead-in had been completely destroyed at that time. Instead of replacing the lead-in, the customer had decided to try a pair of rabbit ears. Reception from a station about thirty-five miles away was snowy, but local stations were received satisfactorily. This had led the customer to believe that his set had escaped damage.

It did not take the service technician long to convince the customer of his error. The technician simply removed the turret drum and showed the customer the contact plate and bracket assembly which may be seen in the photograph of Fig. 1. Note that the spring contacts in the RF section of the tuner housing are almost completely burned away. The contacts in the oscillator section appear to be in satisfactory condition, and this fact made it possible for the customer to use his set even though the RF stage was inoperative. Sufficient signal was being capacitively coupled through the RF amplifier to the mixer, and usable pictures were being reproduced from the local stations.

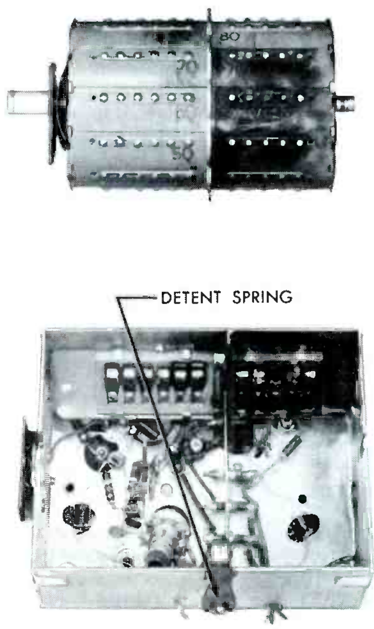

Fig. 1. Drum and Tuner Housing Showing Lightning Damage.

The first step in repairing one of these Standard Coil tuners which has been damaged in this manner is to remove it from the chassis. To do this, it is necessary to disconnect all the leads between the tuner and the rest of the receiver. The tuner mounting screws on top of the chassis are then removed, and the tuner is lifted out. The bottom cover of the tuner is removed by pulling the front end of it loose first and then by unhooking the rear end.

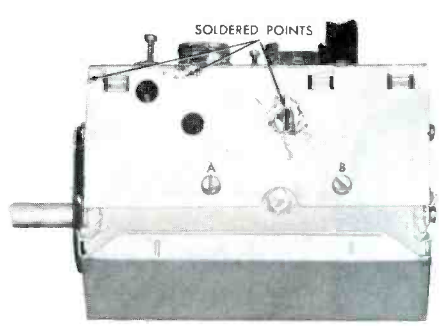

Fig. 2. Screws and Soldered Points Which Hold Side Cover in Place.

To remove the drum from the tuner, first take off the retaining springs on each end of the tuner. Next, the small fiber washer that is located on the tuner shaft must be slid away from the tuner chassis. The drum can then be lifted out; however, it will take a little pressure to overcome the holding power of the detent spring which is indicated in Fig. 1.

With the drum removed, the contact plate and bracket assembly is exposed for inspection along with most of the other components. If the contacts are damaged beyond use (as these were) or if they are worn excessively, it will be necessary to replace them.

At this point in the servicing procedure, an analysis of the other components should be made to see if any more of them need replacing. In the case under discussion, it was thought advisable to put in a new set of channel-6 strips because the contacts on the original RF strip for this channel were badly pitted.

Obtaining a new contact plate and bracket assembly was no problem because the technician had a Standard Coil Parts Kit No. 1011 on hand. This kit contains 104 of the most commonly needed parts for servicing Standard Coil tuners. The parts are boxed separately and can be purchased singly in order to restock the kit.

The kit does not contain channel insert strips. These can be purchased separately by sets.

In order to remove a defective contact plate and bracket assembly,

* * Please turn to page 40 * *

Meet 90% of your phonograph replacement cartridge needs — and save money!

With AMERICAN'S new "5-PAK" Service Kit

Every thing you need in one package!

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Here's a new idea that will meet 9 out of 10 of your replacement cartridge service requirements . . . a new idea that puts more money in your pocket! It's AMERICAN'S new "5-PAK" Service Kit. It contains 5 of the most used replacement cartridges—all in one handy reusable box—together with other necessary items for more complete service. And you buy it all at a money-saving price.

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GRID EMISSION and GAS in VACUUM TUBES

by THOMAS A. LESH

Grid emission and gas are tube defects which bring on similar troubles for different reasons. A better understanding of these faults should help the service technician when he is trying to track down the cause of deteriorated performance in a radio or TV receiver.

Grid emission, as the name indicates, is the giving off of electrons by the control grid. This condition often develops after cathode-coating material vaporizes and then condenses on the gird. The contaminating substance emits electrons when the grid is heated by adjacent elements. If heating is intense enough, emission may come from the material of the grid itself. Manufacturers have endeavored to reduce grid emission in certain tubes by coating the grids in these tubes with gold.

If grid emission occurs in a tube, the emitted electrons join the stream of plate current and they are replaced on the grid by other electrons which are attracted from ground through the grid-return circuit. The resulting current is called negative grid current in contrast to the positive grid current which flows under positive-bias conditions from cathode to grid to ground.

Negative grid current flowing through the grid resistance causes the voltage on the grid to go in a positive direction. Positive grid current tends to drive the voltage on the grid in a negative direction.

Gas gets into a tube by vaporization from the elements (especially when the tube handles high power) or through tiny leaks in the envelope. The condition causes trouble when some of the gas molecules ionize.

Ionization occurs when plate current starts to flow, and electrons collide with gas molecules in their path. At high voltages, these electrons are moving with enough velocity to knock other electrons out of the molecular structure of the gas. The electrons from the gas molecules join the flow of plate current. The remainder of each gas molecule becomes a heavy, positively charged ion.

Some of these positive ions collect on the control grid if it is negative. The flow of plus charges to the grid neutralizes some of the bias and is, effectively, negative grid current. This action in a gassy tube can be visualized from a study of Fig. 1. At low bias voltages, the grid loses much of its control of plate current because of the positive-ion sheath which coats it.

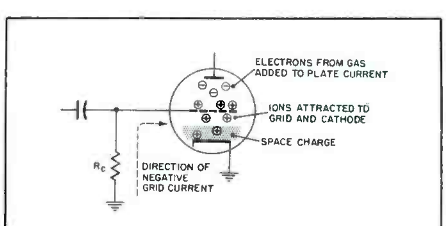

Fig. 1. Ionization in a Gassy Tube.

Positive ions are also strongly attracted to the cathode. In high-power tubes such as rectifiers, they bombard the cathode with such force that they may eventually destroy the emitting surface. Even if such drastic effects do not take place when gas is present, the plate current can still be expected to increase abnormally for three reasons:

1. Electrons from the gas add to plate current.

2. The space charge, a cloud of electrons which normally surrounds the cathode and acts as a reservoir to supply plate current, is disrupted by the positive ions. The cathode is then exposed to the full force of plate potential. An additional force which tries to pull electrons out of the cathode is the electric field surrounding each positive ion.

3. Negative grid current tends to shift the bias in a positive direction and to reduce the ability of the grid to limit plate current. If the bias is low, the tube appears to fire like a thyratron (a gas-filled triode). Gas ionizes heavily and allows heavy plate current to flow continuously.

A leakage path between grid and plate is another possible cause of negative grid current. The results of leakage are similar to the effects of grid emission.

The amount of negative grid current, even in a defective circuit, may be only a few microamperes. The significant thing is the voltage drop produced across the grid resistance. If two microamperes (.000002 ampere) flow through 5,000 ohms, according to Ohm's law the voltage is:

$$E = IR = .000002 \times 5000 = 0.01 \text{ volt.}$$

If the resistance is increased to two megohms, the voltage is:

$$E = .000002 \times 2{,}000{,}000 = 4 \text{ volts.}$$

This voltage tries to oppose the normal grid-bias potential. The maximum negative grid current allowed by design specifications is an important limit on the size of grid resistors.

A sensitive microammeter in the grid circuit can be used to measure negative grid current; or more conveniently, a relative indication can be seen by switching a large resistor in and out of the grid return and by noting the effect on the plate

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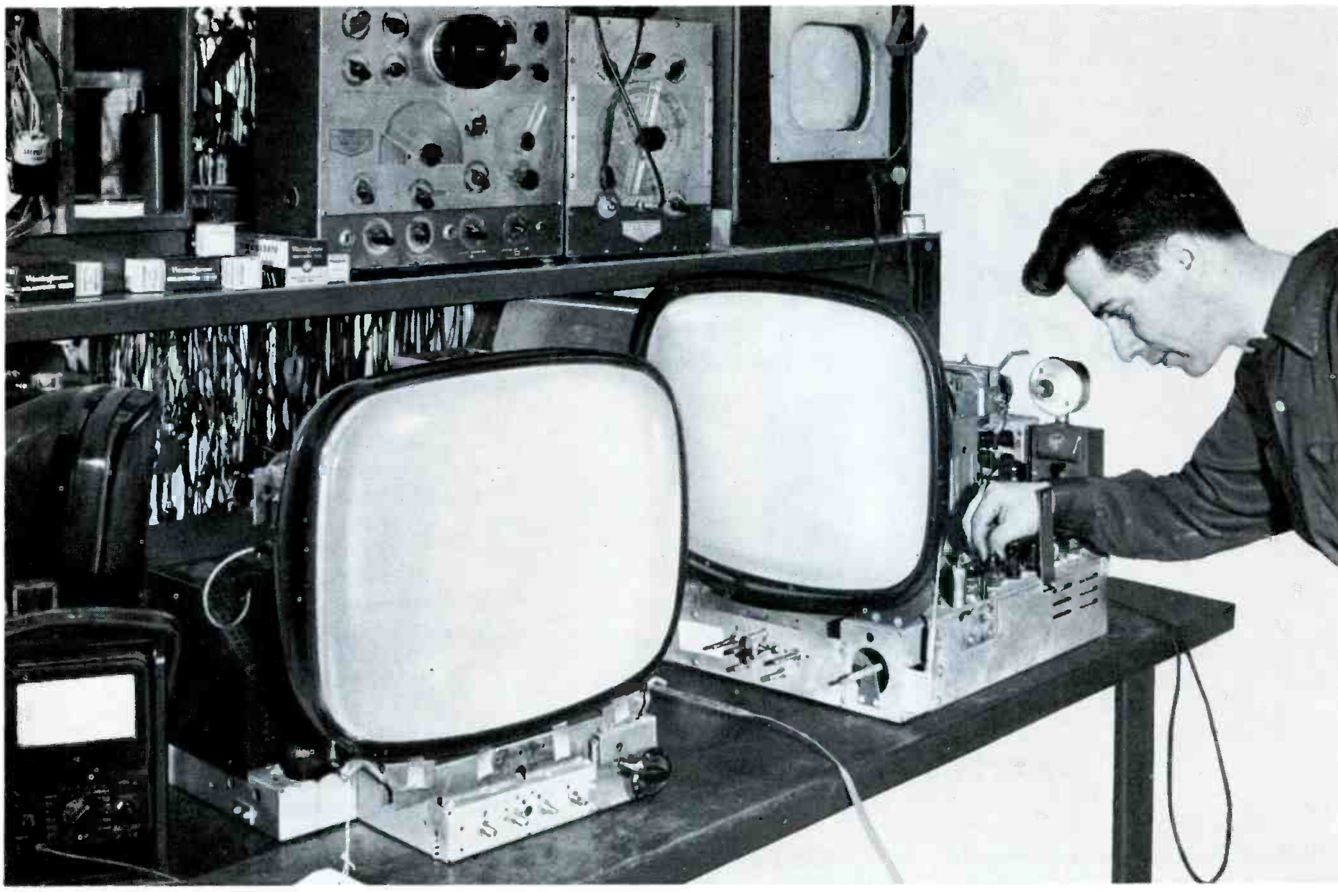

2 chassis, like the one pictured above (left) were used by Planet TV, B'klyn TV Service Center, to make their fact-finding call-back tests. The results? Planet says:

"Westinghouse Receiving Tubes Cut Our Call-Backs by More Than 30%!"

One of the oldest and largest TV service organizations in New York—Planet TV—submitted Westinghouse Receiving Tubes and the tubes of other manufacturers to a rigorous, factual "call-back" test.

The test was set up by equipping two identical chassis; one with all Westinghouse types and the other with identical tubes of other manufacturers. The sets were turned on and operated 8 hours per day for 5 consecutive days, the average period during which Planet TV's records show that call-backs normally occur after renewal tube installation.

The chassis equipped with Westinghouse tubes showed no failures. The other chassis showed 3 tube failures—3 potentially costly Planet call-backs.

Why don't you make this simple, profitable call-back test in *your* shop. Prove to yourself, too, that Westinghouse Receiving Tubes can drastically reduce your call-back problems—and increase your profits! See your Westinghouse distributor today! Start using Westinghouse Reliatron® Tubes *right away!*

	BREAKDOWNS: SET A (WESTINGHOUSE TUBES ONLY)	BREAKDOWNS: SET B (THREE COMPETITIVE BRANDS)
Monday	None	None
Tuesday	None	5U4G defective
Wednesday	None	None
Thursday	None	6AU6 defective, 5U4G soft
Friday	None	None

ET-95070

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RELIATRON® TUBES

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

Dollar and Sense Servicing

by John Markus

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

MYSTERY. Back in our home town recently (population 311,349), we stopped over at one of the leading hotels, quite impressive in its modernity. However, prominently displayed on the mirror of the dresser was this perplexing card:

WARNING!
ELECTRIC CURRENT

Please use care with electric appliances. The current varies from AC to DC without warning. For information call Extension 55.
The Management

How does it do it? And why? And now, too late, the thought comes: Why didn't we call the management to find out why?

CODE. The special background music recordings used by Muzak represent an investment of many thousands of dollars in research to achieve a particular emotional response with music. For relaxing music, there can be no sudden crescendos; for let's-work-harder music, there can be no quiet passages that let the factory workers go back to semi-sleep as they connect and solder, connect and solder, all day long.

To protect its investment and improve its service, Muzak is transferring all its recordings to magnetic tape in such a way that it can easily detect unauthorized copies. At irregular intervals ranging from 30 seconds to 2 minutes, the letters MUZAK are placed on the tape in Morse code by a harmonic-withdrawal process. The momentary loss of harmonics in a certain band cannot be noticed by listeners, but the code signals are easily read when the tape is played back through equipment designed to suppress the audible musical content. And that's how bootleg background music is being detected today.

PAY-AS-YOU-SEE. Subscription TV will mean a lot of things to a lot of people if it gets going. The public will have to pay if they wish to acquire the necessary coin-in-the-slot unscrambling gadgets. The charge will be concealed in the program fees, or it will be in the form of an initial installation charge.

The service technicians who install and maintain these gadgets will be getting a good share of these payments, either as regular employees of pay-as-you-see firms or as independents working on a per-call basis.

PRESS CARD. More and more the big conventions are restricting attendance to the people who control the actual buying of the products shown by the exhibitors. This makes sense, because even without the crowds it is still a tough job to see and talk to all the exhibitors you'd like to in the few short days and limited hours of a convention. Those seeking to get in are thus undergoing a close screening at the registration desks.

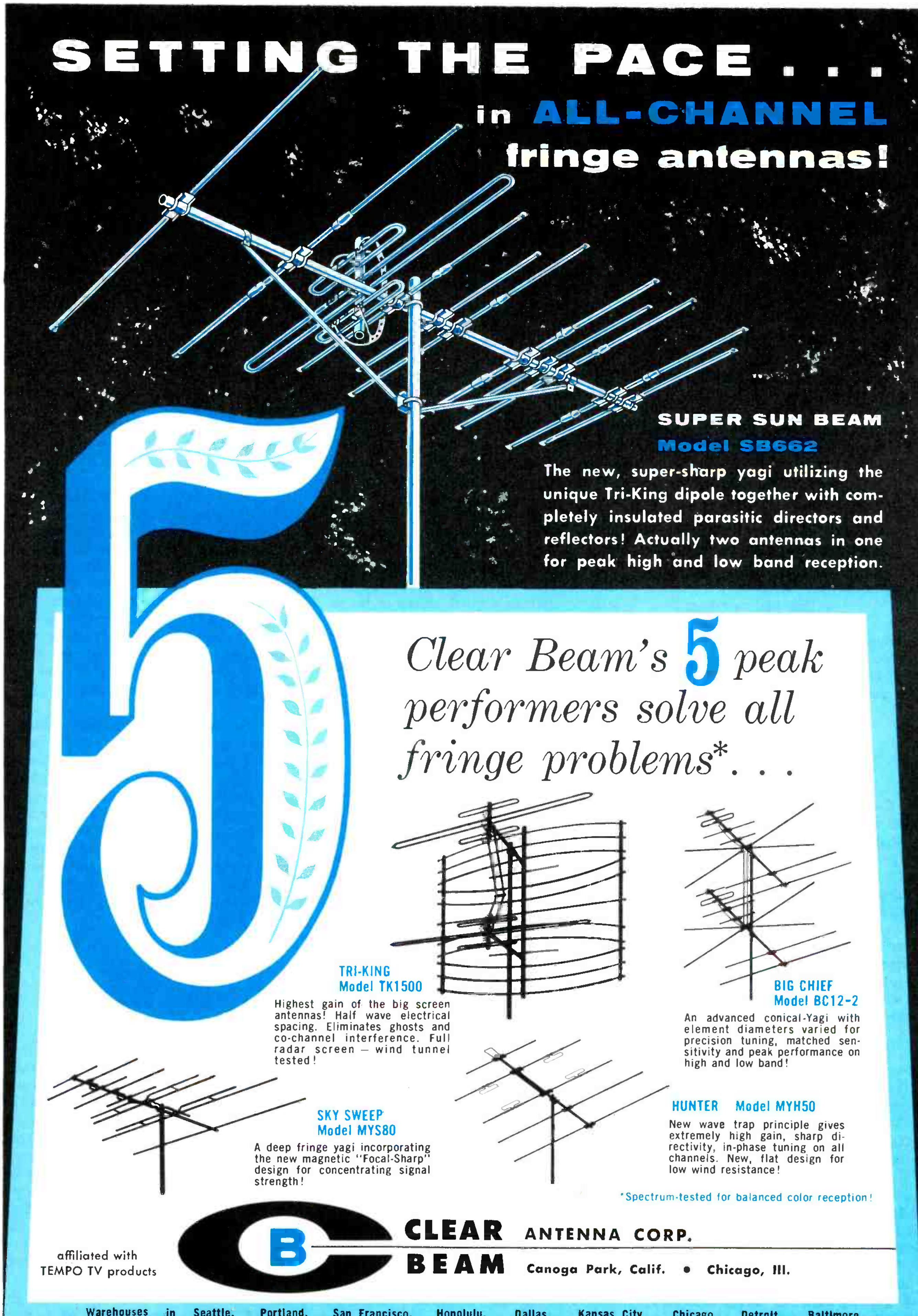
This brings up the question of passes. Each exhibitor gets a certain number of them, presumably for his best customers; but friends can often talk one out of a friend. Then there are press cards which are even better than passes at some shows and are sometimes easier to get. In one press room, for example, the head of the show was busy on the phone when we (covering the show for the first time and hence unknown to him) asked for a press pass. Pointing to the typewriter, he grunted, "Go ahead and type it out yourself." We did, and so did the next guy! Curious, we lingered over the table of press releases. Then came a friend of the show manager, who likewise was puzzled by the parade of guys typing their own press passes. The manager then explained his philosophy, "I figure that if they can type, they're legitimate editors."

The usual identification cards issued at conventions have your name typed on a standard machine, usually with a worn-out ribbon so that the name is almost impossible to read at hand-shaking distance. This calls for a combination of head bending and hearty hand shaking as two long-lost friends try to jog their memories for names without letting the other one know they're forgotten and are sneaking a look at the card.

Recognizing that the same name-remembering problem exists when guests are taken through its plant to meet dozens of people, Minneapolis-Honeywell has its guards letter up an identification card for each visitor. This fits into a man's breast pocket, with the name clearly visible on the projecting top portion. Much better than the usual carbon copy of the admission pass usually given at factory entrances.

GARAGE-DOOR CONTROLS. Now that we have electric elevators for front seats of cars and electric lifts for windows, more and more people are getting interested in automatic garage-door openers. For literature on three different types featuring radio, hydraulic, or key-switch control, write Alliance Mfg. Co., Alliance, Ohio. The hydraulic control, by the way, is simply actuated by means of a hose across the driveway.

* * Please turn to page 46 * *


SETTING THE PACE . . .
in ALL-CHANNEL
fringe antennas!
SUPER SUN BEAM
Model SB662
The new, super-sharp yagi utilizing the unique Tri-King dipole together with completely insulated parasitic directors and reflectors! Actually two antennas in one for peak high and low band reception.
5
Clear Beam's 5 peak performers solve all fringe problems*. . .
TRI-KING
Model TK1500
Highest gain of the big screen antennas! Half wave electrical spacing. Eliminates ghosts and co-channel interference. Full radar screen — wind tunnel tested!
BIG CHIEF
Model BC12-2
An advanced conical-Yagi with element diameters varied for precision tuning, matched sensitivity and peak performance on high and low band!
SKY SWEEP
Model MYS80
A deep fringe yagi incorporating the new magnetic "Focal-Sharp" design for concentrating signal strength!
HUNTER Model MYH50
New wave trap principle gives extremely high gain, sharp directivity, in-phase tuning on all channels. New, flat design for low wind resistance!
*Spectrum-tested for balanced color reception!
affiliated with
TEMPO TV products
CLEAR BEAM ANTENNA CORP.
Canoga Park, Calif. • Chicago, Ill.
Warehouses in Seattle, Portland, San Francisco, Honolulu, Dallas, Kansas City, Chicago, Detroit, Baltimore

Color TV Training Series

(Continued from page 11)

IF section should be checked. It is possible that this section is misaligned and therefore is not providing proper amplification of the chrominance signal.

In the event that the amplitude of the chrominance signal appears to be normal at the grid of the bandpass amplifier, it is probable that this stage is not providing the proper amount of amplification. Since a new tube should have been tried, the voltages around this stage should be measured. A low plate or screen voltage could cause the trouble, or the bias on the stage may be excessive.

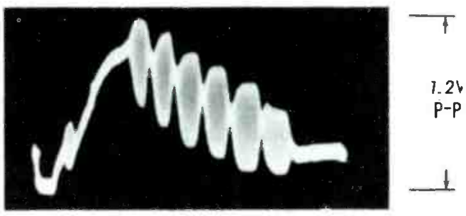


Fig. 12-16. Normal Waveform of the Signal at the Grid of the First Video Amplifier.

The circuit drawing in Fig. 12-13 includes the circuit of the color killer. This circuit is employed to cut off the bandpass amplifier during monochrome reproduction. Similar circuits are used for this purpose in several makes of receivers. The color killer is usually held at cutoff by a negative voltage which is developed at one of the phase-detector stages by the burst signal. Such is the case in the circuit under discussion. A weak burst signal will not develop enough negative voltage at the plate of V28B to hold the color killer at cutoff. As a result, the color killer will conduct and a negative voltage will be developed in the plate circuit. This negative voltage will appear at the grid of the bandpass amplifier and reduce the gain of this stage.

A negative voltage at the grid of the bandpass amplifier is an indication that the color killer may be conducting. If the burst signal observed at the phase detectors does not appear to have the proper amplitude, the voltages around the burst-amplifier stage should be measured. The alignment of the burst-amplifier transformer should be checked if no discrepancies are found in the voltages around the burst amplifier. Fig. 12-17 shows the waveform of a normal burst signal at the input of the phase detectors.

Reference Signals Lack Amplitude

If the amplitude of the chrominance signal at the input of the demodulators appears to be normal, the reference signals applied to these stages should be observed.

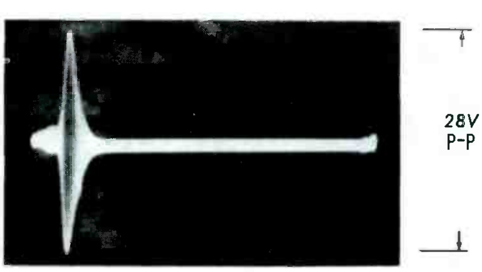


Fig. 12-17. Normal Waveform of the Burst Signal at the Input of the Phase Detectors.

The waveform in Fig. 12-18 shows how these signals should appear. Insufficient signal amplitude indicates that the signal from the 3.58-mc oscillator is not receiving the proper amplification. A probable reason for this is that the quadrature amplifier is not providing enough amplification. A measurement of the voltages around this stage should be a help in discovering the reason for the trouble.

In the circuit under discussion, there is a remote possibility that both the chrominance signal and the two reference signals applied to the demodulators are normal. This would be a strong indication that the gain of each of the two demodulator stages has been reduced by an equal amount. It is very unlikely that this trouble would be caused by the two tubes becoming equally weak at the

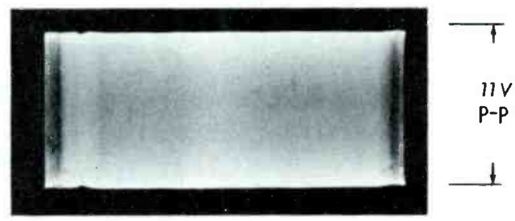


Fig. 12-18. Normal Waveform of the CW Reference Signal at the Input of Either Demodulator.

same time. A better guess is that some component common to these two stages in causing the trouble.

Refer again to Fig. 12-13, and note that the screen grids of the two demodulators have a common voltage supply. If the filter capacitor C8D becomes leaky, the voltage applied to these screen grids will be reduced. A sufficiently low screen voltage on the demodulator stages will cause a loss of saturation.

Loss of a Color-Difference Signal

Wrong colors can be caused by the loss of a color-difference signal. Two such signals are produced in the chrominance demodulation process. They may be called I, Q, R - Y, or B - Y signals depending on the type of receiver. Ordinarily, when one of the color-difference signals is lost, the colors reproduced on the screen are those which lie along the axis of the remaining color-difference signal. Thus, in a receiver which demodulates along the R - Y and B - Y axes, values of red and cyan should be reproduced in the absence of the B - Y signal, and values of blue and greenish yellow should be reproduced in the absence of the R - Y signal.

In a receiver which demodulates along the I and Q axes, values of orange and cyan should be reproduced in the absence of the Q signal and values of green and magenta should be reproduced in the absence of the I signal. Fig. D9 of the Color Plate shows the pattern produced when the Q signal is lost, and Fig. D10 shows the pattern produced when the I signal is lost. Note that when either the I or Q signal is lost, the receiver can reproduce only two colors.

Let us examine the circuits in Fig. 12-19 for possible causes of the loss of a color-difference signal. The specific tubes which could cause the loss of the I signal without affecting the Q signal are the I demodulator, the I amplifier, and the I phase splitter. The tubes which could cause a loss of the Q signal are the Q demodulator and the Q phase splitter.

If tube replacement does not correct the trouble, an oscilloscope should be employed to find the stage that

HYCON MODEL 622

5" OSCILLOSCOPE

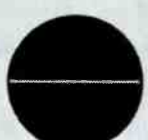
GOODBYE TO SYNC PROBLEMS

Now, Hycon brings you a really *new* oscilloscope, particularly adapted to random signals or low duty cycle pulses. Its unique *automatic triggered sweep* reduces adjustments, makes synchronization positive, protects phosphors in the absence of signal.

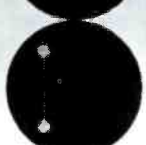
See and operate the new Model 622 at your local electronic parts jobber.

THE NEW 622 OFFERS...

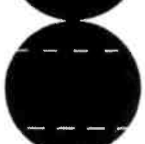
- preset TV sweep frequencies
- 6 mc (±3 db) vertical bandpass
- 5" flat face CRT . . . undistorted edge to edge
- illuminated graticule with dimmer
- electronically regulated power supplies
- unusually light weight
  and
- AUTOMATIC TRIGGERED SWEEP

1 

No signal . . . a stable sweep condition provides reference trace

2 

Signal on Y-axis . . . monostable sweep mode automatically assumed

3 

Triggered sweep (square-wave input) obtained by simply turning sync-level control

4 

Typical TV signal (off-air pickup by receiver) across full CRT screen. Can be expanded across X-axis if desired.

BASIC SPECIFICATIONS

VERTICAL AMPLIFIER
Frequency Response: 6 cps to 6 mc ±3 db; down less than 0.5 db @ 4 mc
Sensitivity: 10 mv rms (28 mv peak-to-peak) per inch
Input Impedance: 1 megohm, 40 mmf (±2 mmf) over entire attenuator range

HORIZONTAL AMPLIFIER
Frequency Response: 1.5 cps to 500 kc ±3 db
Sensitivity: 75 mv rms (210 mv peak-to-peak) per inch
Input impedance: 100k, 25 mmf

SWEEP CHARACTERISTICS
Usable writing speed . . . 0.03 sec/in to .3 μsec/in
Ranges . . .
a. 10 cps to 300 kc
b. Preset H & V television @ 7875 and 30 cps
c. 60 cps, variable phase line
Type . . . automatic triggered or straight triggered (by switching)

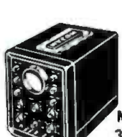
SYNCHRONIZATION
Internal, external, positive, negative or AC line

CALIBRATION
Internal 60 cps square-wave .05 volts peak-to-peak ±3%

POWER REQUIREMENTS
115 volts, 60 cycles, 175 watts

SIZE . . . WEIGHT
13⅝" x 10½" x 18¾" . . . 32 lbs.

HYCON *also brings you these test instruments . . . ready for color TV servicing*

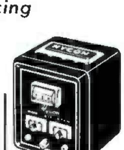


Model 617 3" Oscilloscope

High deflection sensitivity (.01 v/in rms); 4.5 mc vertical bandpass ±1 db; internal 5% calibrating voltage. **Flat face 3" CRT for usable trace edge to edge.**

Model 614 VTVM

Has 21 ranges (28 with peak-to-peak scales); 6½" meter; 3% accuracy on DC and ohms, 5% on AC; response with auxiliary probe to 250 mc. **Test probes stow inside case, ready to use.**



Model 615 DIGITAL VTVM

Reads out in numerical form . . . no interpolation, no reading wrong scale. Has 12 ranges; 1% accuracy DC and ohms, 2% on AC. **You CAN'T read this meter incorrectly.**

Hycon Mfg. Company

2961 East Colorado Street • Pasadena 8, California

"Where accuracy counts"

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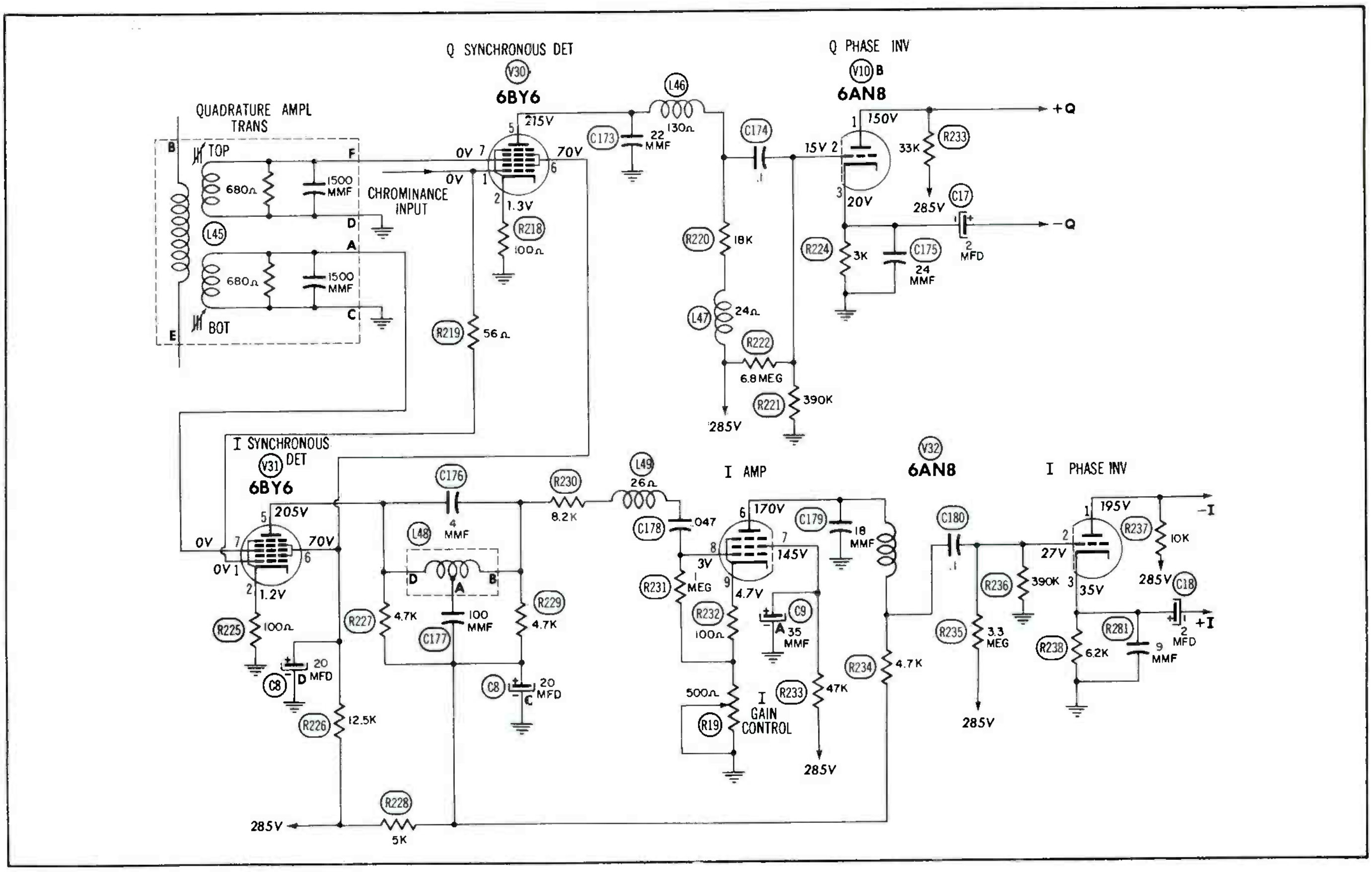


Fig. 12-19. Circuit Drawing of the I and Q Channels Used in the RCA Victor Model CT-100 Color Receiver.

is not passing the signal. Normal waveforms of the signals in this section are shown in Fig. 12-20. A good place to start tracing the lost signal is at the output of the demodulator stage associated with this signal. A normal signal at this point would indicate that the demodulator stage is functioning properly and that the fault is confined to a stage between the demodulator and the matrix sections. After the troublesome stage has been isolated, a VOM may be used to find the defective component in the conventional manner.

The absence of a signal at the output of a demodulator stage indicates that this stage is not functioning properly. The reason for this may be discovered by measuring the voltages around the stage and observing the signals at the input of the stage.

Some receivers incorporate a matrix section which requires specific values of both positive and negative color-difference signals in order to form the desired signal voltages. In the case of the RCA Victor Model CT-100, phase splitters are used to supply I and Q signals of both polarities to the matrix section (see Fig. 12-19). Because of the circuitry involved, it is possible to lose one polarity of a color-difference signal and not the other. For instance, if the 2-mfd capacitor C17 were to open, the minus-Q signal would not be applied to the matrix section.

This particular signal is needed to form the proper signal voltage for the green gun. An absence of this signal will reduce the conduction of the green gun during the reproduction of colors which contain green and will cause the green gun to conduct during the reproduction of colors which should contain no green. Fig. D11 of the Color Plate shows the color-bar pattern produced when the minus-Q signal is not applied to the matrix section.

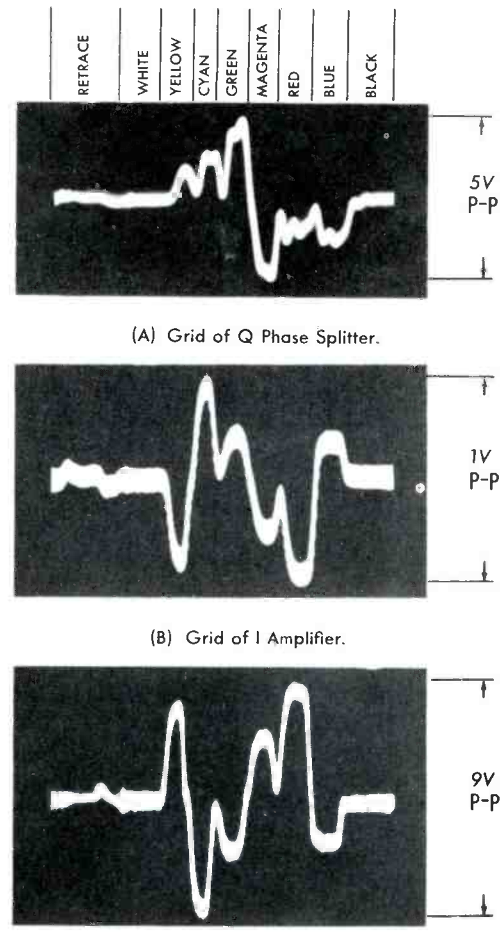
Referring to the schematic diagram in Fig. 12-19, it can be seen that the plus-I signal is applied to the matrix section through the 2-mfd coupling capacitor C18. This signal is needed in the matrix section to form the proper signal voltage for the red gun. An absence of the plus-I signal will reduce the conduction of the red gun during the reproduction of colors which contain red and will cause the red gun to conduct during the reproduction of colors which contain no red. Fig. D12 of the Color Plate shows the pattern produced when the plus-I signal is not applied to the matrix section.

Phase of 3.58-Mc Oscillator Signal Incorrect

A trouble may develop in a color receiver and cause that receiver to reproduce incorrectly all of the hues represented by an incoming signal. In some cases, the hues of the colors may be changed only slightly; and in other cases, the color bars may change to completely different hues. If the hues have shifted only a small amount, an adjustment of the hue control will generally correct the trouble. If the hues have changed completely, an adjustment of the hue control probably will not correct the trouble. It should be remembered that two wrongs do not make a right; and if a radical change from the normal setting of the hue control is required to restore the proper hues, there must have developed in the receiver circuits a trouble which should be located and corrected.

Information relating to the hues represented by a transmitted signal is denoted by the instantaneous phase relationship between the chrominance signal and the color burst. The hues reproduced on the screen of a color receiver are dependent upon the phase relationships between the chrominance signal and each of two reference signals. The source for these reference signals is a 3.58-mc oscillator in the color-sync section. Through the use of appropriate circuitry, the phase of the signal supplied by this oscillator is locked in step with the phase of the burst signal. If this phase relationship is not accurately maintained, the hues reproduced on the screen of the receiver will be incorrect; consequently, if a trouble develops in a color receiver and causes all of the hues to be reproduced incorrectly, that trouble should be located in the color-sync section.

The schematic drawing in Fig. 12-13 includes the color-sync section of the RCA Victor Model CT-100 color



(A) Grid of Q Phase Splitter.

(B) Grid of I Amplifier.

(C) Grid of I Phase Splitter.

Fig. 12-20. Normal Waveforms in the I and Q Channels.

receiver. From the discussion on the theory of operation of the color-sync circuits, it may be recalled that the burst-keyer stage and the burst-amplifier stage are used to separate the color burst from the chrominance signal. The phase detectors compare the phase of one of the two reference signals with the phase of the burst signal. Any phase error in the reference signal will cause a DC correction voltage to be developed at the center tap of the secondary winding of the burst-amplifier transformer. This correction voltage appears at the grid of the reactance tube and controls the current flow through this tube. An increase in the conduction of the reactance tube will retard the phase of the oscillator signal, and a decrease in the conduction of this tube will advance the phase of the oscillator signal.

Tube Troubles

One might think that a weak reactance tube would result in an error in the phase of the oscillator signal. Actually, this is not the case. If this tube becomes weak, the phase of the oscillator signal will tend to advance. This change will be noted in the phase-detector circuit. One of the tubes will conduct more heavily than the other, and a positive DC correction voltage will be developed. This positive correction voltage will cause the reactance tube to increase in conduction, and the phase of the oscillator signal will be retarded until it is correct. For this reason, the reactance tube itself should not be suspected of causing an error in the phase of the oscillator signal.

On the other hand, the tubes used as phase detectors might well be suspected. If one of these tubes becomes considerably weaker than the other, they will not conduct equally when the oscillator signal has the correct phase. As a result, a correction voltage will be applied to the reactance tube and will change the current through this tube. This will change the phase of the oscillator signal so that it will be incorrect. To a certain extent, this trouble may be compensated for by a readjustment of the hue control; however, if a considerable change from the normal setting of this control is needed, a definite trouble exists.

Note that the AFC balance control R20 will also compensate for a difference in the conduction of the detector tubes. Slight readjustments of this control are permissible, since the aging of components is bound to cause some change in their values. If a radical change in the setting of this control is required, one of the detector tubes has become very weak or one of the associated components has changed in value. It is always better to find the reason for the change and to make the necessary corrections rather than to compensate for the change by making a radical readjustment of a control.

Defective Components

If the replacement of tubes or the adjustment of controls does not correct the phase of the oscillator signal, the chassis should be removed from the cabinet for further analysis. To make sure the burst-amplifier stage is operating properly, the signal at the input of one of the phase detectors should be observed on the oscilloscope. The normal waveform of this signal was shown in Fig. 12-17.

Under certain conditions, the entire chrominance signal instead of just the burst signal may appear at the inputs of the phase detectors. This would result if capacitor C156 became leaky or shorted and allowed a positive voltage to appear on the grid of the burst amplifier. The keying pulse which is normally applied to this grid would be greatly reduced, and the bias on the stage would be such that all of the chrominance signal at the grid would be amplified and applied to the phase detectors. A waveform which shows the signal at the input of one of the phase detectors when C156 is leaky can be seen in Fig. 12-21.

The phase of the chrominance signal is different for each color it represents. The phase detectors cannot follow rapid changes; consequently, the correction voltage applied to the reactance tube is developed from the average phase of the chrominance signal and is not correct. The oscillator signal will not have the proper phase, and the colors reproduced on the screen will be incorrect.

If the burst signal at the inputs of the phase detectors appears to be normal, the DC voltages at the cathode of V27B and at the plate of V28B should be measured with a VTVM. The voltage at V27B will be positive, and the voltage at V28B will be negative. If one of these voltages is higher than normal and the other voltage is lower than normal, R201 or R202 may have increased in value or C158 or C159 may have changed in value.

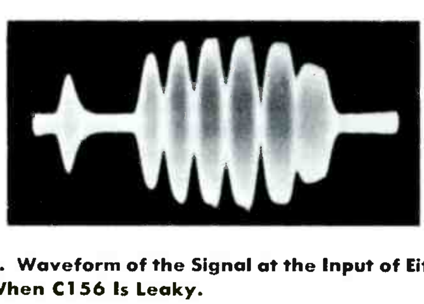


Fig. 12-21. Waveform of the Signal at the Input of Either Phase Detector When C156 Is Leaky.

If the voltages on the phase detectors appear to be normal, the DC correction applied to the grid of the reactance tube should be measured. A VTVM should be used to make this measurement. When the receiver is tuned to a signal from a color-bar generator, this voltage should measure between -.4 volt and -.6 volt. One reason for an abnormal voltage at this grid is a misadjustment of the reactance transformer L43. Another reason is that the reactance tube is weak; however, as previously mentioned, a weak reactance tube will probably not cause the hues to be reproduced incorrectly.

Misalignment

Wrong colors may also result if any of the tuned circuits in the color-sync section are not aligned properly. Normal operation can generally be restored by adjusting the hue and saturation controls; however, if either of these controls has to be changed to a setting that is far from normal in order to obtain the proper colors, an alignment of the color-sync section may be in order.

If it is determined that a particular circuit is not aligned properly, it is possible that some component in this circuit has changed value. All possibilities of changed values should be exhausted before it is assumed that the trouble is due to misalignment. The tuned circuits in a color receiver are generally stable and should not become misaligned through normal usage unless there has been a radical change in the value of a circuit component.

Summary

The symptoms of wrong colors fall into three categories. These are a loss of color saturation, a complete or partial loss of a color-difference signal, and an error in the phase of the 3.58-mc reference signal.

The stages in which a trouble is most likely to develop and cause a loss of saturation are the bandpass amplifier, the first video amplifier, and the quadrature amplifier. It is also possible for a loss of saturation to be caused by a misalignment of the video IF section or a faulty component which is common to both of the demodulator stages.

If the symptoms indicate that one of the color-difference signals has been lost, it is likely that the trouble is in a stage through which this signal must pass in order to reach the matrix section. On rare occasions, a signal will not appear at the output of a demodulator because either the chrominance signal or the reference signal is not available to this stage. If only one polarity of a color-difference signal is lost, the trouble lies between the associated phase-splitter stage and the matrix section.

An error in the phase of the 3.58-mc oscillator is due to a misalignment of the color-sync section or a faulty component within this section. The tubes most likely to cause this trouble are those used as the phase detectors.

This concludes the discussion on the trouble-shooting procedures involved in determining the causes of wrong colors. The next section of this series will cover procedures involved in finding causes for a loss of color synchronization.

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 and VERNE M. RAY

Transport Mechanism in Ampex Model 600 Tape Recorder

(Continued from page 13)

and the drawings in Figs. 4, 5, 6, and 7, we can see how and why this unit operates so consistently and satisfactorily.

In Figs. 1 and 2, the more easily recognized features of the tape recorder are shown. Fig. 3 shows four views of the mechanism which is normally hidden by the front panel. The most important working parts are indicated by name; and since most of them can be seen from more than one angle, some understanding of their form and purpose can be gained.

The drawings in Figs. 4, 5, 6, and 7 show the important moving parts (or the parts that turn) as seen from the front-panel side. They are shown in the positions they occupy during the different operating modes and as they would appear if the front panel and other obstructions were invisible. Connecting arms and levers that shift the parts on their pivots are not shown for the sake of simplicity.

Important and interesting parts such as the holdback brakes and the brake-shock-relief assemblies warrant special attention. The hold-back brakes are simple. They are very flexible, felt-faced pieces that automatically drag on the black bakelite drums when the shafts rotate away from them. There is no need for outside levers or controls to actuate the brakes.

The rewind and the take-up turntables each have an associated brake-shock-relief assembly. These assemblies are swung on their pivots by levers in order to produce added tape tension and in some cases in order to lock the clutch assemblies so that they cannot turn. When the corrugated surfaces of the rollers (which do not turn freely) are swung into position against the rubber rims of the clutches, braking action is produced if the clutches are rotated away from the rollers. When a clutch is rotated toward a roller, the clutch is locked and brought to a standstill.

The smooth and positive operation of such uncomplicated parts as those used in conjunction with the clutch assemblies (which are composed of various metal, plastic, and felt discs upon which pressure is maintained by springs) makes the Ampex Model 600 a very reliable and trouble-free unit.

Standby Mode

In Fig. 4, the major moving parts are shown in the positions they occupy when the recorder is operating in the standby mode or when it is turned off. In the standby mode, the ON-OFF switch in the electronic section (not shown) is turned on and the motor is turning. In fact, the motor is always running whenever the ON-OFF switch is turned on. This keeps the motor warmed up and operating at normal speed to ensure smooth, positive tape motion when the recorder is shifted into any of the operating modes.

The play-record control and the rewind and fast-forward control are shown in their neutral or standby positions. Because of the interlocking mechanism previously mentioned, neither can be turned from its neutral position if the other control has been set in one of its operating positions.

If the motor is running, the flat nylon drive belt will turn the flywheel which causes the round rubber take-up belt to turn the take-up pulley. But the tape is not moved when the recorder is in the standby mode because the reels are not turned and because the tape is not held against the capstan. The direction in which each pulley rotates is shown by an arrow in Fig. 4.

Play-Record Mode

The play-record control has been turned to the PLAY position in Fig. 5. The control and the parts that moved to put the mechanism in the play mode are shown in color.

The parts remain in the same PLAY positions when the play-record control is turned to the RECORD position because the only changes made are in the switching of electronic circuits. In other words, the tape is handled in the same manner in the play and record modes; but the playback and record circuits are switched.

The tape moves when the recorder is in this mode because the tape is held against the rotating capstan by the capstan idler (or pressure roller) which has been swung into position on its pivot.

The take-up pulley has been swung on its pivot to the position which allows the take-up belt to ride against the play and take-up clutch. The take-up pulley turns the take-up reel to take up the tape being pulled off the supply reel by the capstan. The take-up reel does not pull the tape across the heads; but because of the slippage allowed by the clutch, a constant tension is maintained on the tape as the tape winds on the take-

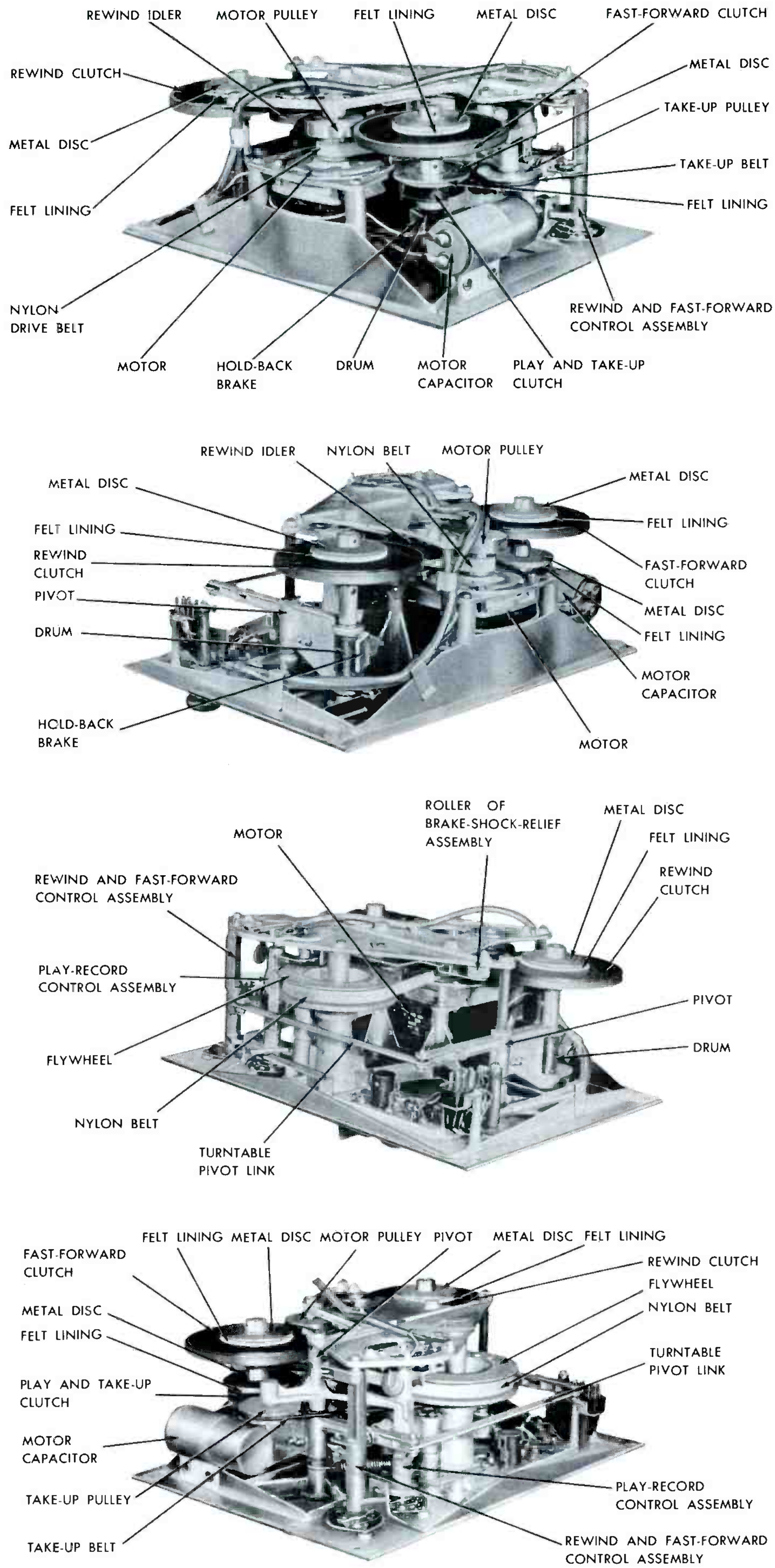


Fig. 3. Four Views From Four Different Directions Showing Important Operating Parts With Controls in Neutral or Standby Position.

up reel. Because of the effective increase in diameter of the reel as the tape fills the reel, the speed of the take-up reel slows down.

During the playback or record mode, the turntable for the supply reel rotates counterclockwise. As a result, the rewind clutch is held motionless by the brake-shock-relief assembly. This action produces tension on the tape as it is pulled from the supply reel. Added tension is supplied by the drag of the hold-back brake on the drum, which is on the turntable shaft, as the drum rotates away from the brake pad. This tension is needed to hold the tape in contact with the faces of the erase head, record head, and playback-monitor head because no pressure pads are used.

Rewind Mode

In Fig. 6, the parts that changed position when the recorder was shifted to the rewind mode are shown in color. The reel turntables have been swung to the right on their pivots. The rim of the rewind clutch therefore bears against the rewind idler wheel which is moved in its retaining slot to make contact with the larger rim of the motor pulley. This causes the rewind turntable to turn in a clockwise direction and pull the tape off the take-up reel. The rewind turntable can turn freely because the roller of the brake-shock-relief assembly associated with this turntable does not touch the rim of the clutch and because the holdback brake does not hold when the shaft turns in a clockwise direction. Rewinding is accomplished at high speed because the idler wheel runs on the portion of the motor pulley where the diameter is larger.

Light tension is maintained on the tape by the holdback brake on the shaft of the take-up turntable. The brake-shock-relief assembly associated with this turntable has been pivoted away from the rim of the fast-forward clutch. Enough tension is applied to the tape to keep it from spilling but not enough to make it have unnecessary and undesired contact with the faces of the heads. Such contact would cause needless wear of the heads.

When the rewind and fast-forward control is turned back to its neutral (or middle) position, the brake-shock-relief assemblies snap back to their standby positions in which their rollers press against the rims of the clutches and stop the movement of the tape.

Fast-Forward Mode

Fig. 7 shows in color the parts that moved when the mechanism was put in the fast-forward mode. Both reel turntables have been shifted to the left. The rim of the play and take-up clutch presses against the large-diameter section of the motor pulley, and the take-up reel is turned at high speed to pull the tape off the supply reel.

Sufficient tape tension is maintained by the holdback brake on the shaft of the supply turntable. This tension is obtained in a manner similar to the way it was accomplished during the rewind mode and for the same reasons.

The braking and stopping action is the same when the control is turned back to neutral as it is when the control is turned back from rewind.

It may seem that a lot of time has been spent in discussing and showing examples of tape-transport mechanisms. This has been for a reason. Their importance cannot be overstressed because any discrepancy in mechanical performance will be reflected in the recording and playback performance. Good results cannot be obtained when recording or playing back, if the tape is not handled with a high degree of accuracy by the transport mechanism.

ROBERT B. DUNHAM

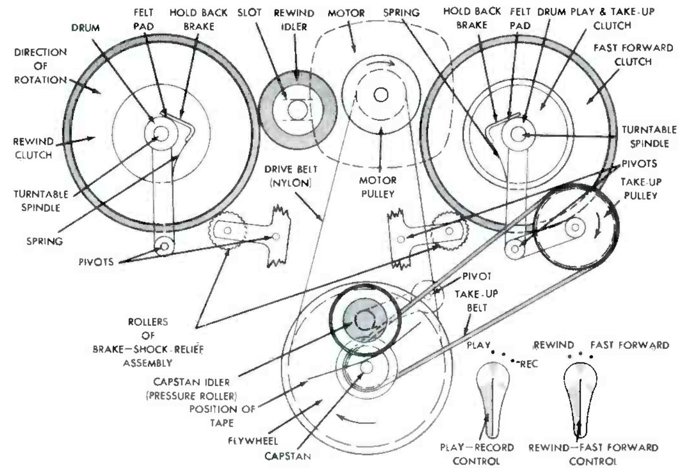


Fig. 4. Drawing Showing Position of Parts When Controls Are in Standby Position and Viewed From Front Through Panel.

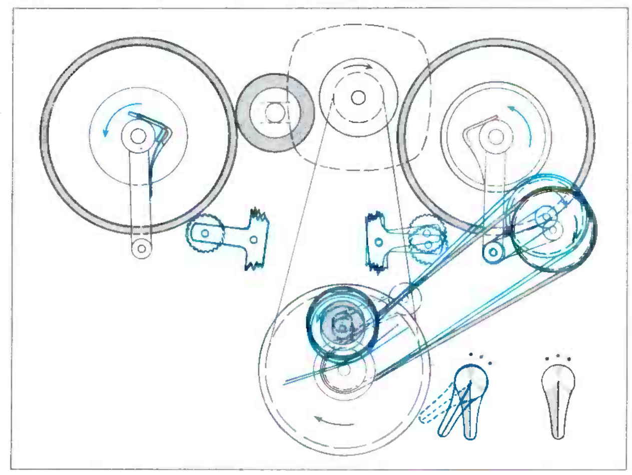


Fig. 5. Parts Which Move When Play-Record Control Is Moved to Play Position. Positions Before Moving Are Shown in Black and After Moving Are Shown in Color.

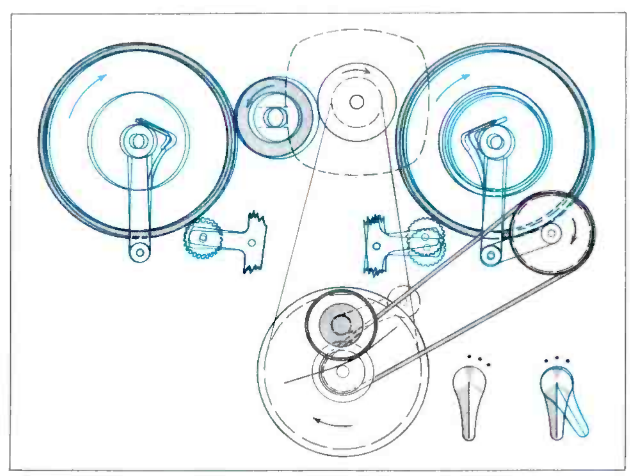


Fig. 6. Parts Which Move When Rewind and Fast-Forward Control Is Moved to Rewind Position. Positions Before Moving Are Shown In Black and After Moving Are Shown in Color.

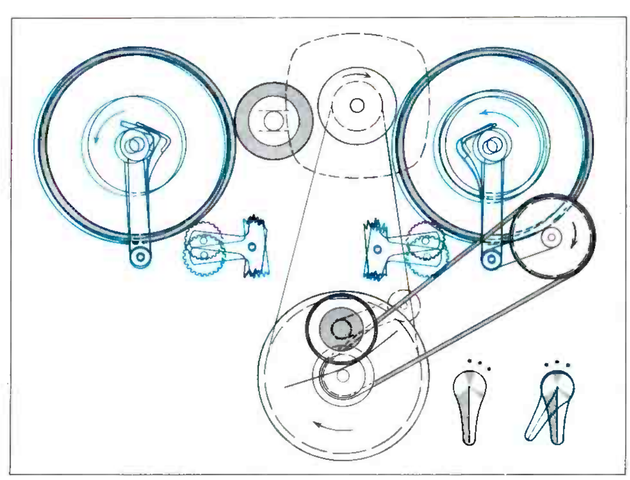
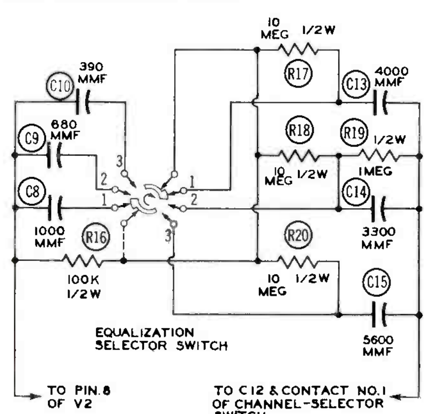


Fig. 7. Parts Which Move When Rewind and Fast-Forward Control Is Moved to Fast-Forward Position. Positions Before Moving Are Shown in Black and After Moving Are Shown in Color.

CORRECTION NOTE

In the June 1955 issue of the PF REPORTER, a schematic diagram of a preamplifier and control unit appeared on page 25. One terminal of the equalization-selector switch was left unconnected on this diagram. This terminal should be connected as shown by the dotted line in the schematic diagram which accompanies this correction note.



CONNECT SWITCH TERMINAL AS SHOWN BY DOTTED LINE

Also, in the original schematic diagram R34 should be a 47Ω 1 Watt resistor as given in Parts List.

In the Interest of Quicker Servicing

(Continued from page 25)

it is necessary to remove the side cover of the tuner. First, take out screws A and B which are designated in Fig. 2. Then heat the soldered points, which are also shown in Fig. 2, with the soldering iron. At the same time, slip a screwdriver under the cover to spread the seams. Allow each soldered point to cool before going on to the next.

After the side cover is removed, the solder lugs for the contacts will be exposed as shown in Fig. 3. Because there are a total of nine solder lugs to be disconnected, it is advisable to make a sketch showing the lugs and the leads or components attached to them. The drawing need not be elaborate, although it should show

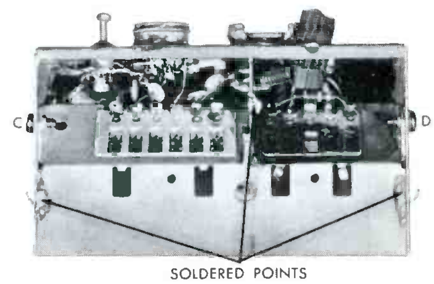


Fig. 3. Screws and Soldered Points Which Hold Contact Plate and Bracket Assembly in Place.

enough detail to prevent any confusion. A mistake in reassembling can be costly in both time and labor because the chances are that the mistake may not be discovered until the set is put back together and tested.

Next, the leads are unsoldered. This should be done carefully. The component leads are very short on account of the limited space and the high frequencies at which the circuit operates, and too much heat and rough handling may result in one or more damaged components.

After all the leads are unsoldered from the contact plate, the next step is to remove the entire contact plate and bracket assembly. First remove screws C and D, and then unsolder the points shown in the photograph in Fig. 3.

The photograph in Fig. 4 shows the damaged RF strip and the damaged contact plate and bracket assembly alongside the new strip and assembly for comparison. Note that three of the contacts on the original assembly are almost completely gone.

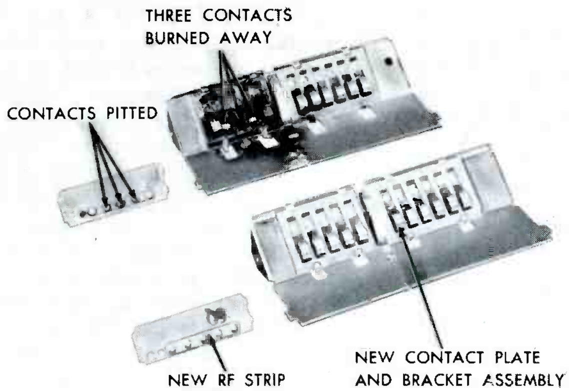


Fig. 4. Damaged Parts and New Parts for Replacement.

Fig. 5 shows the tuner with the new contact plate and bracket assembly partially inserted. Note the slot into which the bracket assembly slips. From here on, the procedure is just the reverse from that for removing the assembly and covers. Make sure that these covers are well soldered at the specified points.

Before operating a set after the repair of lightning damage, it is

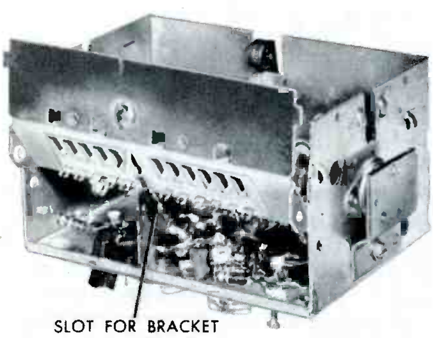


Fig. 5. New Contact Plate and Bracket Assembly Partially in Place.

advisable to check the line-filter capacitor or capacitors which are in the AC input circuit of the receiver. Too often these capacitors become shorted when the set is hit by lightning. If this has occurred and if the set is again hooked up to an outdoor antenna which happens to be grounded, the RF coil and the contacts may again be burned. The drawing in Fig. 6 shows the low-impedance path through which power-line current can travel and do damage. If one side of the power line is connected directly to the receiver chassis, make sure that the blocking capacitors in the antenna input circuit are not shorted.

IN THE HOME

Substituting Tubes in Series-Parallel Filament Strings

A large number of television receivers employ series-parallel filament strings. These receivers generally contain from 15 to 20 tubes. Locating an open filament in such a receiver poses quite a problem, since not only must tubes be checked until the open filament is found but the balance of the filament circuit must also be checked so that the technician can make sure that no other tubes have open filaments.

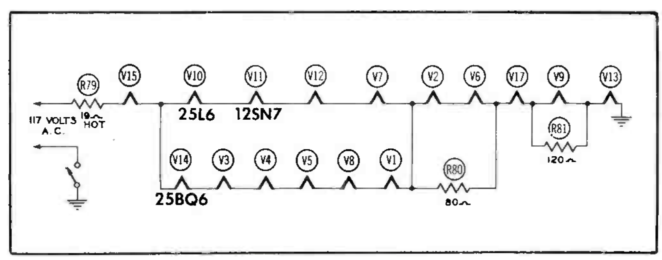


Fig. 7. Filament Circuit in Motorola Chassis TS-315A.

A technician recently made a call to service a Motorola Chassis TS-315A. The receiver employed a series-parallel filament string such as that shown in Fig. 7. Notice that in this string there are four tubes connected in parallel to six other tubes.

The customer's complaint was that there was no sound, no picture, and no raster. Using a filament tester, the technician determined that the 25BQ6 tube V14 had an open filament. A new tube was installed, and power was applied. This resulted in a momentary flash in the new tube which then failed. Too late it was realized that a thorough and complete check of all of the tubes should have been made before power was applied. Subsequent investigation revealed that not only had the original 25BQ6 tube V14 failed but that the 25L6 tube V10 and the 12SN7 tube V11 had also failed.

The reason for this multiple failure can be arrived at from a study of the filament circuit in Fig. 7. A failure of one of the tubes in one of the parallel branches will increase the total resistance in the filament circuit. The current through the tubes V15, V2, V6, V17, V9, and V13 will be lower than normal; and the voltage which is dropped across this series of tubes will also be lower than normal. As a result, the voltage across the series of tubes in the remaining parallel branch will rise and one or two tubes in this branch may fail.

After all of the tubes with open filaments had been located and replaced in the faulty receiver, power was applied to the receiver. Almost immediately, there was a hissing sound accompanied by an odor like that of oil. Investigation revealed that a B+ filter capacitor rated at 200 microfarads and 150 volts had failed apparently because of the surge that occurred on the B+ line when the tubes failed.

Questioning of the customer revealed that the receiver had been left on for a considerable length of time after the sound and picture had disappeared.

Two points are brought out by this experience. Not only must the technician check the entire receiver thoroughly, but also the customer should be cautioned to turn off the receiver at once whenever there is a complete loss of raster. This procedure on the part of the customer and the service technician will help to prevent the future occurrence of such a chain of events.

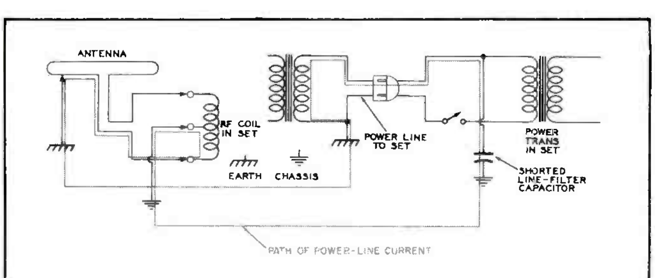


Fig. 6. Path of Power-Line Current When Line-Filter Capacitor Is Shorted.

A similar situation with a different receiver arose a few days later. This time, the receiver involved was a General Electric table model. The customer's complaint was (as in the other case) that there was no sound, no picture, and no raster. Investigation again revealed an open filament, this time in a 25BQ6 tube. In this particular case, the remainder of the tubes were checked and two more tubes with open filaments were located. These were in the other parallel branch of the filament circuit and were the 25L6 audio-output tube and the 12AU7 vertical-output tube.

After all of the defective tubes were replaced, the receiver was turned on. It was noted that the sound was very weak. The chassis was removed, and inspection revealed that the cathode resistor in the audio-output stage was burned through. This resistor failure was evidently the result of a heater-to-cathode short in the original 25L6 audio-output tube. A later check of this tube confirmed this suspicion.

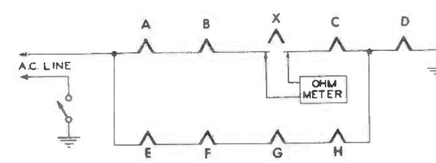


Fig. 8. Setup for Quick Check of Filament Continuity in Series-Parallel String.

If one branch of a parallel network has an open filament, there is a fast method of checking the other branch of the network. Refer to Fig. 8 which is a simplified schematic diagram of a series-parallel string. If tube X is found to have an open filament after tubes A, B, and X have been checked, then the tubes C, E, F, G, and H can all be checked at once by measuring continuity between the two filament connections at the socket of tube X. Since this tube is already out of its socket, the ohmmeter prods can be inserted into the proper socket holes from the top of the chassis.

If the meter shows a resistance of less than 500 ohms, then it is known that the tubes which are in series between the two test points have their filaments intact. On the other hand, an indication of a high resistance means that one or more of the tubes C, E, F, G, or H are bad. Tube D must be checked separately.

A schematic diagram of the filament circuit must be available for reference in order for the technician to make the foregoing quick check of the filaments.

HENRY A. CARTER and

CALVIN C. YOUNG, JR.

Shop Talk

(Continued from page 5)

characteristics. Replacement with new tubes could be done; but from a business point of view, it would not be economically feasible.

TABLE I

Six Ways That Three Tubes Can Be Placed In Three IF Stages

First IF Stage	Second IF Stage	Third IF Stage
Tube A	Tube B	Tube C
Tube A	Tube C	Tube B
Tube B	Tube A	Tube C
Tube B	Tube C	Tube A
Tube C	Tube A	Tube B
Tube C	Tube B	Tube A

Checking Filament Resistance

A desirable facility in any tube tester is its ability to reveal the filament current drawn by a tube when the rated voltage of the tube is applied. This is an important factor now that the trend toward connection of tube filaments in series appears to be gaining in popularity. A tube that has a filament resistance that is higher than normal will take more than its allotted share of voltage when connected in a series string. Since just a certain amount of voltage is available across the string, the additional amount that one tube takes must be deducted from the filament voltage of one or more other tubes. If one of these other tubes is sensitive to variations in filament voltage, then even a slight decrease may reduce plate current just enough to prevent that tube from functioning properly. In an amplifier, the result may be reduced gain; and in an oscillator, oscillations may cease.

To discover a tube with a filament resistance that is too high or too low without measuring its filament current is not a simple job. So far as the writer knows, only the Precise and Sylvania tube testers possess special facilities for revealing this characteristic. On other tube testers, this high-resistance tube will appear normal. You may be able to locate the tube by measuring the drop in its filament voltage when the tube is in the set, but this method is frequently successful only if the deviation from normal is considerable. When the variation is less than 15 per cent, the service technician is not always given a clear-cut indication.

In one of their manuals, Hickok offers the following test to reveal the ability of a tube to perform under adverse conditions (such as that in which filament voltage is lower than normal). Here are their suggestions:

1. Test the tube in the normal way.

2. If the tube is satisfactory, the meter reading should be in the GOOD sector of the meter scale. If the needle is near the center of the GOOD sector or beyond, proceed to step 3. If not, adjust the ENGLISH control until the needle does reach the center of the GOOD sector.

3. While holding everything else constant, reduce the filament voltage one step, allow time for the filament to cool, and note the new meter reading.

4. If the meter still reads in the GOOD sector, the tube has a large reserve of life and will perform satisfactorily.

It is recommended that the voltage reductions be made according to Table II.

TABLE II

Settings of Filament-Voltage Selector

Normal Setting (volts)	Reduced Setting (volts)
1.5	1.1
2.0	1.5
2.5	2.0
3.0	2.5
5.0	4.3
6.3	5.0
7.5	6.3
10.0	7.5
12.6	10.0
35.0	25.0
50.0	35.0

Your particular transconductance tester may not have a control marked ENGLISH, but there are other testers on which this same control is frequently marked SENSITIVITY. In either case, the control is a shunt across the meter; and it regulates by its setting the amount of current passing through the meter. Even if your tester has neither of these control markings, you can learn to judge a tube by noting how much the needle drops when the filament voltage is reduced one step.

REVIEW

A check list of possible sources of trouble for specific defects is really a court of last appeal to which the harried technician turns in the desperate hope that perhaps he will find some clue that will bring him the solution he seeks. A check list that has been carefully compiled can be of considerable assistance, not only in the late stages of a service job, but also as a convenient memory jogger from time to time. Some people may have the enviable faculty of remembering better than others what they have learned; but for the rest of us, periodic booster shots are required to help us remember.

Eugene F. Coriell, a major in the United States Air Force, has made an extensive search of existing literature on the causes of hum in audio equipment and has compiled these causes into a check list under four different categories. It was felt that the readers of the PF REPORTER would find this check list of value, if only for reference; and for that reason, this article is being reviewed.

The original check list for audio hum appeared in the May 1953 issue of Radio-Electronics, a magazine published monthly by Gernsback Publications, 25 West Broadway, New York 7, New York. Subscription rates in the United States, its possessions, and Canada are $3.50 per year. Single copies are 35 cents each.

This check list which is concerned solely with audio hum is divided into the following four categories:

1. Power-supply hum.

2. Hum in associated circuits.

3. Hum in amplifier proper.

4. Last-ditch measures.

Although the aforementioned list contains 86 items, some of these were not considered as likely possibilities for the technician who deals only with AM, FM, or TV receivers of the types customarily used in the home. These items were therefore omitted, others were reworded, and still others were elaborated or modified.

AUDIO HUM CHECK LIST

Power-Supply Hum

1. Line-cord plug reversed in AC wall outlet. Don't scorn simple suggestions such as these. Many service technicians are so well versed in the complex causes that they overlook the simple ones.

2. Defective rectifier tube. In any service situation, tubes are checked early in the investigation.

3. Defective electrolytic filter capacitor.

4. Power transformer and choke improperly oriented or too close to audio transformers. Should be at opposite end of chassis from input transformer. (Rotate AF transformers for minimum hum.)

5. Omitted or open AC line-filter capacitors.

6. Lead from the center tap of the power transformer goes through one hole in chassis, and other leads from same winding go through another hole. This forms a single magnetic turn which induces circulating hum currents around a portion of the chassis.

7. The 110-volt AC input wiring too close to hum-sensitive elements.

8. Mechanical vibration from transformer or vibrator causing cyclic variation in spacing of tube elements. This hum is produced by microphonism in tube.

9. Separate power-supply chassis too close to amplifier chassis.

10. Hum-balancing potentiometer across filament supply omitted or improperly adjusted.

11. Half of secondary of the power transformer defective in full-wave power supply.

12. Filament winding of the power transformer not grounded at center tap or end of winding.

13. Chassis forms a common core lamination between power and audio transformers. Mount power transformer on brass bushings.

14. Common lead used to carry filament return and B-minus between separate power supply and amplifier chassis. Use separate leads for each.

15. Filament leads not twisted.

Hum in Associated Circuits

1. No earth ground on amplifier.

2. No common grounding conductor between associated chassis.

3. Feedback due to multiple earth grounds on interconnected equipment.

4. Defective connection between amplifier and turntable.

5. Coiled-up slack in turntable cables which then become effective hum-pickup coils.

6. AC power line cabled with other wires of amplifier.

7. Capacitive coupling between AC line and both the turntable-motor

frame and the amplifier chassis. Ground motor frame to amplifier chassis by separate conductor. Do not use the shield of the pickup lead for this purpose.

8. Modulation or tunable hum. Generally due to defective or missing line-filter capacitor or to leakage between heater and cathode in RF, oscillator, or converter tubes. Check also any filter capacitors in plate supply of oscillator tube.

9. Leads of speaker hum-bucking coil reversed.

10. Poorly soldered joints. This could occur anywhere in equipment.

11. Acoustic coupling between loudspeaker and audio-input tube. Install rubber-mounted or "floating" socket.

12. Interference from short-wave diathermy machines, fluorescent lamps, commutator sparking, and other nonaudio sources. Rightfully, this item should not be included in this listing because the noise produced can usually be distinguished from audio hum; however, some men might be confused by this trouble, and so it is mentioned here. Actually, in order to determine whether some external electrical device is causing the interference, move equipment to another location where power is received from a different line. If the trouble is due to one of the aforementioned causes, it will not be heard at this new location.

Possible cures can often be obtained by use of a commercial interference filter. In the case of fluorescent lamps, a new unit might prove less troublesome. Also helpful is a change of location in the same room or to another part of the house.

Hum in Amplifier Proper

1. Defective tubes.

2. Defective decoupling resistors and capacitors.

3. Open or leaky cathode bypass, screen bypass, and coupling capacitors.

4. Shield of grid lead not grounded.

5. Dirty or corroded grid caps or tube-base prongs.

6. Grid leads too close to filament leads.

7. Grid lead too long. This may cause inductive or capacitive hum pickup, especially if the lead sags and alters the lead dress.

8. Grid lead and grid return too far apart. The loop they form must be reduced in area by running these leads close together or by having the grid-lead shield serve as the grid return.

9. Circuit grounds made to wrong point or points on chassis.

10. Metallic tube shields missing or not grounded to chassis.

11. Unshielded plate lead in low-level stages. Ordinarily, one worries about unshielded grid leads; however, the plate lead of one stage is essentially the grid lead for the next one. If the signal level is low, plate leads should receive as much attention as grid leads.

12. Heater-to-cathode leakage inside a tube. Replace the tube.

13. Leakage or capacitive coupling between tube prongs across tube-socket insulation. This can be a particularly troublesome type of defect, especially since unused socket terminals are frequently used as tie points for unrelated portions of the circuit. An oscilloscope is generally a useful service instrument for this type of trouble.

14. Leakage between bypass capacitors in single-can, multiple-capacitor assemblies.

15. Input tube located too close to power transformer. Try installing a tube shield and reorienting transformer.

16. Sheet-iron shield needed around power transformer.

17. Replace present input transformer with one which is better shielded.

Last-Ditch Measures

1. Use DC on heaters.

2. Apply a positive DC bias (about 45 to 60 volts) to AC heaters.

3. Rebuild power supply on separate chassis.

4. Rebuild amplifier on nonmagnetic chassis.

In this final category, the suggestions are directed more to the home constructor than to the commercial service technician. The latter, in his everyday work, is concerned only with returning equipment to its original condition. He is not ordinarily concerned with design modification nor improvement.

MILTON S. KIVER

Dollar and Sense Servicing

(Continued from page 29)

NEED A HOBBY? For fascinating relaxation while still using your technical know-how, give a thought to finding and putting on tape the music of bygone days, such as that from calliopes, music boxes, barroom pianos, and no-man bands. All you need is a good tape recorder and a supply of nickels to drop in the slots.

All over the country, there are some excellent collections of these old instruments which play automatically. One truly outstanding array of working models is up on the third floor of one of the largest music stores in Syracuse, N. Y. Then there's the Deansboro Musical Museum in Deansboro, N. Y., the Cottman merry-go-round at Sylvan Beach, N. Y., and one or more machines in almost any city museum.

For tips on microphone placement when recording these mechanical musicians, read George Walter's article, "Capturing Yesterday's Music," in the June 1955 issue of Tape Recording.

With a hobby like this you'll meet a lot of interesting people, forget the problems of your work completely, and come up with recordings that can bring you some extremely valuable business publicity if you run them off now and then for local club groups. Once you get started, there'll be no problem in finding new machines to record, as the owner of each machine will tell you about others. Such a hobby will also make a vacation more enjoyable by giving a real goal for vacation planning. Through music boxes, you can make friends who'll guide you to interesting scenes the average tourist never sees.

OCTOPUS. With a quantity tube sale, RCA now offers a Multicord line cord resembling an octopus; and it deserves mention for its ability to speed up TV servicing in the home. At one end of the cord is an ordinary plug. At the other end are: the usual cheater socket for the set, a cube tap for soldering gun and test equipment, the special cord connector needed on some sets, and a handy light with switch and clamp.

Another interesting octopuslike cord is used by Westinghouse in its Metuchen, N. J., plant in order to facilitate testing and alignment of black-and-white TV sets. This cord is hooked up to some half-dozen places on each set as the set comes off the assembly line. The cord goes along with the set all the way through final testing. Each operator can easily hook up his own signal source and meter to the plugs and sockets of the cord instead of having to hunt all over the chassis for the right connection points or even to hunt under the chassis sometimes.

MOONGLOW. About the only trip not yet offered TV dealers as bait for selling more sets is space travel to the moon. Big problem with these bonus trips, says an Admiral executive, is that they take the dealer away from his store and hence cut down the number of sets he sells after the contest is over. The newest deal at Admiral is a share of the firm's stock (which sells for around $25) with each package of five TV sets purchased during the period of the deal.

JUKEBOX. Newest Seeburg coin-in-the-slot job for drugstore and restaurant trade uses tiny doughnut-shaped ferrite cores to remember the customer's selections. This magnetic memory has proved simpler and more reliable than former relay and switch mechanisms used for the purpose.

ROYALTIES. If you've got the urge to write a book and would like to know what's in it for you financially, the standard royalty figure today is 10 per cent of the retail selling price. By outlining the book, working up a few representative chapters complete with illustrations, and preparing a market analysis indicating your guesses as to who would buy how many books in what time, you can often obtain a firm contract with a publisher — and sometimes even a small cash advance on royalities — before putting all the work into the book. Pick a publisher who is now doing a good job of selling your type of book.

BATTLE REPORT. From the University of Illinois comes the latest report on the battle of the starlings. In the university towns of Urbana and Champaign, the starling situation was so bad that it became impossible to park cars under trees in the evening or even walk along the sidewalks without getting whitewashed.

The distress-call technique was selected as having the most promise. A natural cry was obtained from a starling having a string tied to one leg and fighting with his natural enemy, the blackbird. A slight boost was given to the high-frequency components during the recording of the resulting cries. The best section of this tape was spliced into a loop and repeated for re-recording to get a 6-minute tape. This was given to the local radio station WDWS for broadcasting on an early-evening free spot. Newspapers carried advance notice of the special public-service broadcast, and the station urged its listeners to place their sets near open windows and turn up the volume.

The first test disturbed the birds but not enough to get fly-away action. The tape was then lengthened to provide 15 minutes of playing time and was repeated on four broadcasts the following week. These threw the birds into utter confusion, and off they went. Only a few returned, chiefly to areas where public cooperation hadn't been too good.

If your own community has a starling problem, look up "Operation Starling" in the June 1955 Radio & Television News for helpful suggestions. One is to warn the public to turn down the volume at the end of the program. Another is the use of sound trucks and auto radios to cover dead spots such as in business districts where few radios are on in the evening hours.

X. Looks as if color sets will for some time require a final adjustment in the home to compensate for the earth's magnetic field. The top of the cabinet of RCA's new 26-tube color set is removable for this purpose among others. Once adjusted, moving the set may cause trouble unless an X marks the spot where it was. Pieces of Scotch tape can be put down on the floor or rug under the feet of the cabinet to guide the housewife in getting the set back in position after moving for housecleaning or other reasons.

MAGNETIC PICTURES. From off a ribbon of vinyl-backed magnetic tape came a complete 15-minute color TV program for closed-circuit transmission halfway across the country to a half-dozen 21-inch RCA color sets at the dedication of Minnesota Mining's new research laboratory. The 1/2-inch magnetic tape was run through the machine in NBC's New York studios at 20 feet per second, which is a new low in speed considering that a bandwidth of nearly 4,000,000 cycles encompassing both color picture and sound is used.

The chief problem is maintaining a uniform speed. Slight variations cause line jitter, seen as groups of lines displaced from others. An improved servo system now holds tape-speed variations down to less than 1 part in 5,000,000, but still greater improvements are needed and promised before video tape recording goes into use on a commercial basis.

Bing Crosby Enterprises, working separately on the same problem, has already built a machine for recording on magnetic tape the pictures seen on radar screens. This has important military uses, one of which is recording the pictures which appear on a radar monitor just as the CAA now records all verbal conversations with pilots at airports. This firm expects soon to demonstrate its version of a color TV recorder.

SCARCE COLOR TUBES. When color TV gets going full blast, probably this fall, keep a close watch on the tube situation. Right now some of the receiving tubes in the older color TV sets are really scarce, chiefly because there weren't enough sets sold to justify long production runs for these special tubes. Go overboard a bit on ordering for stock the new tubes that'll be appearing in the new sets. Then you'll have them when needed. You'll soon find out which ones are in the circuits which cause tube life to be short and can stock more of these types.

BIRTHS. Cute cartoon by Sid Hix in a recent issue of Broadcasting-Telecasting shows two men in the Vital Statistics Department looking at a sharply-descending city-birth-rate curve on the wall. One asks, "Wonder if the improved quality of the late TV shows has anything to do with it?"

John Markus

Servicing Modular TV Receivers

(Continued from page 21)

1/2 watt; therefore, the total wattage rating of the two units would be the required 1 watt. The resistive elements are of the printed-circuit type and are printed on the bottom side of wafer No. 2. R82 is printed on the top side of the same wafer. The resistance of R82 is 270K ohms, and connections are made to risers 2 and 12.

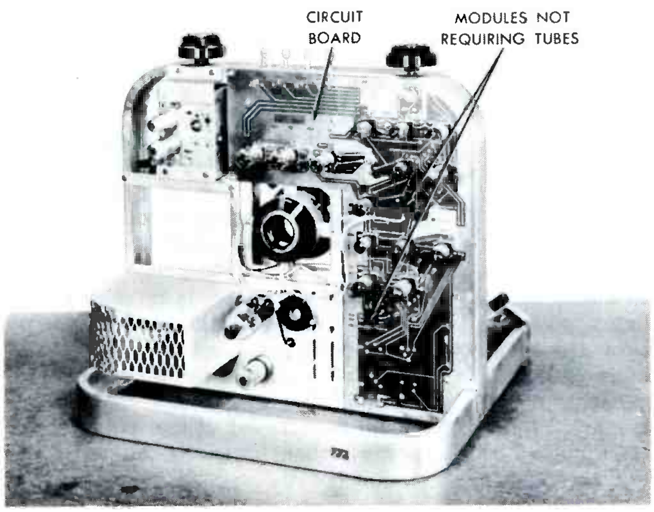


Fig. 3. Wiring Side of Modular TV Receiver.

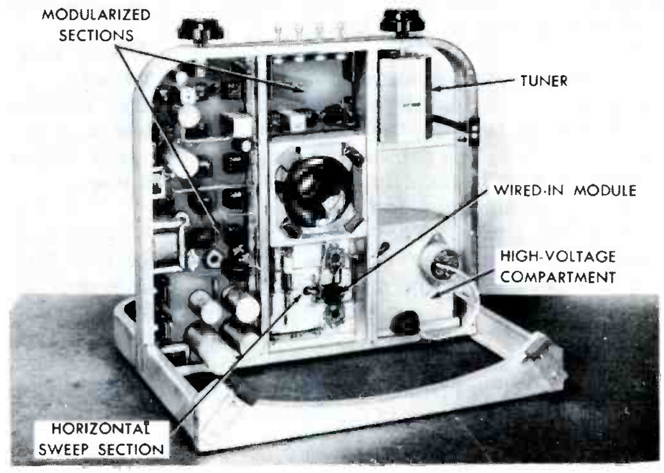


Fig. 5. Modular TV Receiver.

The schematic indicates that C65 is connected between risers 5 and 10 and that risers 4 and 10 are connected to each other. This circuitry is contained on wafer No. 3.

Wafer No. 4 contains C64 on its top side. The capacitor terminals are connected to risers 8 and 9. C66 is contained on the bottom side of wafer No. 5 and has connections to risers 2 and 5.

In the particular module just discussed, riser 6 is cut between wafers 3 and 4; and risers 7 and 12 are both cut between wafers 2 and 3. This was done to reduce coupling between risers.

In some modules, a riser wire beyond a cut is employed as a terminal point for making interconnections. Whenever this is done, the terminal point may be specified on the schematic diagram by a special mark. Such a mark would identify the number of the riser wire and also indicate that the point is not accessible at wafer No. 1 where the riser wire is usually connected to the chassis. This presents no serious servicing problem, however, since it is not usually necessary to make measurements at such terminal points. After all of the elements have been incorporated in the wafers shown in Fig. 2D and after all of the specified connections have been made, the completed module represents the entire circuit of Fig. 2B.

An index notch is placed on the edge of each wafer. The purpose of these notches is twofold: (1) for the alignment of the wafers during the construction process and (2) for orientation of the completed module when it is incorporated into the receiver chassis. The completed module is usually dipped into a special paint which dries to a hard, protective coating. Different colors of paint may be used for identification purposes.

How Modules Are Produced

In order to produce modules so that their cost will be competitive with present wiring procedures, extremely efficient methods of production must be employed. Complete automation of the manufacturing process has been adopted so that the cost can be kept low. The automation process is so complete that all elements are applied to the wafers and the wafers are assembled entirely by machinery. In addition, every wafer is tested before it is assembled into a module. Each completed module is tested under dynamic conditions to ensure 100-per-cent reliability. All tests are performed by machinery, and any defective wafer or module is automatically rejected.

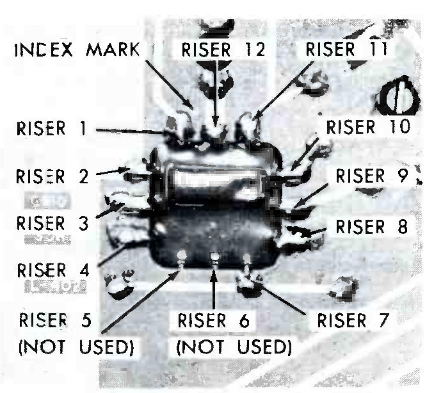


Fig. 4. Mounting Detail of Module in Circuit Board.

Such a system of automation is employed by ACF Electronics, a division of ACF Industries, Inc., Alexandria, Va. This company has registered the name of "Compac Module" for their product.

How Modules Are Mounted

Although it is difficult to predict exactly what methods will be used by the receiver manufacturers when installing modules in the receiver chassis, it is very possible that this operation will be done entirely by machinery. Machines can be used to orient the module automatically, to insert it into the circuit board, and to bend over the riser wires. A mass-soldering operation would then complete the wiring.

Fig. 3 shows the wiring side of a TV receiver which incorporates modules and printed wiring. The printed wiring is similar to that which has been used in radios and TV receivers for some time. The only difference is in the configuration of the wiring necessary to connect to the modules. Fig. 4 is a close-up of a portion of the circuit board and shows the mounting detail of a module which does not require a tube. The module has been inserted into the square hole in the chassis board, and the riser wires have been bent over and soldered to the printed wiring. Note the index mark that serves as

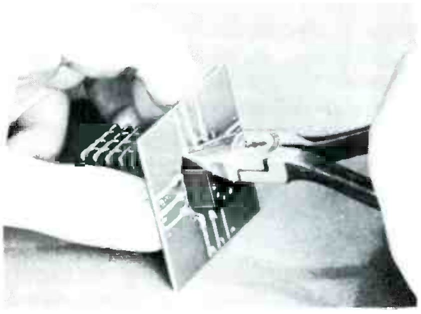


Fig. 6. Cutting Risers on Module Which Has Tube Socket.

a guide for the identification of the numbers of the riser wires which are numbered in a counterclockwise direction from the index mark.

On the circuit board, there are also markings identifying the point in the circuit to which the riser wires are connected. The points are marked GRID and SCR to identify these riser wires as connectors to the grid and screen of a tube. These markings and markings in other circuits could be incorporated by the manufacturer if so desired.

Fig. 5 shows the other side of the same receiver that was shown in Fig. 3. The positioning of the modules can be seen as can the rest of the components not included in the modules. The horizontal-sweep section includes the horizontal-output and the damper tubes. These tubes are wired in a conventional manner using tube sockets and leads. The high-voltage compartment and tuner are also wired in a conventional manner. Of particular interest is the wired-in module shown in the horizontal-sweep section. This module is not mounted on the chassis board but instead is self-supported by the riser wires which are wired to a conventional terminal strip. This method of mounting could be used in other instances if the manufacturer preferred.

How Modules Are Replaced

The replacement of a module is not an involved process but does require care. Let us assume that a module has been proved to be faulty and that a replacement unit is available.

The first step is to examine the plated side of the circuit board and to make sure that the index mark is visible. The position of the index notches on the original module will give a clue as to the position of the index mark. If the index mark cannot be seen, a substitute mark should be made on the plated side of the circuit board and in line with the index notches.

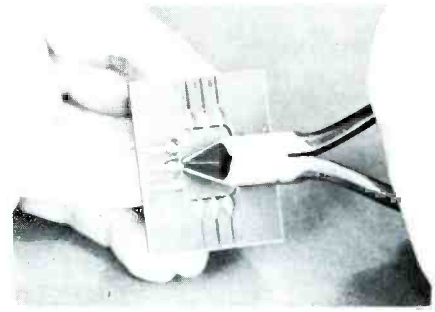


Fig. 7. Cutting Risers on Module Which Does Not Have Tube Socket.

A lead pencil should not be used to make this substitute mark because the graphite in the pencil is conductive and may introduce an unwanted resistance into the circuit. Use a nonconducting paint, corona dope, or a wax pencil for making the mark.

The next step is to remove the faulty module. If there is a tube on the module, remove the tube from its socket. Then cut the riser wires with a pair of diagonal pliers. The risers should be clipped at the point where they are bent over the edges of the circuit board.

The photograph in Fig. 6 shows diagonal pliers being used to cut a riser on a module which has a tube socket. It is almost imperative that a small pair of pliers be used to cut the risers on this type of module because space is limited.

The photograph in Fig. 7 shows diagonal pliers being used to cut a riser on a module which does not have a tube socket. The absence of the socket provides more space for the pliers, and the risers are easier to cut.

The photograph in Fig. 8 shows the cutout in the circuit board after the module has been removed. Note that the ends of the riser wires are still soldered to the plated conductors.

The ends of the risers should be removed by using a small soldering iron and a rag or brush. A small iron of 25 watts or less is recommended because excessive heat might loosen the plated wiring on the circuit board. Apply heat to the soldered points, remove the ends of the riser wires, and wipe off the excess solder with a rag or brush. Do not allow the solder to drip onto other parts of the receiver. The use of a rag rather than a brush is preferred because the solder will cling to the rag and will not drip.

After the terminals have been cleaned properly, the new module should be inserted into the cutout in the circuit board. The risers will usually exert sufficient force on the edges of the cutout to hold the module in place. Make certain that the index notches on the new module are aligned with the index mark on the plated side of the circuit board.

Bending the risers over the edges of the circuit board is the next step, but there are several warnings which should be mentioned. When a tube socket is mounted on a module, the terminals of this socket are connected to the riser wires by fired-silver conductors on the bottom and in some cases also on the top of the first wafer. These conductors should be treated with care. They are pointed out in Fig. 9.

The presence of the silver conductors on the first wafer is another reason for using a small iron during soldering operations. Excessive heat can melt the silver and cause an open circuit which will result in a permanently damaged module.

When bending the risers over the edges of the circuit board, do not allow the tip of the tool being used to touch the top of the first wafer. If the tip touches the wafer, the sharp edge of the tool might scrape off or break the silver conductors. As previously mentioned, this will result in a damaged module.

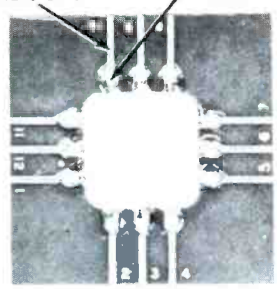


Fig. 8. Circuit Board Before Removal of Ends of Risers.

There are several methods of bending the riser wires, but the recommended method is performed as shown in the sketch of Fig. 10. The blade of a screwdriver is placed at the side of the tube socket at a point directly opposite the wire to be bent. Make sure that the tip of the screwdriver does not touch the first wafer. Use one hand to hold the module against the circuit board, and move the handle of the screwdriver outward. The riser should be bent only slightly with the screwdriver as indicated in Fig. 10. Then the eraser end of a pencil can be used to flatten the ends of the risers against the plated conductors on the circuit board.

If the module does not have a tube socket, the eraser end of a pencil can be used for the complete bending process. Hold the pencil as nearly parallel as possible to the circuit board, and push the end of the riser wire over the edge of the circuit board. Then hold the pencil at right angles to the board, and press down the end of the riser wire so that it will make firm contact with the conductor.

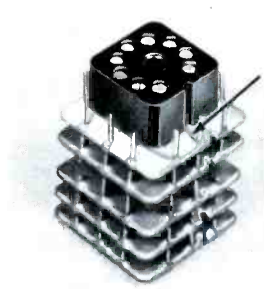


Fig. 9. Silver Conductors on Top of Wafer No. 1.

When the riser wires are bent over the ends of the plated conductors, make sure that the only bend in each riser is at the edge of the circuit board. If the riser is bent at any other place, it will not lie flat on the conductor; and a poor solder joint may result.

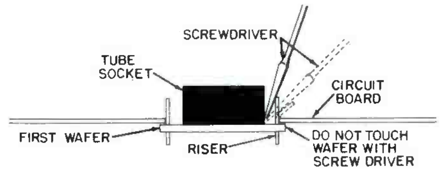


Fig. 10. Diagram Showing Recommended Method of Bending Risers.

Soldering the ends of the risers to the plated conductors is the final step in the replacement procedure. Although this procedure seems rather involved, a technician having only a limited amount of experience in the replacement of modules should be able to perform the complete operation in approximately two minutes.

Part II of "Servicing Modular TV Receivers" will discuss recommended procedures for the trouble shooting and servicing of receivers which employ modules. Particular emphasis will be placed on methods of overcoming servicing problems that are peculiar to this type of construction.

We wish to express our thanks to ACF Electronics for their assistance in supplying us with technical data included in this article and for making available to use the completed modular receiver and the individual module units shown in the illustrations.

WILLIAM E. BURKE and W. WILLIAM HENSLER

Examining Design Features

(Continued from page 15)

photograph of Fig. 3 is a top view of a typical T-Series tuner with the top plate removed to expose a few of the inner components. It may be noticed from the photograph of this particular tuner that each tube shield is grounded and mechanically secured to the tuner chassis with a bonding strap. One of the reasons for this added strap is to prevent a tube shield from falling off and causing a short between the receiver chassis and the cabinet in case a metal cabinet is used.

The RF test point shown in Fig. 3 may be reached through a hole in the removable top cover. Many receiver manufacturers connect a short length of wire to this test point and extend the wire up through the hole in the top plate. The test point is connected in the mixer-grid circuit, and it is used as an input terminal for the sweep and marker generators during the alignment performance. All the tuner shields should be in place before attempting alignment; and as in the earlier models, the fine-tuning control must be set at the midrange point before the oscillator slugs are adjusted.

The tuner alignment involves the following adjustable components: two trimmers in the RF stage, one trimmer in the mixer stage, a slug-tuned coil for each channel in the oscillator stage, and the mixer-plate coil. All of these alignment points except the oscillator slugs are easily reached at the top of the unit. The oscillator slugs, as in the majority of turret tuners, are accessible through a hole in the front of the tuner housing.

The IF output point shown in Fig. 3 is a small loop of wire fed through an insulator and extending above the tuner chassis. This wire affords a convenient test point; and the output to the main chassis may be connected directly from this point. In other cases, the output is connected internally to one of the unused terminals located at the side of the tuner; and from there, it is fed to the receiver.

The terminal strip located at the side of the tuner is illustrated in the drawing of Fig. 4. All terminals

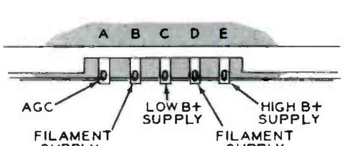


Fig. 4. Terminal Strip on T-Series Tuner.

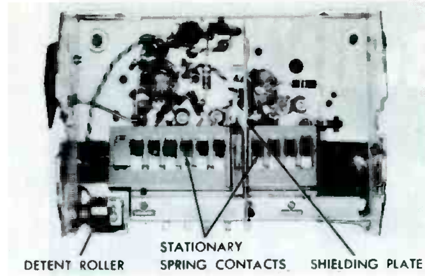


Fig. 5. Bottom View of T-Series Tuner With Turret Removed.

are coded with a letter (A through E) stamped into the tuner chassis above each connection. Terminal A is a connecting point for the AGC voltage supplied to the tuner. Terminal B is used as a filament-supply point for both series and parallel arrangements. Terminal C serves as the B+ supply point. Terminal D is used for one of the filament connections required when the tuner tubes are wired in series. Terminal E is most frequently used as a connection for the additional B+ supply voltage required when the tuner employs a cascode RF amplifier stage. In some cases, terminal D or E may be wired as an IF output point.

The spring contacts located inside the tuner are shown in the photograph of Fig. 5. As in earlier designs, these finger-like springs can become damaged or weak and make poor contact with the point contacts on the insert strips. The tension on these springs can be increased by pulling slightly outward on each one; however, care should be taken not to disengage the free end from the mounting board. The detent roller, also indicated in Fig. 5, is basically the same style as that employed in the earlier models; but it is located at the front of the tuner rather than in the middle.

With regard to UHF reception, another new feature of the T-Series tuners is the change in the individual UHF insert strips. In previous designs, each pair of UHF insert strips contained a harmonic-generating crystal and a mixer crystal. In the new tuners, the harmonic-generating crystals are still mounted on the individual insert strips; but a single mixer crystal that serves for all UHF channels is mounted on top of the tuner chassis. The location of the clip for the mixer crystal is shown in Fig. 3. One end of the crystal is grounded to the tuner chassis, and the other end is connected to one of the spring contacts. Maintenance requirements for this new tuner are similar to those needed for the earlier types.

LESLIE D. DEANE

Notes on Test Equipment

(Continued from page 19)

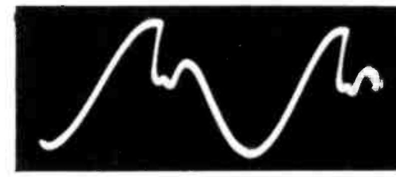
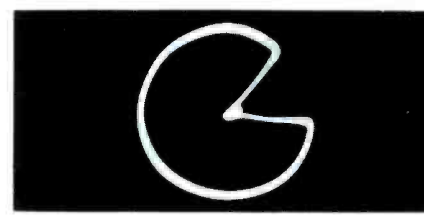


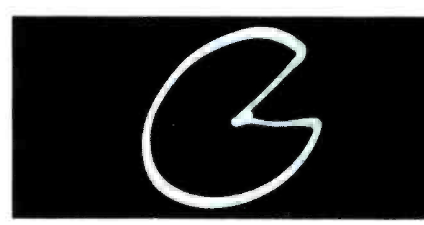
Fig. 6. Waveform of the Q Signal in a Color Receiver Using the WIN-TRONIX Model 150 Rainbow Generator.

former may be obtained. In Fig. 6 the waveform obtained at the cathode of the phase inverter in the Q channel is shown. For an indication of correct quadrature adjustment, the square-wave pulse should be displaced

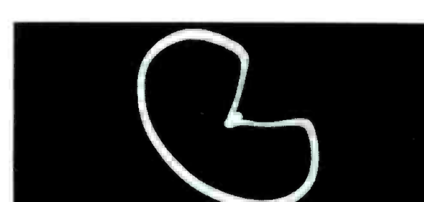


(A) Notched Circle Showing Correct Adjustment of the Hue Phase Control and the Quadrature Transformer.

(B) Notched Circle Showing Incorrect Adjustment of of the Hue Phase Control.



(C) Notched Ellipse Resulting From Misadjustment of Quadrature Transformer in One Direction.



(D) Notched Ellipse Resulting From Misadjustment of Quadrature Transformer in Direction Opposite to That Indicated in C.

Fig. 7. Oscilloscope Patterns Obtained From the Demodulator Circuits in a Color Receiver Using the WIN-TRONIX Model 150 Rainbow Generator.

on the sine wave by exactly 90 degrees from its position in the preceding figure. At the particular observation point selected, the signal is a minus-Q signal rather than a Q signal; consequently, the waveform is inverted to that for a normal Q signal.

An interesting application of the Model 150 generator is its use in checking and adjusting the hue-control circuit and the quadrature circuit through the use of Lissajous patterns on an oscilloscope. To develop these patterns, the output of the generator is applied to the antenna terminals of the receiver; and signals are picked up at points after the I and Q demodulators and are fed to the oscilloscope. The signal from the I channel is fed to the vertical input of the oscilloscope, and the signal from the Q channel is fed to the horizontal input.

The result is a pattern which should be a notched circle if the signals in the two channels are at 90-degree phase relationship with each other. The phase response of the horizontal and vertical amplifiers of the oscilloscope should be substantially the same at the frequencies involved, and this will generally be the case with good quality oscilloscopes. The gain of each amplifier should be adjusted to obtain equal vertical and horizontal deflections so that the circle will not be stretched into an ellipse.

The circle shown in Fig. 7A was obtained in the manner just described. The missing sector (which is like a piece cut out of a pie) results from the square-wave pulse in the generator signal. The position of this sector, measured in degrees about the center of the circle, indicates the relative setting of the hue phase control. As the hue control is rotated, the sector in the pattern also rotates to a new position such as that shown in Fig. 7B.

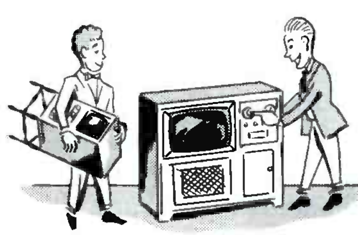
Correct settings for I and Q receivers and for R - Y and B - Y receivers are illustrated in the WINTRONIX instruction manual. The pattern shown in Fig. 7A is very close to the correct one for an I and Q receiver.

In color receivers which demodulate on the I and Q axes or R - Y and B - Y axes, correct adjustment of the quadrature transformer will result in a circle such as that shown in Fig. 7A or Fig. 7B. If this transformer is improperly adjusted, demodulation in the two color channels no longer takes place with a 90-degree phase relationship; and the circle becomes an ellipse, as in Fig. 7C or Fig. 7D. These figures illustrate the cases in which the quadrature transformer has been detuned, first in one direction and then in the other.

It may occur to the reader that an ellipse can also be obtained from the circle if the horizontal- and vertical-deflection amplitudes in the oscilloscope are not equal. How, then, is the technician to distinguish one case from the other? The answer is that an ellipse obtained solely through misadjustment of the horizontal- or vertical-deflection amplitudes will have its long axis in either a horizontal or vertical direction. An ellipse resulting solely from quadrature misadjustment will have the long axis tilted at an angle lying somewhere between the horizontal and vertical directions. No amount of subsequent adjustment of the gain controls on the oscilloscope can change this ellipse to a circle.

A number of other tests and adjustments are listed in the WINTRONIX instruction manual. The examples covered in this discussion should give some idea of the usefulness of this type of service instrument.

PAUL C. SMITH



TRADE-IN. One of the roughest things to take, when buying a new car these days, is the panning that the salesmen give your old car before announcing the trade-in allowance. For two years we couldn't take it and just walked away from the salesmen one after another to go back to that old '49 model which was still good for another hundred thousand miles (our opinion).

The salesman who finally got our signature on the line was a true gentleman. His firm wholesaled its trade-ins immediately to used car dealers, so he got up to bid on the car. The amount was so low that he added a hundred dollars, even though already squeezed by preliminary without-trade-in negotiations. Only after closing the deal did he reveal that our sweet little '49 was only bringing him $145.

In all types of trade-in selling, concentrate on the good features of what your're selling rather than on the faults of what's being traded in. Compliment the prospect on his judgment in choosing his old set originally, but switch immediately to the improvements that have been made since that time. Make him want the new set so badly that he'll take your first fair figure when you get down to prices.

MARKUS · · *Dollar and Sense Servicing*

STATUS OF TV BROADCAST OPERATIONS

Supplement No. 1

When combined with the data presented in the February 1955 issue of the PF REPORTER, this supplemental data presents a complete picture of the status of TV broadcasting operations in the United States (including Alaska, Hawaii, and Puerto Rico) as of June 25, 1955.

The total numbers of operating stations, construction permits granted, and the stations that have discontinued operations are shown in the first chart.

OPERATING STATIONS		CONSTRUCTION PERMITS		DISCONTINUED OPERATIONS	
Total 436		Total 180		Total 55*	
Commercial	317 VHF 106 UHF	Commercial	52 VHF 105 UHF	Commercial	10 VHF 44* UHF
Educational	10 VHF 3 UHF	Educational	9 VHF 14 UHF	Educational	0 VHF 1 UHF

* Includes 31 UHF commercial stations which have reverted to CP status.

In respective order, the remaining charts show: (1) the construction permits granted, (2) the new stations which went on the air, and (3) the construction permits that have been relinquished and the stations that have discontinued operations during the period between January 1 and June 25, 1955.

CONSTRUCTION PERMITS GRANTED FROM JANUARY 1 THROUGH JUNE 25, 1955

ALABAMA		
Andalusia	WAIQ	Ch. 2#
Mobile	- - -	Ch. 5
ARIZONA		
Tucson	KDWI-TV	Ch. 9
ARKANSAS		
Jonesboro	KBTM-TV	Ch. 8
CALIFORNIA		
Sacramento	KCRA-TV	Ch. 3
Stockton	*KTVU	Ch. 36
FLORIDA		
Ft. Pierce	WTVI	Ch. 19
GEORGIA		
Atlanta	*WQXI-TV	Ch. 36
Macon	*WOKA	Ch. 47
Savannah	WSAV-TV	Ch. 3
IDAHO		
Lewiston	KLEW-TV	Ch. 3
INDIANA		
Anderson	WCBC-TV	Ch. 61
IOWA		
Des Moines	*KGTV	Ch. 17
KANSAS		
Goodland	- - -	Ch. 10
Wichita	KTVR	Ch. 3
LOUISIANA		
Shreveport	KTBS-TV	Ch. 3
	KCIS	Ch. 12
MAINE		
Lewiston	*WLAM-TV	Ch. 17
MISSISSIPPI		
Hattiesburg	WDAM	Ch. 9
NEBRASKA		
Hastings	KHAS-TV	Ch. 5
NEVADA		
Reno	KAKJ	Ch. 4
NEW JERSEY		
Asbury Park	*WRTV	Ch. 58
NEW MEXICO		
Carlsbad	- - -	Ch. 6
NEW YORK		
Schenectady	*WTRI	Ch. 35
NORTH CAROLINA		
Charlotte	*WQMC	Ch. 36
New Bern	WNBE-TV	Ch. 13
NORTH DAKOTA		
Bismarck	KBMB	Ch. 12
OKLAHOMA		
Oklahoma City	*KMPT	Ch. 19
Tulsa	*KCEB	Ch. 23
OREGON		
Roseburg	- - -	Ch. 4
PENNSYLVANIA		
Allentown	*WFMZ-TV	Ch. 67
New Castle	*WKST-TV	Ch. 45
Sunbury	WKOK-TV	Ch. 38
SOUTH DAKOTA		
Florence	KDLO-TV	Ch. 3
TENNESSEE		
Memphis	WREC-TV	Ch. 3
VIRGINIA		
Danville	*WBTM-TV	Ch. 24
Roanoke	WDBJ-TV	Ch. 7
WASHINGTON		
Ephrata	KBAS-TV	Ch. 43
Yakima	- - -	Ch. 23
WEST VIRGINIA		
Charleston	*WKNA-TV	Ch. 49
Fairmont	*WJPB-TV	Ch. 35
WISCONSIN		
Milwaukee	*WCAN-TV	Ch. 25
	- - -	Ch. 31
HAWAII		
Wailuku	KMVI-TV	Ch. 12
PUERTO RICO		
Mayaguez	WORA-TV	Ch. 5
San Juan	WUTV	Ch. 6#

Educational.

*Reverted from operating status to CP status.

NEW STATIONS WHICH WENT ON THE AIR BETWEEN JANUARY 1 AND JUNE 25, 1955

ALABAMA	
Birmingham	
WBIQ	Ch. 10#
Dothan	
WTVY	Ch. 9
CALIFORNIA	
Sacramento	
KBET-TV	Ch. 10
FLORIDA	
Tampa	
WFLA-TV	Ch. 8
WTVT	Ch. 13
IDAHO	
Twin Falls	
KLIX-TV	Ch. 11
IOWA	
Des Moines	
KRNT-TV	Ch. 8
KENTUCKY	
Lexington	
WLEX-TV	Ch. 18
LOUISIANA	
Baton Rouge	
WBRZ	Ch. 2
Lafayette	
KLFY-TV	Ch. 10
MASSACHUSETTS	
Boston	
WGBH-TV	Ch. 2#
MINNESOTA	
Minneapolis-St. Paul	
KEYD-TV	Ch. 9
MISSOURI	
Jefferson City	
KRCG	Ch. 13
St. Louis	
KTVI	Ch. 36
NEVADA	
Henderson	
KLRJ-TV	Ch. 2
OREGON	
Portland	
KLOR	Ch. 12
RHODE ISLAND	
Providence	
WPRO-TV	Ch. 12
SOUTH DAKOTA	
Rapid City	
KOTA-TV	Ch. 3
TENNESSEE	
Jackson	
WDXI-TV	Ch. 7
TEXAS	
Beaumont	
KFDM-TV	Ch. 6
TEXAS (Continued)	
San Antonio	
KCOR-TV	Ch. 41
Waco	
KWTX-TV	Ch. 10
VIRGINIA	
Norfolk	
WTOV-TV	Ch. 27
WISCONSIN	
Green Bay	
WFRV-TV	Ch. 5
ALASKA	
Fairbanks	
KFAR	Ch. 2
KTVF	Ch. 11
HAWAII	
Hilo	
KHBC-TV	Ch. 9
Wailuku	
KMAU	Ch. 3

Educational

CP'S RELINQUISHED AND STATIONS DISCONTINUING OPERATIONS FROM JANUARY 1 THROUGH JUNE 25, 1955

CP's Relinquished

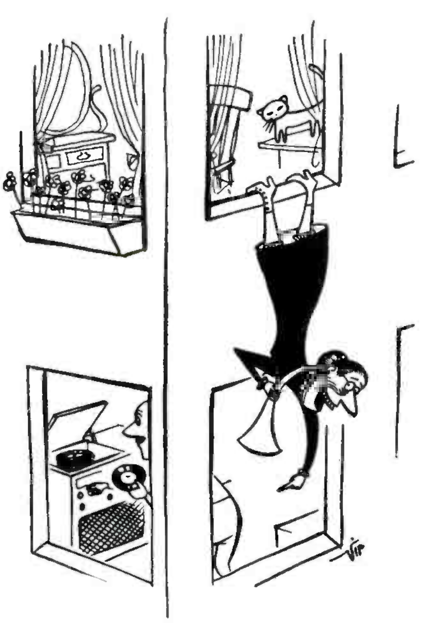
ARKANSAS	
Little Rock	
KETV	Ch. 23
CALIFORNIA	
Los Angeles	
KTHE	Ch. 28#
Sacramento	
KBIE-TV	Ch. 46
San Diego	
KUSH	Ch. 21
IOWA	
Sioux City	
KCTV	Ch. 36
LOUISIANA	
Lafayette	
KVOL-TV	Ch. 10
Monroe	
KFAZ	Ch. 43
New Orleans	
WCNO-TV	Ch. 32
MONTANA	
Butte	
KOPR-TV	Ch. 4
OKLAHOMA	
Miami	
KMIV	Ch. 58
PENNSYLVANIA	
Erie	
WLEU-TV	Ch. 66
Philadelphia	
WIBG-TV	Ch. 23
Sharon	
WSHA	Ch. 39
TEXAS	
Amarillo	
KLYN-TV	Ch. 7
Corpus Christi	
KTLG	Ch. 43
Dallas	
KDTX	Ch. 23
Houston	
KTVP	Ch. 23
San Antonio	
KALA	Ch. 35
UTAH	
Provo	
KOVO-TV	Ch. 11
WISCONSIN	
LaCrosse	
WTLB	Ch. 38

Discontinuing Operations

CALIFORNIA	
Stockton	
*KTVU	Ch. 36
GEORGIA	
Atlanta	
*WQXI-TV	Ch. 36
Macon	
*WOKA	Ch. 47
IOWA	
Des Moines	
*KGTV	Ch. 17
MAINE	
Lewiston	
*WLAM-TV	Ch. 17
MINNESOTA	
Minneapolis-St. Paul	
WMIN-TV	Ch. 11
MISSISSIPPI	
Jackson	
WJTV	Ch. 25
MISSOURI	
St. Louis-Belleville, Ill.	
WTVI	Ch. 54
NEW JERSEY	
Asbury Park	
*WRTV	Ch. 58
NEW YORK	
Schenectady	
*WTRI	Ch. 35
NORTH CAROLINA	
Charlotte	
*WQMC	Ch. 36
OKLAHOMA	
Oklahoma City	
*KMPT	Ch. 19
Tulsa	
*KCEB	Ch. 23
PENNSYLVANIA	
Allentown	
*WFMZ-TV	Ch. 67
New Castle	
*WKST-TV	Ch. 45
VIRGINIA	
Danville	
*WBTM-TV	Ch. 24
WEST VIRGINIA	
Charleston	
*WKNA-TV	Ch. 49
Fairmont	
*WJPB-TV	Ch. 35
WISCONSIN	
Milwaukee	
*WCAN-TV	Ch. 25

Educational

*Reverted to CP Status



"Ah, they must have gotten a JENSEN NEEDLE"

Audio Facts

(Continued from page 23)

covered with rubber insulation, a tinned-copper braided shield, and an outside cover of brown cotton braid.

Fig. 2B shows a small plastic microphone cable, Belden No. 8411, which has an outside diameter that is approximately .144 inch. The conductor is composed of three No. 33 tinned-copper and four No. 33 tinned-steel wires. The conductor is covered with cellulose-yarn braid, polyethylene-plastic insulation, a tinned-copper braided shield, and an outside cover of chrome vinyl plastic. The nominal capacitance is 34 micromicrofarads per foot. This cable is flexible, although not to the degree featured by the No. 8431 cable; and it is rugged.

The No. 8401 cable shown in Fig. 2C is similar to the No. 8411, but it is larger (approximately .2 inch in outside diameter) and has a capacitance of 25 micromicrofarads per foot.

The No. 8410 cable shown in Fig. 2D is a single-conductor, rubber, microphone cable with an outside diameter of approximately .245 inch. Three No. 33 tinned-copper and four No. 33 tinned-steel strands are used in the center conductor. The conductor is covered with cellulose-yarn braid, rubber insulation, rayon braid, a tinned-copper braided shield, a rayon wrap, and an outside black rubber cover. Nominal capacitance is 33 micromicrofarads per foot.

Usually, it does not make much difference which one of these is used as a cable to feed the signal from one piece of equipment to another. If the cable is long and is connected to an output of high impedance, a cable of low capacitance should be used to avoid loss of high frequencies. Actually, all of these cables are types that have low capacitance, and the choice depends mostly on physical and mechanical properties such as the flexibility of the No. 8410 rubber cable.

The popular phono plug is almost universally used on cables such as those intended for service as interconnecting signal cables, but the standard phone plug and some types of

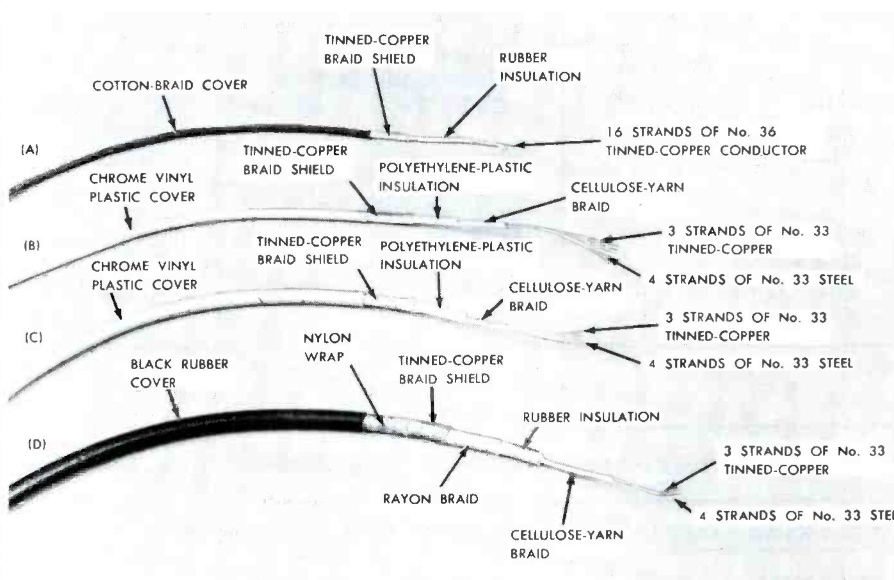
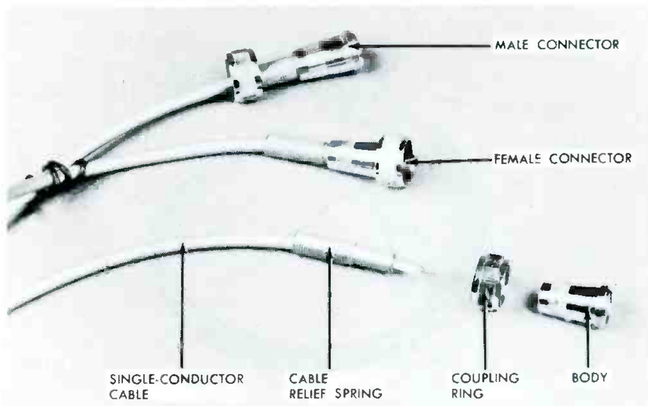
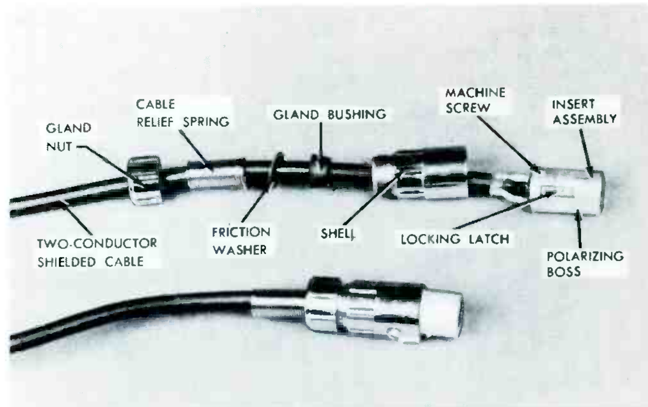


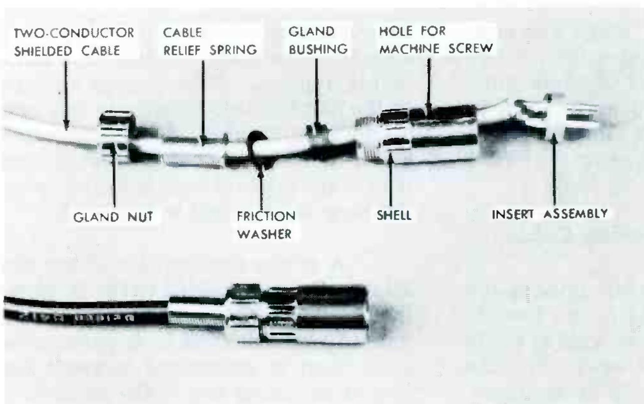
Fig. 2. Four Types of Single-Conductor Cables. (A) Belden No. 8431 Phono Cable. (B) Belden No. 8411 Plastic Microphone Cable. (C) Belden No. 8401 Plastic Microphone Cable. (D) Belden No. 8410 Rubber Microphone Cable.



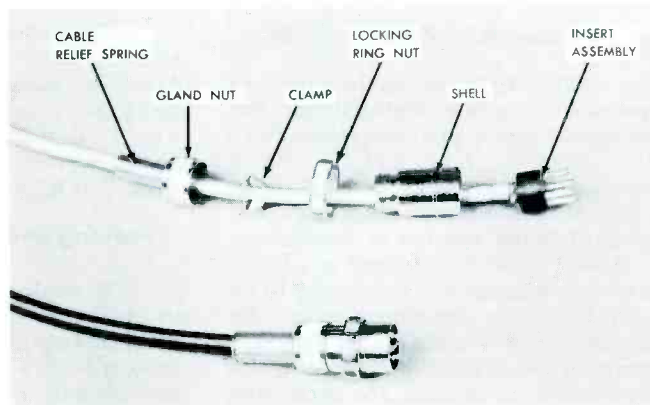
(A) Amphenol 75-MC1F.



(B) Cannon XL-3-11.



(C) Cannon XL-3-12.



(D) Amphenol 91-MC4M.

Fig. 3. Views of Various Microphone Connectors During Assembly.

microphone connectors are sometimes employed.

Microphone Cables

Many types of microphone cables, in addition to those mentioned in the discussion of interconnecting signal cables, are used with what seems to be an endless variety of microphones. The great number of microphones can be divided into groups according to the use which is to be made of them. Roughly, these are: (1) home recording and amateur types, (2) public address (PA) and semiprofessional types, and (3) professional recording and broadcasting types. Certain types of cables and connectors are commonly used with each of these groups.

Many of the inexpensive microphones for home recording use small single-conductor cables (such as the No. 8411 cable shown in Fig. 2B) with phono plugs or, in some cases, standard phone plugs. Lapel microphones usually use a small cable of this type because of flexibility and size as well as ruggedness.

Many PA or semiprofessional microphones use the heavier single-conductor cables, such as the No. 8401 shown in Fig. 2C and the No. 8410 shown in Fig. 2D, with single conductor microphone connectors. The Amphenol 75-MC1F shown in Fig. 3A is an example of this type of connector. It is shown three ways: (1) disassembled, (2) attached to No. 8401 cable and ready for use as a female connector, and (3) as a male connector.

Some of the PA and semiprofessional microphones, together with many of the professional units, use two-conductor shielded cable with suitable and more elaborate connectors like those shown in Figs. 3B, 3C, and 3D.

The Cannon XL-3-11 female connector shown in Fig. 3B has three contacts and is shown attached to a two-conductor shielded cable, the Belden No. 8412. An exploded view of the Cannon XL-3-11 is shown to illustrate its construction. The Cannon SL-3-12 is a male three-contact connector and is shown in Fig. 3C. Two views of the Amphenol 91-MC4M which is a male, four-contact, microphone connector are shown in Fig. 3D.

Some special and expensive microphones use special cables, preamplifiers, and power supplies; but the cables and connectors mentioned here are the ones usually encountered in home music systems.

Loudspeaker Cables

The usual music system for the home presents no great problem when a suitable cable is selected to connect the loudspeaker system to the amplifier. Suitable terminals are usually provided on both the amplifier and the loudspeaker, and the cable is connected directly to them. Since no shielding is required for loudspeaker cables in most locations, a twisted pair or parallel cord with conductors of size No. 18 or larger is suitable. Twin lead such as that used with FM and TV antennas is also satisfactory.

The installation of armored cable (BX) for loudspeaker lines in new houses under construction is recommended because the lines will be run in walls and floors together with AC lines and because the shielding and physical protection afforded by the armor is worth while.

Various types of cables are supplied for PA, intercommunication, and studio use; but in home music systems, the twin lead and other conductors mentioned are very convenient and satisfactory as loudspeaker cables.

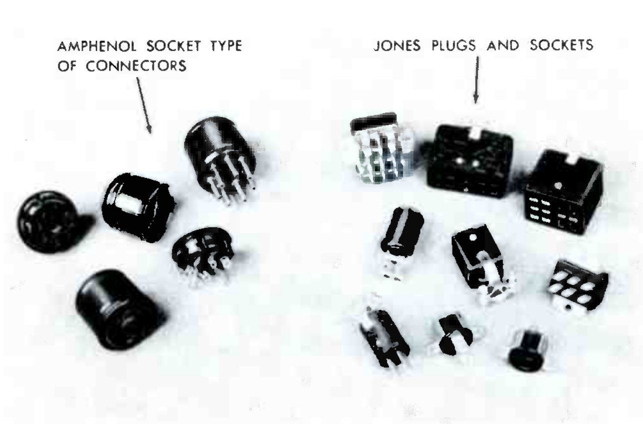


Fig. 4. Assortment of Connectors and Plugs.

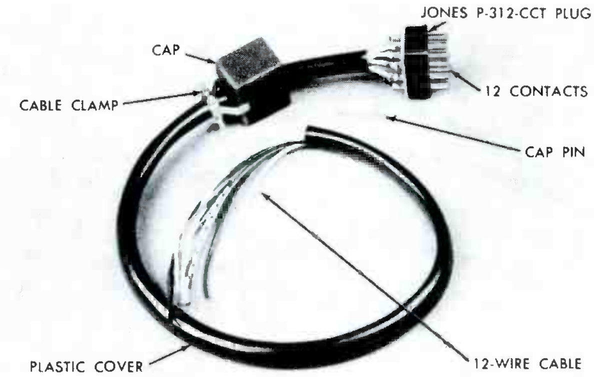


Fig. 5. Jones P-312-CCT Plug Attached to 12-Wire Cable.

Power and Miscellaneous Cables

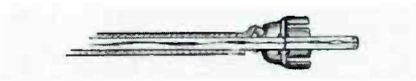
Miscellaneous cables are required in some installations for supplying power and completing control circuits. A great variety of multiconductor cables are available for use with suitable connectors and plugs, but the number of conductors and other features desired in a cable will depend upon the conditions to be met in each individual case. As mentioned previously, most special-purpose cables are supplied with audio equipment; or at least, the necessary plugs and connectors are furnished as specified.

Connectors and plugs are supplied by many manufacturers. A few Amphenol socket types of connectors and some Jones plugs are shown in Fig. 4. A P-312-CCT Jones plug is shown attached to a short 12-wire cable in Fig. 5.

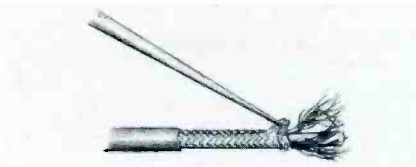
Making and Preparing Cables

It would be nearly impossible to give complete details on how to make and prepare every kind of cable used in audio work, but we can discuss and describe some basic procedures. Probably the phono plug and cable are the most logical with which to begin because they no doubt receive more attention than any others in a home music system. This is true because of the number used and their tendency to develop trouble if handled often. Their useful life can be lengthened if certain precautions are taken when the plug is attached to the cable.

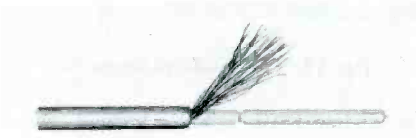
A cross section of a phono plug attached to a No. 8401 cable is shown in Fig. 6A. In the preparation of a cable to be attached to a phono plug, care must be exercised to avoid cutting or breaking any of the strands of the conductor or shield and to guard against damaging the insulation. The



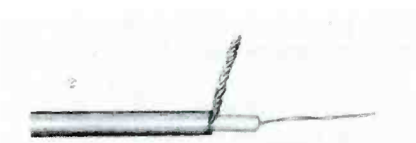
(A) Cross Section of Phono Plug on Cable.



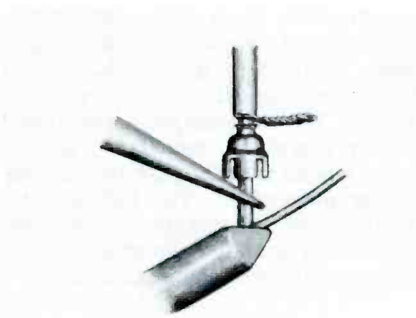
(B) Unbraiding the Shield.



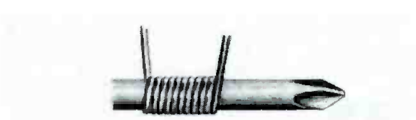
(C) Cable After Shield Is Unbraided.



(D) Cable With Shield and Conductor Twisted and Tinned.



(E) Soldering Conductor to Plug.



(F) Construction Details of Guard and Handle for Phono Plug.

(G) Guard and Handle Soldered to Plug.

Fig. 6. Assembly Steps in Attaching Phono Plug to Cable.

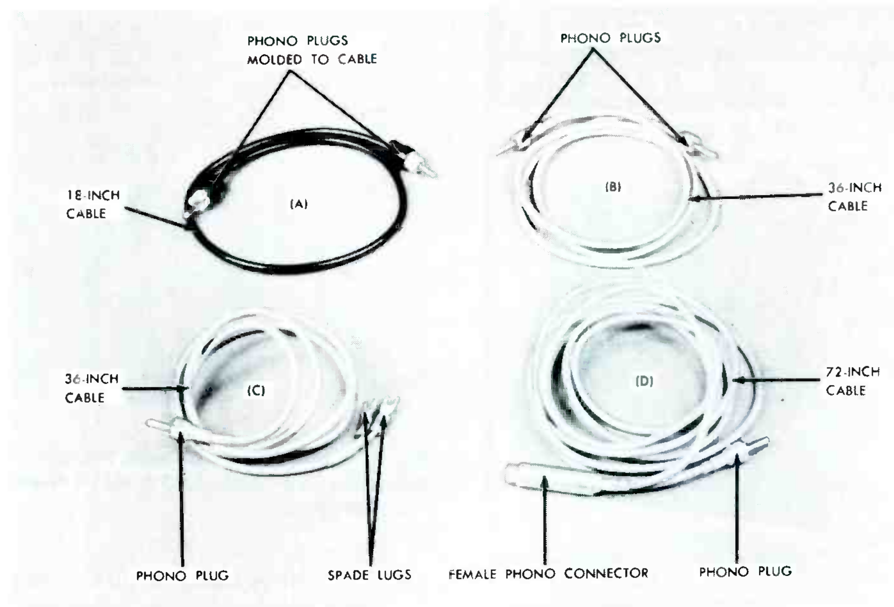


Fig. 7. Examples of Complete Cables. (A) Made by Lab-Tronics, Inc. (B), (C), and (D) Made by CBS Electronics Co., Inc.

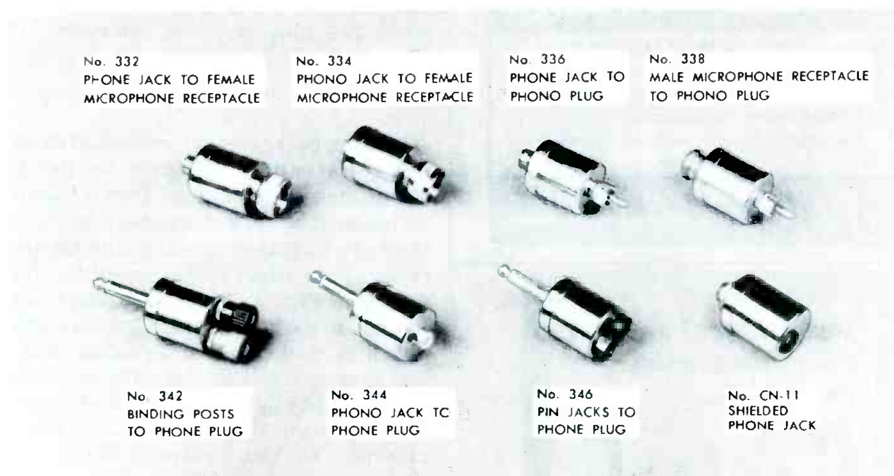


Fig. 8. Adapters Made by Switchcraft, Inc.

outer cover must be carefully removed and the shield unbraided with a pointed instrument, such as a soldering tool. See Fig. 6B. After the strands of the braid have been straightened (Fig. 6C), they are twisted (Fig. 6D).

The insulation on the center conductor is cut or scored with a tool (probably with a knife, in most cases) somewhere near the point indicated in Fig. 6C. One must be careful not to nick or cut the conductor. Enough insulation must be removed to allow the conductor to extend through the end of the plug, as shown in Fig. 6A. Sufficient insulation should remain to prevent the shorting of the center conductor to the shell of the plug. The conductor is twisted, and then both it and the twisted shield are tinned with solder before they are attached to the plug.

When soldering the plug to the cable, enough heat must be applied with a soldering iron or gun to make a good connection; but too much heat can melt and damage the insulation on the cable or burn the insulating washer in the plug. First, the cable is inserted into the plug which is held upright on the soldering iron with a pair of long-nosed pliers. (See Fig. 6E.) Rosin-core solder is applied at the tip of the plug, and the conductor is soldered to the end of the center pin. A good solder joint can be made in this way, and the solder will form a smooth rounded surface on the end of the center pin when the plug is withdrawn from contact with the soldering iron. The twisted and tinned portion of the shield is then soldered to the outside shell of the plug. If this operation is performed carefully, a very solid and serviceable cable will be made.

We have often added a little guard or handle to phono plugs that must be used frequently. The handle is made by winding a length of No. 22 or No. 20 bare hookup wire around the shaft of a No. 2 Phillips screwdriver. See Fig. 6F. The resulting coil is removed, the ends are clipped, and

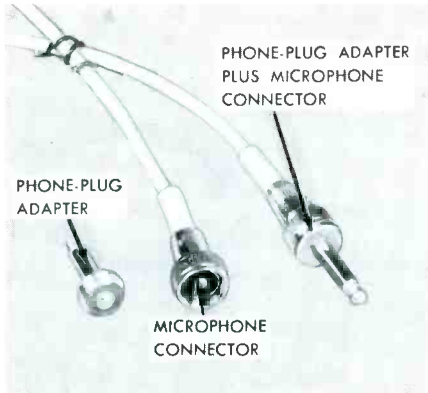


Fig. 9. Phone Plug Made with Microphone Connector and Amphenol 75-MC1P Phone-Plug Adapter.

then the coil is sweated with solder to form a solid cylinder. When soldered to the plug (Fig. 6G), this guard protects the cable, particularly if the cable is a small one such as the Belden No. 8431. The guard also serves as a very convenient handle when the plug is being inserted or removed.

Several manufacturers now make complete cables designed for use in home music systems. These should be found to be very convenient because they are supplied in many lengths and types. Four representative cables are shown in Fig. 7. The phono plugs are molded to the ends of the 18-inch cable which is made by Lab-Tronics, Inc., and is shown in Fig. 7A. Three other cables made by the CBC Electronics Co., Inc.,have all connectors and plugs clamped to the cables. They are shown in Figs. 7B, 7C, and 7D.

The adapters manufactured by Switchcraft, Inc., and shown in Fig. 8 are very convenient when a cable with one type of connector must be used with another type. Most any combination is available.

Phone-plug adapters can be used with single-conductor microphone connectors to form phone plugs

Fig. 10. Common Phone Plug.

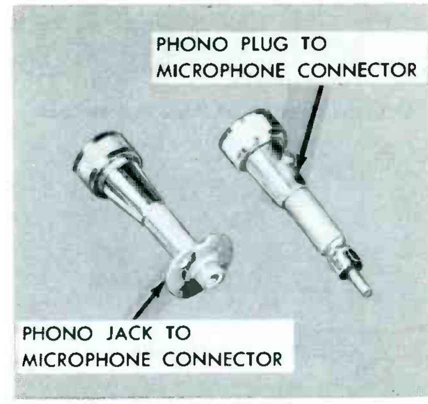


Fig. 11. Custom-Built Adapters.

which will fit into standard phone jacks. An Amphenol 75-MC1P phone plug adapter is shown in Fig. 9. The phone plug shown in Fig. 10 is one of many types and styles commonly used in all phases of audio work.

Some adapters were made in our laboratories and were found to be very convenient and useful in our experimental work involving pieces of equipment fitted with different types of connectors. These adapters were constructed some time ago before the series of adapters shown in Fig. 8 were available. Two examples of these custom-built units are shown in Fig. 11. One adapts a phono jack to a microphone connector, and the other adapts a phono plug to a microphone connector. The fact that the microphone connectors can be used as male or female connectors adds to the versatility of the adapters.

ROBERT B. DUNHAM

A STOCK GUIDE FOR TV TUBES

The following chart has been compiled to serve as a guide in establishing proper tube stocks for servicing TV receivers. The figures have been derived by combining (1) a production factor (the number of models and an estimate of the total number of receivers produced by all manufacturers) and (2) a depreciation factor (based on an average life of six years for each receiver, and the figures are reduced accordingly each two months).

1. The figures shown are based on a total of 1,000 units. This was done in order to eliminate percentage figures and decimals. The figure shown for any tube type then represents a percentage of all tubes now in use. For example, a figure of 100 would imply that that particular tube type constitutes 10 per cent of all tube applications.

2. Some consideration should be given to the frequency of failure of a particular type of tube. A tube used in the horizontal-output stage will fail much more frequently than a tube used as a video detector. Thus, even though the same figure may be given for both tubes, more of the horizontal-output type should be stocked.

3. The column headed '46 to '55 is intended for use in those areas where television broadcasting was initiated prior to the freeze. Entries in this column include all tubes used since 1946 except those having a value of less than one, which is the value of the minimum entry in this chart. The '52 to '55 column applies to the TV areas which have been opened since the freeze. Since the majority of receivers in these areas will be of the later models, only the tubes used in these newer sets are considered in this column. The minimum value of one also applies to this column.

4. The listing of a large figure for a particular tube type is not necessarily a recommendation for stocking that number of tubes. The large figure does indicate that this tube is used in many circuits and emphasizes the necessity for maintaining a stock sufficient to fill requirements between regular tube orders.

	46-55 Models	52-55 Models
1B3GT	41	44
1X2	4	1
1X2A	3	5
c1X2B	-	-
c3A3GT	-	-
*3BC5	-	-
*3BN6	-	-
*3CB6	-	-
*5AW4	-	-
*5J6	-	-
c5U4G	47	49
*5U8	-	-
5V4G	6	-
5Y3GT	4	2
6AB4	3	2
6AC7	7	7
c#6AF4	3	3
6AG5	29	8
6AG7	2	2
6AH4GT	3	4
6AH6	7	9
6AK5	3	3
c6AL5	73	74
6AL7GT	5	-
c6AM8	-	-
#6AN4	-	-

	46-55 Models	52-55 Models
c6AN8	1	1
6AQ5	13	14
6AQ7GT	2	2
6AS5	2	2
c6AS6	-	-
*6AS8	-	-
6AT6	4	3
*6AT8	-	-
c6AU4GT	-	-
6AU5GT	4	4
c6AU6	126	117
*6AU8	-	-
6AV5GT	2	3
c6AV6	16	17
*6AW8	-	-
6AX4GT	10	9
6AX5GT	1	2
6BA6	13	10
6BC5	9	7
c6CB7	-	-
c6BD4	-	-
6BE6	6	7
6BG6G	11	6
6BH6	6	-
6BJ6	1	-
c*6BJ7	-	-

	46-55 Models	52-55 Models
6BK5	3	3
6BK7	3	5
6BK7A	2	2
6BL7GT	5	8
6BN6	5	5
*6BQ6GA	-	-
6BQ6GT	19	26
6BQ7	6	12
c6BQ7A	5	5
c6BY6	-	-
6BZ7	7	1
6C4	10	9
c6CB6	107	138
c6CD6G	9	10
6CF6	1	1
c6CL6	1	2
*6CM6	-	-
6CS6	2	2
*6CU6	-	-
c6DC6	-	-
*6DE6	-	-
*6DG6GT	-	-
6J5	3	3
6J5GT	1	1
6J6	31	29
6K6GT	15	9
6S4	9	10
6SH7GT	2	-
6SL7GT	3	2
c6SN7GT	70	77
6SN7GTA	5	5
6SQ7	2	2

	46-55 Models	52-55. Models
6SQ7GT	2	2
#6T4	-	-
6T8	13	14
c6U8	8	11
6V3	2	3
6V6GT	20	18
6W4GT	27	28
6W6GT	7	11
6X5GT	1	1
6X8	5	7
6Y6G	3	1
7N7	2	-
c12AT7	14	13
c12AU7	45	32
*12AU7A	-	-
12AV7	3	3
12AX4GT	2	4
12AX7	5	6
12AZ7	-	2
*12B4	-	-
c12BH7	9	12
12BY7	6	7
12BZ7	2	-
*12L6GT	-	-
12SN7GT	5	4
*12W6GT	-	-
*25BK5	-	-
25BQ6GT	3	4
*25CU6	-	-
25L6GT	5	5
25W4GT	1	1
5642	1	2

A stock of these tubes should be maintained in UHF areas.

* New tubes recently introduced.

c These tubes have been used in color television receivers.

Grid Emission and Gas in Vacuum Tubes

(Continued from page 27)

current. A change indicates that grid current is flowing and that the bias is therefore being shifted. The latter method is used for a gas test in a number of tube testers.

An example of a gas-test circuit in a tube tester is shown in Fig. 2. This particular circuit is used in the Triplett Model 3423. For both the gas test and the value (or transconductance) test, a 4-kc signal is injected into the grid circuit through C9. In the plate circuit, C3 and L1 form a tuned circuit which responds to the signal component of the plate current. The meter, together with its rectifier and filter, measures only the 4-kc voltage developed across the tuned circuit. A choice of any one of five DC plate voltages is available.

The cathode potential is 100 volts positive with respect to ground. The bias potentiometer R21 supplies from 70 to 110 volts DC for the grid circuit. To make the gas test, the VALUE-GAS switch is first set at the VALUE position, and R21 is adjusted to a point near grid cutoff, at which point the meter reads only 300 micromhos.

When the switch is thrown to the GAS position, a one-megohm resistor R32 and a capacitor C10 (a bypass for the signal voltage) are placed in the grid return. If negative grid current flows through R32, it causes a voltage drop which shifts the bias on the tube and alters its gain. A signal-voltage change amounting to one scale division on the meter is the recommended borderline between good tubes and gassy ones.

The actual performance of a tube which is slightly gassy (or one with grid emission) depends largely on certain features of the circuit in which it is used. These features are (1) the value of the grid resistance

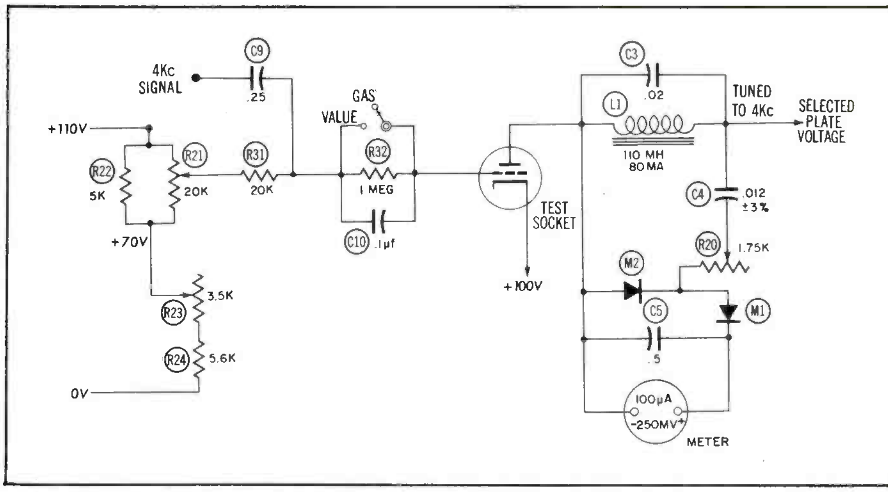


Fig. 2. Schematic Diagram of Gas-Test Circuit Used in Triplett Model 3423 Tube Tester.

and (2) the extent to which the bias can shift without causing distortion in the output. If a circuit has a low grid resistance or if it can tolerate an appreciable shift in bias without an accompanying distortion of output, a slightly gassy tube may operate satisfactorily in this circuit.

The following discussion covers one case history of abnormal performance caused by negative grid current. A General Electric Model 21T17 receiver had unstable horizontal synchronization. A schematic diagram of the horizontal-oscillator section of this receiver is shown in Fig. 3.

There is no horizontal-hold control on the front panel of this receiver, and the only adjustment which can be made to alter the frequency of the horizontal oscillator is that of the horizontal-stability coil L33 at the back of the set. It was found that the picture could be synchronized by adjustment of L33, but the setting of the control was critical. A set that is operating normally should remain in synchronization throughout a moderately wide range of settings of L33.

Readjustment of L33 probably would have been only a temporary remedy for the trouble in this set. Poor synchronization would be expected to develop again as components in the horizontal circuits aged and changed value. A check for further trouble seemed to be necessary.

When the 12AT7 dual triode in the horizontal-oscillator circuit was tested for gas, a strong indication of gassiness was observed during the test of one of the triode sections. Severe grid emission rather than gas was suspected, because only one of the two sections gave an abnormal reading in the test. Gas would be expected to diffuse throughout the tube and affect both triodes equally.

The defective grid was in the first section V13A of the horizontal oscillator. An investigation of the oscillator circuit should reveal the reasons for the abnormal operation of the receiver.

The oscillator V13 is a cathode-coupled multivibrator, and both cathodes are returned to ground through

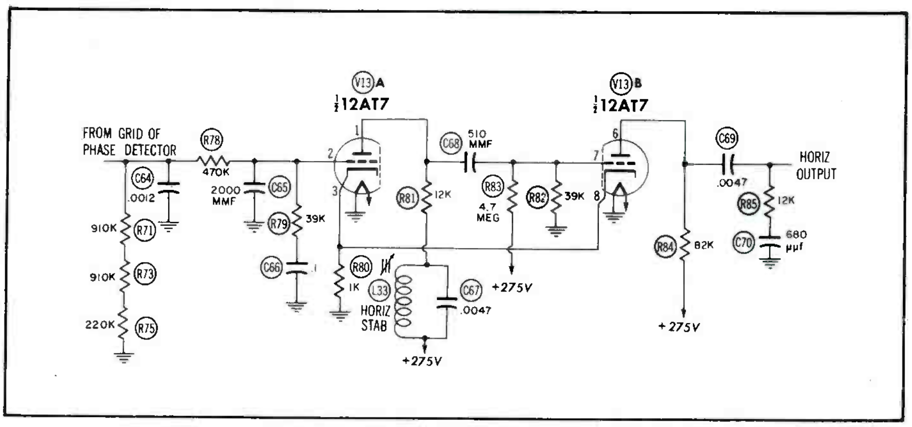


Fig. 3. Horizontal-Oscillator Circuit in General Electric Model 21T17.

R80. V13B goes into conduction only during retrace time. At the same time, V13B draws grid current which charges C68. Then, in the ensuing sweep period when V13A conducts heavily, the charge on C68 holds the grid of V13B below cutoff until most of the charge leaks off through R82.

The ringing circuit made up of C67 and L33 produces a sine wave at the horizontal frequency. This wave is superimposed on the voltage at the grid of V13B. Changing the frequency of the sine wave alters the voltage rise toward the point of cutoff and hence regulates the free-running frequency of the oscillator.

The grid of V13A is supposed to permit external control of the oscillator speed. It is DC coupled to the output of the phase detector which compares incoming sync pulses with samples of the horizontal-output voltage and delivers a correction voltage to the grid of V13A.

A voltage more positive than normal on this grid slows down the oscillator because V13A conducts more heavily than normal. The greater conduction of V13A produces on C68 a heavier charge which takes longer to leak off. In addition, the voltage across R80 increases and there is a greater cathode bias on V13B. C68 has to discharge more completely in order to overcome this increased bias. This requires more discharge time, and the oscillator slows down.

On the other hand, a correction voltage that causes the grid voltage of V13A to go in a negative direction speeds up the oscillator because the charge on C68 and the voltage on the cathode of V13B are reduced. The voltage on the grid of V13B reaches the conduction level sooner under these conditions, and the oscillator speeds up.

The circuit of V13 is prone to disturbances caused by gas or grid emission in the tube. In this circuit, the bias levels on both triode sections are critical. A difference of a few volts on either grid will interfere with the timing of the circuit. Moreover, when we check the DC return path through the phase detector from the grid of V13A, we find a high resistance of about 2.5 megohms. Appreciable voltage can be developed by a slight negative grid current through this resistance.

The graphs of Figs. 4A and 4B show what happens to the voltages measured with a VTVM on the grid and cathode of V13A when the resonant frequency of the ringing circuit is varied by changing the setting of L33. The curves of Fig. 4A were observed when a good tube was used as V13, but those of Fig. 4B were observed when a tube which had grid emission was used as V13. The graphs were recorded when a fairly strong incoming signal was being fed to the receiver.

At the beginning of each test, the slug of L33 was adjusted so that the natural frequency of the oscillator would be higher than the sync-pulse frequency. The setting of L33 was gradually changed until the natural frequency of the oscillator was finally much slower than the frequency of the sync pulses. The horizontal base line of the graphs is not drawn to scale — each grid square does not represent a change of a certain number of cycles. The curves simply represent the result of a smooth, gradual reduction in the frequency of the ringing circuit.

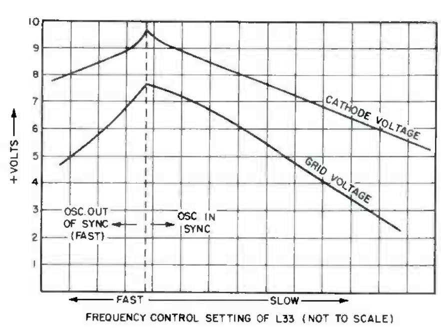
The voltage represented by the vertical distance from the upper curve to the lower curve in each graph is equal to the bias voltage on V13A.

The oscillator was not in synchronization when the first portion of each curve was plotted. The first peak in each voltage occurred when the positive correction voltage took over the job of slowing the oscillator to the correct speed. Further tuning of L33 caused the natural frequency of the oscillator to decrease below the frequency of the sync pulses. The phase detector then began supplying the grid of V13A with a control voltage which was negative with respect to the cathode. The value of this bias voltage increased throughout the range in which the oscillator stayed in synchronization.

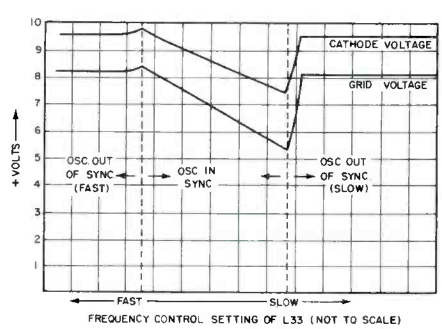
When the good tube was in the circuit, synchronization was maintained throughout many turns of L33. See Fig. 4A. Grid and cathode voltages were driven in a negative direction, and the bias on V13A was increased.

When the bad tube was placed in the circuit, the oscillator stayed in synchronization through only a narrow portion of the range of L33. See Fig. 4B. Once the grid bias reached approximately two volts, the picture snapped out of synchronization and the grid and cathode voltages of V13A rose to the same value which they maintained when no incoming signal was present. Varying the setting of L33 from slow to fast frequency resulted in pairs of curves which are almost identical to those in Fig. 4.

The bad tube was unable to maintain a bias greater than two volts because of the negative grid current caused by grid emission. Electrons did not pile up on the grid of V13A in sufficient number to restrict the



(A) With Normal Tube.



(B) With Tube Having Grid Emission.

Fig. 4. Graphs Showing Variations in Cathode and Grid Voltages of V13A When Horizontal-Stability Control L33 Is Varied.

cathode current of the tube very greatly because they were emitted at a rapid rate from the grid.

This same bad tube was tried in several other circuits; but it did not affect them as greatly as it did the oscillator, even though a tube tester would have rejected it promptly in a gas test.

Substitution is the best way to find and eliminate a gassy tube; but if that is inconvenient, there are a few warning signs which suggest the presence of gas in a tube or negative grid current in a circuit. A tube which tests unusually high in transconductance or emission may be doing so because it is passing excessive current caused by gas ionization or by a bias shift due to negative grid current. This increase in negative grid current can also mask low cathode emission and make a weak gassy tube appear to be good when it is given an ordinary value test.

A bluish glow between tube elements is a positive indication of gas, but gas may be present even though no glow appears. The plate potential and degree of ionization may simply not be high enough to make the gas visible.

Glow due to gas should not be confused with envelope glow which has a similar color but appears near the glass envelope of the tube. The condition of envelope glow is not sufficient cause for rejection of a tube.

Signal distortion due to incorrect bias shows up in a variety of ways. A few cases of such distortion are:

1. Unstable synchronization.
   a. Due to sync-tip clipping or compression in the IF and video amplifiers.
   b. Due to faulty control of oscillators.
2. Distortion of sound.
3. Faults in size, brightness, and linearity of the picture.

Output stages may be expected to develop more trouble with gas and grid emission than other circuits because of the large signal amplitudes and because of the high power dissipated.

The resistance from grid to ground should be checked in suspected circuits. If it is high, the effect of any negative grid current will be multiplied.

THOMAS A. LESH

PF REPORTER

CATALOG and LITERATURE SERVICE

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American's New Tape Recorder Microphone, Crystal and Ceramic Types, Attractively Styled, and Available in Matching Colors. Bulletin No. 203. *See advertisement page* 26.

2H. BUSSMANN (Bussmann Mfg. Co.)
TV Fuse List. *See advertisement page* 4.

3H. CBS-HYTRON (CBS-Hytron, a Division of Columbia Broadcasting System, Inc.)
CBS-Hytron Crystal Diode Manual, 2nd Edition. *See advertisement page* 24.

4H. CENTRALAB (Centralab, Division of Globe-Union, Inc.)
Free sample package of five actual MD Molded Disc Cermaic Capacitors together with complete literature giving all the high quality details of this precision unit. *See advertisement page* 53.

5H. CLEAR BEAM (Clear Beam Antenna Corp.)
Clear Beam's Big Five All Band Fringe Antennas. *See advertisement page* 30.

6H. CORNELL-DUBILIER (Cornell-Dubilier Electric Corp.)
Vibrator Replacement Guide Catalog No. VD. *See advertisement page* 47.

7H. EICO (Electronic Instrument Co., Inc.)
Free 12-page catalog describes EICO's complete line Kits and Instruments—VTVMs, Scopes, Signal Generators, VOMs, Tube Testers, Battery Eliminators, etc. *See advertisement page* 52.

8H. ELECTRO-VOICE (Electro-Voice, Inc.)
New two-color, 14-page condensed Catalog No. 123 describes and illustrates completely Electro-Voice and RME electronic equipment. Includes latest specifications and prices in addition to information on many new products. *See advertisement page* 51.

9H. ERIE (Erie Resistor Corporation)
New D-55 Distributor Catalog. *See advertisement page* 34.

10H. GRAMER-HALLDORSON (Gramer-Halldorson Transformer Corp.)
Catalog G-24. Exact replacement sweep components and transformers for brand name TV receivers. *See advertisement page* 66.

11H. IRC (International Resistance Co.)
Standard Catalog of Replacement Parts—DC55—Form S-021. *See advertisement 2nd cover.*

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Wall Chart. *See advertisement page* 58.

13H. MALLORY (P. R. Mallory & Co., Inc.)
Handy 20-page substitution replacement catalog for all "can" type electrolytic capacitors. *See advertisement page* 6.

14H. MOSLEY (Mosley Electronics, Inc.)
Literature describing MOSLEY "Vest Pocket" 40 Meter Rotary Beam . . . for amateur use. *See advertisement page* 60.

15H. PERMA-POWER (Perma-Power Company)
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Form No. PPSL-7 Numerical Listing of All Permo Needles. *See advertisement page* 64.

17H. PHAOSTRON (Phaostron Company)
"555" Multimeter "Measures More". *See advertisement page* 36.

18H. PYRAMID (Pyramid Electric Company)
CRA-1 Capacitor-Resistor Analyzer. *See advertisement page* 22.

19H. QUAM (Quam-Nichols Co.)
Catalog No. 70, listing complete specifications on over 100 Adjust-a-Cone Replacement Speakers. *See advertisement page* 46.

20H. RADIART (The Radiart Corp.)
F-925 Vipower Catalog. *See advertisement page* 1.

21H. RADION (The Radion Corp.)
Specification sheets for new Model 900 Antenna and new Model LA75 Arrester. *See advertisement page* 64.

22H. RADIO RECEPTOR (Radio Receptor Co., Inc.)
Transistor specification sheet on new low price RR125, including experimental circuit, Bulletin G50-A. *See advertisement page* 40.

23H. SPRAGUE (Sprague Products Co.)
K200 Ceramics Capacitors TV Replacement Manual, 64 page complete listing on TV sets made since 1950. *See advertisement pages* 2, 52, 58, 62.

24H. TELETEST (Teletest, Inc.)
Catalog and specification sheets on Teletest Model RT203 Rejuva-Tester, FT100 Flyback Tester, and CT355 Capaci-Tester. *See advertisement page* 50.

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Literature on Model 120 Crystal Calibrator, Model 150 Rainbow Generator, Model 160 White Dot Generator, Model 810 Fly Back and Yoke Tester, Model 820 Dynamic Sweep Circuit Analyzer, and Model 330 Field Strength Meter. *See advertisement page* 42.

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COLOR TV TRAINING SERIES

QUESTIONS ON PART XV

Part XV 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. How will a monochrome picture be affected by 60-cycle hum which originates in the color circuits of a receiver?
2. What section of the receiver would be at fault if the hum modulation appeared as wide horizontal bars of yellow and blue?
3. Name the three categories into which the causes for improper colors may be classified.
4. Name the two signals either of which might be lacking in amplitude if the receiver cannot reproduce fully saturated colors in any hue.
5. How would color reproduction be affected if the tube used as the bandpass amplifier were weak?
6. Will the colors reproduced by a receiver lack saturation if the color killer is not completely cut off?
7. If a receiver can reproduce only values of orange and cyan, what signal is not reaching the matrix section?
8. In what section might a defective tube be found if the receiver could reproduce only hues of green and magenta?
9. What can be said of the 3.58-mc oscillator signal if the receiver does not reproduce the hue of any color correctly?
10. If one of the tubes used as a phase detector were weak, what symptoms might be noted with respect to the colors reproduced on the screen?

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PF REPORTER

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August, 1955

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CK* Reference Chart No. 8

3439 COLOR-BAR GENERATOR

ceiver That Is Operating Normally.

Fig. 5. Pattern Indicating Improper Setting of Hue Control.

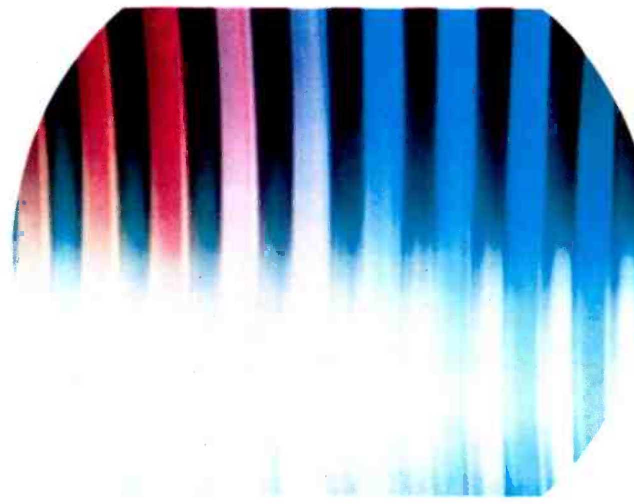
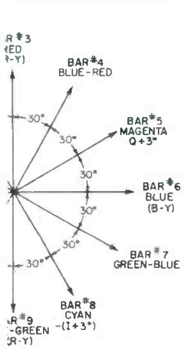


Fig. 6. Pattern Produced by Depressing MOD. Button.



Phase Angles of the

ng Loss of Red Signal.

ng Loss of Green Sig-

ng Loss of Blue Signal.

Fig. 5 illustrates a picture which has improper colors. Note that the first bar is orange instead of the second bar. Such a condition indicates an error of 30 degrees in the demodulation process.

If only one of the color-difference signals is present, each of the color bars will remain predominantly at one of two hues. If the receiver demodulates on the I and Q axes and if the Q signal is being lost, all the color bars will appear predominantly an orange or a cyan color as they do in Fig. 2. If the I signal is being lost, the color bars will appear predominantly green or magenta as in Fig. 3. As the hue control is varied, the green and magenta bars will appear to vary in saturation and some of them may take on the opposite hue.

If the receiver demodulates on the R - Y and B - Y axes and if either of the demodulator sections fail, a condition similar to that described in the previous paragraph will exist. The only difference will be in the colors produced. If the B - Y signal is lost, the bars will appear predominantly red or cyan. If the R - Y signal is lost, the bars will appear predominantly greenish yellow or blue.

Another significant thing that will be noted when checking a receiver that has lost one of the color-difference signals is that some of the bars may lose all color at certain settings of the hue control. After it has been determined which signal is absent, a signal-tracing procedure should disclose the faulty stage.

Figs. 20, 21, and 22 are color patterns which result from the loss of the red, green, and blue signals, respectively. Although the loss of any one of these color signals would affect the operation of the color receiver during monochrome reception, the patterns are shown in order to provide a comparison with Figs. 2 and 3 which are patterns resulting from the loss of a color-difference signal.

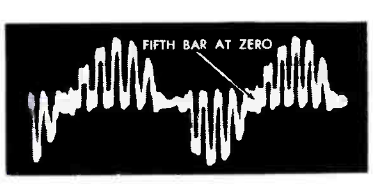


Fig. 11. Signal at Plate of I Demodulator Illustrates Proper Cancellation of the Fifth-Bar Signal.

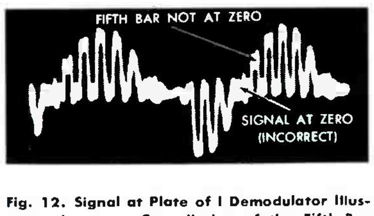


Fig. 12. Signal at Plate of I Demodulator Illustrates Improper Cancellation of the Fifth-Bar Signal.

Checking Demodulator Action

Defects associated with phase errors in the CW reference signals or in the chrominance signal can be located through the use of the signal produced by the generator. If (after adjustment of the contrast, brightness, hue, and saturation controls) the receiver cannot produce a pattern such as that shown in Fig. 4, check the operation of the demodulators. Inject a signal into the receiver; then using an oscilloscope, check the signal at the plate of the I demodulator. Adjust the hue control to obtain a zero signal during the scanning time of the fifth bar. Fig. 11 illustrates the pattern that will be obtained under these conditions. Fig. 12 illustrates a pattern that will be obtained when there is incorrect setting of the hue control. As the hue control is rotated on either side of the correct setting, the polarity of the signal during the scanning time of the fifth bar will go alternately positive and negative. If the receiver under test employs an R - Y demodulator

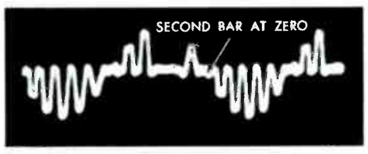


Fig. 13. Signal at Plate of Q Demodulator Illustrates Proper Cancellation of the Second-Bar Signal.

Fig. 14. Signal at Plate of Q Demodulator Illustrates Improper Cancellation of the Second-Bar Signal.

instead of an I demodulator, adjust the hue control for zero signal during the scanning time of the sixth bar instead of the fifth.

With the hue control set so that the I signal is at zero during the scanning time of the fifth bar, connect the oscilloscope to the plate of the Q demodulator. Without readjusting the hue control, check to see that there is zero signal during the scanning time of the second bar, as illustrated by the waveform in Fig. 13.

The result of an incorrect condition is shown in the waveform of Fig. 14. If the receiver under test employs a B - Y demodulator instead of a Q demodulator, check for zero signal during the scanning time of the third bar instead of the second.

If the signal is not at zero during the scanning time of the second (or third) bar, an adjustment of the quadrature transformer must be made. (In some receivers, the order of checking the signals at the plates of the demodulators may be reversed. Consult the receiver service data to determine the proper order.)

After making the quadrature adjustment, set the hue control to its proper position by adjusting it for cancellation of the unwanted signal at the plate of one of the demodulators. If the colors obtained are not satisfactory, check the operation and alignment of the matrix in the manner specified in the receiver service data.

Figs. 15 through 18 illustrate color-difference signals that are obtained when using the Triplett Model 3439 color-bar

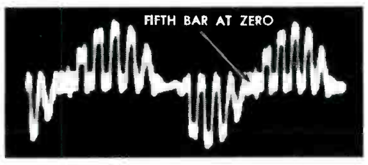


Fig. 15. A Minus I Signal.

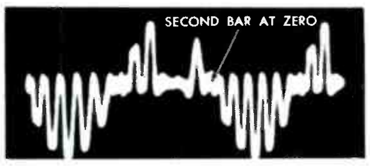


Fig. 16. A Minus Q Signal.

Fig. 17. A Minus R—Y Signal.

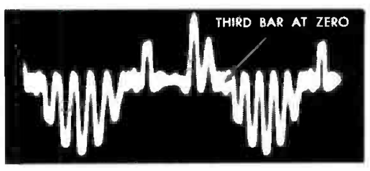


Fig. 18. A Minus B—Y Signal.

generator. Fig. 15 shows a minus I signal, Fig. 16 shows a minus Q signal, Fig. 17 shows a minus R - Y signal, and Fig. 18 shows a minus B - Y signal. These waveforms can be referred to when checking demodulator operation, when adjusting the matrix, and when checking the operation of the color-difference amplifiers.

LOSS OF COLOR SYNCHRONIZATION

If the reference oscillator of the receiver does not synchronize with the color-burst signal, color demodualtion takes place at a random rate. Under these conditions, diagonal or horizontal stripes of variegated colors appear in the picture. These stripes may or may not move, depending upon the operating frequency of the reference oscillator. When loss of color synchronization is experienced, trouble in the burst amplifier or color-synchronizing stages should be suspected.

Because of the fact that some color is produced, two things are known: (1) the color signal is being applied to the demodulators and (2) the CW reference oscillator is operating. The problem is to find out why the color burst does not synchronize the CW oscillator.

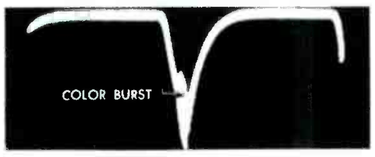


Fig. 19. Signal at Plate of Burst Amplifier.

Fig. 19 illustrates the waveform present on the plate of the burst amplifier. The large spike is caused by the keying pulse obtained from the horizontal-output stage. Note the color-burst position at the tip of the spike. If the color burst is not present, rotate the horizontal-hold control and note whether the color burst appears. When checking some receivers or when using an oscilloscope which has only medium gain at 3.58 megacycles, it may be necessary to increase the vertical gain of the oscilloscope to maximum in order to see the color burst. Position the pattern so that the tip of the spike is visible, and then check to see if the color burst is visible.

If the color burst is present in the output of the burst amplifier, trace the signal to the color-synchronizing section. The type of synchronizing circuit used in the receiver being serviced will dictate the servicing procedure that should be used in the color-sync stages; but in the majority of receivers, voltage and resistance checks will disclose the defective component.

PHOTOFACT COLORBLOCK*
*REG. U. S. PAT. OFF.

Reference Chart No. 8

A PHOTOFACT COLORBLOCK Which Outlines the Uses of The Triplett Model 3439 Color-Bar Generator in Adjusting and Servicing Color Receivers.

Prepared by the Editorial Staff of the PF REPORTER for the Electronic Service Industry—August, 1955

PHOTOFACT COLORBLO
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USING THE TRIPLETT MODEL 3

Fig. 2. Pattern Indicating Loss of Q Signal.

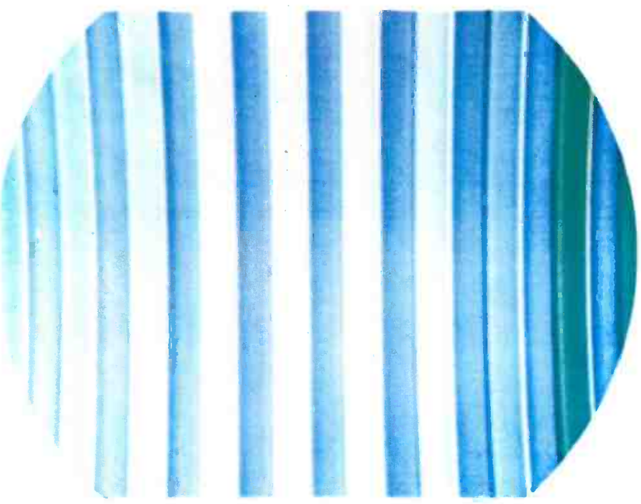

Fig. 3. Pattern Indicating Loss of I Signal.

Fig. 4. Pattern Produced by a Re

Fig. 1. The Triplett Model 3439 Color-Bar Generator.

GENERAL DESCRIPTION

The Triplett Model 3439 color-bar generator produces signals which can be used to test and adjust color receivers. The cabinet of the instrument is styled so that it matches other Triplett equipment. Not only can the unit be used on the bench, it can also be used as a portable instrument. The controls are neatly arranged and clearly marked to facilitate the selection of the desired signals. A built-in VTVM is provided to enable monitoring and proper adjustment of signal amplitudes. Fig. 1 is a photograph of the Triplett Model 3439.

SIGNALS PROVIDED

The Model 3439 produces a video signal or a modulated RF signal. The video signal is available at either a positive or negative polarity, and the RF signal is modulated by the composite picture signal. The instrument is normally supplied with crystals for operation on channel 3. Operation on channel 2 or 4 may be had by changing crystals and by recalibrating. The sound carrier is unmodulated and may be turned off by depressing the SOUND CAR. OFF button on the front panel.

The composite color video signal produced by the Model 3439 consists of a sync pulse and eleven subcarrier bursts. This video signal is illustrated in Fig. 7. The phase of each of the subcarrier bursts is delayed 30 degrees from the preceding one. In operation, the receiver interprets the first subcarrier burst as the color-synchronization burst; and the remaining ten bursts produce ten color bars, each bar being representative of a color displaced by 30 degrees from its adjacent bar. Fig. 4 illustrates the pattern that is seen on a receiver that is operating normally. Note that the color bars vary in hue, starting with a yellow-orange on the left and ending with a green on the right.

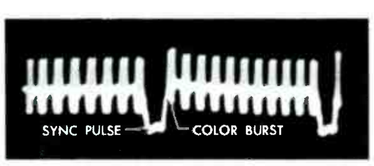

Fig. 7. Waveform of Color Signal.

The phase angle of the subcarrier and the color for each of the bars are identified on the color-phase diagram shown in Fig. 8 in which bar No. 1 is yellow-orange, bar 2 is orange, bar 3 is red, bar 4 is blue-red, bar 5 is magenta, bar 6 is blue, bar 7 is green-blue, bar 8 is cyan, bar 9 is blue-green, and bar 10 is green. Note that the third bar is an R - Y signal, bar 6 is a B - Y signal, and bar 9 is a minus R - Y signal. Bars 2, 5, and 8 are only three degrees off the I, Q, and minus-I signals, respectively. Because of the fact that the hue control of a receiver covers a much greater range than three degrees, these three bars can be used to adjust circuits in receivers which demodulate on I and Q axes.

The five controls which are positioned horizontally across the panel of the instrument starting from right to left are labeled as follows: (1) POWER METER, (2) METER ZERO, (3) SUB. CARRIER MOD., (4) HORIZ. HOLD, and (5) VIDEO. The POWER METER control is a five-position switch which serves as an on-off-standby switch and as a control to supply various signals to the meter for setting modulation levels. These levels are adjusted by means of the three controls which are accessible through the three holes in the upper left-hand corner of the instrument. Although these controls seldom require adjustment, the built-in meter permits frequent checks of the modulation levels to ensure proper operation.

The METER ZERO control provides for zeroing of the meter when the POWER METER control is in the METER ZERO position.

The SUB. CARRIER MOD. control can be adjusted to reduce the subcarrier modulation so that the color-lock characteristics of the receiver under test can be checked.

The repetition rate of the horizontal sync pulses can be varied by adjustment of the HORIZ. HOLD control. The control should be set so that a 10-bar pattern such as that shown in Fig. 4 is visible on the screen.

The VIDEO switch which is labeled (+) and (-) permits the selection of a video signal of either a positive or negative polarity. The video signal is available from a jack at the lower left-hand corner of the instrument. This jack is labeled VIDEO-LO and supplies a video signal which is to be connected to low-impedance circuits. A shielded cable is provided to make this connection. Adjacent to this jack are two banana jacks labeled VIDEO-HI and GND. A video signal of either polarity is also available from these two jacks. Two leads are provided to connect from these jacks to a high-impedance circuit.

The R.F. OUT jack is located at the lower right-hand corner of the unit. A cable which has a balanced output is provided to connect the RF signal to the receiver.

To the left of the R. F. OUT jack is a push button labeled SOUND CAR. OFF. The sound carrier may be turned off by depressing this button. By so doing, any 920-kc beat which might be present in the picture is removed. If no 920-kc beat is present, no change will be noted in the picture when the button is depressed.

Adjacent to the SOUND CAR. OFF button, there is another push button labeled MOD. When this button is depressed, 60-cycle modulation is applied to the signal and a brightened horizontal bar appears in the picture. This signal is helpful in testing the amplitude characteristics of a receiver. Fig. 6 illustrates the appearance of the pattern when the 60-cycle modulation has been applied. Note that although the color in one portion of each bar is of a different saturation than the color in the rest of the bar, the hue is the same throughout the length of the bar. In a receiver that is improperly adjusted, the portion of each bar in the bright area will be of a different hue than that in the dark area of the same bar.

CHECKING RECEIVER OPERATION

Connect the RF output of the generator to the antenna terminals of the receiver under test. Set the channel selector of the receiver to the proper channel, and adjust the fine-tuning control to tune in the pattern so that a minimum 920-kc beat is obtained. Adjust the HORIZ. HOLD control on the instrument in order to obtain ten bars in the picture.

Adjust the brightness, contrast, saturation, and hue controls of the receiver in an attempt to produce the proper pattern like that shown in Fig. 4. If the receiver produces a satisfactory pattern, its operation can be considered normal.

If a satisfactory picture cannot be produced, analyze the symptoms in order to determine what section is not operating properly. All color troubles will fall into these three categories: (1) loss of color, (2) wrong color, and (3) loss of color synchronization. After determining the proper category of the symptoms, substitute tubes in the stages involved. If no improvement is noted, proceed as outlined in the servicing section.

SERVICING

The operation of the color stages can be checked with the signal available from the Triplett Model 3439. In every case, it is assumed that the receiver operates normally when receiving a monochrome transmission.

NO COLOR

If no color can be produced by injecting an RF signal at the antenna terminals, inject a video signal across the video-detector load. If color can be obtained by injecting the signal at this point, the trouble must lie in the IF stages or in the tuner. Do not overlook the possibility that the tuning range of the tuner might be insufficient. Reconnect the RF output of the generator to the antenna terminals, and check the setting of the fine-tuning slug or trimmer. If color cannot be received even though the fine-tuning range is known to be correct, check the alignment of tne tuner and IF amplifier.

If color cannot be received by injecting a video signal at the video detector, check the input of the signal at the demodulator stages. Fig. 9 illustrates the signal which should be present at the input of the demodulators. If the signal is not present, check the operation of the bandpass amplifier and locate the point at which the signal is being lost. If the receiver employs a color-killer stage, check to see that this stage is not cutting off the bandpass amplifier. If such should be the case, check the operation of the color-sync section as outlined under "Loss of Color Synchronization."

Color demodulation should take place if both the chrominance signal (Fig. 9) and the CW signal (Fig. 10) are present at the demodulators. If either is absent, locate the defective stage by signal tracing backward through the circuits. After the defective stage is located, voltage and resistance measurements will usually identify the defective component.

WRONG COLOR

Defects associated with wrong color can be classified into two main categories: (1) complete or partial loss of one of the color-difference signals, and (2) a phase error either in the chrominance signal that is applied to the demodulators or in the CW reference signals that are applied to the demodulators.

The fact that there is any color produced indicates that the CW reference oscillator is operating and that the reference and chrominance signals are being fed to at least one of the demodulators. The first step is to determine whether or not both demodulator circuits are working. This can be done by noting the effects on the pattern as the hue control is rotated. In receivers that are operating normally, the colors on the screen will vary through a wide range as the hue control is varied.

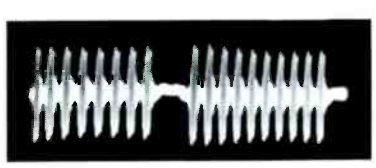

Fig. 9. Chrominance Signal at Input of Demodulators.

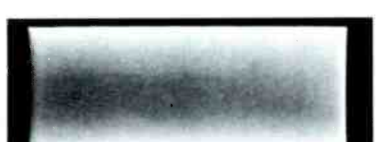

Fig. 10. CW Signal at Input of Demodulators.

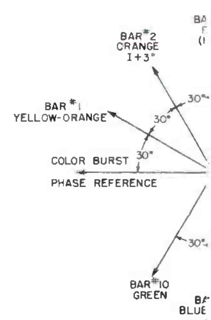

Fig. 8. Diagram Showing Chrominance Signal.

Fig. 20. Pattern Illustrati

Fig. 21. Pattern Illustrati nal.

Fig. 22. Pattern Illustrati

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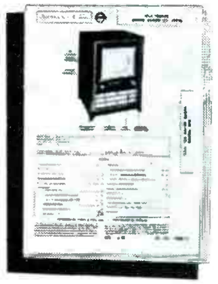

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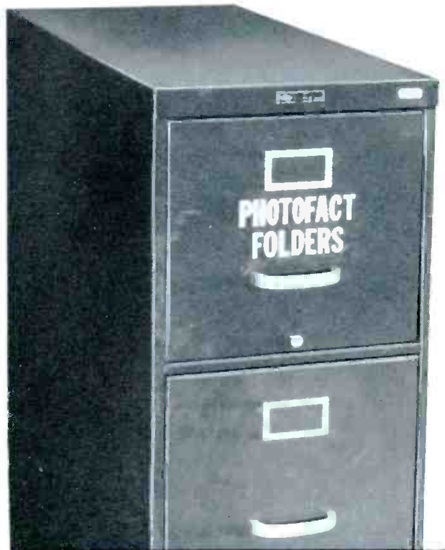

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31. PHOTOFACT maintains an inquiry service bureau for the benefit of its customers.

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MERIT

THE most complete replacement line

a transformer or coil for every TV-radio need.

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P-3059 *this and 57 others.*

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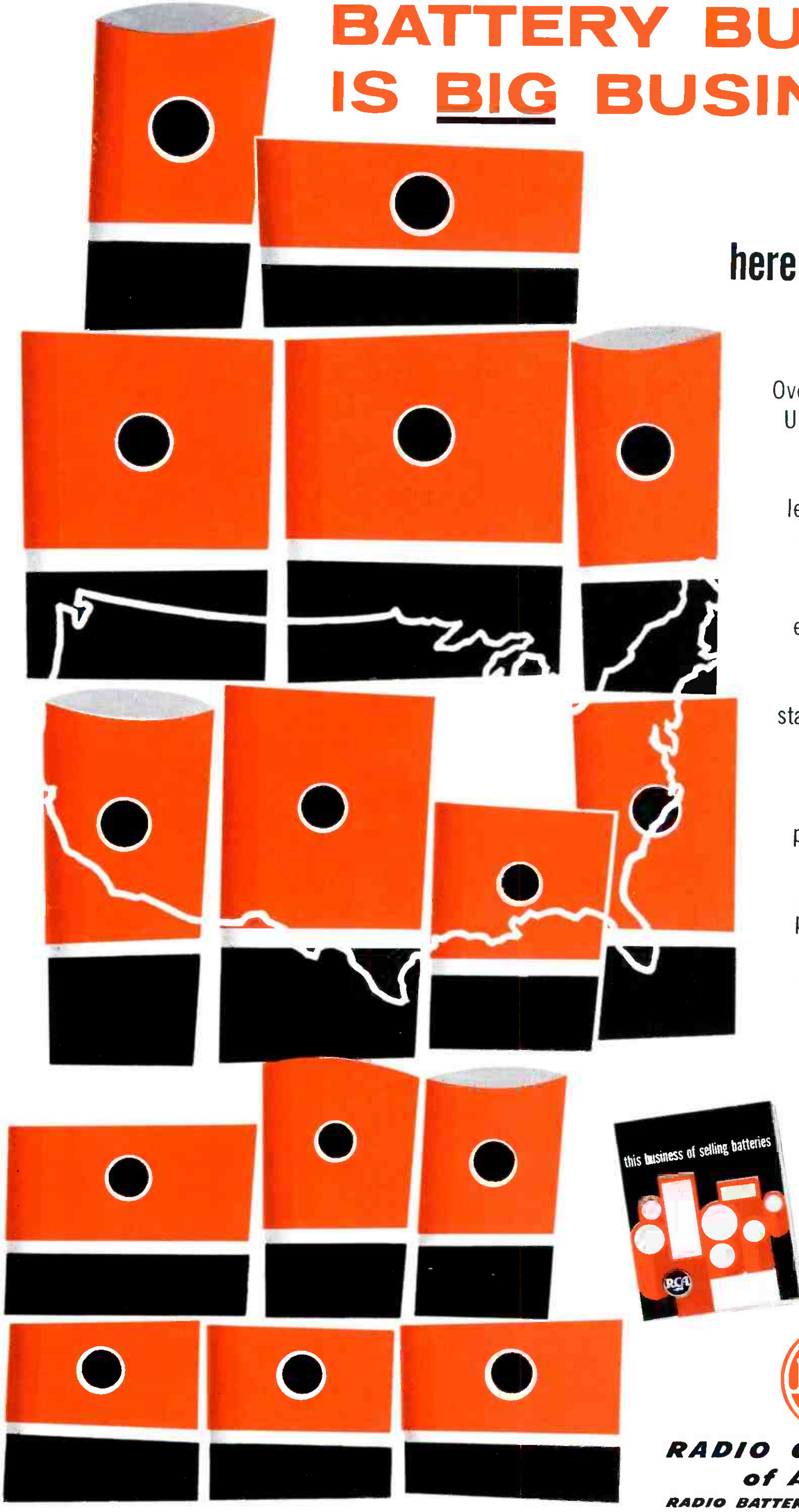

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Over 15 million portables in the USA today make this business of selling batteries a big business. Get your share by letting RCA give selling power to your battery selling plans. Remind your customers that RCA Batteries are radio-engineered for extra listening hours . . . manufactured to the highest performance standards of the greatest name in radio. Your RCA Battery Distributor is ready now to supply you with fresh, full-powered RCA Batteries. And, remember, when you place your order, ask about RCA's profit-building battery selling aids. They're available with your purchase of fast-selling RCA Batteries.

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3AG - 1/4 A
3AG - 1/2 A
LITTELFUSE
EASY TO MOUNT
1 determine the most handy location above or near your work bench.
2 using one channel as a guide locate the position for the screws for the number of channels required—single, double or triple bank.
3 insert screws in position—do not turn all the way down. Slide channel down, letting screw head come through large part of the keyhole slot. Slip narrow part of slot behind the screw head and tighten.
VERSATILE
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. Fuses now dispense from the middle or the bottom of the channel.
To serve you . . . to increase your profits . . .
LITTELFUSE again streamlines your fuse service operation with a program that makes sure you have the right fuse at your fingertips at all times—time saved, effort saved build up your service profits.
ASK YOUR JOBBER about the Littelfuse Single Channel Fuse "Stocker" Package: 10 single (double dispensing) fuse channels, 10 boxes (50) 3 AG 1/4 fuses and 10 boxes (50) 3 AG 1/2 fuses in one complete package FOR THE COST OF THE FUSES ALONE.
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