Techni-talk

on AM, FM, TV Servicing

Electronic TUBES

The fundamentals of the NTSC color television system have been described in the eight previous issues. The transmitter portion will be concluded in this issue with a description of gamma correction, delay lines and a summary. At a later date color receiver circuits and color picture tubes will be covered.

GAMMA CORRECTION

Either monochrome or color picture tubes have a brightness vs. signal voltage characteristic similar to that shown in Fig. 1. Since the brightness level does not increase in direct proportion to an increase in signal voltage, the brightness characteristic results in a curved line instead of a straight line as shown. This indicates that the brightness range is stretched out in the high light region and compressed in the shadows. It is seldom necessary to incorporate a gamma correction circuit in the monochrome system because adequate compensation may be obtained by operating the monochrome camera so that maximum high lights fall somewhat above the shoulder of the camera response curve. Since this type of correction would not be practical in the color camera, special circuits have been incorporated in the transmitter to compensate for the characteristic illustrated in Fig. 1.

The characteristic of a gamma correction circuit is shown in Fig. 2. If the curve shown in Fig. 1 is superimposed over the curve shown in Fig. 2, the brightness characteristic becomes practically linear as shown by the dotted line in Fig. 3. It should be pointed out that these drawings are not exact characteristic curves but have been drawn only to illustrate how gamma correction is accomplished in the color transmitter.

Gamma correction circuits could be added to the receiver instead of the transmitter, but this would add additional circuitr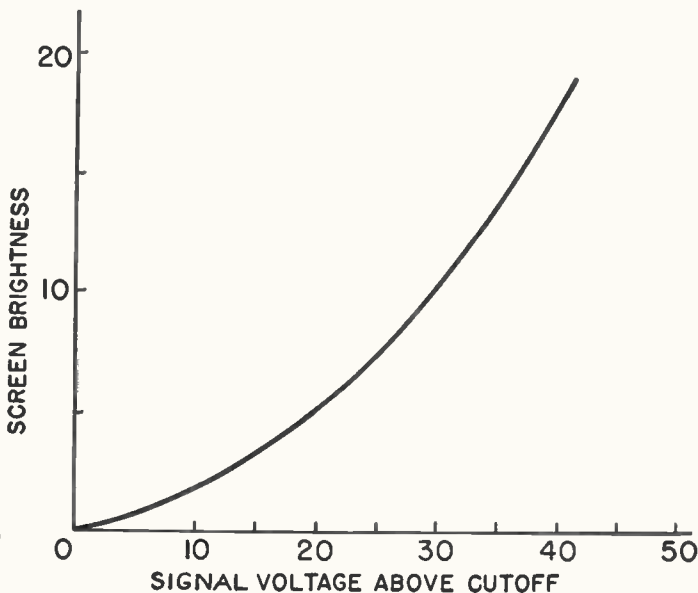y to the already expensive and complex receiver. Also by adding these circuits to the transmitter an improvement in the signal-to-noise ratio results, particularly in the low and
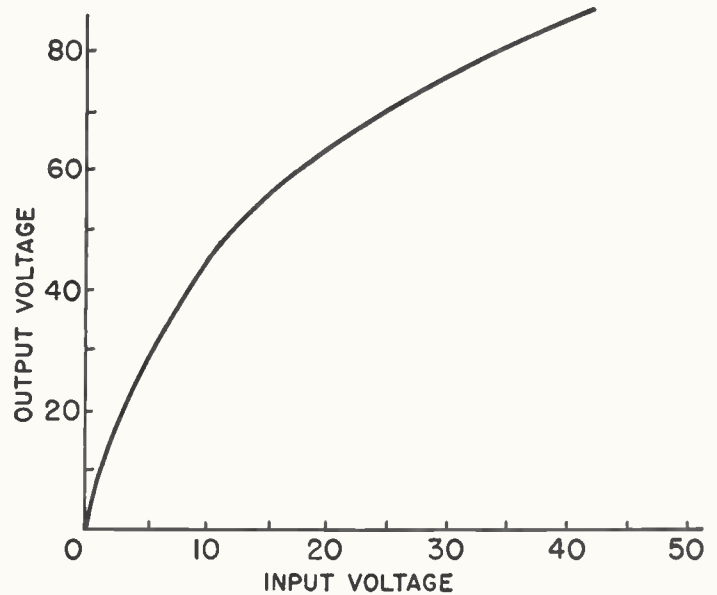

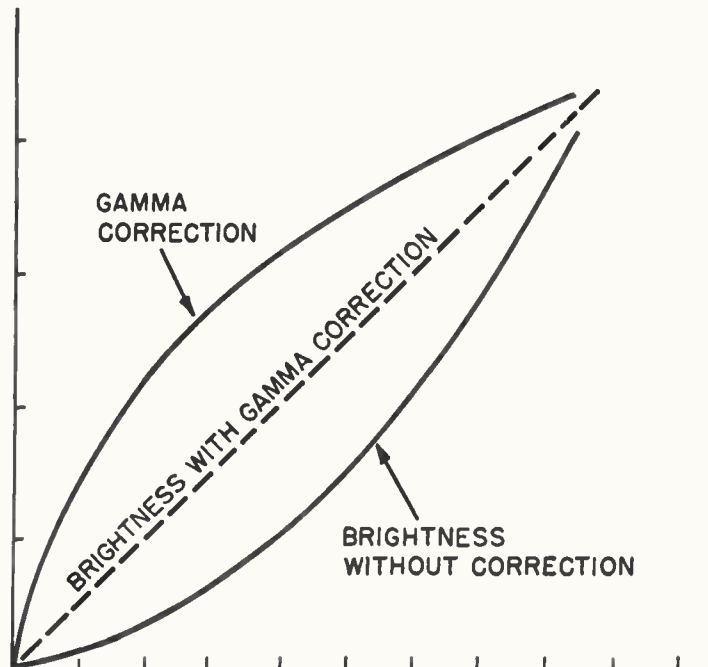Fig. 2. Type of curve produced by gamma correction circuit.

Fig. 1. Typical brightness characteristic of a picture tube.

Fig. 3. Typical brightness and gamma correction curves with straight dotted line indicating the gamma corrected brightness characteristic.

DELAY LINE

medium brightness areas of the color picture.

Whenever the "'" (prime) notation is used in relation to color TV signal voltages it indicates that gamma-correction has been made. Therefore gamma-corrected E_R, E_G and E_B signal voltages will be shown as E_R', E_G' and E_B'.

DELAY LINES

It will be recalled that three signals (Y, I and Q) are used for the brightness and chrominance information. These three signals have different bandwidths; the Y signal is 4.2 mc, the I signal 1.3 mc and the Q signal 0.6 mc. The correct bandwidth for the I and Q signals is obtained by passing these two signals through band-pass filters.

Whenever a signal is passed through a filter which reduces its bandwidth, the signal is delayed in time. The delay increases as the bandwidth is reduced as illustrated in Fig. 4. This shows that the square wave is practically unchanged at the output of the 4.2 mc filter, whereas a considerable delay has occurred at the output of the other two filters. The dotted square waves represent the output

— FLEXIBLE TUBE
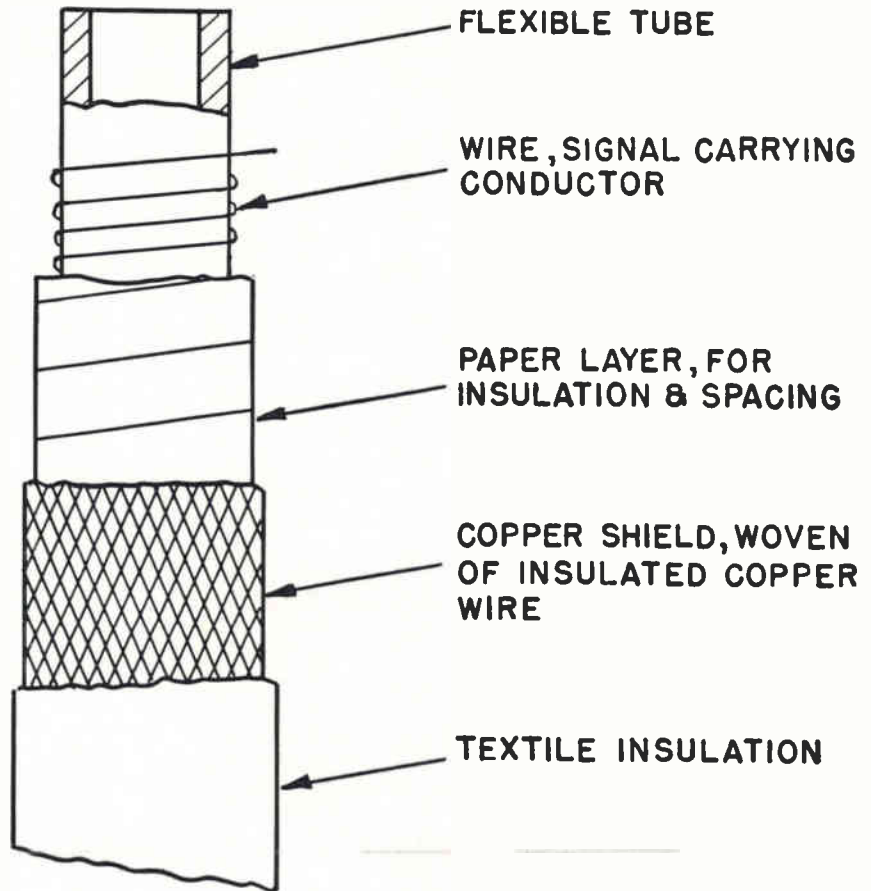
— WIRE, SIGNAL CARRYING CONDUCTOR

— PAPER LAYER, FOR INSULATION & SPACING

— COPPER SHIELD, WOVEN OF INSULATED COPPER WIRE

— TEXTILE INSULATION

Fig. 5.   One type of construction used for delay line.

Fig. 6.   Symbol used for delay line on schematic diagrams.

at the 4.2 mc filter superimposed over the other two output signals to indicate the delay caused by the filters. The delay and the change in wave shape have been exaggerated in Fig. 4 to illustrate the effect of band-pass filters.

Since accurate reproduction of color TV pictures requires that the picture produced by any one color be accurately superimposed over the same picture produced by the other two colors, any delay caused by band-pass filters would result in considerable misregistration. Fig. 4 indicates that the band-pass filters cause the "Q" signal to be delayed somewhat
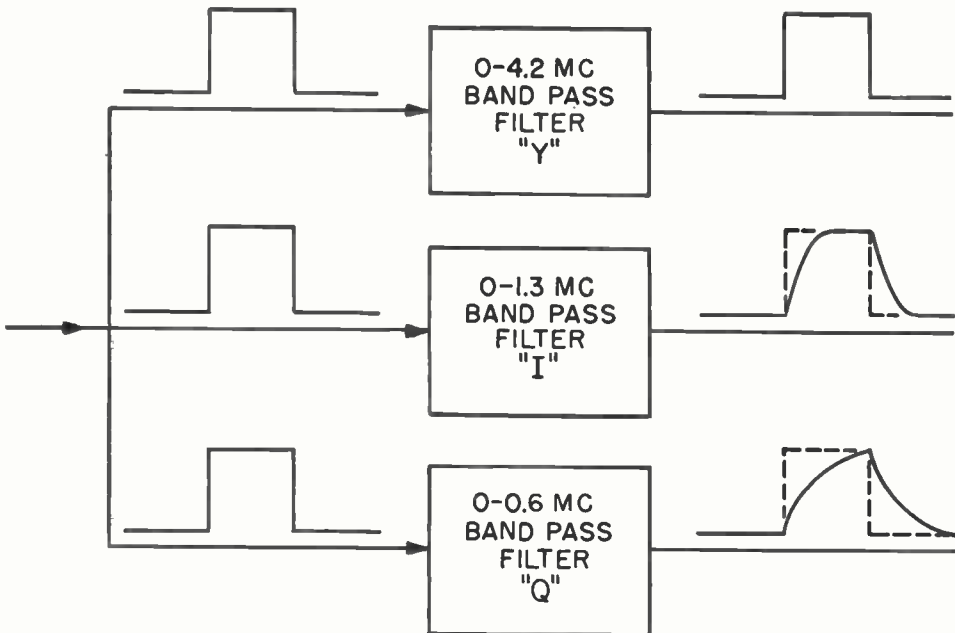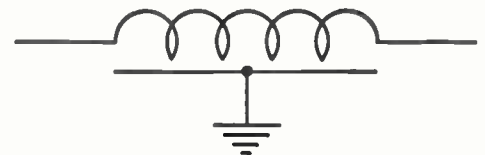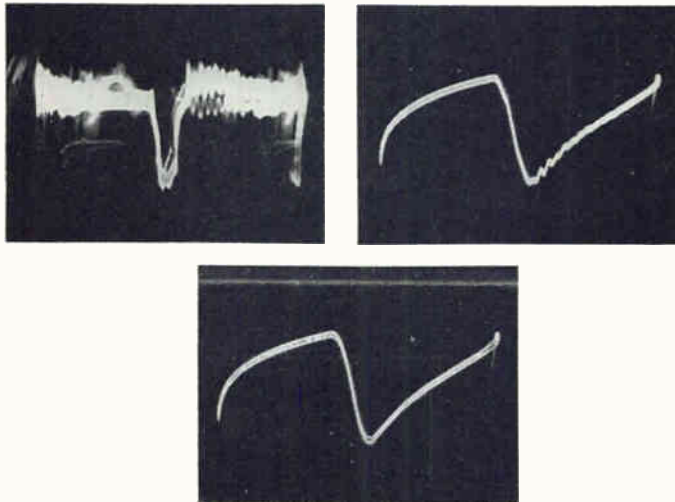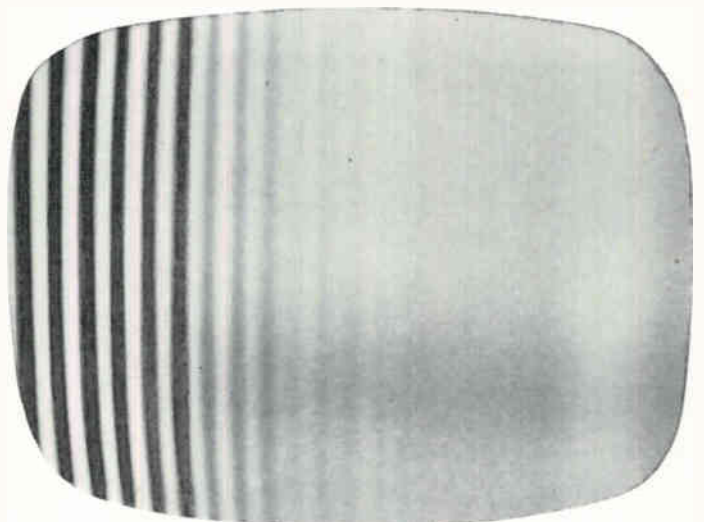

Fig. 4.   Illustration of time delay resulting as a square wave passes through three different band-pass filters.

Tele-Clues ▶

TELE-CLUE F-203 and 204—The vertical striations were caused by a defective C-464 capacitor in a 21T4 type General Electric receiver. The electrical location of this capacitor is shown in Fig. 1 and the physical location in Fig. 2. This capacitor checked OK on a capacitor checker, but it had apparently lost its effectiveness at higher frequencies as indicated in the waveform photographs. The first waveform was taken with the oscilloscope connected to the grid of the picture tube. The second and third waveforms were taken with the oscilloscope connected across a 10-ohm resistor in the B+ side of the horizontal yoke winding. The oscilloscope was synced at one-half the horizontal frequency. The first and second waveforms indicate that spurious frequencies are present in both the video signal and the horizontal sweep current. A new C-464 capacitor removed these spurious frequencies as shown in the third waveform. It was also found that a .25 or .5 mfd 600-volt capacitor connected across the original C-464 or a 1000-ohm resistor in series with the B+ lead to the head end was effective in eliminating the vertical striations. Similar visible striations have been noticed on other General Electric models. These were also due to defective filter capacitors.
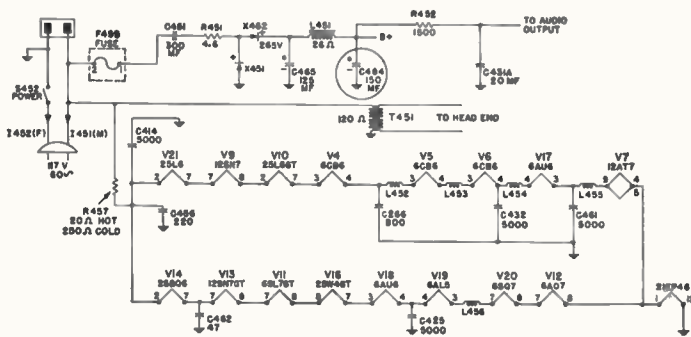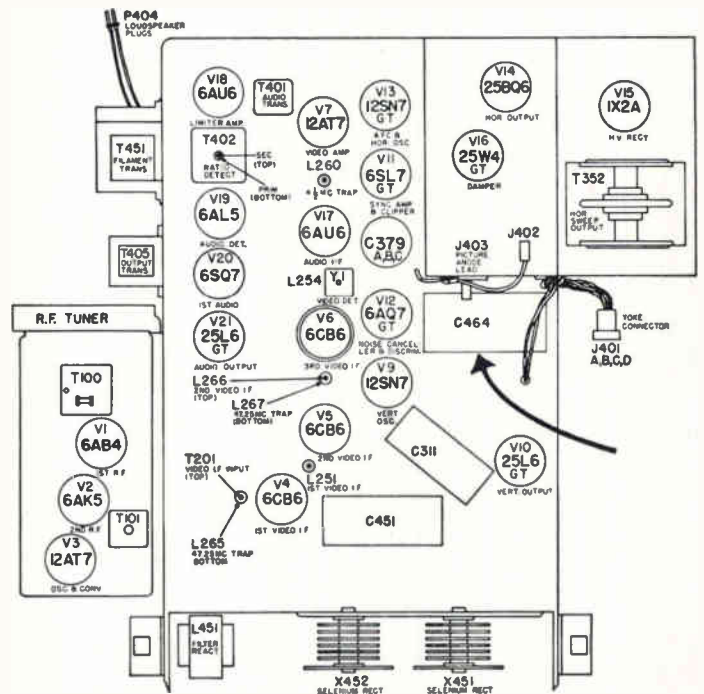

Fig. 1

THIS page of Tele-Clues has been punched for insertion in your Tele-Clue binder. These binders which contain two hundred and two Tele-Clues and an index sheet are available through your local G-E tube distributor.

The letter which precedes each Tele-Clue number identifies the circuit in which the defect exists. Please enter the Tele-Clue number in the proper column on the index sheet according to the key letter which precedes each number.


Fig. 2

SNIVETS

Tele-Clues E-205, 6, and 7 show fairly typical "snivets" which are spontaneous, spurious oscillations generated within the horizontal output tube. The frequency is dependent upon geometric configuration and applied potentials. It is also affected by magnetic fields (which can be thought of as changing the geometric configuration). Because of the slight change in geometry necessary to alter the frequency, the snivet characteristics of sweep tubes vary between tubes of the same manufacture but generally more between manufacturers. Likewise, the voltage conditions vary between sets so that some sets of the same manufacture are more prone to snivet than others and some manufacturers' sets are more prone to snivet than others.

Because the voltage conditions at the tube change during a scan line, various frequencies of oscillation occur. If any of the multitude of frequencies generated happens to be within the r-f bandpass of the receiver, it shows up as 100% modulated and thus a black spot on the scan line. The decreased intensity in E-207 with a video signal is due to AGC and the attendant decreased sensitivity of the receiver.

The peculiar pattern effect is due to the heater's magnetic field affecting the frequency. Because the a-c magnetic field is synchronous with the frame frequency, the pattern stands still. The effect is due to the magnetic field changing the apparent geometry so that the particular band of frequencies being observed occurs at different tube potentials and thus at various horizontal positions as the picture is scanned vertically.

The pattern may vary as the frequency of the UHF converter is changed because the observed snivet frequencies fall in and out of the bandpass of the receiver. In a double conversion UHF converter the identical pattern may be observed in two places since the image will be received, depending upon how good image rejection is.

Sometimes, tubes of a given design are prone to snivet more in the UHF band than in the VHF band or vice versa. Others snivet well in either band. Some set manufacturers use an ion trap magnet near the horizontal amplifier to eliminate snivets. This may only shift the frequency to some other region such as from VHF to UHF.
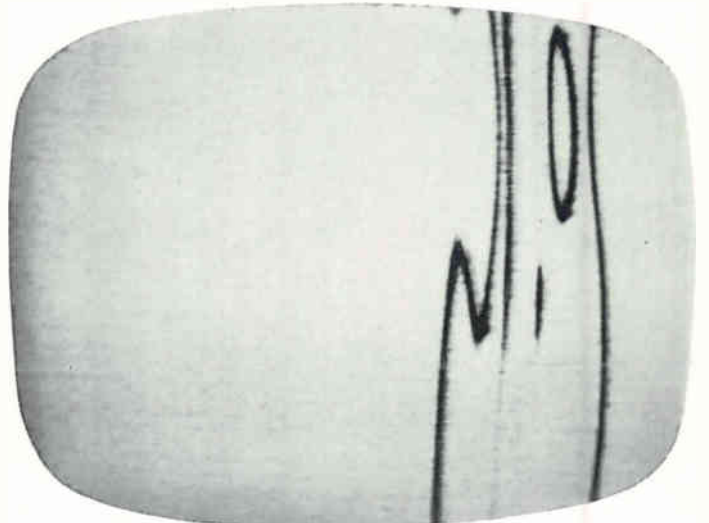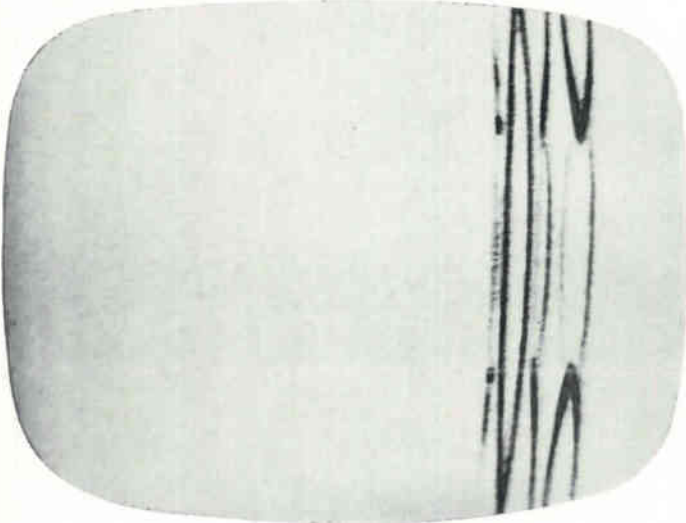
TELE-CLUE E-205 AND 206—These dark patterns on the right side of these two photographs are due to "snivets." This condition was previously described and illustrated in Tele-Clues E-193 and 194. The "snivets" shown above appeared only when a separate UHF converter was used. The pattern changed as the frequency of the converter was changed and at some settings the raster was "clean."

TELE-CLUE E-207—This shows the effect of "snivets" when a picture is received. A different horizontal output tube may eliminate the "snivets" entirely or change the frequency so the picture is "clean." Another method which may be used is to place an ion-trap magnet over the horizontal output tube as shown in the photographs on the right. The ion-trap is then slowly turned until the "snivets" disappear.
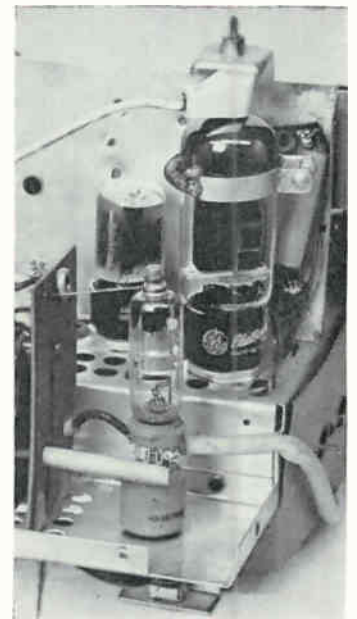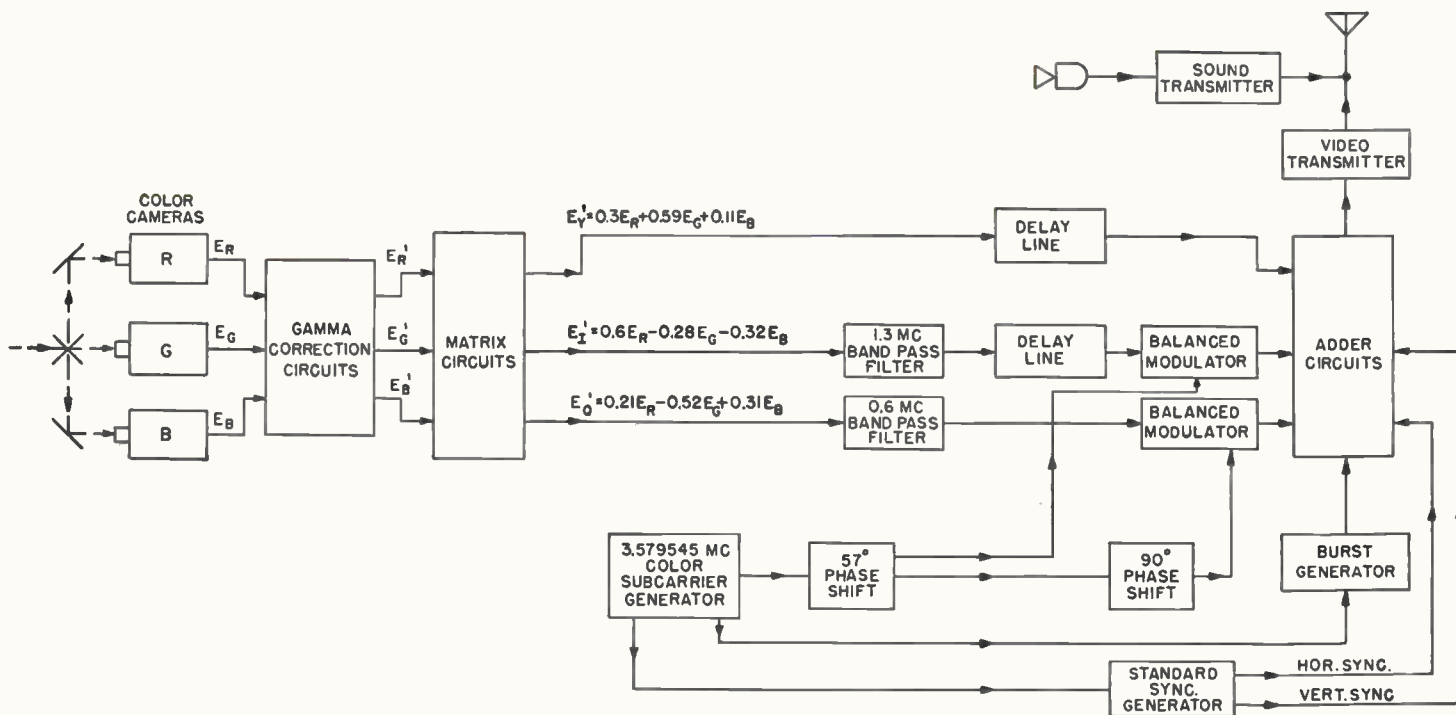
Fig. 7. Simplified block diagram of color TV transmitter.

longer than the "I" signal and the "I" signal longer than the "Y" signal. Since the "Q" signal is delayed the longest, both the "I" and the "Y" signals must also be delayed so that all three signals will coincide.

A delay in time could be accomplished by passing the signal through a long piece of transmission line which would require considerable space. The same result is accomplished with a much shorter length of specially constructed "delay line." One type of delay line is constructed as shown in Fig. 5 and has an appearance similar to "RG" type insulated cable. Delay lines are also used in the color receiver and can be identified on schematic diagrams by the symbol shown in Fig. 6.

COMPLETE TRANSMITTER

A simplified block diagram of a color transmitter is shown in Fig. 7. This will be used to summarize briefly the basic method used to transmit a color TV signal.

The three color cameras produce color signals E_R, E_G, and E_B in proportion to the amounts of these colors in the scene. These three color signals are fed to the gamma correction circuits and then to the matrixing circuits. The matrixing circuits combine the various portions of the E_R', E_G' and E_B' signals and produce E_Y', E_I' and E_Q' signals.

The E_Y', which is the brightness signal,

is passed through a delay line and then to the adder circuits. The E_I', which is one of the chrominance signals, is fed to the 1.3 mc filter and then to the delay line. The output of this delay line is fed to the balanced modulator circuit where it modulates a portion of the output of the subcarrier generator which has been shifted in phase by 57 degrees. The output of this balanced modulator is fed to the adder circuits. The E_Q' signal, which is the other gamma-corrected chrominance signal, is fed to the 0.6 mc filter and then to the balanced modulator circuit where it modulates another portion of the output of the subcarrier generator which has been shifted in phase by 147 degrees (57 degrees + 90 degrees). The output of this balanced modulator is also fed to the adder circuits.

The color subcarrier generator produces the 3.579545 mc subcarrier frequency. A portion of this frequency is fed to a standard sync generator which divides the subcarrier frequency to produce horizontal and vertical sync pulses. In this way the frequency of the sync pulses is properly timed to keep the chrominance signal interleaved with the brightness signal as explained in the Volume 6 No. 5 issue. The output of the sync generator is fed to the adder circuits.

Another portion of the subcarrier frequency is fed to the burst generator. This generator is pulsed so that it adds

about 8 cycles of the subcarrier frequency to the back porch of each horizontal sync pulse as described in the preceding issue. The output of the burst generator is also fed to the adder circuits.

A portion of the subcarrier frequency is shifted in phase by 57 degrees and fed to the E_I' balanced modulator and another portion is shifted an additional 90 degrees and fed to the E_Q' balanced modulator. Since the subcarrier fed to the E_I' balanced modulator is 90 degrees out of phase with the subcarrier fed to the E_Q' balanced modulator the two chrominance signals when combined in the adder produce the quadrature modulated chrominance signal.

The adder circuits combine the brightness and chrominance signals with the horizontal sync pulses plus the burst signal and the vertical sync pulses. The composite signal at the output of the adder is fed to the video transmitter.

The sound signal is fed to the sound transmitter which is the same as used for monochrome. The output of the sound transmitter is fed to the transmitting antenna with the output of the video transmitter.

This concludes the discussion of that phase of color television relating to basic color and the transmission of the NTSC signal. Color picture tubes, color receiver circuits, color test equipment, and troubleshooting the color receiver will be covered in future issues.

BENCH NOTES

ARCING SOCKETS

Vertical sweep amplifiers may have a high pulse voltage on the plate pin of the socket. This may cause an arc to the adjacent cathode or filament pin.

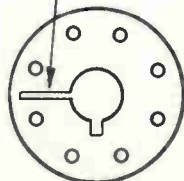There is no repair fluid suitable, and socket replacement, while proper, may take considerable time.

I suggest that a slot be cut with a key-hole saw between the pins which are defective. This air gap between the defective pins now provides better insulation than the original socket.
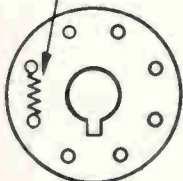
SHORT ACROSS PINS	SAW SLOT
BEFORE	AFTER

David M. Rice
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Merrick, L. I.

REBASING PICTURE TUBES

I was called in to service a TV receiver, because the picture tube base had come off. When I tried to repair this, I had an extremely hard time to get the wires from the tube into the base. First three would go in and then the other two would go in but not all five together. I found this an almost impossible task, due to the shortness of wires and long base.

Then I thought of making a template of the inside of the base, fixing this on the wires from the tube and then putting on the base socket. I made the template out of a manila letter file folder by cutting out a rough circular form and putting it inside the tube base. Then using an awl, I punched the holes, corresponding to tube base pins. Then I put template on wires and gently pushed tube base socket over this and the wires fitted into socket very easily. I had spent two hours trying to get wires into pins before this thought occurred to me. I cemented the tube base socket on with General Cement "Pli-O-Bond" and then soldered the tube pins in place. The job was completed in only about five minutes with the template.

PINS

TUBE BASE SOCKET   TEMPLATE

PICTURE TUBE

SOCKET   WIRES   TEMPLATE
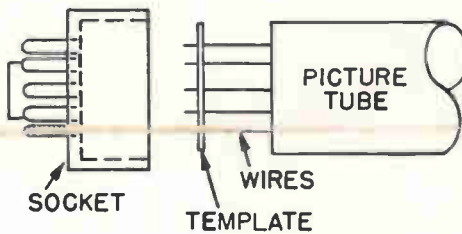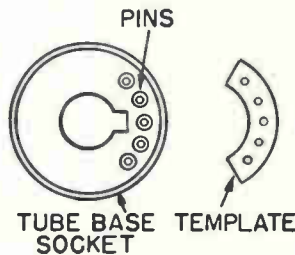
Earl W. Maxson, R.T.
Maxson's Radio Service
46 William Street
Hudson Falls, New York

## What's new! 6BH8

TRIODE-PENTODE

The 6BH8 is a general-purpose miniature tube which contains a sharp-cutoff pentode and a medium-mu triode in one envelope. Except for the electrical characteristics of the triode section, the 6BH8 is identical to the 6AU8.

Like the 6AU8, the tube is suitable for a wide variety of general-purpose applications in both monochrome and color television receivers. The high figure of merit of the pentode section makes it particularly suited for service as a video amplifier, video intermediate-frequency amplifier, and sound intermediate-frequency amplifier. The triode section is intended for use as a sync amplifier, separator, or clipper or as a sweep oscillator. The triode section of the 6BH8 may be diode-connected and employed as a high-perveance diode in video-detector applications. The diode operation can be obtained either with the triode grid connected to the triode plate and the combination operated as the plate of the diode, or with the triode plate grounded and the triode grid operated as the plate of the diode.

Heater, AC or DC— 6.3 Volts, 0.6 Amperes
Heater Warm-up Time* 11 Seconds

CHARACTERISTICS AND TYPICAL OPERATION

CLASS A_1 AMPLIFIER	Pentode Section	Triode Section	
Plate Voltage	200	150	Volts
Screen Voltage	125	...	Volts
Grid #1 Voltage	...	−5	Volts
Cathode-bias Resistor	82	...	Ohms
Amplification Factor	...	17	
Plate Resistance, approx.	150000	5150	Ohms
Transconductance	7000	3300	Micromhos
Plate Current	15	9.5	Milliamperes
Screen Current	3.4	...	Milliamperes
Grid #1 Voltage, approx. $Ib = 100$ Microamperes	−8	−14	Volts

* Heater warm-up time is defined as the time required in the circuit shown at the right for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1). For this type, $E = 25$ volts (RMS or DC), $V_1 = 5.0$ volts (RMS or DC), and $R = 31.5$ ohms.
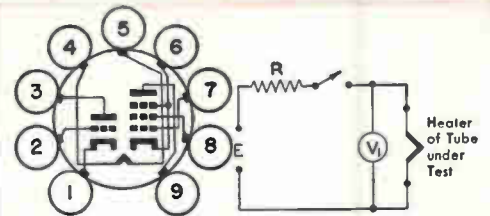
Heater of Tube under Test

Form 3547 Requested
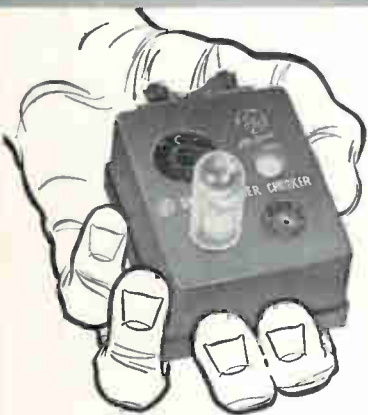
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E-222

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