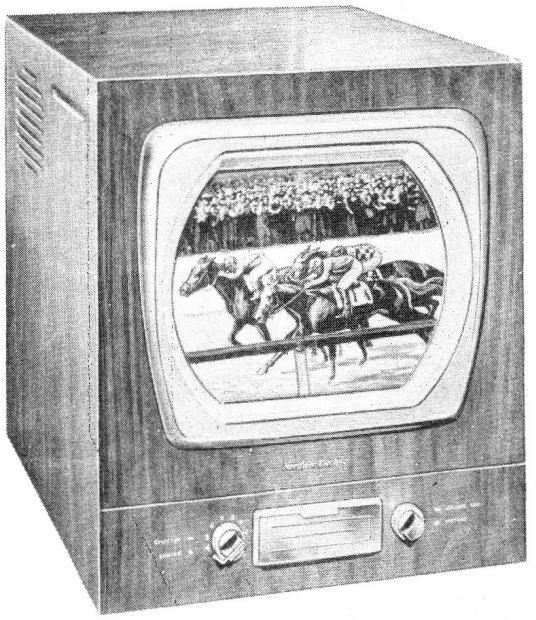
SERVICE BULLETIN

Northern Electric
COMPANY LIMITED
A NATIONAL ELECTRICAL SERVICE

Northern Electric RADIO

MODEL NT121
TABLE MODEL
TELEVISION RECEIVER



SPECIFICATIONS

OVER-ALL DIMENSIONS:		Height Inches	Width Inches	Depth Inches
		19 3/4	17 1/4	20 3/16
ELECTRICAL RATING:	Frequency.....25-60 cycles Voltage.....115 v. a-c Watts.....150 w.			
INTERMEDIATE FREQUENCIES:	Television Video.....45.75 MC Television Audio..41.25 and 4.5 MC			
AUDIO POWER OUTPUT:	Undistorted.....1.0 watts Maximum.....2.0 watts			
LOUDSPEAKER:	Type	PM Alnico		
	Cone Diameter.....5 1/2 in. Voice Coil Imp.....3.2 Ω (400 cps)			
ANTENNA:	Type...Folded dipole, or equivalent Impedance.....300 ohms			

R-F FREQUENCY RANGE:

Selector Switch Position	Frequency Range MC	Picture Carrier	Sound Carrier
		MC	
No. 2	54-60	55.25	59.75
No. 3	60-66	61.25	65.75
No. 4	66-72	67.25	71.75
No. 5	76-82	77.25	81.75
No. 6	82-88	83.25	87.75
No. 7	174-180	175.25	179.75
No. 8	180-186	181.25	185.75
No. 9	186-192	187.25	191.75
No. 10	192-198	193.25	197.75
No. 11	198-204	199.25	203.75
No. 12	204-210	205.25	209.75
No. 13	210-216	211.25	215.75

TUBES CRYSTAL	Symbol	Purpose	Type
	V1	1st RF Amplifier.....	6AB4
	V2	2nd RF Amplifier.....	6BC5
	V3	Converter Oscillator.....	12AT7
	V4	1st Video IF Amplifier.....	6BC5
	V5	2nd Video IF Amplifier.....	6BC5
	V6	3rd Video IF Amplifier.....	6BC5
	V7	Video Amplifier.....	12AT7
	V8	Picture Tube.....	12LP4A
	V9	Vertical Sweep Generator and Output.....	12SN7GT
	V10	Sync Amplifier and Clipper..	6SL7GT
	V11	Horizontal Discriminator....	6AL5
	V12	Horizontal AFC and Sweep Oscillator.....	12SN7GT
	V13	Horizontal Output.....	19BG6
	V14	High Voltage Rectifier.....	1B3G/8016
	V15	Damper.....	25W4GT
	V16	Audio IF Amplifier.....	6AU6
	V17	Audio Limiter and Amplifier.	6AU6
	V18	Audio Detector.....	6AL5
	V19	Audio Amplifier.....	6SQ7
	V20	Audio Output.....	25L6GT
	Y1	Video Detector (crystal)....	1N64

CAUTION NOTICE

THE REGULAR B+ VOLTAGES ARE DANGEROUS AND PRECAUTIONS SHOULD BE OBSERVED WHEN THE CHASSIS IS REMOVED FROM THE CABINET FOR SERVICING. THE HIGH VOLTAGE SUPPLY (10,000 VOLTS) AT THE PICTURE TUBE ANODE WILL GIVE AN UNPLEASANT SHOCK BUT DOES NOT SUPPLY ENOUGH CURRENT TO GIVE A FATAL BURN OR SHOCK. HOWEVER, SECONDARY HUMAN REACTIONS TO OTHERWISE HARMLESS SHOCKS HAVE BEEN KNOWN TO CAUSE INJURY. SINCE THE HIGH VOLTAGE IS OBTAINED FROM THE B+ VOLTAGE, CERTAIN PORTIONS OF THE HIGH VOLTAGE GENERATING CIRCUIT ARE DANGEROUS AND EXTREME PRECAUTIONS SHOULD BE OBSERVED.

THE PICTURE TUBE IS HIGHLY EVACUATED AND IF BROKEN, GLASS FRAGMENTS WILL BE VIOLENTLY EXPELLED. IF IT IS NECESSARY TO CHANGE THE PICTURE TUBE OR TO REMOVE CHASSIS FROM CABINET ALWAYS WEAR SAFETY GOGGLES.

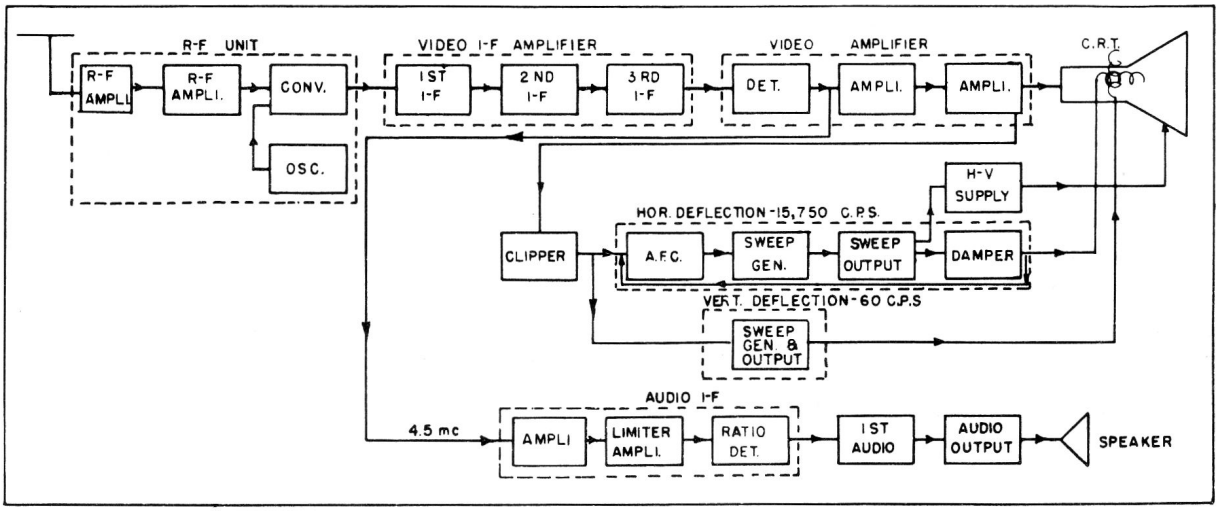


Fig. 1. Block Diagram

GENERAL INFORMATION

The Model NT121 is a table model type television receiver providing reception on all twelve commercial television channels. The picture is produced on a 12 1/2-inch picture tube electromagnetically deflected.

Features of this line of television receivers include a built-in antenna, a two-stage r-f amplifier, balanced input impedance, selenium type rectifiers, intercarrier sound system, ratio detector, improved focus control, safe high voltage for the picture tube, automatic frequency control for horizontal sweep synchronization. The head-end assembly which contains the r-f amplifier, the oscillator and converter section is mounted on a separate chassis which is insulated from the main chassis and is readily demounted. The local oscillator operates on the high-frequency side of the r-f channel frequencies for all channels.

The video i-f is stagger tuned to pass the video i-f of 45.75 mc and the sound i-f of 41.25 mc. As this receiver uses intercarrier sound i-f, the video signal is detected at Y1 as well as a 4.5 mc FM television sound signal which is the beat frequency between the 45.75 mc video i-f and the 41.25 mc sound i-f.

Horizontal and vertical sync signals are tapped off on the plate load of V7B and fed into the sync amplifier and clipper, V10. The vertical sweep generator and output is a 12SN7 connected as a multivibrator. The horizontal sync circuit contains a 6AL5 (V11) tube which is the automatic frequency control discriminator. V12A is a reactance tube which is one section of a 12SN7 tube. Tube V12B operates as a sine-wave oscillator and saw-tooth generator. V13 is a 19BG6 tube and serves as the horizontal sweep output tube. V15 (25W4GT) is a damper tube in the horizontal sweep output circuit. V14 (1B3GT/8016) is a rectifier tube to supply high voltage d-c from the kick voltage during the retrace period of the horizontal sweep developed at the horizontal output transformer, T351.

The 4.5 mc FM sound signal is taken from the diode load of Y1 and is fed into tube V16 (6AU6) which is a sound i-f amplifier.

Tube V16 is coupled by a transformer T401 to the tube V17 (6AU6) which is a limiter amplifier. Tube V17 is coupled to tube V18 (6AL5) ratio detector by the ratio detector transformer T402. The television audio is then amplified by V19 tube (6SQ7) and coupled to the audio output tube V20, (25L6GT) which delivers its power to the loudspeaker coupled by the output transformer.

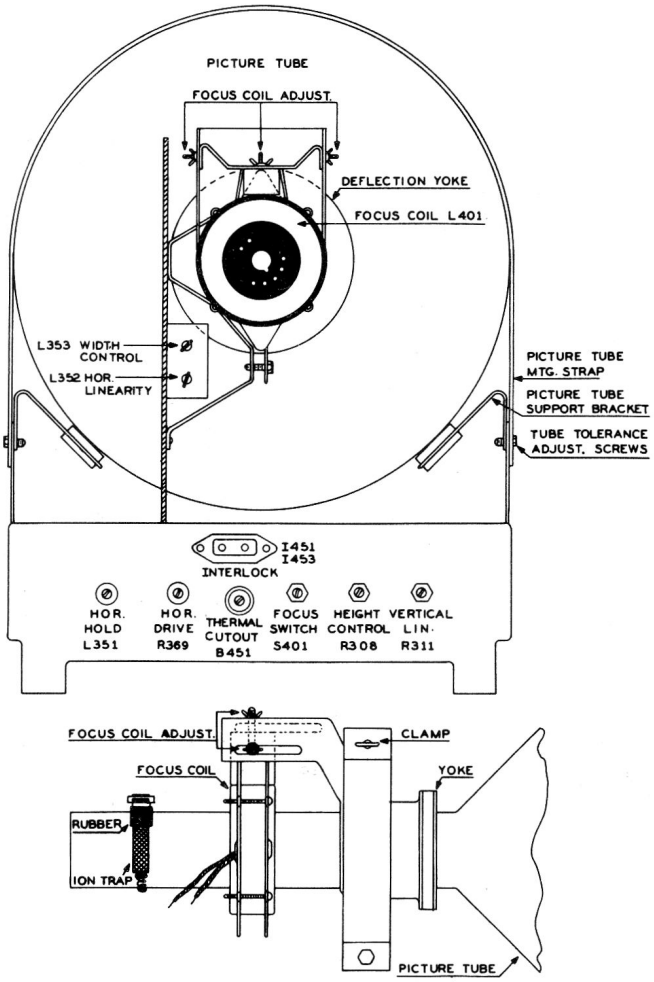


Fig. 2. Preset Adjustments P-8530363-0

NOTE: ALWAYS WEAR SAFETY GLASSES WHEN HANDLING PICTURE TUBE

PREPARATION FOR USE

These receivers are shipped with the picture tube. Carefully unpack the receiver. A rubber band is used to secure the 1B3GT rectifier tube in its socket and a piece of glass tying tape is used to secure the 19BG6 tube in its socket during shipment. It is not necessary to remove these when installing the receiver, but they should be removed the first time the chassis is removed from the cabinet for service. The two tubes are easily accessible by opening the hinged high voltage shield.

In order to prevent damage to the picture tube, all receivers have their focus coil moved close to the yoke assembly and a shipping sleeve slipped between the focus coil and the tube neck. Loosen all wing nuts on the focus coil bracket, remove the shipping sleeve and move the focus coil back. Then focus and center the picture, using a temporary test power cord (see Preset Control Adjustment).

The picture tube is pressed against the mask by means of a cable harness, made of stainless steel. It may become magnetized sufficiently so as to affect the picture by shifting or distorting it. In order to prevent this undesired effect, it is recommended that this cable harness be removed and discarded at the time the receiver is installed.

RECEIVER INSTALLATION

1. If the built-in antenna is used, it is advisable to observe the reception in various locations of the room in order to obtain best results.
2. In case an outdoor antenna has to be used, the antenna lead-in should be as short as possible. The built-in antenna is connected to the dipole terminal, therefore, it is necessary to disconnect the wires of the built-in antenna altogether and connect the transmission line (impedance 300 ohms) of the outdoor antenna installation to the dipole terminals. Any type of antenna system may be used as long as it is connected over a balanced transmission line to the balanced input of 300 ohms of the receiver. The choice of the antenna depends on the operating area of the receiver, the number and location of stations to be received. In order to avoid multiple images (ghosts) and interferences, careful experimentation with the antenna system is necessary to obtain satisfactory reception. These problems may be aggravated in fringe areas and sometimes an elaborate installation has to be made to obtain satisfactory results.
3. A power outlet providing 110 volts at 25 or 60 cycles per second must be in easy reach of the television receiver.
4. Locate so that the room illumination, in daytime or nighttime, falling on the screen of the picture tube may be controlled. If this cannot be done, locate the receiver in such a position that light from a window does not fall directly on the screen of the picture tube. For nighttime use, it is unnecessary to turn out all lights when viewing.
5. Ventilation of the television receiver is very important. Slots are provided in the cabinet back and bottom for ventilation. These slots should not be obstructed. Do not locate the receiver on or too near any heating device.

LIGHTNING PROTECTION--All outdoor antenna installations must conform to certain standards as set up by the Canadian Electrical Code which is usually supplemented by Local Code requirements. In general, some of the requirements are as follows:

1. The metal mast supporting the antenna should be permanently and effectively grounded. Use a ground wire of minimum size as specified in the Local Code.
2. An approved television lightning arrester must be used with the antenna lead-in conductors at a point of entrance to the building. If shielded lead-in cable is used, the shield may be permanently grounded in lieu of using the lightning arrester.

PRESET CONTROLS

THERMAL CUT-OFF--This is a protective a-c switch which disconnects the line voltage in case of excessive current drain of the receiver caused by an internal short circuit or breakdown of components. In case this switch cuts off, a five minute period should be allowed to elapse before resetting this switch.

FOCUS--The focus switch S401 on the rear panel should be set to the position which allows the front panel focus control R421 to focus the raster nearest the center of its rotation and to give most uniform focus over the greatest picture area.

PICTURE TILT--If the picture or raster does not square with the picture tube mask, loosen the wing nut at the top of the yoke clamping bracket and rotate the deflection yoke in the proper direction until the picture squares with the mask. Clamp the yoke tightly in place.

PICTURE CENTERING--Centering of the picture or raster is accomplished by loosening the wing nuts which secure the focus coil and adjusting the position of the focus coil until the raster or the picture is centered.

The focus coil may be moved slightly in various directions: it may be moved vertically by loosening the two side wing nuts; it may be moved horizontally or rotated about its vertical axis by loosening the top wing nut. Furthermore, it may be tilted about a horizontal axis by loosening the two side wing nuts.

NOTE: The focus coil should be kept as far back towards the base of the picture tube as possible to give uniformity of focus over the greatest picture area.

When making the adjustment, it is advisable to loosen all three wing nuts and make an approximate adjustment of the focus coil. Tighten the three wing nuts enough to maintain the focus coil in place but loose enough so it may be moved to a final position. After a final position has been found which gives good centering of the picture, tighten the three wing nuts securely.

A slight dimming of the picture may be encountered as the focus coil is moved towards the base of the picture tube. It may be necessary to lose some brightness to obtain good centering and uniformity of focus, since the brightness may be regained by increasing the brightness.

Do not leave the focus coil set in such a position as to give neck shadow at one edge of the picture. (Fig. 13.)

HORIZONTAL HOLD--Rotate the front panel Horizontal Hold control R365 to the middle of its range. Adjust the core of the rear panel Horizontal Hold control L351 until the picture is synced and is phased at the center of the raster. Slight rotation of the front panel Horizontal Hold control (R365) either way should move the picture, slightly left or right without losing sync.

Adjust the Contrast control (R262) for a picture of low contrast. Check the front panel Horizontal Hold control R365 by rotating it slowly. The receiver should not lose horizontal sync. If it does readjust rear panel Horizontal Hold control L351 if necessary.

HORIZONTAL LINEARITY--The Horizontal Linearity control (L352) adjusts the picture for correct horizontal proportions. For best adjustment, use a test pattern and adjust the Horizontal Linearity control until the distance from the center of the test pattern to the left- and right-hand edges of the test pattern measures approximately the same. The adjustment of this control is very broad and it should be made simultaneously with the adjustment of the Width control (L353) to get proper picture width and correct horizontal linearity. (See Fig. 12.)

HORIZONTAL DRIVE--The Horizontal Drive control (R369) should be set approximately 1/3 of its total rotation from the counter-clockwise end of its rotation. If white vertical bars or black beaded lines appear in the picture, the Drive control should be turned in either direction to just remove these white vertical bars.

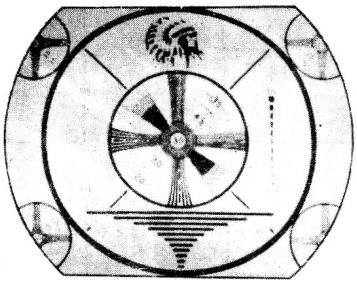
WIDTH--Adjust the Width control (L353) so that the edges of the picture extend approximately one-eighth inch past the right- and left-hand edge of the mask and are not visible (Fig. 11).

VERTICAL LINEARITY--This control (R311) should be adjusted to give good vertical proportions to the picture. The adjustment should be made on a test pattern so that the distance from the center to the top and bottom edges of the pattern measures approximately the same. This adjustment will alter the height of the picture slightly. (See Fig. 9).

HEIGHT--This control (R308) changes the picture height and should be adjusted so that the picture extends approximately 1/8 inch beyond the top and bottom edges of the mask. This adjustment should be made simultaneously with the Vert. Linearity Control R311.

HIGH CHANNEL TRAP--This receiver incorporates a trap on the head-end unit which is switched into the antenna circuit on all low-band channels and will eliminate high-chennel interference on these channels. This interference manifests itself as horizontal bars or herringbone pattern or as a picture in the background. If the receiver is tuned to Channel #5, a strong station operating on Channel #11 may beat with the second harmonic of the local oscillator to form an i-f frequency which will ride through unhindered and appear on the picture screen. In order to prevent the interfering signal from reaching the converter, a trap consisting of a fixed inductance and a variable capacitance is adjusted for maximum rejection of the interfering station. This type of interference is also possible on the Channels #4 and #6 due to interfering stations on Channel #8 and #13, respectively. The trap is adjusted at the factory approximately for Channel #11 rejection. It may be necessary to readjust the trap slightly for maximum rejection of Channel #11.

PICTURE DEFECTS



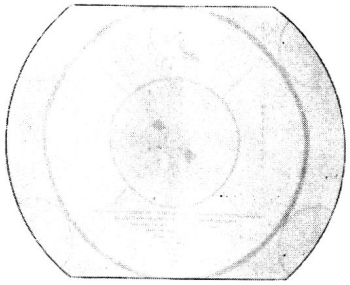
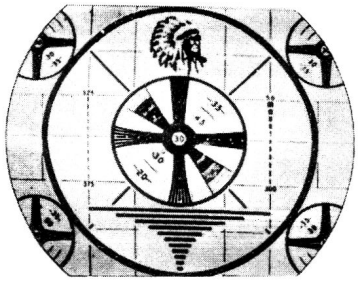
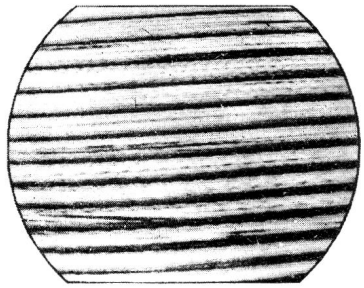
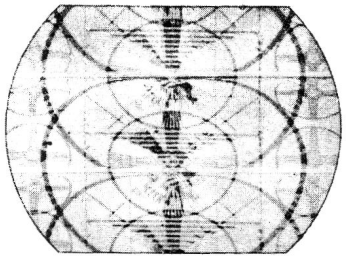
NORMAL PICTURE

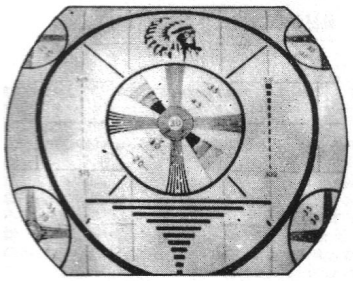
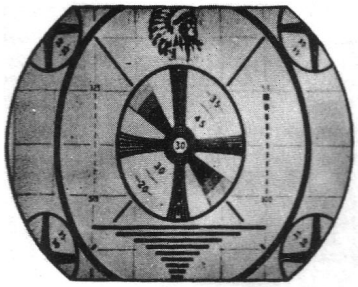
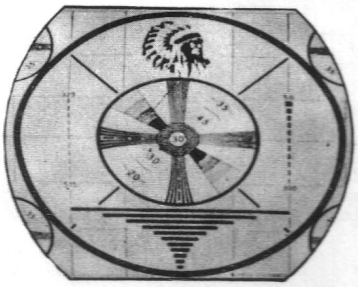
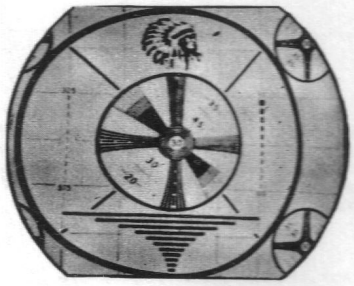
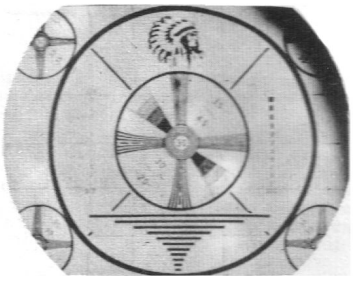
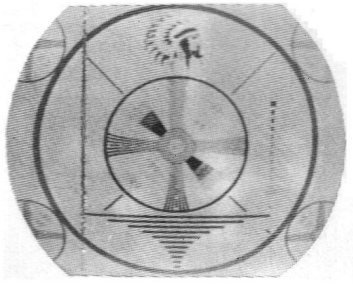
Fig. 3

The following illustrations show picture defects which are caused by incorrect setting of operation controls, the preset controls or by interference picked up by the antenna. The possible remedy is indicated for each defect.

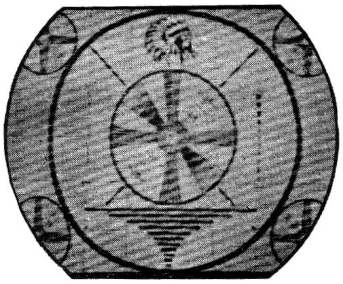
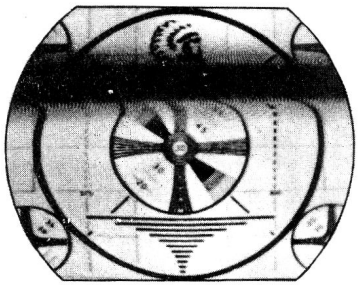
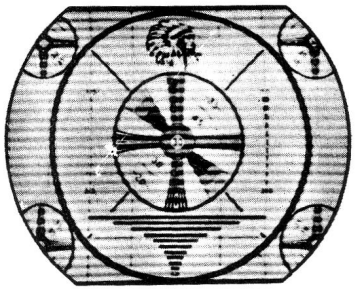
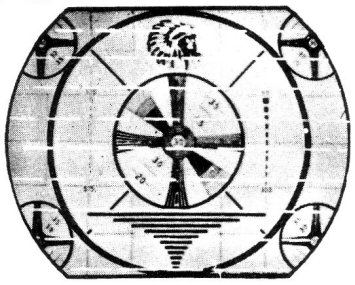
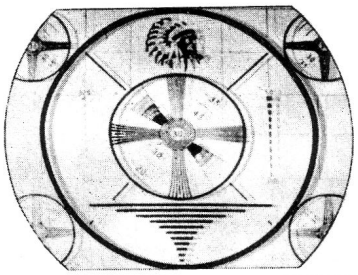
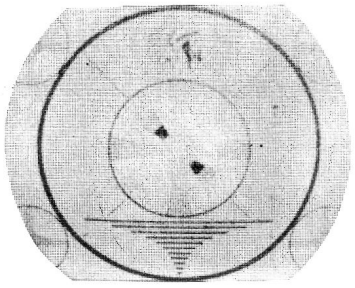
The adjustment of controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated, which is normally transmitted just prior to the scheduled program.

The normal picture should show good focus and a good contrast between blacks and white with intermediate shades of gray. The picture should not tend to move vertically or horizontally and should have good linearity.

PICTURE	DEFECT	REMEDY
	**PICTURE TOO LIGHT** Fig. 4	1. Increase contrast control setting and/or reduce brightness. 2. Weak signal. This may be caused by insufficient pickup on antenna or defective lead-in. Insufficient pickup at maximum contrast usually is accompanied by "snow" on the picture.
	**PICTURE TOO DARK (CONTRAST)** Fig. 5	1. Reduce contrast control setting and/or increase brightness control setting. 2. Too strong signal. If it is not possible to reduce signal adequately with contrast control, install suitable resistor antenna pad.
	**BLURRED PICTURE** Fig. 6	1. Adjustment of front panel focus control. 2. Check for optimum uniformity of focus by moving focus coil (see installation and service adjustments, page 3). 3. Check coarse focus control at rear of chassis. 4. Mistuning of receiver or misalignment.
	**PICTURE BREAKS UP** Fig. 7	1. Adjust Horizontal Hold control (front panel control). 2. Check adjustment of rear panel Horizontal Hold Control. 3. Horizontal Drive control set too far clockwise. 4. Signal improperly tuned.
	**VERTICAL PICTURE MOVEMENT** Fig. 8	1. Adjust Vertical Hold control (until picture shows no tendency to slide up or down or lock out of frame).

PICTURE	DEFECT	REMEDY
	**PICTURE ELONGATED VERTICALLY** Fig. 9	1. Adjust Vertical Linearity control. This adjustment may alter the Height Control adjustment.
	**PICTURE TOO TALL** Fig. 10	1. Adjust Height control so that the top and bottom picture edges are just covered by mask. Recheck Vertical Linearity control setting.
	**PICTURE TOO WIDE** Fig. 11	1. Adjust Width control so that the right and left picture edges are just covered by the mask.
	**PICTURE ELONGATED HORIZONTALLY** Fig. 12	1. Adjust Horizontal Linearity control. This adjustment may require resetting of Width control.
	**NECKING** Fig. 13	1. Misadjustment of Focus coil--tilted too far 2. Ion trap improperly set, 3. Deflection yoke not forward against bell of the picture tube.
	**BARKHAUSEN OSCILLATION** Fig. 14	One or several vertical dark lines when program is being received. 1. Readjust Horizontal Linearity control. 2. Change 19BG6 sweep output tube.

PICTURE INTERFERENCES

PICTURE	DEFECT	REMEDY
	**HERRINGBONE PATTERN OVER PICTURE** Fig. 15	This interference is caused by a television station operating on the next lower channel or by a short-wave radio transmitting and receiving equipment. Police and "ham" transmitters in your locality will usually cause the most severe conditions. The interference produces moving ripples or diagonal streaks or, in some cases, may cause loss of contrast of the picture. The use of an antenna wavetrap tuned to the interfering signal may assist. If the interference is from a TV or FM station, a transmission line shorted stub may remove the interference. If the pickup is on the lead-in, a shielded lead-in, will help correct the trouble.
	**DIATHERMY INTERFERENCE** Fig. 16	Diathermy equipment is used by hospitals and doctors and can be very annoying because it might ruin the reception completely. This interference manifests itself in a herringbone pattern or one or two dark bars moving slowly up or down the picture. If the disturbance is extremely strong, the interference pattern will remain stationary while the picture floats in the background. Improve your antenna installation using directive antenna systems and shielded transmission line.
	**HORIZONTAL BARS ON PICTURE** Fig. 17	This interference is caused by adjacent channel sound or microphonics in receiver. If adjacent channel sound is responsible for this defect, readjust the adjacent channel trap L205 as outlined on page 10. A microphonic video amplified tube, V8, or oscillator tube V3, may cause the condition.
	**IGNITION INTERFERENCE** Fig. 18	Ignition interference from trucks, automobiles, and airplanes may be identified by streaks and splashes on the picture. The ignition system of trucks will produce the most intense interference pattern. Install antenna away from road carrying traffic. Shielded lead-in may help if interference is picked up on it.
	**MULTIPLE IMAGE (GHOSTS)** Fig. 19	This is caused by the television signal following a multiple path, one of which is the direct path, and the other is reflected from some object such as a tall building or a large storage tank or hills. The signal following the longer reflected path arrives later at the receiver producing the second image. In case a built-in antenna is used, try to turn the cabinet until the ghost picture is dimmed out. If your receiver is connected to an outdoor installation, a reorientation of the antenna might improve the reception.
	**"SNOW"** Fig. 20	1. Too weak signal; increase efficiency of antenna installation. 2. Adjust tuning control.

CIRCUIT ALIGNMENT

TO PROTECT TEST EQUIPMENT ALWAYS USE AN ISOLATION TRANSFORMER

GENERAL

A complete alignment of the receiver tuned circuits is given in the following charts. Read all alignment notes before making an alignment. The alignment procedure described follows the sweep method using General Electric test equipment. When other test equipment is used, check that they meet the different requirements for proper alignment. Suitable test equipment is essential for proper alignment of the receiver and under no circumstances try to align with inadequate test equipment. In order to speed up the alignment procedure, it is advisable to use the service diagram, Figure 33, and the tube and trimmer location, Figure 22.

In connecting the test equipment to the points indicated on the charts, make the leads as short as possible. This is particularly necessary of the ground leads of the test equipment which should be connected to the B--bus of the receiver.

Always allow test equipment and receiver to warm up for at least 15 minutes before starting the alignment.

It is often advisable to perform the alignment with the picture tube removed. The filament circuit can be completed by using a Type 6SN7 tube with all pins clipped off except pins No. 7 and No. 8 which must be plugged into No. 1 and No. 12 of the picture tube socket.

TEST EQUIPMENT

The following test equipment is necessary in order to affect alignment of the tuned circuits of the receiver:

1. R-F SWEEP GENERATOR.

a.) Frequency Requirements:
4.5 MC with 500 KC and 2 MC sweep width.
40-50 MC with approximately 10 MC sweep width.
50-90 MC, 170-220 MC with 15 MC sweep width.
b.) Constant output in the sweep range.
c.) Minimum output 0.1 volt.

2. MARKER GENERATOR.

The marker generator must have good frequency stability, accurate calibration and must cover the following frequencies:

a.) 41.25 MC for video IF
42.50 MC for video IF
44.20 MC for video IF
44.50 MC for video IF
45.00 MC for video IF
45.75 MC for video IF
47.25 MC for video IF
b.) 4.5 MC for sound IF and trap alignment.
c.) Picture and sound carrier frequencies for Channel No. 2 through No. 13.

3. BALANCED OUTPUT ADAPTER.

See RF Alignment, note 1.

4. OSCILLOSCOPE.

The oscilloscope should have good sensitivity and preferably a 5-inch screen with a good wide-band frequency response on the vertical deflection circuits. Although the high frequency response is not necessary for alignment, it is imperative when making waveform measurements.

5. VACUUM TUBE VOLTMETER.

A vacuum tube voltmeter (VTVM) is necessary to measure the bias of 4 volts required for video and RF alignment.

6. DETECTOR NETWORK.

A crystal detector network as shown in Figure 27 is necessary when aligning the 4.5 mc trap, L260.

7. MISCELLANEOUS.

a.) One 10,000 ohm resistor to isolate the scope as noted in the charts.
b.) One .01 mf. capacitor for isolation of sweep generator.
c.) One 680 ohm resistor for IF coil shunt (RF alignment).
d.) One 400 mf. electrolytic capacitor, 350 volt for reducing hum (RF alignment).
e.) One 100 ohm resistor for reducing hum (RF alignment).
f.) Impedance matching pad for RF alignment as shown in Figure 28.
g.) Bias battery to supply- 4 volts as noted for Video IF and RF Alignment.

VIDEO I-F ALIGNMENT

NOTES:

1. The sweep generator should be properly terminated in its characteristic impedance. Couple the signal to the input to give a video response curve of 3/4 volt as shown in Figure 21.

2. Connect a bias battery from junction of C261, R263, and the picture control R262 to B- with the positive side of the battery connected to B- . Adjust picture control to give a - 4 volt bias at the grid pin 1 of tube V4 measured with a VTVM. Disconnect its leads during alignment.

3. The traps L227 and L253 must be detuned before aligning the video i-f amplifier by turning the cores all the way out of the coil. When returning these traps to 47.25 mc (as in step 6), for minimum amplitude, increase scope gain as amplitude at 47.25 mc marker point is attenuated, to provide optimum setting.

4. Set channel switch to Channel #12 or #13 and check for oscillator influence by turning the tuning control. If response curve is affected, switch to another channel where oscillator influence is absent.

5. In general, it is only necessary to perform an over-all alignment of the video i-f, as in step 7 of the Video Alignment Chart, in order to obtain i-f response curve of Figure 21-E.
When aligning the i-f coils, L251 will adjust the audio or low frequency side of the i-f response curve, while L252 will adjust the video or high frequency side of the i-f response curve. L226 and L254 should be adjusted simultaneously to reduce the saddle-back at the peak of the curve and to give maximum gain and retain 45.75 mc and 42.50 mc markers at the 50% mark.

6. It is necessary to detune the i-f coils by shorting as noted in the alignment chart to prevent the coil preceding the signal input point from influencing the response curve.

7. It is important that the 45.75 mc marker should fall at the 50% response point to give proper curve of Figure 21-E.

8. After adjustment of the two sound traps, readjust the i-f curve to obtain the proper response curve as illustrated in Figure 21-E.

VIDEO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
1	--	--	--	--	Detune L227 and L253 by turning cores out of coil.	3
2	44.50 MC	40-50 MC	V6 grid (pin 1) through .01 mf. cap. and B- on head-end shield. Pins 5-6 shorted on V5.	Junction L256, R265, C268 through 10K ohms and B- on V7 socket.	Core of L254 for curve of Fig. 21 A.	1,2,4,6
3	45.75 MC		V5 grid (pin 1) through .01 mf. cap. and B- on head-end shield. Short L251. Remove short of step 2.		Core of L252 for curve of Fig. 21-B.	
4	42.50 MC, 45.75 MC,		V4 grid (pin 1) through .01 mf. cap. and B- on head-end shield. Short L226. Remove short of step 3.		Core of L251 for curve of Fig. 21-C.	
5	44.2 MC		Junction L215 and L216 on second RF switch wafer through .01 mf. cap. and B- on head-end shield. Remove short of step 4.		Core of L226 for curve of Fig. 21-D.	1,2,3,4,7
6	47.25 MC				Cores of L227 and L253 for min. output at 47.25 MC (Fig. 21-E).	
7	41.25 MC, 42.50 MC, 45.00 MC, 45.75 MC, 47.25 MC,				Cores of L251, L252, L254 and L226 for curve of Fig. 21-E.	1,2,4,5,7, 8

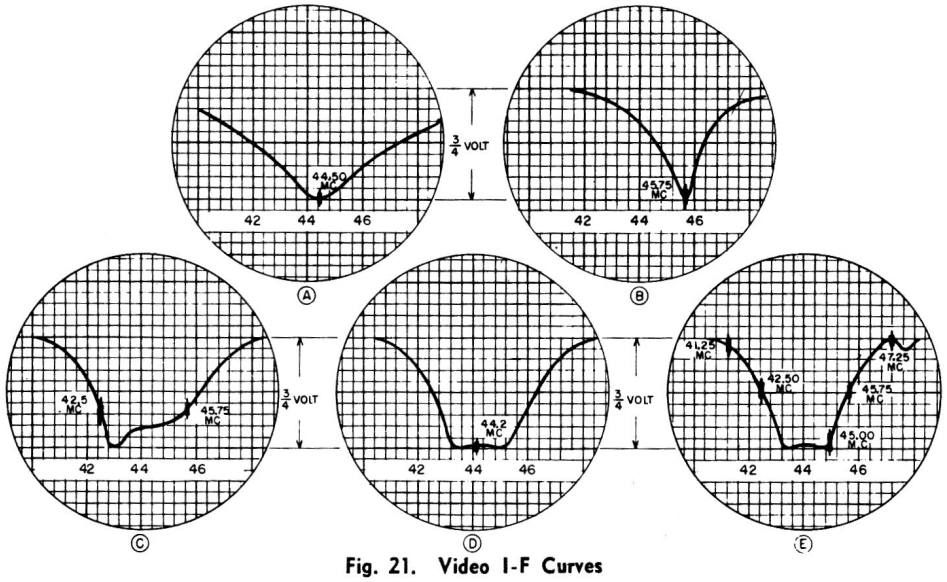


Fig. 21. Video I-F Curves

AUDIO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
8	4.5 MC	4.5 MC ±500 KC keep signal below limiting level of receiver.	Pin 1 of V16 through .01 mfd. cap. and B-.	Junction of R404, C404 & sec. of T401 through 10K and B-.	Primary and secondary of T401. See Fig. 23-A.	1,2,5
9			Pin 1 of V17 through .01 mfd. cap. and B-.	Junction of R408, C411 and R411 through 10K and B-.	Secondary of T402. See Fig. 23-B.	1,3,5
10					Primary of T402. See Fig. 23-B.	1,4,5
11					Secondary of T402. See Fig. 23-B.	1,3,5
12	Recheck alignment of step 11 on operating station as in note 6.					6

AUDIO I-F ALIGNMENT

NOTES:

1. Feed a 4.5 mc signal with a 500 kc sweep and adjust for proper response curve as indicated in the chart.

2. Transformer T401 is adjusted for maximum amplitude and symmetry of the response curve about 4.5 mc marker (Figure 23-A).

3. The secondary of T402 is adjusted for curve, Figure 23-B. This adjustment should give as straight a slope as possible between the positive and negative peaks with the center of the 4.5 mc marker falling midway between the peaks.

4. The primary of T402 is adjusted for maximum of the positive and negative peaks. If necessary, readjust the secondary of T402 so that the marker falls midway between the peaks.

5. Keep the input signal of the sweep generator low enough so that limiting does not take place, otherwise the response curve will broaden out preventing correct adjustment. Check by increasing the output of the generator: the response curve should increase in amplitude.

6. As a final check (step 12), readjust the secondary of T402 for minimum buzz on all available stations.

7. An alternate method to the visual alignment is the sound output method using an operating television station, preferably when transmitting tone modulation during test pattern transmission.

a. Tune the receiver for best detail.
b. Set the picture control to give reduced contrast or by using a resistor pad in the antenna circuit.
c. Adjust transformer T401 and primary of T402 for maximum sound output.
d. Adjust the secondary of T402 for best quality audio reception and for minimum buzz in the output.

Fig. 23. Audio I-F Curve

R-F ALIGNMENT

NOTES:

1. Disconnect the transmission line to the antenna from the head-end. Couple the input of the sweep generator to the head-end terminals through balanced output adapter G-E ST-8A, or equivalent. Couple this to the head-end terminals through a piece of 300-ohm transmission line. Terminate the 300 ohm line in a pad, as shown in Figure 28-A.
If a balanced output is not available for the sweep generator a matching network as shown in Figure 28-B may be used. A balanced output is recommended since a matching network as shown in Figure 28-B may introduce frequency shift and cause a misleading tilt to the response curve.
Ro shown in Figure 28-B is the terminating resistor. If this resistor is not already incorporated in the output of the sweep generator, it should be added to the matching network as shown.

2. It is necessary to connect a bias battery from the junction of the picture control, C261, and R263 to B- with plus of bias battery to B-. Adjust the picture control to give a -4 volts bias measured from pin 1 of V2 to the head-end chassis B-.

3. Shunt L226 with a 680 ohm, 1/2 watt resistor during r-f alignment to prevent the oscillator from influencing the response curve. To reduce the effect of hum on the response curve, connect a 100 ohm resistor between the head-end B+ and the chassis B+ and connect an electrolytic capacitor of approximately 400 mf., 350 volt from head-end B+ to head-end B-.

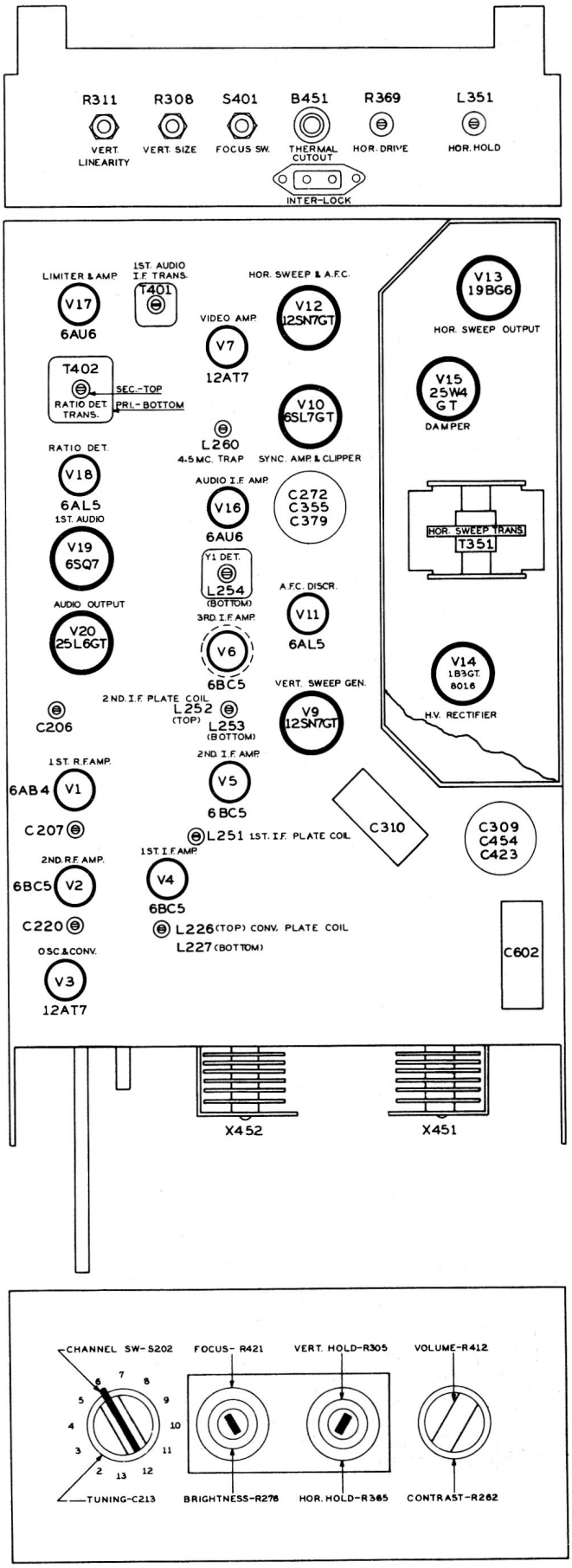


Fig. 22. Tube and Trimmer Location

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4. On all channels the picture carrier marker should not be less than 75% of the peak of the r-f response curve. The sound carrier marker should not be less than 50% of the peak of the response curve. On the high channels the picture carrier marker should ride up nearer to the top of the curve provided the sound carrier marker does not go below 50%. On the low channels the picture carrier marker should ride as high up on the curve as possible and still keep the sound carrier marker above 50%.

5. Coils for Channels #12 through #7 are fixed inductances. Check the alignment on these channels as in steps 16 through 21 for proper response curve. Readjust L210 and L217 on Channel #13 and C207 and C220 on Channel #7 if necessary.

6. Coils for Channels #5 and #4 are fixed inductance. Check the alignment on these channels for proper curve. Readjust coils L208 and L215 to give proper curve on Channels #6, #5, and #4.

7. The coil for Channel #2 is a fixed inductance. Check the alignment on this channel for proper curve. Readjust L205 and L212 to give proper curve on Channels #3 and #2.

8. The trimmers C207 and C220 may be used to compensate for differences in tube capacities which affect tracking when it is necessary to change the tubes V1 or V2. The variations in tube capacities has normally little effect on the over-all performance of the head-end.

R-F ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Connect Oscilloscope	Channel Switch	Adjust	See Note
13	211.25 MC, 215.75 Mc	No. 13 with 15 MC sweep	Antenna terminals at head-end (see Note 1).	Junction of L226, C217 and R218 through 10K resistor and B- at head-end chassis.	No. 13	Screw of L210, screw of L217, for Fig. 24-A.	1,2,3, 4,5
14	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7	Trimmers C207 and C220 for response curve, Fig. 24-A.	1,2,3, 4,5,8
15	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep			No. 13	Readjust screw of L210 and screw of L217 for curve, Fig. 24-A.	1,2,3, 4,5
16	205.25 MC, 209.75 MC	No. 12 with 15 MC sweep			No. 12	No adjustments.	5
17	199.25 MC, 203.75 MC	No. 11 with 15 MC sweep			No. 11		
18	193.25 MC, 197.75 MC	No. 10 with 15 MC sweep			No. 10		
19	187.25 MC, 191.75 MC	No. 9 with 15 MC sweep			No. 9		
20	181.25 MC, 185.75 MC	No. 8 with 15 MC sweep			No. 8		
21	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7		
22	83.25 MC, 87.75 MC	No. 6 with 15 MC sweep			No. 6	Screw of L208 to place 83.25 MC marker and screw of L215 to place 87.75 MC marker as shown in Fig. 24-B.	1,2,3, 4,6
23	77.25 MC, 81.75 MC	No. 5 with 15 MC sweep			No. 5	No adjustments.	6
24	67.25 MC, 71.75 MC	No. 4 with 15 MC sweep			No. 4		
25	61.25 MC, 65.75 MC	No. 3 with 15 MC sweep			No. 3	Screw of L205 to place 61.25 MC marker and screw of L212 to place 65.75 MC marker as shown in Fig. 24-B.	1,2,3, 4,7
26	55.25 MC, 59.75 MC	No. 2 with 15 MC sweep			No. 2	No adjustments.	7

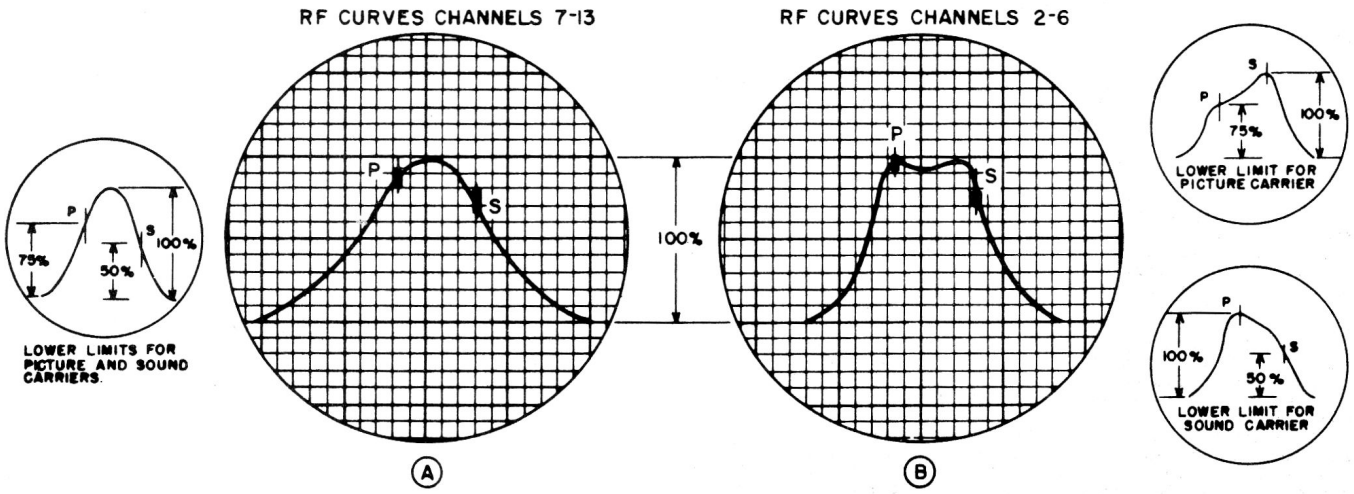


Fig. 24. RF Alignment Curves

OSCILLATOR ALIGNMENT

NOTES:

Before attempting this oscillator alignment, it must be certain that the video i-f stages and r-f stages are properly aligned as outlined previously.

1. Disconnect the 300 ohm line from the r-f head-end terminals and connect sweep generator to head-end properly terminating sweep generator output cable as shown in Figure 28-A or 28-B. See Note 1 of RF Alignment.
2. Alignment is made by viewing the response curve at the output of the video i-f detector.
3. Use a video carrier marker as shown in each step of the Alignment Chart.
4. The oscillator inductances for Channels #12 through #7 are fixed. The alignment on these channels should be checked to see that the tuning control C213 will move the video carrier marker up and down the entire high frequency side of the response curve. Readjust L225 if necessary.
5. When adjusting L225 as in step 27, the tracking on Channels #12 through #7 should be checked. Set C213 at the center of its rotation. Adjust L225 so that the video carrier marker falls as near as possible to the 50% point on the high frequency slope as the receiver is switched to each channel from 7 through 13 with this setting of C213 for all channels from 7 through 13.
6. On Channels #6 through #2 set the tuning control C213 at the center of its rotation and make the indicated adjustment so that the video carrier marker falls at the 50% mark on the high frequency slope of the response curve.

OSCILLATOR ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep Generator Frequency for Channel	Signal Input Point	Connect Oscilloscope Between	Channel Switch Setting	Adjust	See Note
27	211.25 MC	No. 13 with 15 MC sweep	Antenna terminals of head-end (see Note 1).	Junction of L256, R265, C268 through 10K ohm resistor and B- at V7 socket (pin 3).	No. 13	L225 by squeezing or spreading turns slightly.	1,2,3, 4
28	205.25 MC	No. 12 with 15 MC sweep			No. 12	No adjustments.	5
29	199.25 MC	No. 11 with 15 MC sweep			No. 11		
30	193.25 MC	No. 10 with 15 MC sweep			No. 10		
31	187.25 MC	No. 9 with 15 MC sweep			No. 9		
32	181.25 MC	No. 8 with 15 MC sweep			No. 8		
33	175.25 MC	No. 7 with 15 MC sweep			No. 7		
34	83.25 MC	No. 6 with 15 MC sweep			No. 6	Screw of L223.	1,2,3
35	77.25 MC	No. 5 with 15 MC sweep			No. 5	Screw of L222.	
36	67.25 MC	No. 4 with 15 MC sweep			No. 4	Screw of L221.	
37	61.25 MC	No. 3 with 15 MC sweep			No. 3	Screw of L220.	
38	55.25 MC	No. 2 with 15 MC sweep			No. 2	Screw of L219.	

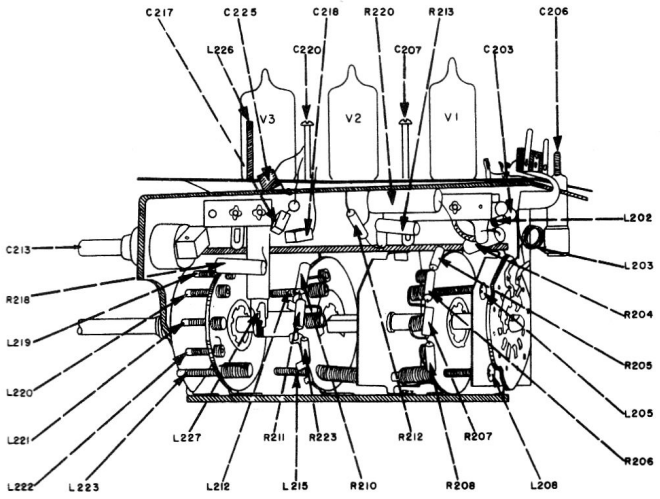


Fig. 25. Head-end Unit

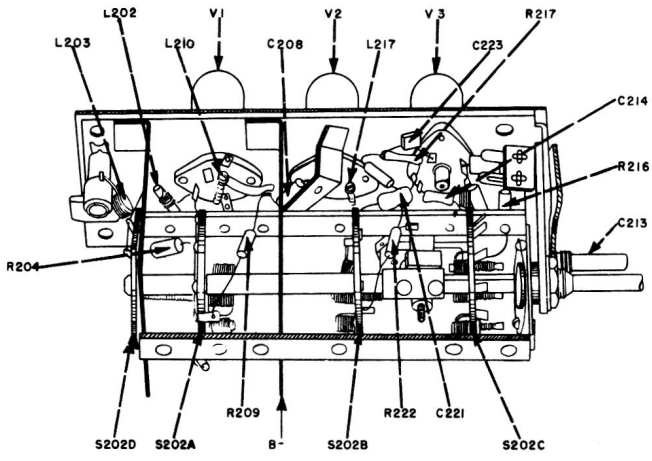


Fig. 26. Head-end Unit

ADJUSTMENT OF VIDEO AMPLIFIER 4.5 MC TRAP (L260).

This trap is used to remove 4.5 mc audio i-f from the video amplifier which shows up in the picture as a cross-hatch pattern. This trap will very rarely require adjustment. Adjustment is as follows:

1. The trap (L260, C271, C270) is adjusted for minimum amplitude of the 4.5 mc marker. Use a detector network as shown in Figure 27 connected from junction of L264 and C275 to B- to detect the signal.
2. Adjust the vertical hold control to remove the vertical pulses from the response curve.
3. Short horizontal oscillator coil L351 to remove horizontal oscillator interference in the response curve.

4.5 MC TRAP (L260) ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Oscilloscope	Adjust	See Notes
37	4.5 MC	4.5 MC ±1 MC	Junction L256, R265, C268 and B- thru .01 mf.	Across 100K resistor as shown in Fig. 27. (See Note 1.)	L260 for min. amplitued of 4.5 mc marker. Increase scope gain.	1,2,3

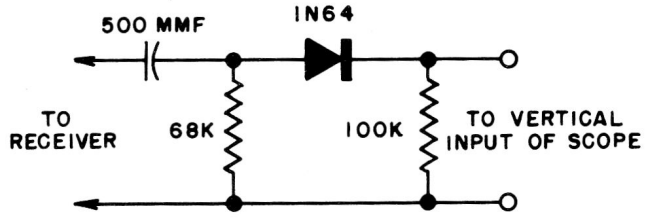
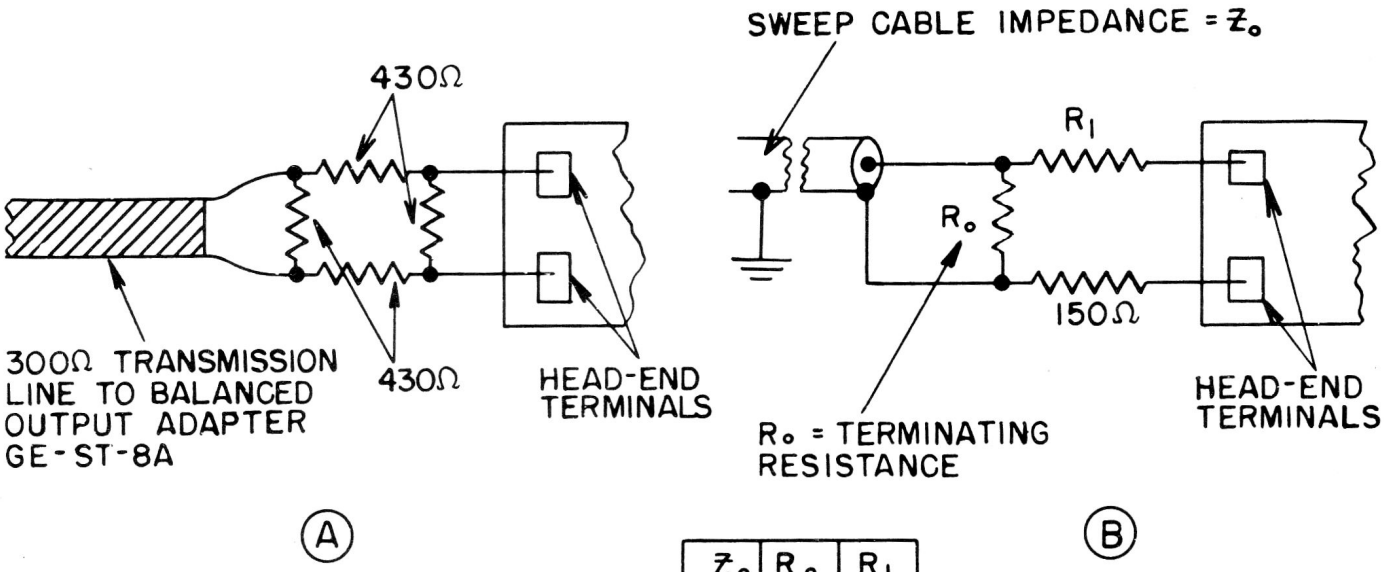


Fig. 27. Detector Network



Z_0	R_0	R_1
50Ω	56Ω	120Ω
72Ω	82Ω	110Ω
92Ω	110Ω	100Ω

Fig. 28. Sweep Generator Termination

TROUBLE SHOOTING SECTION

In order to speed up trouble shooting procedure, this trouble shooting section is divided in two parts: Trouble Shooting Charts and Trouble Shooting Analysis. The charts are subdivided according to the symptoms as they affect the picture or sound so that it is an easy matter to find the symptoms observed on the particular receiver. The second columns of the charts indicate the part or section to be checked. The third columns refer to the respective paragraphs in the following Trouble Shooting Analysis which describe in detail the possible source of defect or the necessary adjustments to obtain normal operation of the receiver.

TROUBLE SHOOTING CHARTS

Symptom	Check	Analysis No.
Picture Quality Defects		
1. No picture, no raster, no sound.	(a) Power supply	
2. No picture, no raster, sound normal.	(a) Picture tube. (b) High voltage power supply. (c) Ion trap.	
3. No picture, no sound, raster normal.	(a) RF and video IF circuit.	A,1
4. No picture, raster and sound normal.	(a) Video amplifier.	B,1
5. Poor focus. (See Fig. 6)	(a) Focus coil. (b) Focus coil circuit.	
6. Poor focus and picture blooming.	(a) For gassy picture tube.	C,3
7. Neck shadow. (See Fig. 13)	(a) Focus coil adjustment. (b) Ion trap adjustment. (c) Yoke assembly adjustment.	G,1 G,2 G,4
8. Ghost. (See Fig.19)	(a) Antenna orientation. (b) Antenna lead-in. (See page 3)	
9. "Snow." (See Fig. 20)	(a) Antenna installation. (See page 3)	
10. Poor detail.	(a) RF and video IF circuits. (b) Picture control circuit.	A,1 A,4
11. Insufficient brightness.	(a) Ion trap adjustment. (b) Picture tube. (c) Pix tube anode voltage.	G,2
12. Excessive contrast. (See Fig. 5)	(a) Sync Section.	F,1
13. Excessive contrast with shaky picture.	(a) Sync Section.	F,2
14. Very bright, fuzzy picture.	(a) Picture tube circuit.	C,5
15. No picture on one channel.	(a) Channel switch.	A,6
16. Distorted picture.	(a) Video amplifier.	B,1
17. Smeared picture.	(a) Video amplifier.	B,4
Raster Defects		
1. Raster not centered.	(a) Focus coil adjustment.	G,1
2. Tilted raster.	(a) Focus coil adjustment.	G,1
3. Excessive raster size.	(a) Low anode voltage to pix tube.	
4. Raster width too small.	(a) Circuit of horizontal sweep output tube. (b) Width control shorted or misadjusted.	
5. Raster height too small.	(a) Height control circuit. (b) Circuit of vertical sweep output tube.	G,5
6. Unsymmetrical, trapezoidal raster.	(a) Deflection yoke position.	G,3
7. Barrel distortion.	(a) Deflection yoke position.	G,3

Symptom	Check	Analysis No.
Sweep and Sync Defects		
1. No horizontal or vertical sync.	(a) Clipper circuit of V10.	D,6
2. Insufficient sweep width.	(a) Horizontal sweep circuit.	D,2
3. No raster, one horizontal line.	(a) Vertical sweep circuit. (b) Vertical deflection yoke.	E,1 G,3
4. No raster, one vertical line.	(a) Horizontal deflection yoke.	G,3
5. Raster not stable.	(a) High voltage power supply.	
6. Poor horizontal linearity.	(a) Horizontal sweep circuit. (b) Horizontal linearity control.	D,3
7. Poor vertical linearity.	(a) Vertical linearity control. (b) Vertical sweep circuit.	 E,3
8. Picture not centered.	(a) Focus coil adjustment. (b) Horizontal sweep circuit.	 D,4
9. Unstable horizontal sync.	(a) Horizontal sweep circuit.	D,5
10. Unstable vertical sync.	(a) Vertical sync input.	E,5
11. Reduction of height	(a) Height control. (b) Vertical sweep circuit.	 E,3 4,6
12. Small picture.	(a) Picture tube circuit.	C,5
13. Retrace lines increasing towards top.	(a) Picture tube circuit.	C,4
14. Vertical does not sync.	(a) Vertical sweep circuit.	E,2
Audio Defects		
1. No sound, picture normal.	(a) Audio section.	H,1
2. Hum or buzz.	(a) Audio section.	H,2
3. Distortion.	(a) Crystal Y1. (b) Audio IF alignment. (See page 9)	
Miscellaneous		
1. Sound bars.	(a) Picture tube circuit.	C,2
2. Light and dark vertical bar, poor horizontal linearity.	(a) Damper tube.	
3. Two heavy black horizontal bars across screen.	(a) Power supply (electrolytic capacitor)	
4. Excessive contrast with bright lines on bottom and top.	(a) Sync section.	F,2
5. Picture distorted and reverse action of picture control.	(a) Sync section.	F,3
6. Picture flutters at 60 cycles rate.	(a) Capacitor C251 in video IF circuit.	A,5

Symptom	Check	Analysis A No.
7. "Window shade" effect.	(a) Picture tube circuit.	C,5
8. Barkhausen oscillation. (See Fig. 14)	(a) Drive control, R369. (b) 19BG6 tube.	
9. "Busy background"	(a) Video amplifier.	B,2
on trailing edge.		
10. Black lines across picture.	(a) Video amplifier.	B,3
11. Very bright picture with black lines.	(a) Video amplifier.	B,5

TROUBLE SHOOTING ANALYSIS

A. R-F and Video I-F Circuit

1. Misalignment of RF, video IF stages or sound traps will cause poor picture detail. If some stages are totally detuned, the signal might not get through at all, failing to produce a picture.

2. If the oscillator circuit fails to produce the required frequencies, no IF signal is formed and no signal will get through: No picture and no sound will be the result. Any defective component in the oscillator circuit may have this effect.

3. Any interruption of the signal path through the RF and video IF stages will result in a distorted picture or no picture at all. The location of an open component is easily accomplished by methods used in radio service work.

4. An overloading of the stages will result in loss of picture detail; check picture control circuit.

5. In case the capacitor C251 is short circuited, sound bars will appear in the picture and trailing white shadows. If this capacitor opens up, the picture will flutter at a 60-cycle rate and at minimum picture control audio motorboating will start.

6. A defective channel switch will result in intermittent reception of one channel or in extreme cases a channel might be interrupted completely. Clean switch with a cleaning fluid or bend the contacts to increase contact pressure. In some cases it is best to replace head-end unit.

B. Video Amplifier

1. If the path of the signal within the video amplifier is broken, the picture will be distorted or wiped out completely. This may be caused by open chokes L259, L261, L262 or coupling capacitor C268.

2. Misalignment of the 4 1/2 mc trap will cause a "busy background" effect on the trailing edge of the picture.

3. If choke L264 or coupling capacitor C275 is open, there will be always enough coupling capacity to carry along at least a fraction of the signal. The resultant picture will have black lines across the picture.

4. Open or shorted resistances are easily located. Before resistors open up completely, they often show high resistance value. If this happens with the resistors R269 and R272, the effect will be a smeared picture. A high resistance of R273 will cause picture distortion at high values of picture control.

5. A shorted capacitor C275 will have the following effects: The picture is very bright with black lines across it. Brightness control does not reduce the brightness.

C. Picture Tube Circuit

1. A defective picture tube can be the cause of a faint picture, a distorted and unsteady picture or no picture at all.

2. Parts of the electron gun structure might vibrate under the influence of a strong loudspeaker output, resulting in sound bars in the picture.

3. A gassy picture tube will cause a blooming picture which is out of focus.

4. In case the capacitor C279 on the cathode of the picture tube breaks down, a high voltage will be right on the cathode blanking out the picture. If this capacitor opens up, horizontal lines appear on the picture increasing towards the top.

5. A leaking capacitor C278 will cause a small picture with poor brightness and vertical linearity. If the other capacitor C277 becomes defective, the following effects occur: A shorted capacitor will produce a fuzzy and very bright picture while an open capacitor will produce a bright horizontal area advancing towards the top with increasing brightness control setting ("window shade" effect).

D. Horizontal Sweep Section

1. No raster on the picture tube indicates a lack of high voltage or horizontal sweep voltage.
This may be caused by a defect in the high voltage rectifier circuit (V14), in the horizontal sweep output circuit (V13); the horizontal oscillator (V12B) may not be functioning properly or there may be a short in the horizontal deflection circuits (the secondary of T351, width control L353 or deflection coils D351).

2. Insufficient sweep width may be caused by defective components in the horizontal deflection circuits. Check the secondary circuits of T351 for defective components. When L353 is shorted or has shorted turns, the picture will be too narrow and L353 will have no or little control on the width.

3. Poor horizontal linearity may be caused by a short in L352, resulting in L352 having no control on the horizontal linearity. High leakage in capacitor C370 will cause poor linearity and also will increase the width.

4. A short in capacitor C377 will change the d-c component through the horizontal deflection coils which will shift the picture horizontally such that it may not be centered with the focus coil setting.

5. Poor horizontal sync with good vertical sync may be caused by a defect in the circuits of V11, or V12-A or -B.

6. No vertical or horizontal sync may be caused by defects in the clipper circuits of V10.

E. Vertical Sweep Section

1. The vertical sweep generator contains a multivibrator circuit which is made inoperative by the defects of the following capacitors: If shorted capacitor C304, C305 or C308. If the capacitor C305 is open, the oscillator is stopped.

2. The frequency of the generator is thrown off by a short circuit of the capacitors C301 and C302 with the effect that the vertical does not sync.

3. The linearity of the vertical sweep is impaired when the electrolytic capacitor C309 loses its capacity to an appreciable extent. If it opens up completely, the height reduces to approx. 1/5 of the normal size.

4. If the paper capacitor C308 develops any leakage, the vertical size is reduced so that the height control R308 does not suffice to obtain the desired height.

5. In case the capacitor C302 has an open circuit, the vertical sync becomes less stable.

6. If the B+ voltages supplied to the circuit is too low, the deflection voltages will not suffice to deflect the beam across the entire surface of the tube.

7. Microphonic tubes might give rise to a very unstable operation, resulting in a jumpy picture.

F. Common Sync Section

1. A shorted capacitor C354 on pin 1 of V10 tube will produce excessive contrast which cannot be reduced to normal by the picture control. If this capacitor opens up, both horizontal and vertical sync will be inoperative.

2. An open capacitor, C353 on the plate (pin 5) of tube V10 will produce a shaky picture with excessive contrast, while an open capacitor on the grid (pin 4) of tube V10 (C351) will produce bright lines on bottom and top together with poor horizontal and vertical sync which is independent of picture control setting.

3. Distorted picture and reverse action of picture control is caused by an open capacitor C261 on the picture control. If C261 is open, increasing picture control will decrease picture and vice-versa.

G. Focus Coil, Ion Trap and Deflection Yoke

1. To obtain good focus and centered raster, the focus coil must be carefully positioned as outlined under Preset Control Adjustment.

No sharp picture will be possible with an open or shorted coil. A partial short will throw the picture out of focus. Before looking for obscure trouble, be sure to check the focus. Before looking for obscure trouble, be sure to check the focus control circuit for defective components.

2. The correct adjustment of the ion trap will result in maximum brilliance and at the same time will insure long tube life. For adjustment of this trap, see Preset Control Adjustment.

3. Any unsymmetry of the deflection yoke will cause picture distortion. A shorted coil or shorted turns will cause barrel distortion and unsymmetric trapezoidal distortion. An open deflection yoke will produce a horizontal or vertical line across the screen: An open horizontal deflection coil produces a vertical line while an open vertical deflection coil produces a horizontal line.

4. The yoke assembly must be pressed against the bell of the picture tube to avoid neck shadow.

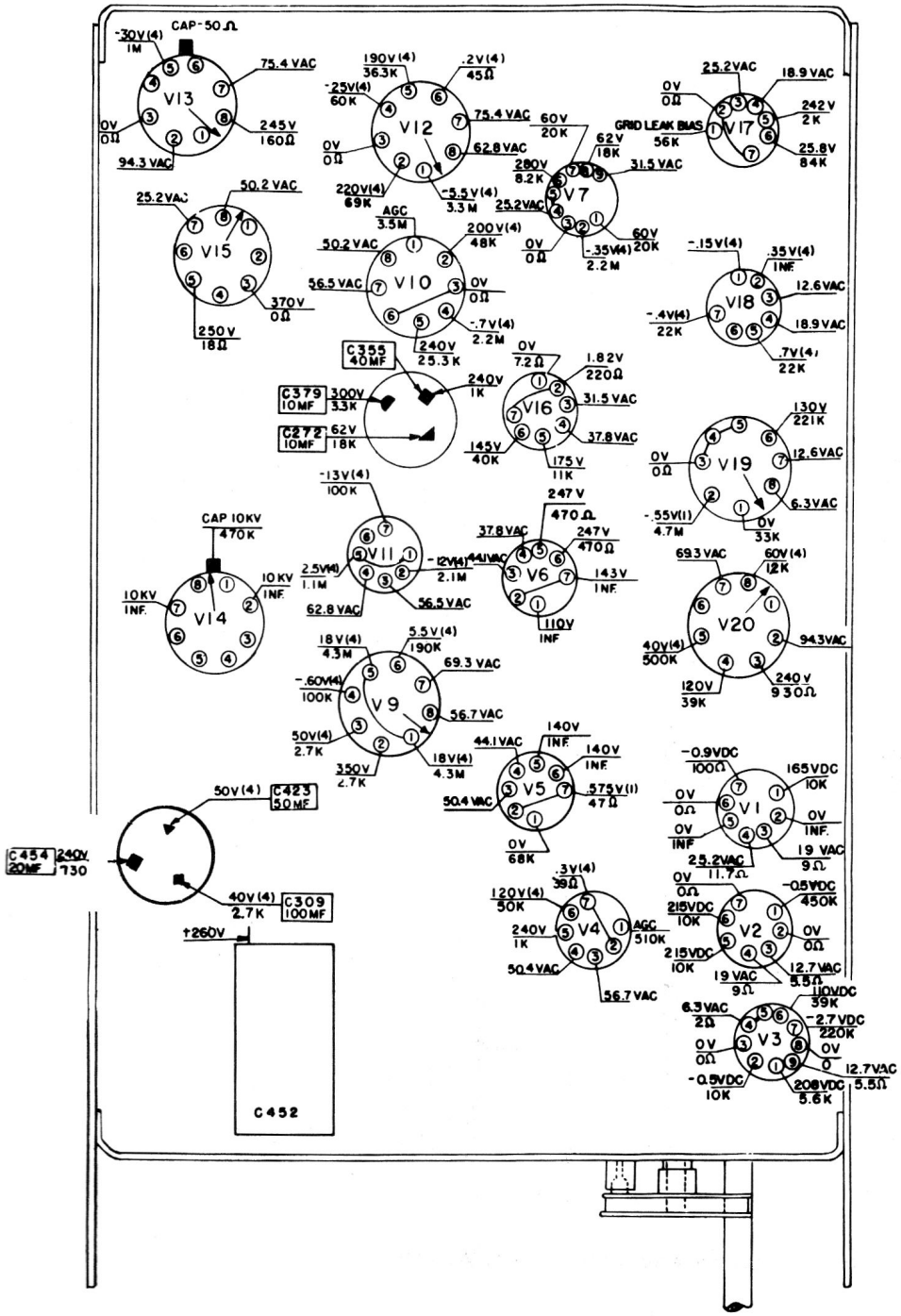
5. The correct picture size is obtained by adjusting the width and height control as outlined under Preset Control Adjustment.

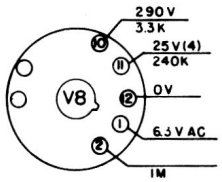
H. Audio Stages

1. The FM modulated signal can reach the 1st audio tube only when the two IF transformers are aligned properly. In localizing defective components, follow normal radio trouble shooting procedure.

2. In case of improper alignment especially of discriminator secondary, a buzz or hum is heard when receiving a television station.

3. In case of no sound output the following components should be checked in turn: tubes (V16 through V20) output transformer T403, capacitors C419, C421, C418, C409, C403, and defective speaker.





AC voltages measured with respect to Pin 12 of picture tube socket.

DC voltages measured with respect to B-.

Meter 20000 Ω/volt
Line Volts 117V.

All Controls Set For
Normal Sweeps. Focus
And Brightness

(1) Use 2.5V Range
(2) " 10V "
(3) " 25V "
(4) Voltage Vary More Than ±20%

RESISTANCE MEASUREMENTS

Short Capacitor C602
Short Pin 3 of V15 to B-

Inf. Denotes Infinite resistance
Turn the Following Controls Full Clockwise:
Focus Control
Contrast
Brightness
Vertical Hold
Vertical Size
Vertical Linearity
Values Listed May Have a Tolerance of ±20%

Fig. 29. Socket Voltage and Resistance Diagram

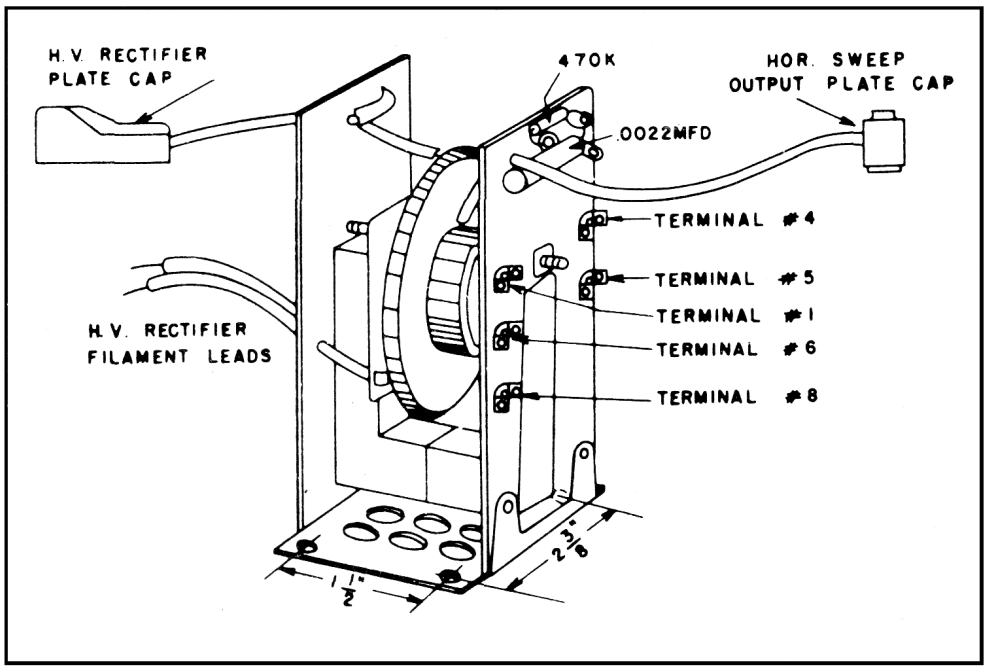


Fig. 30. Horizontal Sweep Transformer

PRODUCTION CHANGES

1. A few receivers at the start of production used the circuit as shown in Fig. 31 for sync signal take-off to the sync amplifier. To provide better horizontal sync pulse shape, this circuit was later changed to that shown in the Schematic Diagram Figure 32. This change is incorporated in receivers with the letter "Z" stamped on the back apron of the chassis and on the cabinet back.

2. To improve synchronization resistor R353 has been changed from a one megohm value to 470,000 ohms and capacitor C353 from a 220 uuf. value to 470 uuf. These components are in the coupling network between the two sections of V10, type 6SL7GT, sync amplifier and clipper tube.

3. In order to increase the vertical sweep amplitude, the charging capacitor C308 in the vertical sweep generator was changed from a value of .03 uf. to a value of .025 uf. 600 volt rating. All chassis with this change have been stamped with letter "Y".

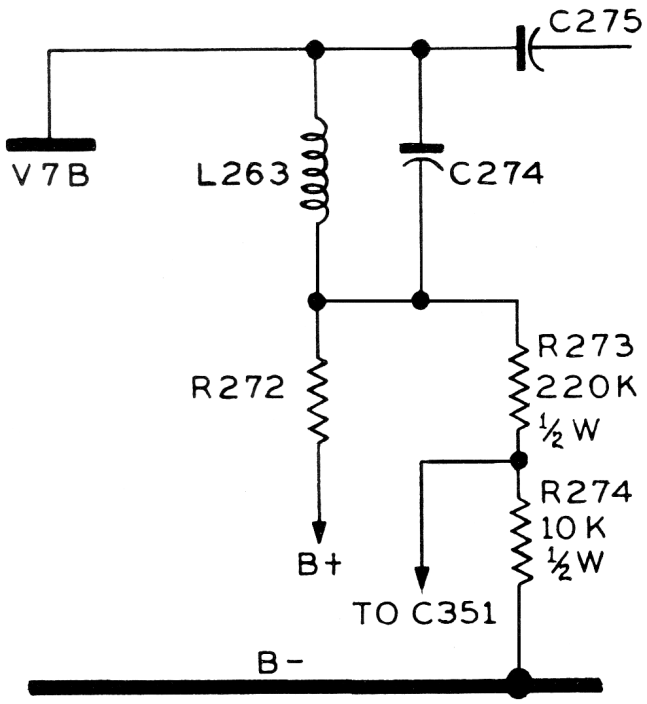


Fig. 31

Part Number	Symbol	Description
		R-F HEAD END UNIT
M64-1		Head-end - Completely aligned with tubes
K66J755-2		Tube socket for V1, V2
K68J752		" " " V3
M76J921-2	C213	Capacitor - Trimmer
K69J100-2	C205	" - Ceramic, stand-off 680 mmf. special
M77J119-2	L226,L227	Converter plate coil
K69J873-1	L201	Input transformer
K65J478-2	L202	Choke coil
K65J478-1	L218	Cathode choke
M76J772-31	L219	Coil - Oscillator - Channel 2
M76J772-32	L220	" - " - " 3
M76J772-33	L221	" - " - " 4
M76J772-34	L222	" - " - " 5
M76J772-35	L223	" - " - " 6
M76J772-37	L225	" - " - " 13
M76J772-52	L204	Coil - 1st R-F - Channel 2
M76J772-15	L205	" - " - " 3
M76J772-10	L206	" - " - " 4
M76J772-32	L207	" - " - " 5
M76J772-51	L208	" - " - " 6
M76J772-55	L210	" - " - " 13
M76J772-54	L211	Coil - 2nd R-F - Channel 2
M76J772-10	L212	" - " - " 3
M76J772-53	L213	" - " - " 4
M76J772-32	L214	" - " - " 5
M76J772-51	L215	" - " - " 6
M76J772-56	L217	" - " - " 13
M76J772-50	L203	Coil - Trap - Channel 11
K67J790-1	C207	Capacitor - Trimmer
K67J790-3	C220	" - "
K69J271-5	C206	" - "
K59J365-7056	C203,C214	" - Ceramic 1.5 mmf. special
M77J166-1101	C216,C218	" - Mica 5 mmf. 10%
M77J166-1053	C212	" - " 12 mmf. 5%
K63J885-29	C208,C211	" - Ceramic 3.3 mmf. special
K69J94-2	11 used	" - " 800 mmf. special
	R221	Resistor - 39 ohm 1/2 W. carbon 10%
	R203	" - 110 " " " " 5%
	R207,R219	" - 470 " " " " 10%
	R206	" - 680 " " " " 10%
	R205	" - 820 " " " " 10%
	R210	" - 1200 " " " " 10%
	R211	" - 1300 " " " " 5%
	R214	" - 2200 " " " " 10%
	R208	" - 4300 " " " " 5%
	R209	" - 4700 " " " " 10%
	R216,222	" -10,000 " " " " 5%
	R223	" -22,000 " " " " 10%
	R217	" -220,000 " " " " 10%
K71J186-1	R220	" - 43 " 4 Watts carbon
	R212,R213	" - 5100 " 1 " " 5%
	R215	" - 5600 " 1 " " 10%
	R204	" -10,000 " 1 " " 10%
	R218	" -39,000 " 1 " " 10%
		RECEIVER CHASSIS
M77J172-1		Support - Safety glass support. short
M77J172-2		" - " " " long
IRS650DA-1	LS2	Speaker - 6-1/4" PM speaker
V24J101		Cord - for tuning control
T75J819-1		Overlay
T75J818-1		Escutcheon for picture tube
P74J824-3		" - Knob door
K71J424-1		Mask - Rubber mask (gasket)
P74J519-8		Knob - Brown, Brightness, Vertical Hold
P74J752-4		" - Brown, Focus, Horizontal Hold
M77J176-2		" - Blonde, Channel Selector
P74J752-5		" -- Blonde, Volume - Off - On
P74J519-1		" - Blonde, Brightness, Vertical Hold
M77J176-1		" - Brown, Channel Selector
P74J752-1		" - Brown, Volume - Off - On
P74J752-7		" - Blonde, Tuning Control
P74J752-8		" - Blonde, Contrast Control
M8531038		Safety glass
8379		Caster
K71J387-1	X451,X452	Rectifier - 300 Ma. selenium

Part Number	Symbol	Description
		Receiver Chassis (Cont'd)
K66J847-2		Insulator for volume control
K69J263		" " deflection yoke
K68J691		" - HI - voltage insulator
M77J235		" for rectifier
K69J903		" " interlock
K69J537		Support for power cord
K66J674-4		Connector - Anode connector
M76J557-2		Receptacle - Power cord receptacle (male)
K69J528-5		Socket for picture tube V8
UCF60636		" - Tube socket for V9, V19, V10, V20
K59J385-3		" - " " " V13, V14
K65J187-1		" - " " " V15
K66J755-3		" - " " " V4
K68J481-1		" - 7 pin tube socket for V11, V18
K68J837		" - 7 pin shielded tube socket for V5, V6, V17
K65J356-2		" - Tube socket. Shock mounted for V12
K71J148-3		" - " " for V16
K69J607-1		" - 9 pin tube socket for V7
M77J5-1	L351	Coil - Horizontal oscillator coil
M77J2-1	D301,D351	Deflection yoke
M77J4-1	L353	Coil - Width control
M77J4-5	L352	Coil - Horizontal linearity
K68J786-4	L256	Choke - R.F. choke 31 UH. for video detector
M77J3-1	L401	Coil - Focus coil
K65J429-8	L257,L263	Choke - Video comp. 165 UH.
M77J124-9	7 used	Coil - Heater choke 2 UH. (L258, L402, L452, L453, L454, L455, L456)
M77J164-2	L259, L262	Choke - Video comp. choke 165 UH.
M77J165-1	T401	Coil - 1st audio I.F. transformer
M77J119-3	L251	Coil - I.F. coil - 1st
M77J185-1	L260	Coil - 4.5 MC. video trap coil
M77J201-2	L261	Coil - Video peaking coil 110 UH.
M77J201-1	L264	Choke - Video comp. choke 130 UH.
M77J119-5	L252,L253	Coil - I.F. 2nd
M8531021-1	Y1	Assembly - Video detector assembly (L254, L255, C265, C267, 1N64)
K71J405-1		Ion trap
K69J766		Clamp - Picture tube clamp
K69J690-3		Sling - Picture tube mounting sling
K71J124-1		Cushion - Sling and center
K71J124-2		" - Picture tube strap
K71J120		" - " " cushion (large)
K68J685		Shield - Corona shield for V14
K66J617-2		Spring for tuning control
K69J356		Shaft - Extension shaft for L353, L352
K68J797-3		Shaft - Tubular tuning shaft
K68J799-2		Pulley and hub assembly for tuning control
K68J766	R308	Potentiometer - 3 meg. height control
K71J112-1	R311	" - 4000 ohms 2W. vertical linearity
K71J71-1	R412,R262	" - Dual. 500 K volume. 2 met. contrast for C2T3, C2T7 only
K71J69-1	R276,R421	" - Dual, 100 K focus. 500 K brilliance
K71J70-1	R413,R280	" - Dual, 500 K volume. 2 meg. contrast for C2C7 only
K71J397-1	R305,R365	" - Dual, 125 K vertical hold, look horizontal hold
K71J442-1	R369	" - 25 K drive
K69J819	B451	Thermal cut-out
K69J54-1	S401	Switch - Focus
K69J88	L600,L451	Reactor - Filter reactor
M76J725-1	T402	Transformer - Ratio detector
K68J489	T301	" - Vertical sweep output
M77J1-4	T351	" - Horizontal sweep output
K71J409	T403	" - Audio output for C2T3, C2T7
K69J91-1	T404	" - Audio output for C2C7 only
M76J557-1		Power cord - Interlock female
		Capacitors and Resistors
K67J955-10	C309,C423 C454	Capacitor - Electrolytic 10 mfd. 350 V., 50 mfd. 100 V., 100 mfd. 75 V.
K65J365-33	C410	" - " 1 mfd. 50 V.
K69J283-1	C310	" " 30 mfd. 450 V.
K67J955-7	C272,C355 C379	" " 10 mfd. 450 V., 40 mfd. 300 V., 10 mfd. 150 V.
K71J73-1	C451,C601	" " 300 mfd. 150 V.
K71J73-2	C452,C602	" " 125 mfd. 350 V.
K66J425-2	C376	" - 500 mmf. 20,000 volts
M77J166-1101	C255,C259	" - 5 mmf. silver mica. special
K68J68-1	32 used	" -5000 mmf. ceramic 450 V. - 0%+150%
K58J954-2	C274	" - 6 mmf. mica 25%
M77J166-115	C462	" - 47 mmf. " 10%
K71J438-9	C369	" - 6 mmf. " 1500 volt
K58J954-127	C356	" - 130 mmf. " 5%
M77J166-107	C370	" - 22 mmf. " 500 volt 10%

Part Number	Symbol	Description
		Capacitors and Resistors (Cont'd.)
K58J954-1128	C201,C202	Capacitor - 150 mmf. mica 800 volt 10%
	C357,C404	" - 100 mmf. "
K58J954-520	C364	" - 220 mmf. " 500 volt 10%
K58J954-524	C303,C304 C353,C363	" - 470 mmf. " 500 volt 10%
	C366	" - 1000 mmf. "
K58J954-531	C365	" - 1800 mmf. " 500 volt 10%
K66J332-3	C305	" - 1000 mmf. " 1000 volt 20%
K58J954-535	C362,C367	" - 3900 mmf. " 500 volt 10%
	C360	" - 680 mmf. "
K58J954-1520	C455,C456	" - 220 mmf. " 800 volt 10%
K66J332-8	C380	" - 82 mmf. " 1500 volt 10%
	C301,C411	" - .001 mfd. paper 600 volt
	C302,C418	" - .002 mfd. " 600 volt
	C422	" - .005 mfd. " 1000 volt
K67J700-17	C361,C419 C354	" - .01 mfd. " 600 volt 10%
K59J346-9	C358	" - .02 mfd. " 200 volt 10%
	C416	" - .01 mfd. " 200 volt
K63J786-6113	C279,C351 C352	" - .02 mfd. " 600 volt +40%-10%
	C268,C273 C278,C359 C375	" - .05 mfd. " 600 volt
	C306	" - .1 mfd. " 200 volt
	C277	" - .2 mfd. " 200 volt
	C251,C377	" - .5 mfd. " 200 volt
	C418	" - .003 mfd. " 600 volt
	C308	" - .025 mfd. " 600 volt
	C275,C373 C374,C421	" - .1 mfd. " 600 volt
K71J281-2	R455	Resistor - 35 ohms. globar +5%-15%
K69J552-5	R427	" - 1700 " 3 watt WW 5%
K69J936-1	R451	" - 4.6 " 5 " ""
	R374	" - 150 ohms. 1/2 watt carbon 20%
	R420	" - 120 " " " " 10%
	R257,R260 R261	" - 47 " " " " 10%
	R273,R401	" - 220 " " " " 10%
	R408	" - 270 " " " " 10%
	R264	" - 470 " " " " 20%
	R255,R407 R419	" - 1000 " " " " 20%
	R279	" - 2700 " " " " 10%
	R265	" - 3600 " " " " 5%
	R309	" - 4700 " " " " 20%
	R371	" - 15,000 " " " " 10%
	R314,R315 R377	" - 1200 " " " " 10%
	R269	" - 1500 " " " " 10%
	R368,R403 R274	" - 10,000 " " " " 10%
	R409,R410	" - 22,000 " " " " 5%
	R266,R411 R251,R278 R372	" - 22,000 " " " " 10%
	R364	" - 27,000 " " " " 10%
	R362,R416	" - 33,000 " " " " 10%
	R302,R402	" - 39,000 " " " " 10%
	R253,R354	" - 47,000 " " " " 10%
	R404	" - 56,000 " " " " 10%
	R354,R304 R256,R366 R259,R414	" - 68,000 " " " " 10%
	R303,R306 R405	" - 100,000 " " " " 5%
	R301	" - 82,000 " " " " 10%
	R358	" - 150,000 " " " " 10%
	R355,R422	" - 180,000 " " " " 10%
	R277,R417 R273	" - 220,000 " " " " 10%
	R379	" - 270,000 " " " " 10%
	R453,R258 R406,R418 R353	" - 470,000 " " " " 10%
	R201,R202	" - 3.3 meg " " " " 10%
	R275,R356 R357,R361 R370,R456	" - 1 " " " " 10%
	R263	" - 1.5 " " " " 20%
	R268,R351	" - 2.2 " " " " 10%
	R307	" - 4.3 " " " " 5%
	R415	" - 4.7 " " " " 10%
	R424	" - 430 ohms. 1 watt " 5%
	R375	" - 470 " " " " 10%
	R425,R426	" - 820 " " " " 5%
	R313	" - 1000 " " " " 20%
	R312	" - 1500 " " " " 20%
	R310	" - 2700 " " " " 10%

REPLACEMENT PARTS LIST (Cont'd.)

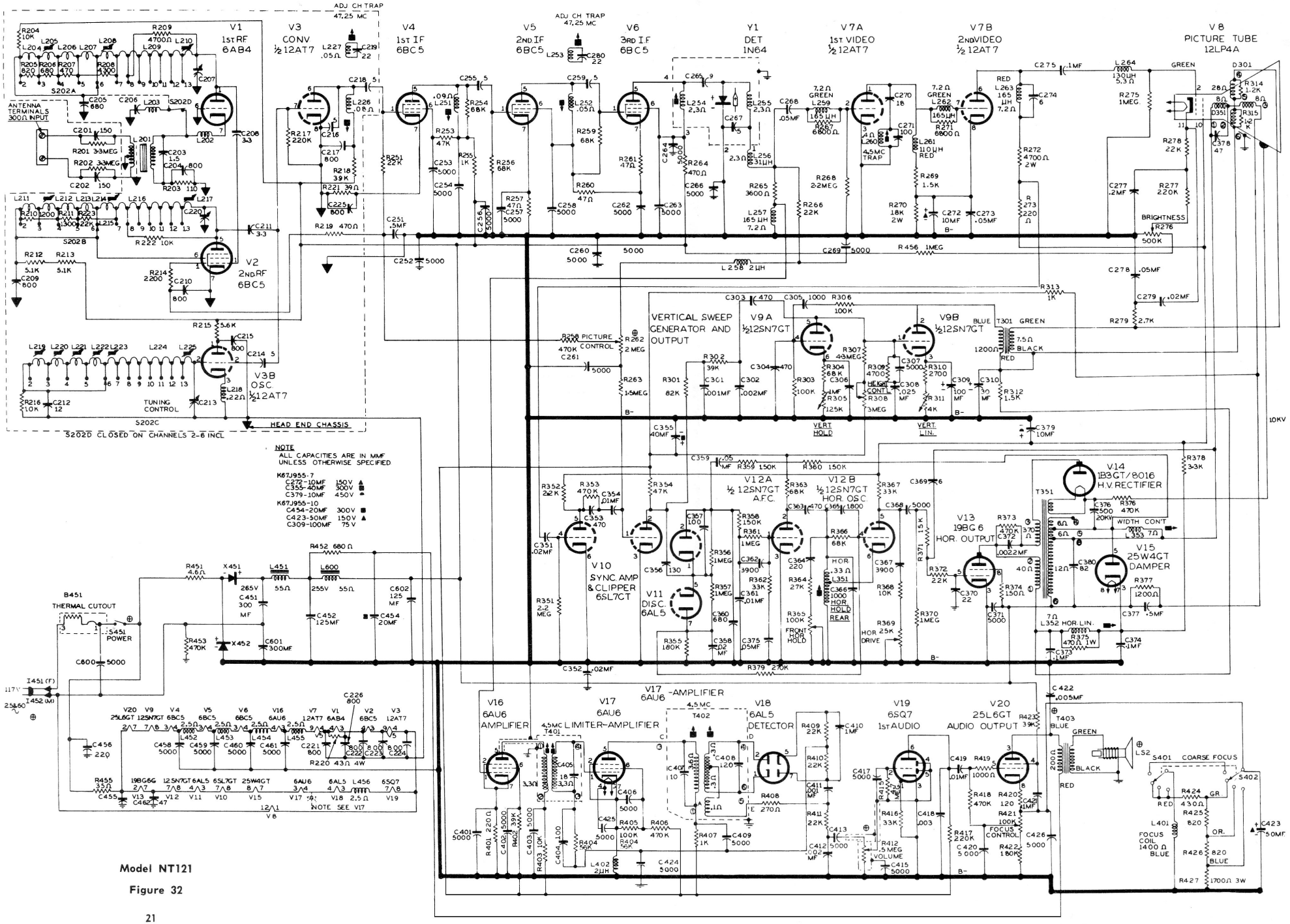
Part Number	Symbol	Description
		Capacitors and Resistors (Cont'd.)
	R352	Resistor - 22,000 ohms. 1 watt carbon 10%
	R367	" - 33,000 " " " " 10%
	R423	" - 39,000 " " " " 10%
	R363	" - 68,000 " " " " 10%
	R359,R360	" - 150,000 " " " " 10%
	R376	" - 470,000 " " " " 20%
	R452	" - 680 " 2 watt " 10%
	R272	" - 4700 " " " " 10%
	R270	" - 18,000 " " " " 10%

All prices subject to change without notice.

Where part numbers are shown, it is recommended that these parts be used and not substituted.

Always state Model No. of receiver when ordering parts.

We do not stock the above listing of standard carbon resistors and paper or mica capacitors - purchase these from your local Radio Parts Jobber.



Model NT121

Figure 32

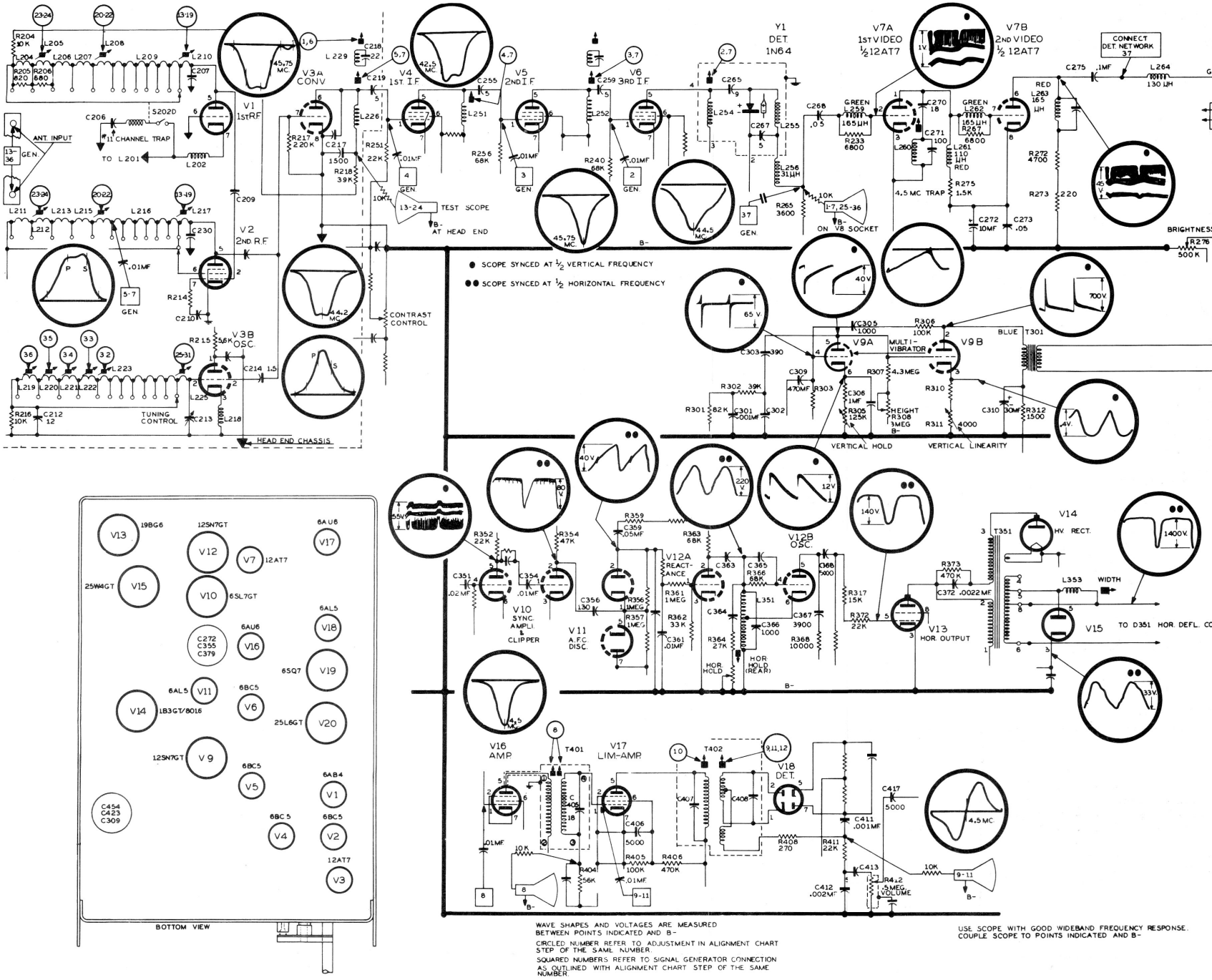


Fig. 33. Service Diagram, Model NT121

SERVICE DIAGRAM

The alignment procedure is shown in table form on pages 7, through 12. In order to accelerate the whole procedure, this service diagram should be consulted. The encircled numbers indicate the number of the step of the alignment chart and the arrow points to the component to be adjusted. The generator feeding in the signal is symbolized by a square with the number of the step of the alignment chart. The exact point of feed-in is indicated by the arrow connected with the numbered square. The oscilloscope is represented by the symbol of the cathode ray tube. The number inside the symbol refers to the step of the alignment chart. On the left side of the diagram is shown the tube location inside the chassis so that it is an easy matter to locate quickly the correct points for connection to the generator and the oscilloscope. In order to clarify the diagram, only those parts of the circuit are shown which are needed for quick location of the test points. Within the large circles are shown the waveform of an average television receiver, wherein the controls have been adjusted for a normal picture with correct contrast, height, width, and linearity. Use suitable scope with probe. Most measurements must be made when a signal is being received.

The oscilloscope of which the vertical amplifier has been precalibrated is used to make measurements at the point indicated by the arrow connected to the individual waveshape within the circle. The oscilloscope is synced at half of the respective sweep frequency of the circuit being analyzed.