ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE 3' X 4'

R-F FREQUENCY RANGES

Channel Number	Channel Freq. Mc.	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.	Receiver R-F Osc. Freq. Mc.
1	44-50	45.25	49.75	71
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

FINE TUNING RANGE

Plus and minus approximately 300 kc on channel 1, and plus and minus approximately 750 kc on channel 13.

POWER SUPPLY RATING

Tuner 115 volts, 60 cycles, 200 watts
Picture 115 volts, 60 cycles, 300 watts

AUDIO POWER OUTPUT RATING

Undistorted 4.5 watts
Maximum 5.6 watts

LOUDSPEAKER (970121-1)

Type 12 inch Permanent Magnet
Voice Coil Impedance 8 ohms at 400 cycles

WEIGHT

Tuner Chassis with Tubes in Cabinet lbs.
Picture Chassis with Tubes in Cabinet lbs.

PICTURE I-F FREQUENCIES

Picture Carrier Frequency	25.75 Mc
Adjacent Channel Sound Trap	27.25 Mc
Accompanying Sound Traps	21.25 Mc
Adjacent Channel Picture Carrier Trap	19.75 Mc

SOUND I-FREQUENCIES

Sound Carrier Frequency	21.25 Mc
Sound Discriminator Band Width (between peaks)	350 kc

VIDEO RESPONSE	To 4 Mc
FOCUS	Electrostatic
SWEEP DEFLECTION	Magnetic
SCANNING	Interlaced, 525 line
HORIZONTAL SCANNING FREQUENCY	15,750 cps
VERTICAL SCANNING FREQUENCY	60 cps
FRAME FREQUENCY (Picture Repetition Rate)	30 cps

RECEIVER ANTENNA INPUT IMPEDANCE 300 ohms balanced

DIMENSIONS (inches)	Length	Height	Depth
Tuner Cabinet (Outside)	14"	12¼"	19"
Picture Cabinet (Outside)	54"	71¼"	29½"

TUBE COMPLEMENT

Remote Tuner

	Type tube used	Function
1	6J6	R.F. Amplifier
2	6J6	R.F. Oscillator
3	6J6	Converter
4	6BA6	1st Sound I.F.
5	6BA6	2nd Sound I.F.
6	6AU6	3rd Sound I.F. limiter
7	6AL5	Sound Discriminator
8	6AT6	1st Audio Amplifier
9	6V6	2nd Audio Amplifier
10	6AG5	1st Video I.F.Amplifier
11	6AG5	2nd Video I.F.Amplifier
12	6AG5	3rd Video I.F.Amplifier
13	6AG5	4th Video I.F.Amplifier
14	6AL5	2nd Video Detector
15	6J6	Video Cathode Follower
16	5U4G	Rectifier

Picture Cabinet

17	6AU6	1st Video Amplifier
18	6L6G	2nd Video Amplifier
19	6AU6	Sync clipper
20	6SN7	1st & 2nd Sync Amp
21	6SN7	Sync Clipper Separator, Vertical Sync Amplifier
22	6SN7	Horizontal Sync Amplifier, Horizontal discharge
23	6SN7	Vertical Blocking Osc.
24	6U6GT	Vertical Amplifier
25	6K6GT	Horizontal Oscillator
26	6AC7	Reactance Tube
27	6AL5	Sync discriminator
28	6AL5	D.C.Restorer
29	6BG6	Horizontal Output
30	6BG6	Horizontal Output
31	5V4G	Reaction Scanning
32	6AS7G	Reaction Scanning
33	1B3GT	High Voltage Rectifier Multiplier
34	"	" " " "
35	"	" " " "
36	"	" " " "
37	"	" " " "
38	5U4G	Rectifier
39	5U4G	Rectifier
40	5TP4	Projection Kinescope

Tuner Operating Controls (front panel)

Channel Selector, Fine Tuning	Dual Control Knobs
Picture, Sound Volume and On-Off Switch	Dual Control Knobs

PROJECTOR

The Schmidt Optical System is used incorporating a Type 5TP4 Projection Kinescope. Horizontal and Vertical (optical) positioning controls are provided in the projector assembly. These controls are Factory aligned and should seldom require realignment. If alignment is necessary refer to fig. 10 . An optical Focus Control is located on rear of projector assembly. (See fig. 10)

Non-Operating Controls

Function	Location
Brightness	Rear Low Voltage and Video Chassis
Horizontal Hold	Top Center Vertical & Horizontal Sweep Chassis
Vertical Hold	Top Rear " " "
Syncrolock	Front Side " " "
Height	Rear Side " " "
Vertical Linearity	" " " " "
Horizontal Position	" " " " "
Vertical Position	" " " " "
Peaking	" " High Voltage Chassis
Horizontal Linearity	" " " " "
Horizontal Drive	" " " " "
Focus (Electrical)	" " " " "

INSTALLATION INSTRUCTIONS

TRADIOVISION, Model 13, television receiver is packed in two shipping cases and five cartons.

The shipping cases contain the projector cabinet and the mirror for same. The cartons contain the following chassis: Projector, Low Voltage and Video Chassis, Vertical and Horizontal Sweep Chassis, High Voltage Chassis, and Remote Tuner.

Extreme care should be taken in unpacking the shipping crates. Cut steel bands and use nail puller, being careful not to strike highly polished cabinet surface. The cabinet crate should be unpacked in upright position.

The second crate contains the mirror and should be unpacked in the same fashion as the cabinet, being careful to keep the crate in standing position while doing so.

Unpack the five cartons by tearing open from the top flaps.

1. Remove screen from moorings inside cabinet and mount as shown in Fig. 7

2. Carefully place mirror in cabinet as shown in Fig. 8

3. Mount speaker and grill as shown in Fig. 7

4. Mount projector in cabinet as shown in Fig. 6

5. Mount low voltage and video chassis, and vertical and horizontal sweep chassis in cabinet as shown in Fig. 6

6. Connect cables as shown in Fig. 6

7. Carefully insert projection kinescope in projector following instructions shown in Fig. 9

8. Check all tubes to be sure they are firmly inserted in their respective sockets.

9. Connect antenna and cable to remote tuner.

10. The receiver should now be ready for operation.

11. Turn the power switch to the "On" position and follow operating instructions as shown in Par.

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FOCUS ADJUSTMENT

1. With the top cover of the projector housing removed, adjust focus control on rear of high voltage chassis for best electrical focus on face of type 5TP4 picture tube.

2. The projector has been carefully aligned at the factory and the centering adjustments should normally require no change. If such adjustments are required, refer to Fig. 10 showing alignment of the projector.

3. Adjust focus control (See Fig. 10) for sharpest picture on screen.

4. If corner of the raster is shadowed, it indicates that the electron beam is striking neck of tube. This is most often caused by the projector tube being improperly seated in the deflection yoke.

DEFLECTION YOKE ADJUSTMENT

If the lines of the raster are not all squared with the screen mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment knurled screw.

PICTURE ADJUSTMENTS

It will now be necessary to obtain a test pattern in order to make further adjustments. Refer to receiver operating instructions on Page. 2.

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT

Turn the horizontal hold control to the extreme counter-clockwise position (See Fig. 5 for location of horizontal hold control) The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Normally the picture will pull into sync. Turn the horizontal hold control to the extreme clockwise position. The picture should remain in sync. Momentarily remove the signal. Again the picture should normally pull into sync.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned.

ALIGNMENT OF HORIZONTAL OSCILLATOR

If, in the above checks, the receiver failed to hold dync with the hold control at either extreme or failed to pull into control after momentary removal of the signal, make the adjustments under "Slight Retouching Adjustments". If, after making these retouching adjustments, the receiver fails to pass the above checks, or if the horizontal oscillator is completely out of adjustment, make the adjustments under "Complete Re-alignment".

SLIGHT RETOUCHING ADJUSTMENTS

Tune in a television station and adjust the fine tuning control for best sound quality. Sync the picture and adjust the picture control for slightly less than normal contrast. Turn the horizontal hold control to the extreme position in which the oscillator fails to hold or pull in. Momentarily remove the signal. Turn the synchrolock frequency adjustment on rear of vertical and horizontal sweep chassis until the oscillator pulls into sync. Check hold and pull-in for the other extreme position of the hold control.

COMPLETE RE-ALIGNMENT

Tune in a television station and adjust the fine tuning control for best sound quality. Turn the synchrolock frequency adjustment on rear of vertical and horizontal sweep chassis until the picture is synchronized. Adjust the picture control so the picture is somewhat below average contrast level.

Turn the synchrolock phase adjustment screw under chassis until the blanking bar which may appear in the picture moves to the right and off the raster. (Blanking bar appears as a horizontal fold in the raster, and as it moves off the raster, it appears to unfold.) The range of this adjustment is such that it is possible to hit an unstable condition (ripple in the raster). The screw must be turned clockwise from the unstable position. The length of the stud beyond the bushing in its correct position is usually about one-half inch.

Turn horizontal hold to the extreme counter-clockwise position. Turn synchrolock frequency adjustment clockwise until the picture falls out of sync. Then turn it slowly counter-clockwise to the point where the picture falls into sync again.

Readjust synchrolock phase adjustment so that the left side of the picture is close to the left side of the raster but does not begin to fold over.

Turn horizontal hold to the extreme clockwise position. The right side of the picture should be close to the right side of the raster but should not begin to fold over. Momentarily remove the signal. When the signal is restored, the picture should be in sync. If it isn't, turn synchrolock frequency adjustment counter-clockwise until the picture falls into sync.

Turn horizontal hold to the extreme counter-clockwise position; remove the signal momentarily. When signal is restored the picture should fall into sync. If the picture does not fall into sync after momentary removal of the signal in both extreme positions of horizontal hold, the pull-in range may be inadequate, though not necessarily. A pull-in thru three-quarters of the hold control range may still be satisfactory.

There is a difference between the pull-in range and hold-in range of frequencies.

Once in sync, the circuit will allow 50 to 100% more variation in frequency than it can pull in. The range of the horizontal hold control is only approximately equal to the pull-in range. Considerable variation may be found due to variation in the characteristics of the horizontal oscillator control tube V28.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS

Adjust the height control and the vertical linearity control on rear of the vertical and horizontal sweep chassis until the test picture is symmetrical from top to bottom and of proper height. Adjustment of either control will require the readjustment of the other. Adjust vertical centering control to center the picture within the screen mask.

WIDTH AND HORIZONTAL LINEARITY ADJUSTMENTS

Adjust the horizontal drive and peaking and horizontal linearity controls on rear of high voltage chassis until test pattern is symmetrical left to right and of proper brilliance and size. A slight readjustment of the horizontal drive control may be necessary when either linearity control or peaking control is adjusted. Adjust horizontal centering control to align the picture within the screen mask.

CHECK OF OSCILLATOR ADJUSTMENTS

With a crystal calibrated test oscillator or heterodyne frequency meter, check to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure. The adjustments for channels 1 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Fig. . Adjustments for channels 6 and 13 are under the chassis.

VIDEO PEAKING LINK

A video peaking link is provided (See Fig.) to permit changing the video response. If the pictures from the majority of stations look better with the link closed (2-3 position) then the link should be placed in that position. However, if transients are produced on high contrast pictures then the link should be left open (1-2 position).

ANTENNA TRAP

In some instances interference may be encountered from FM stations that are on the image frequency of a television station. In other instances interference between two television stations may be observed.

Assume that two television stations in a city are operating on channels 6 and 10. When the receiver is tuned to channel 6, a small amount of the oscillator voltage (109 mc) is present on the r-f amplifier grid. This 109 mc voltage beats with the channel 10 picture carrier and produces an 84.25 mc signal. This signal falls within the channel 6 range and interferes with the reception of channel 6. A similar case occurs between channels 5 and 7.

A series resonant trap across the r-f amplifier grid circuit will remove the oscillator voltage from the grids and will eliminate this type of interference. In production, this trap is adjusted to reject the channel 6-10 interference. However, in the field, it may be necessary to retouch the adjustments or to readjust the trap for channel 5-7 or FM image interference.

To adjust the trap in the field, tune in the station on which the interference is observed. Tune both cores of the trap for minimum interference in the picture. See Fig. for the location of the trap. Keep both cores approximately the same by visual inspection. Then, turn one core ½ turn from the original position and repeak the second for maximum rejection. Repeat this process until the best rejection is obtained. For shop alignment of the trap see the alignment procedure

CIRCUIT DESCRIPTION

It is advisable that the reader be familiar with a recent standard textbook of television principles in order to properly understand the receiver circuits and their functions. Such a knowledge is assumed for the purpose of this publication. The discussions which follow will not dwell on the operation of conventional circuits used which have been used in previous receivers and which should be well known. In general, the circuits discussed will be only those that are new to the field.

For ease of understanding the basic operation of the receiver, a 15 unit block diagram of it is shown in Figure 2. The circuit description will follow the numerical order of these blocks in order to logically follow a signal through the set.

R-F UNIT - The r-f unit is a separate subchassis of the receiver. On this subchassis are the r-f amplifier, converter, oscillator, fine tuning control, channel switch, converter transformer, r-f converter and oscillator coils and all their tuning adjustments. The unit provides operation on all thirteen of the present television channels. It functions to select the desired picture and sound carriers, amplifies and converts to provide at the converter plate, a picture i-f carrier frequency of 25.75 mc. and a sound i-f carrier of 21.25 mc.

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R-F Amplifier -- Referring to the Schematic Diagram T1 is a center tapped coil used for the short circuiting of low frequency signals picked up by the antenna which would otherwise be directly applied to the control grids of the 6J6 r-f amplifier, V1, C1 and C2 are antenna isolating capacitors. The d-c return for the grids of V1 is through R3 and R13 which also properly terminate the 300 ohm antenna transmission line. C3 and C4 are neutralizing capacitors necessary to counteract the grid to plate capacitance of the triode r-f amplifier.

In the plate circuit of the r-f amplifier are a series of inductances L1 to L25 and L2 to L26 inclusive. These inductances may be considered as a quarter wave section of a balanced transmission line which can be tuned over a band of frequencies by moving a shorting bar along the parallel conductors.

Adjustable coils L25 and L26 provide the correct length of line for the thirteenth channel, 210-216 Mc. L13 to L23 and L14 to L24 are fixed sections of line which are added to L25 and L26 as the shorting bar is moved progressively down the line. The physical construction of each one of these inductances is a small non-adjustable silver strap between the switch contacts. Each strap is cut to represent a six-megacycle change in frequency. In order to make the jump between the lowest high frequency channel (174-180 mc) and the highest low frequency channel (82-88mc), adjustable coils L 11 and L 12 are inserted. To provide for the remaining five low frequency channels, L1 to L9 and L2 to L10 are progressively switched in to add the necessary additional inductance.

Coils L1 to L9 and L2 to L10 are unusual in that they are wound in figure 8 fashion on fingers protruding from the switch wafer. This winding form produces a relatively non-critical coil since the coupling between turns is minimized. A maximum amount of wire is used for the small inductance which is required, thus permitting greater accuracy in manufacturing.

Convertor -- The convertor grid line operates in a similar manner and is so arranged on the switch to provide coupling between it and the r-f line. C10, C12, C13 and a link, provide additional coupling which is arranged to produce at least a 4.5 megacycle band pass on each of the channels.

L80 and C14 form a series resonant circuit used to prevent i-f feedback in the converter by grounding its grids for i-f frequency. They also act as a trap to reject short-wave signals of i-f frequency which arrive at the converter grids in a push push manner.

A 6J6 twin triode is used as converter. Since the grids are fed in push pull by both the signal and the signal and the oscillator, the heterodyne products (i-f signals) are in phase on the converter plates so the two plates are connected in parallel. Unwanted signals of i-f frequency that arrive at the converter grid in a push pull manner are out of phase on the converter plates. Since the plates are tied together, these signals tend to cancel thus reducing the possibility of interference from this source.

R-F Oscillator -- The oscillator line is similar except that trimmer adjustments are provided for each channel and the low frequency coils are not figure 8 windings. For tuning each channel, brass screws are used in close proximity to the high frequency tuning straps L66 to L76, and brass cores are adjusted through coils L54 to L62. It is obvious that the high frequency adjustments should be made before each lower frequency one.

C15 is a fine tuning adjustment which provides approximately plus or minus 300 Kc variation of oscillator frequency on channel 1 and approximately plus or minus 750 Kc. on channel 13. On a few early production units, slightly less range is available.

The physical location of the oscillator line with respect to the converter grid line is such as to provide some coupling to the converter grids. This coupling is augmented by the link shown on the schematic and provides a reasonably uniform oscillator voltage at the converter grids over the entire tuning range of the unit.

The converter transformer T2 is a combination picture i-f transformer, sound trap, and sound i-f transformer. The converter plate coil is assembled within the structure of a high Q resonant circuit tuned to the sound i-f frequency. This high " coil absorbs the sound i-f component from the primary. Thus on the T2 primary (from which the picture i-f is fed), the sound carrier is attenuated with relation to the picture channel.

SOUND I-F AMPLIFIER AND DISCRIMINATOR - A portion of the energy absorbed by the T2 trap circuit is fed to the first sound i-f amplifier. Three stages of amplification are used to provide adequate sensitivity. A conventional discriminator is used to demodulate the signal. The discriminator band width is approximately 350 Kc. between peaks.

AUDIO AMPLIFIER AND SPEAKER The audio amplifier is a conventional system employing a 6AT6 high mu. triode amplifier and a 6U6GT power output tube feeding a 12 inch P M speaker

PICTURE I-F AMPLIFIER AND DETECTOR - The picture i-f amplifier departs considerably from the conventional coupled amplifier. To obtain the necessary wide band characteristic with adequate gain, four stages of i-f amplification are employed. The converter plate and each successive i-f transformer utilizes only one tuned circuit and each is tuned to a different frequency. The effective Q of each coil is fixed by the shunt plate load or grid resistor so that the response product of the total number of stages produces the desired overall response curve. Figure shows the relative gains and selectivities of each coil and the shape of the curve of the quintuple combination.

In order to obtain this band pass characteristic, the picture i-f transformers are tuned as follows:

Convertor transformer	21.8 mc	(T2 primary)
First pix i-f transformer	25.3 mc	(T103 primary)
Second pix i-f transformer	22.3 mc	(T104 primary)
Third pix i-f coil	25.2 mc	(L183)
Fourth pix i-f coil	23.4 mc	(L185)

In such a stagger tuned system variations of individual i-f amplifier tube gain do not affect the shape of the overall i-f response curve if the Q and center frequency of the stages remain unchanged. This means that the i-f amplifier tubes are non-critical in replacement because variations in Gm do not affect response shape.

To align the i-f system, the transformers are peaked to the specified frequencies with a signal generator. The overall i-f response is then observed by use of a sweep generator and oscilloscope. Slight deviations from standard circuit Q are compensated for with slight shifts in transformer center frequency until the desired response curve is obtained. If this response cannot be obtained, the difficulty is likely to be in a location that affects either the frequency or Q or one or more of the i-f transformers.

The response curve does shift slightly as the picture control is varied due to the Miller effect. This effect is the change in tube input capacitance as its gain is varied by grid bias changes. The change of input capacitance causes a slight de-tuning of the preceding i-f transformer and a small shift in response shape. This effect is slight, however, and when the receiver is aligned with the specified grid bias, no difficulty from this source should be encountered.

For familiarization with the frequencies which are important in the receiver's operation, Figure shows the relative position of the picture and sound carriers for channels 2, 3 and 4. If a station on channel 3 is transmitting a picture with video frequencies up to 4 mc., the picture carrier will have side band frequencies up to 62.25 mc. The lower side bands are suppressed at the transmitter.

With the receiver r-f oscillator operating at a higher frequency than the received channel, the i-f frequency relation of picture to sound carrier is reversed as shown in Figure

TRAPS - Since it is necessary for the picture i-f to pass frequencies quite close to the sound carrier frequency, the sound carrier would produce interference, traps must be added to the picture i-f amplifier to attenuate the sound carrier. If the receiver should be operating on channel 3, it is possible that interference would be experienced from the channel 2 sound carrier and the channel 4 picture carrier. The adjacent channel traps are provided to attenuate these unwanted frequencies.

The first three traps are absorption circuits. The first trap (T2 secondary) is tuned to the accompanying sound i-f frequency, the second trap (T103 Secondary) is tuned to the adjacent channel sound frequency and the third trap (T104 secondary) tuned to the adjacent channel picture carrier frequency. The fourth trap (T105 secondary) is in the cathode circuit of the fourth picture i-f amplifier V113 and is tuned to the accompanying sound carrier i-f frequency. The primary of T105 in series with C181 forms a series resonant circuit at the frequency to which L185 is tuned (23.4 mc.). This provides a low impedance in the cathode circuit at this frequency and permits the tube to operate with a gain. However, at the resonant frequency of the secondary (21.25 mc) a high impedance is reflected into the cathode circuit, and the gain of the tube for this frequency is reduced by degeneration. The rejection with this circuit is limited to the gain of the tube.

PICTURE SECOND DETECTOR - The detector is a conventional half wave rectifier connected to produce a video signal of the proper polarity.

PICTURE CONTROL - The picture (or contrast) control varies the bias on the r-f amplifier and the first, second and third i-f amplifier control grids. It is a manual sensitivity control, and is operated to prevent overloading of the i-f stages and to provide the correct video output level from the second detector. A novel arrangement is used in conjunction with the control. The object of this system is to provide optimum signal to noise ratio from the receiver. This is achieved by allowing the r-f amplifier to run essentially at full gain over a considerable range of the picture control. The gain in the r-f stage is reduced only when it becomes necessary to do so in order to prevent overloading of the first i-f stage. The circuit shown in Figure is used to provide the non-proportional r-f and i-f bias from a single control.

When the picture control is in the maximum gain position, the i-f bias is approximately minus one volt. The r-f bias is taken from a tap up the control network which would be several volts positive except for relatively heavy conduction of the diode. Diode conduction holds the voltage at this point to approximately ground potential.

As the picture control gain setting is reduced slightly, the i-f bias begins to go more negative. At the r-f bias junction, diode conduction is reduced but the voltage remains essentially constant. When the picture control setting is reduced still further, diode conduction is stopped and the r-f bias voltage changes rapidly to assume a more negative potential than the i-f grid.

This high value of bias on the r-f amplifier is necessary to reduce the triode nearly to cut-off. Although triodes are not generally considered to be remote cut-off tubes, sufficient curvature is present in the grid control characteristic to provide approximately a ten to one reduction in gain when the bias approaches the cut-off point.

VIDEO AMPLIFIER AND D-C RESTORER - The function of this section of the receiver is to amplify the video output of the second detector. Two amplifier stages are employed. The gain from the first video grid to output plate is 30X and the frequency response extends to 4 mc.

Noise Saturation Circuit - Since the synchronizing pulse is "blacker than black" and "black" information must drive the Kinescope grid toward cut-off, this means that the video signal polarity must be such that the sync is negative when applied to the Kinescope grid. It is obvious that for the two-stage video amplifier as is used, the sync pulse from the second detector must also be negative at the first video amplifier grid. The first stage is designed so that with a normal signal input level at its grid, the tube will be working over most of its operating range. Any large noise signal above sync will drive the grid to cut-off and the noise will be limited. In effect, the signal to noise ratio is thus improved.

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D-C Restorer - Since the video amplifier is an a-c amplifier, the d-c component of the video signal that represents the average illumination of the original scene will not be passed. Unless this d-c component is restored, difficulty will be experienced in maintaining proper scene illumination. For any given scene, this average illumination could be set properly by the brightness control. However, a change of scene would probably necessitate resetting this control. The d-c restorer accomplishes this setting automatically thus assuring proper picture illumination at all times. For a detailed explanation of the operation of the d-c restorer, See "Practical Television by R.C.A."

KINESCOPE - The Kinescope is a 5" projection tube employing a new type screen material which provides considerably improved picture brilliance. The tube employs magnetic deflection and electrostatic focus.

SYNC AMPLIFIER AND CLIPPER - The function of this system is to amplify the sync signal and effect separation of sync from the video.

Sync Amplifier - The first sync amplifier is 6SN7. The signal from the sync clipper is fed into this amplifier with the polarity such that the sync is in the negative direction. Noise pulses above sync that remain after the limiting action of the first video grid are thus further compressed and the sync to noise ratio is again improved.

Sync Separator - The sync at the sync separator grid is positive in polarity. The operating voltages applied to the grid and plate, are such that the negative portion of the applied signal is cut off. Thus the video and blanking pulses are removed and only the sync pulses appear at the sync separator plate.

Second Sync Amplifier - The sync pulses appearing at the second sync amplifier grid are negative in polarity and must be inverted before they can be injected into the sweep oscillators. The signal at the grid is sufficient to drive the tube beyond cut-off and the signal is again clipped. This final clipping removed all amplitude variations between sync pulses due to noise, hum, etc., at it appears with the correct polarity at the plate.

Integrating Network - The purpose of this network is to separate the horizontal from the vertical sync and to pass the vertical to the vertical oscillator.

Since the horizontal sync pulse is of short duration (5 micro-seconds), and the vertical pulse is of much longer duration (190 microseconds), they can be separated by an r-c filter which is responsive to wave shape. The integrating network which is such a filter is composed of In operation it can be considered as a low-pass filter which by-passes the narrow or high frequency horizontal sync but passes the broad or low frequency vertical sync.

VERTICAL OSCILLATOR DISCHARGE AND OUTPUT - The function of these circuits is to provide a sawtooth of current of the proper frequency and phase to perform the vertical scanning for the Kinescope. To produce such a current in the vertical deflection coil, a somewhat different shaped voltage wave is required.

Since the vertical trace is slow, requiring approximately 16,000 micro seconds, and the vertical deflection coil inductance is small, approximately 50 millihenries, the majority of the voltage across the coil during trace is across its resistive component. In order to produce linear change of current through a resistance, a linear change of voltage is necessary. Retrace, however, must be accomplished within the 666 microsecond vertical blanking time and therefore requires a much faster rate of change of current through the coil. During this time, the effect of its inductance becomes appreciable because of the required fast rate of change of current. It is therefore necessary to apply a large pulse of voltage across the coil in order to obtain rapid retrace. The composite waveform required to produce a sawtooth of current in the coil is a sawtooth of voltage with a sharp pulse as shown in Figure

Vertical Oscillator and Discharge - A single 6SN7 with its associated components form a blocking oscillator and discharge circuit.

Vertical Output - A 6V6 is connected as a triode for the output stage. The vertical output transformer matches the resistance of the vertical deflection coils to the plate impedance of the 6V6GT.

HORIZONTAL SYNC DISCRIMINATOR, HORIZONTAL OSCILLATOR AND OSCILLATOR CONTROL - These circuits are a radical departure from the conventional systems used for framing the picture in the horizontal direction. Their features are ease of operation, stability and good noise immunity.

HORIZONTAL OSCILLATOR - The horizontal oscillator is an extremely stable Hartley oscillator operating at the scanning frequency 15,750 cps. The primary of the syncroblock transformer (terminals A, B and C) is the oscillator coil. This coil is closely coupled to the secondary winding (terminals D, E and F) and thus feeds a sine wave voltage to V2

HORIZONTAL SYNC DISCRIMINATOR - The sync discriminator if a 6AL5 dual diode in a circuit which produced a d-c output voltage proportional to the phase displacement between two input voltages.

The sine wave oscillator voltages applied to the plates of 6AL5 are equal in amplitude and opposite in phase. The synchronizing pulses from the second sync amplifier are fed through a differentiating network to attenuate the vertical sync and then applied to the center tap of syncrolock transformer. The horizontal sync pulses thus appear in phase and of equal amplitude on the diode plates as shown in Figure When the pulse and sine wave are properly phased as in (A), both diodes will produce equal voltage across their load resistances. However, these voltages are of opposing polarity and therefore the sum of the voltages across these two load resistors will be zero. If the phase of the pulse changes with respect to the sine wave as in (B), the top diode will produce more voltage across R337 than the bottom diode produces across R338 . Thus, the voltage across the two will be positive through zero to negative dependent upon the phase relation of the synchronizing signal and the oscillator. This d-c output is applied to the grid of 6AC7.

HORIZONTAL OSCILLATOR CONTROL - The oscillator control is a 6AC7 connected as a reactance tube across the 6K6 oscillator coil. A change in the d-c output of the discriminator produces a change in Gm of 6AC7 which in turn changes the frequency of the oscillator. If the phase of the oscillator shifts with respect to the synchronizing pulse the corresponding change in d-c from the discriminator brings the oscillator back into correct phase. C325 and C324 form a voltage divider to attenuate rapid changes in d-c from the sync discriminator such as are produced by vertical sync or bursts of noise.

Sync Link - If any phase modulation is present in the transmitted sync, a condition which unfortunately still exists in some transmitter to date, a faster response to fluctuations in the sync phase is needed than is provided by the ratio of C325 to C324

The sync discriminator will demodulate sync phase variation quite faithfully, however, the filter resistor R349 together with the capacity attenuator C325 and C324 is just as effective in removing this information as it is with respect to the noise disturbance for which it is intended. The removal of this information will produce a horizontal displacement of portions of the picture.

HORIZONTAL DISCHARGE, OUTPUT AND REACTION SCANNING - The purpose of these circuits is to produce a sawtooth of current in the deflection coils to provide horizontal scanning for the Kinescope.

Horizontal Discharge — One-half of a 6SN7GT is employed for the discharge tube V25B. The function of this stage is to produce a sawtooth voltage for use in the horizontal sweep circuits.

The oscillation in 6K6GT takes place between screen-grid and cathode. Since the peak to peak voltage on its grid is approximately 130 volts, a square wave is produced on its plate. This wave is differentiated by C327 and R359 , and the pulse so obtained is applied to the grid of the discharge tube 6SN7.

ALIGNMENT PROCEDURE

TEST EQUIPMENT

To properly service the television chassis of this receiver, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:

(a) Frequency Ranges
18 to 30 mc., 1 mc. sweep width
40 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

CATHODE-RAY OSCILLOSCOPE, preferably one with a wide band vertical deflection, an input calibrating source, and a low capacity probe.

SIGNAL GENERATOR to provide the following frequencies.

(a) I - F frequencies

19.75 mc. adjacent channel picture trap
21.25 mc. sound i-f sound traps
21.8 mc. converter transformer
22.3 mc. second picture i-f transformer
23.4 mc. fourth picture i-f coil
25.2 mc. third picture i-f coil
25.3 mc. first picture i-f transformer
25.75 mc. picture carrier
27.25 mc. adjacent channel sound trap

(b) R-F frequencies

CHANNEL NUMBER	PICTURE CARRIER Freq. Mc.	SOUND CARRIER FREQ. MC.
1	45.25	49.75
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output on these ranges should be adjustable and at least .1 volt maximum.

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 10 kv.

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SERVICE PRECAUTIONS

If necessary to remove the chassis from cabinet, the kinescope must first be removed. See Fig. and . If possible, the chassis should then be serviced without the kinescope. However, if it is necessary to view the raster during servicing, the kinescope should be inserted only after the chassis is turned on end. The kinescope should never be allowed to support its weight by resting in the deflecting yoke. A bracket should be used to support the tube at its viewing screen.

By turning the chassis on end with the power transformer down, all adjustments will be made conveniently available. Since this is the only safe position in which the chassis will rest and still leave all adjustments accessible, the trimmer location drawings are oriented similarly for ease of use.

CAUTION

Do not short the kinescope second anode lead. Its short circuit current is approximately 3 ma. This represents approximately 9 watts dissapation and a considerable overload on the high voltage filter resistor R235

Adjustments Required - Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require re-adjustment.

Due to the high frequencies at which the receiver operates the r-f oscillator line adjustment is critical and may be affected by a tube change. The line can be adjusted to proper frequency on channel 13 with practically any 6J6 tube in the oscillator socket. However, it may not then be possible to adjust the line to frequency on all of channels 7, 8, 9, 10, 11 and 12. To be satisfactory as an oscillator tube, it should be possible to adjust the line to proper frequency with the fine tuning control in the middle third of its range. It may therefore be necessary to select a tube for the oscillator socket. In replacing, if the old tube can be matched for frequency by trying several new ones, this practice is recommended. At best, however, it will probably be necessary to completely realign the oscillator when changing the tube.

Tubes which cannot be used as oscillator will work satisfactorily as r-f amplifier or convertor.

ORDER OF ALIGNMENT

When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

- Sound discriminator
- Sound i-f transformers
- Picture i-f traps
- Picture i-f trnasformers
- R-F and converter lines
- R-F oscillator line
- Retouch picture i-f transformers
- Antenna trap adjustment
- Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT

Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the third sound i-f grid.

Detune T113 secondary (bottom)

Set the "VoltOhmyst" on the 10 volt scale.

Connect the meter in series with a one megohm resistor to the junction of diode resistors R219 and R220. Do not remove the discriminator shield to make connection to R219 and R220.

Connection can be easily made by fashioning a hook on the 1 meg resistor lead and making connection to the transformer lug "C". through the hole provided for the adjusting tool.

Adjust the primary of T113 (top) for maximum output on the motor.

Connect the "VoltOhmyst" to the junction of R236 and C205.

Adjust T113 secondary (bottom).

It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the third sound i-f amplifier.

ALIGNMENT PROCEDURE - Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of R236 and C205. The pattern obtained should be similar to that shown in Figure 11 If it is not, adjust the T113 (top) until the wave form is symmetrical.

The peak to peak bandwidth of the discriminator should be approximately 350 kc. and it should be linear from 21.75 mc. to 21.325 mc.

SOUND I-F ALIGNMENT - Connect the sweep oscillator to the second sound i-f amplifier grid.

Connect the oscilloscope to the third sound i-f grid return (terminal A T112) in series with a 33,000 ohm isolating resistor. Insert a 21.25 mc. marker signal from the signal generator into the second sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the third sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitted slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

Connect the sweep and signal generator to the top end of the trap winding of T2 (on top of the chassis). Adjust T111 (top and bottom), for maximum gain and symmetry at 21.25 mc.

Reduce the sweep output for the final adjustments so that approximately .3 volt peak-to-peak is present at the third sound i-f grid return.

The band width at 70 % response from the first sound i-f grid to the third i-f grid should be approximately 200 kc.

PICTURE I-F TRAP ADJUSTMENT - Turn the receiver picture control for .3 volts on the picture i-f grids.

Set the channel switch to channel 13.

Connect the "VoltOhmyst" across the picture second detector load resistor R137.

Connect the output of the signal generator to the junction of C14 and R6. This connection is available on a terminal lug through a hole in the side apron of the chassis, beside the r-f unit. This hole is normally down when the chassis is in the recommended position. Connection can be easily made, however, by allowing the receiver to hang over the edge of the test bench by a few inches.

Set the generator to each of the following frequencies and tune the specified adjustment for minimum indication on the "VoltOhmyst". In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency

21.25 mc. - T2 (top)
21.25 mc. - T105 (top)
27.25 mc. - T103 (top)
19.75 mc. - T104 (top)

PICTURE I-F TRANSFORMER ADJUSTMENTS - Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst".

21.8 mc. - T2 (bottom)
25.3 mc. - T103 (bottom)
22.3 mc. - T104 (bottom)
25.2 mc. - L183 (top of chassis)
23.4 mc. - L185 (top of chassis)

If T104 (bottom) required adjustment, it will be necessary to reset T104 (top) for minimum response at 19.75 mc.

PICTURE I-F OSCILLATION - If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage in excess of 3 volts at the picture detector lead resistor. This voltage is unaffected by r-f signal input and sometimes is independent of picture control setting. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the transformers approximately to frequency by setting the adjustment stud extensions of T2, T103, T104, T105, L183, and L185 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may now be possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1000 mmf. capacitors. Connect the signal generator to the fourth pix i-f grid and align L185 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is very stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

R-F AND CONVERTER LINE ADJUSTMENT - Connect the r-f sweep oscillator to the receiver antenna terminals. If the sweep oscillator has a 50 ohm single-ended output, it will be necessary to obtain balanced output by connecting as shown in Figure 12.

Connect the oscilloscope to the junction of C14 and R6 (in the r-f tuning unit) through a 10,000 ohm resistor.

By-pass the first picture i-f grid to ground through a 1000 mmfd. capacitor. Keep the leads to this by-pass as short as possible. If this is not done, lead resonance may fall in the r-f range and cause an incorrect picture of the r-f response.

Turn the picture control for -1.5 volts on the r-f grids. Connect the signal generator loosely to the receiver antenna terminals.

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Turn the antenna trap L81 and L82 cores fully counterclockwise so that the trap will not affect the channel 6 r-f response. Since channel 7 has the norrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7 (see Figure 11 for switch shaft flat location versus channel).

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier 175.25 mc. and 179.75 mc.

Adjust L25, L26, L51 and L52 (see Figure 11) for an approximately flat topped response curve located symmetrically between the markers. Normally this curve appears somewhat overcoupled or double humped with a 10 or 15% peak to valley excursion and the markers occur at approximately 90% response. See Figure , channel 7. In making these adjustments, the stud extension of all cores should be kept approximately equal.

Check the response of channels 8 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observe the response obtained. See Figure 11 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 70% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L25, L26, L51 and L52, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally however, no difficulty of this type should be experienced since the higher frequency channels become comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L11, L12, L37 and L38, for an approximately flat-topped response curve located symmetrically between the markers.

Check channels 5 down through channel 1 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 70% response point. If this is not the case, L11, L12, L37 and L38 should be retouched. On final adjustment, all channels must be within the 70% specification.

Coupling between r-f and converter lines is augmented by a link between L12 and L37. This link is adjusted in the factory and should not require adjustment in the field. On channel 6 with the link in the minimum coupling position, the response is slightly overcoupled with approximately a 10% excursion from peak-to-valley. With the coupling at maximum, the response is somewhat broader and the peak-to-valley excursion is approximately 40%. The amount of coupling permissable is limited by the peak-to-valley excursion which should not be greater than 30% on any channel.

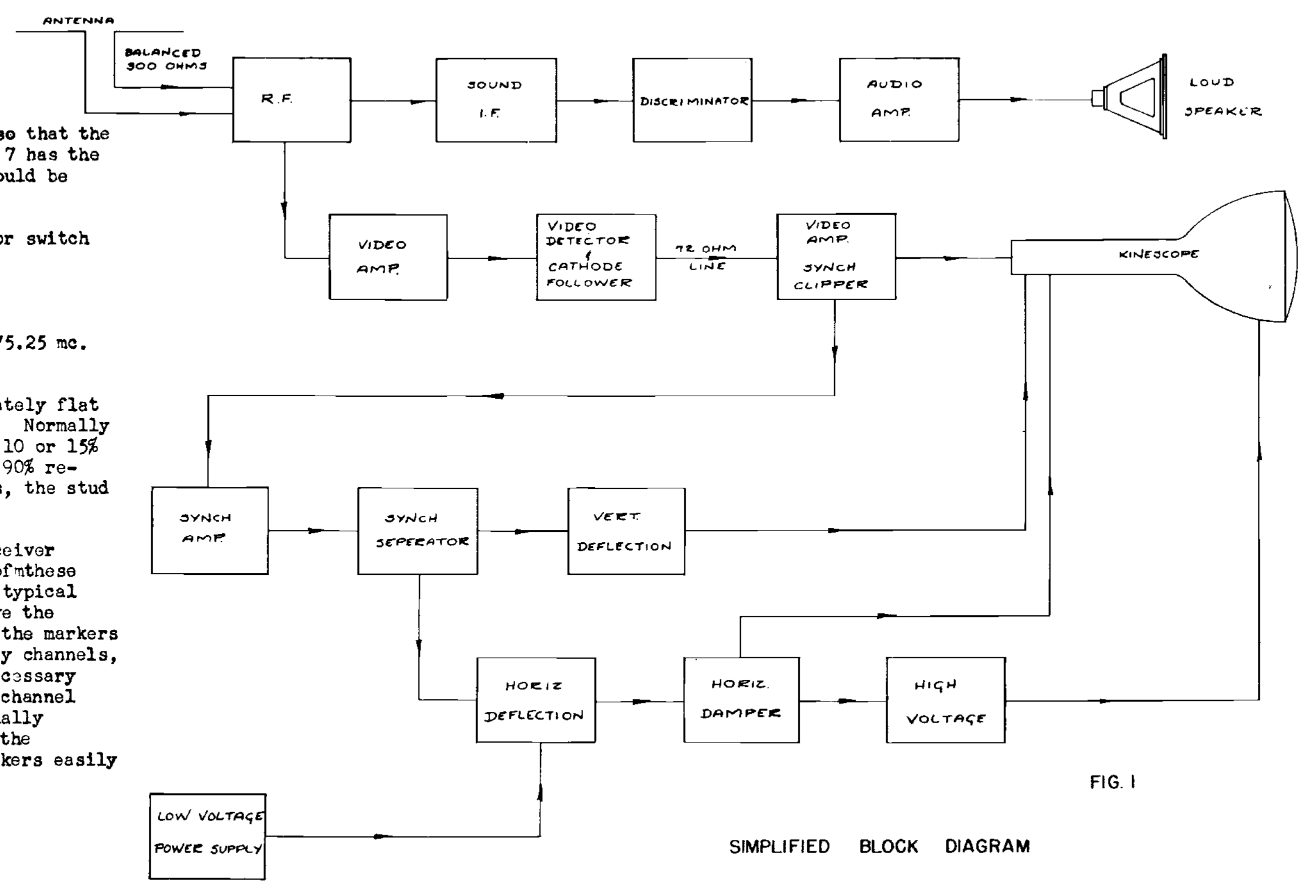

FIG. I

SIMPLIFIED BLOCK DIAGRAM

R-F OSCILLATOR LINE ADJUSTMENT - The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F osc. Freq. must be available.

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Connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

Since lower frequencies are obtained by adding steps of inductanc, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust L77 and L78 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. The core stud extensions should be maintained equal by visual inspection.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L76 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the specified indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and re-check to make sure that all adjustments are correct.

RETOUCHING OF PICTURE I-F ADJUSTMENTS - The picture i-f response curve varies somewhat with change of bias and for this reason it should be aligned with approximately the same signal input as it will receive in operation. If the receiver is located at the edge of the service area, it should be aligned with approximately -1 volt i-f grid bias. However, for normal conditions, (signals of 1000 microvolts or greater), it is recommended that the picture i-f be aligned with a grid bias of -3 volts.

Connect the r-f sweep generator to the receiver antenna terminals.

Connect the signal generator to the antenna terminals and feed in the 25.75 mc i-f picture carrier marker and a 22.3 mc. marker.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under sound carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.
1	71	49.75
2	81	59.75
3	87	65.75
4	93	71.75
5	103	81.75
6	109	87.75
7	201	179.75
8	207	185.75
9	213	191.75
10	219	197.75
11	225	203.75
12	231	209.75
13	237	215.75

If the heterodyne frequency meter method if used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of R236 and C205.

Connect the oscilloscope across the picture detector load resistor.

Turn the picture control for -3 volts at its arm.

Set the sweep output to produce approximately .3 volt peak-to-peak across the picture detector load resistor.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure

If T104 (bottom) required any adjustment, it will be necessary to reset T104 (top) for minimum response at 19.75 mc.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped and with the 22.3 mc. marker at approximately 100% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture definition is impaired by loss of high frequency video response. In making these adjustments, care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

ANTENNA TRAP ALIGNMENT - When the receiver is aligned in the shop, the antenna trap should be adjusted to reject the type of interference which might be encountered at the customer's home. It can be adjusted by actual observation of the interference on the air or by the use of a signal generator. Two methods of adjustment are possible if a signal generator is employed. Select the type of interference and method to suit the test equipment involved.

Method 1 for channel 6-10 interference. Set the "VoltOhmyst" on the 3 volt scale and connect it to the junction of L188 and R137. Turn the picture control to the maximum clockwise position. Connect the signal generator to the antenna terminals through balancing network as shown in Figure 12 . Tune the receiver oscillator to 109 mc. with the fine tuning control as determined by the method employed in the previous section on r-f oscillator line adjustment. Feed in the channel 10 picture carrier (193.25 mc.) from the signal generator. Adjust L81 and L82 for minimum reading on the "VoltOhmyst", keeping both cores about the same. For final touches, adjust L81 one-half turn clockwise and readjust L82 for minimum on the meter. If this minimum is lower than the previous, repeat until the lowest minimum is obtained. If this minimum was higher, adjust L81 one-half turn cc counterclockwise and readjust L82. Repeat for the lowest minimum.

Method 2 for channel 6-10 interference. With the same setup as above, switch the receiver to channel 3 and tune the receiver oscillator to 87 mc. Feed in a signal of 109 mc. from the signal generator and adjust the trap as above.

Method 1 for channel 5-7 interference. With the same setup as above switch the receiver to channel 5 and tune the receiver oscillator to 103 mc. Feed in the picture 7 sound carrier (179.75 mc.) from the signal generator and adjust the trap as above.

Method 2 for channel 5-7 interference. With the same setup as above, switch the receiver to channel 2 and tune the receiver oscillator to 81 mc. Feed in a 103 mc. signal from the generator and adjust the trap as above.

Method for FM image interference. With the same setup as above, switch the receiver to channel 2 and tune the receiver oscillator to 81 mc. Feed in a signal of the frequency of the interfering FM station and adjust the trap as before.

To adjust the trap by observation of the picture under actual operating conditions, connect an antenna to the receiver and tune in the station on which the interference is observed. Adjust the trap as above for minimum interference in the picture. Since the customer's antenna will affect these adjustments slightly, in cases of severe interference it may be necessary to retouch the trap adjustment when the receiver is installed in the customer's home.

SENSITIVITY CHECK - A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in Figure 12 The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

RESPONSE CURVES - The response curves shown on page and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, some variations can be expected. Channel 2 response (not shown) is similar to that of channel 3.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE - Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

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ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED.

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST
	DISCRIMINATOR AND SOUND I-F ALIGNMENT							
1	3rd sound i-f grid (pin 1, V106)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R219 & R220		Detune T113 (bottom). Adjust T113 (top) for max. on meter
2	"	"	"		"	Junct of R236 & C205	Meter on 3 volt scale	T113 (bottom) for zero on meter
3	"	"	3rd sound i-f grid (pin 1, V106)	21.25 center 1 mc. wide .1 v. out	Junction of R236 & C205	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal	
4	2nd sound i-f grid (pin 1, V105)	21.25 reduced output	2nd sound i-f grid	21.25 reduced output	Terminal A, T112 in series with 33,000 ohms	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bottom) for max. gain and symmetry at 21.25 mc.
5	Trap winding on T2 (top of chassis)	21.25 reduced output	Trap winding on T2	21.25 reduced output	"	"	"	T111 (top & bottom) for max. gain and symmetry at 21.25 mc.
	PICTURE I-F AND TRAP ADJUSTMENT							
6	Not used		Not used		Not used	Junction of R189 & R190		Picture control for -3 volts on meter
7	Junction C14 and R6	21.25	"		"	Junction of L188 & R137	Meter on 3 volt scale. Receiver on channel 13	T105 (top) for min.
8	"	21.25	"		"	"	"	T2 (top) for min.
9	"	27.25	"		"	"	"	T103 (top) for min.
10	"	19.75	"		"	"	"	T104 (top) for min. on meter
11	"	21.8	"		"	"	"	T2 (bottom) for max.
12	"	25.3	"		"	"	"	T103 (bottom) for max.
13	"	22.3	"		"	"	"	T104 (bottom) for max.
14	"	25.2	"		"	"	"	L183 (top chassis) for max.
15	"	23.4	"		"	"	"	L185 (top chassis) for max.
16	If T104 (bottom) required adjustment in step 13, repeat step 10.							
	R-F AND CONVERTER LINE ALIGNMENT							
17	Not used		Not used		Not used	Pin 5 or 8 V108		Picture control for -1.5 volts on meter
18	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Junction C14 and R6 through 10,000 ohm series resistor	Not used	1st i-f grid bypass to gnd. with 1000 mmf. Receiver on channel 7	L25, L28, L51 & L52 for approx. flat top response between markers. Markers above 70%
19	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	Check to see that response is as above
20	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"
21	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"
22	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"
23	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"
24	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"
25	If the response on any channel (steps 18 through 24) is below 70% at either marker, switch to that channel and adjust L25, L28, L51, & L52 to pull response up on that channel. Then recheck steps 18 through 24.							

ALIGNMENT TABLE

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST
	R-F AND CONVERTER LINE ALIGNMENT (Cont'd)							
26	Antenna terminal (loosely)	83.25 87.75	Antenna terminals (see text for precaution)	Sweeping channel 6	Junction L80 and R6 through 10,000 ohm series resistor	Not used	Receiver on channel 6	L11, L12, L37 & L38 for response as above
27	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above
28	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"
29	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"
30	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"
31	"	45.25 49.75	"	channel 1	"	"	Receiver on channel 1	"
32	If the response on any channel (steps 27 through 31) is below 70% at either marker, switch to that channel and adjust L11, L12, L37 & L38 to pull response up on that channel. Then recheck steps 26 through 31.							

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST
33	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of R236 & C205 for sig. gen. method only	Fine tuning centered for all adjustments Receiver on channel 13	L77 & L78 for zero on meter or beat on het. freq. meter
34	"	209.75	"	231	"	"	Receiver on channel 12	L76 as above
35	"	203.75	"	225	"	"	Receiver on channel 11	L74 as above
36	"	197.75	"	219	"	"	Receiver on channel 10	L72 as above
37	"	191.75	"	213	"	"	Receiver on channel 9	L70 as above
38	"	185.75	"	207	"	"	Receiver on channel 8	L68 as above
39	"	179.75	"	201	"	"	Receiver on channel 7	L66 as above
40	"	87.75	"	109	"	"	Receiver on channel 6	L63 & L64 as above
41	"	81.75	"	103	"	"	Receiver on channel 5	L62 as above
42	"	71.75	"	93	"	"	Receiver on channel 4	L60 as above
43	"	65.75	"	87	"	"	Receiver on channel 3	L58 as above
44	"	59.75	"	81	"	"	Receiver on channel 2	L56 as above
45	"	49.75	"	71	"	"	Receiver on channel 1	L54 as above
46	Repeat steps 33 through 45 as a check.							
	CONVERTER GRID TRAP ADJUSTMENT							
47	Antenna terminal (loosely)	Sound and Pix Carrier of Selected Channel	Not used		Junction L80 and R6 (in r-f unit)	Not used	Connect sweep to ant. terms. 1st pix i-f grid bypassed to gnd. with 1000 mmf.	Switch through channels 1 through 6. Select channel with flat response and markers above 80%
48	"	"	"		"	"	Move 1000 mmf bypass from 1st pix i-f grid to 2 i-f grid	Adjust C14 for response curve similar to that obtained above
	RETOUCHING PICTURE I-F TRANSFORMERS							
49			Not used		Not used	Junction of R189 & R190	Receiver & sweep on same channel as above. Remove i-f grid bypass	Adjust picture control for -3 volts on meter
50	Antenna terminals (loosely)	22.3 25.75	"		Junction L188 and R137	Not used	Retouch pix i-f adjustments (T2, T103, T104 bottoms L183 & L185) as necessary to provide proper response	
51	If T104 (bottom) was adjusted in step 50, repeat step 2 and step 50.							
	SENSITIVITY CHECK							
52	Connect antenna to receiver through attenuator pad to provide weak signal. Compare picture and sound obtained to that obtained on other receivers under the same conditions.							

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SERVICE SUGGESTIONS

The following is a list of possible failures and an indication of some of the possible faults:

No Raster on Kinescope:

1. No high voltage. If horizontal deflection is operating as evidenced by correct wave form on terminal 4 of horizontal output transformer, the trouble can be isolated to the 1B3 multiplier circuit. Either the high voltage winding is open or one of the 1B3 tubes is defective, or one of the high voltage condensers is shorted.

2. V31 or V32 is inoperative. Check voltage and wave form on grids and plates.

3. Horizontal oscillator, type 6K6 (V27) is inoperative. Check for sine wave on 6K6 (V27) grid or pulse on 6SN7 (V25B) discharge plate and follow to the 6BG6 (V31,V32) grids. Refer to schematic and wave form chart.

4. Reaction scanning tubes 5V4G (V33) and 6AS7G (V34) are inoperative.

5. Defective kinescope.

6. No plate voltage; filter capacitor or choke shorted, negative bleeder open.

No Vertical Deflection:

1. 6SN7 (V29) vertical oscillator or 6V6 (V30) amplifier inoperative. Check voltage and wave forms on grids and plates.

2. Vertical blocking oscillator transformer (T302) or vertical output transformer (T303) open.

3. Vertical deflection coils open.

No Horizontal Deflection:

1. 6K6 (V27) horizontal oscillator, 6SN7 (V25B) discharge tube, 6BG6 (V31, V32) horizontal output tubes or 5V4 (V33) and 6AS7 (V34) reaction screening tubes inoperative. Check voltage and wave forms on grids and plates.

2. High voltage and horizontal output transformer open.

3. Horizontal deflection coil open.

Small Raster

1. Low B plus or low line voltage.

2. Weak tubes in deflection circuits.

Poor Vertical Linearity

1. If adjustment of controls cannot correct, change 6V6 (V30) vertical output amplifier.

2. Vertical output transformer defective.

3. 6SN7 (V29) vertical blocking oscillator inoperative. Check voltage and wave forms on grid and plate.

4. Low bias or plate voltage. Check rectifiers and capacitors in supply circuits.

5. C334, C335, C336 or R347 is defective.

Poor Horizontal Linearity

1. If adjustment of controls do not correct, change 6BG6's (V31, V32) in high voltage chassis or 5V4G (V33) and 6AS7G (V34) reaction scanning tubes.

2. High voltage output transformer defective.

3. Low bias or plate voltage. Check rectifiers and capacitors in supply circuits.

Wrinkles on Left Side of Raster

1. Defective yoke.

Picture Out of Phase Horizontally

1. If adjustments do not correct, synchrolock transformer (T304) is defective.

2. R349 , R350, C321, C322, C323 is defective.

Trapezoidal or Non-symmetrical Raster

1. Yoke is defective. Replace.

Raster and Signal on Kinescope but No Sound

1. RF Oscillator off frequency.

2. Sound IF discriminator or audio amplifier inoperative. Check V104, V105, V106, V107, V108, V109 and their socket voltages.
3. T114 or C209 defective.

4. Speaker defective.

Signal on Kinescope Grid but no Sync.

1. Picture control advances too far.

2. Sync amplifier tubes type 6SN7 (V23, V24, V25) inoperative. Check voltage and wave forms on grids and plates.

3. Sync clipper (V20) tube on low voltage and Video supply inoperative. Check voltage and wave form on grids and plates.

4. Defective inter-connecting cable.

Signal on Kinescope Grid but no Vertical Sync

1. Check 6SN7 (V24) on vertical and horizontal sweep chassis and associated circuit.

2. Intergrating network inoperative. Check C330, C331, C332, R331, R332, R333.

Signal on Kinescope Grid but not Horizontal Sync

1. Synchrolock transformer misadjusted. Readjust as instructed on page

2. 6K6 horizontal oscillator tube (V27) or 6AC7 (V28) reactance tube inoperative. Check socket voltages and wave forms.

3. Syncrolock transformer T304 defective.

4. C318, C325, C321, C322 defective.

5. V25A defective.

Sound and Raster but No Picture or Sync

1. Picture IF, detectors or video amplifiers inoperative. Check V107, V108, V109, V110, V111, V112, V17, V18. Check socket voltages.

2. Kinescope grid lead out of socket.

Picture Stable but Poor Resolution

1. 6AU6 (V17) first video amplifier, 6L6 (V18) second video amplifier, or 6J6 (V112) cathode follower are defective.

2. Peaking coils defective. Check for resistance.
3. C301, C306, C305, C309 defective.

4. Make sure that the focus control operates on both sides of proper focus.

5. RF and IF circuits misadjusted.

Picture Smears

1. Video amplifier overloaded by excess input. Reduce picture control setting.

2. Insufficient bias or video amplifier tube resulting in grid current on video signal.

3. Defective coupling condenser on grid load in video amplifier.

4. Cathode resistors R311 changed value. Check with Ohm meter.

5. This trouble can originate at the transmitter. Check another station.

Picture Jitters

1. Picture control operated at excessive level.

2. Vertical instability may be due to loose connections.

3. Check vertical circuits for possible open condensers.

4. Horizontal instability may be due to unstable transmitted sync. Check another station.

Raster but No Sound, Picture on Sync

1. Defective antenna or transmission lines.

2. RF oscillator or frequency.

3. RF unit inoperative. Check V1, V2, V3 and socket voltages.

Dark vertical line on Left of Picture

1. Reduce horizontal drive and readjust padding and horizontal linearity.

2. Replace 6BG6 (V31, V32) tubes.

Light Vertical Line on Left of Picture

1. Replace reaction scanning tubes, typ 5V4G (V33) and 6AS7G (V34).

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MODELS 13, 14

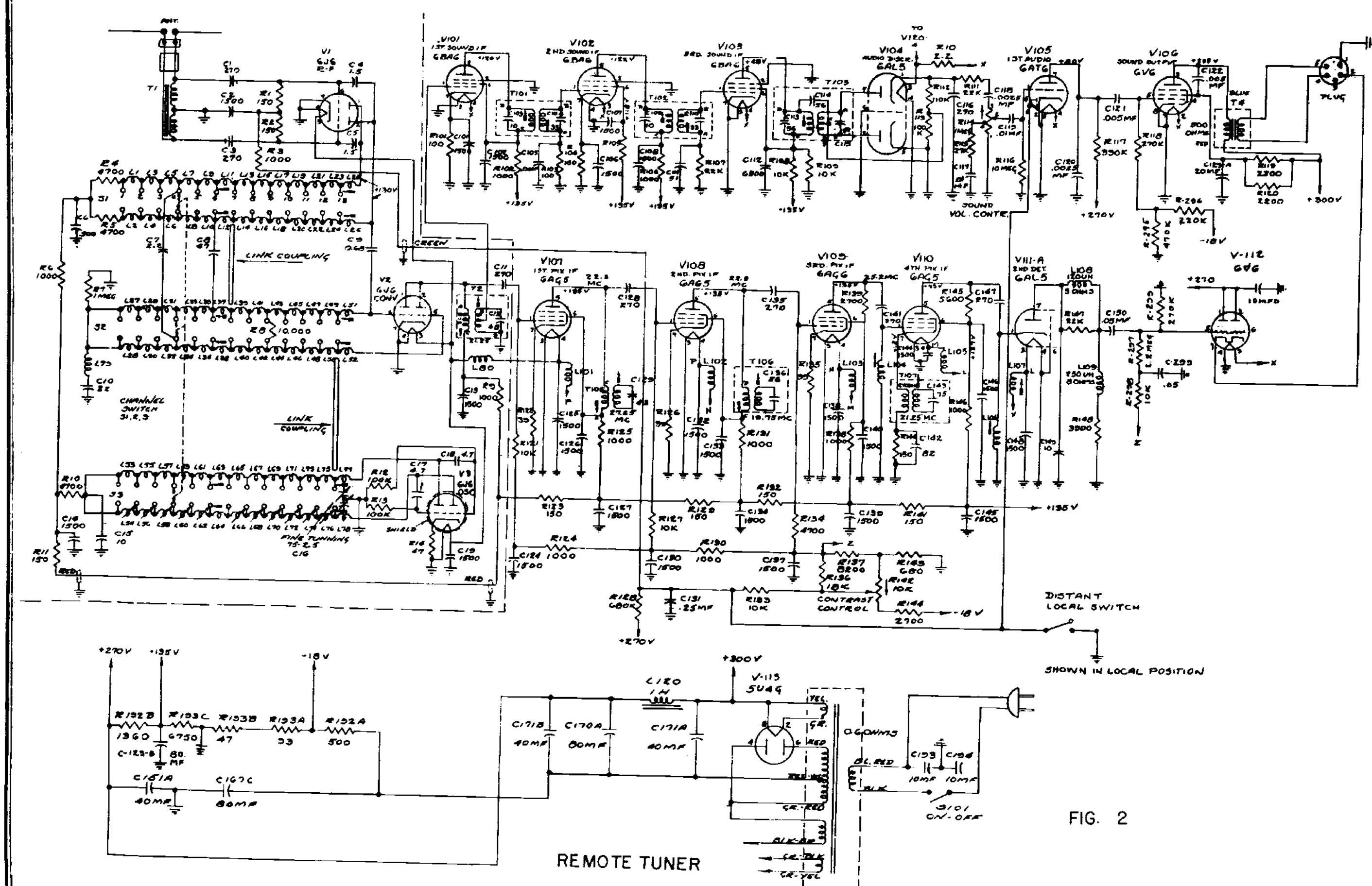
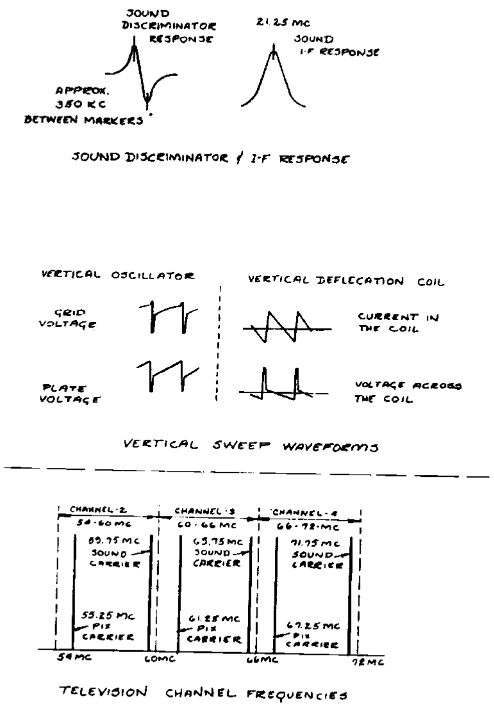
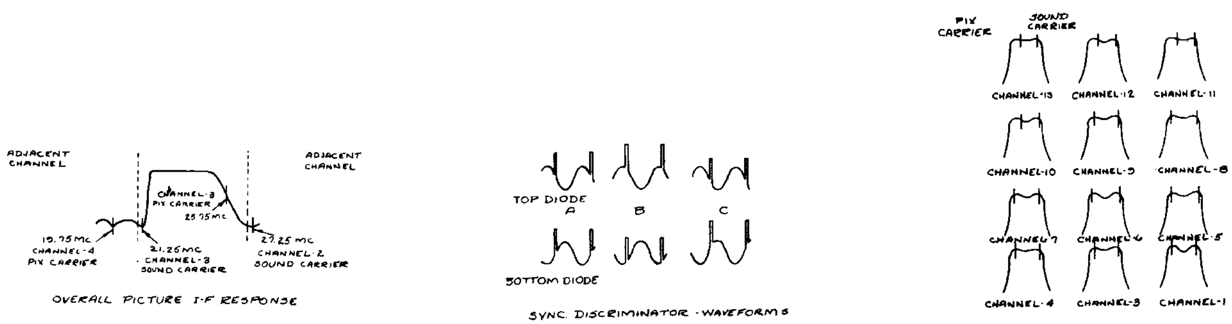
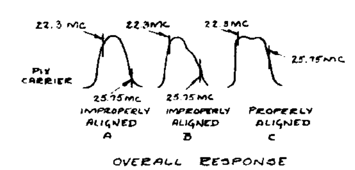


FIG. 2

WAVEFORMS







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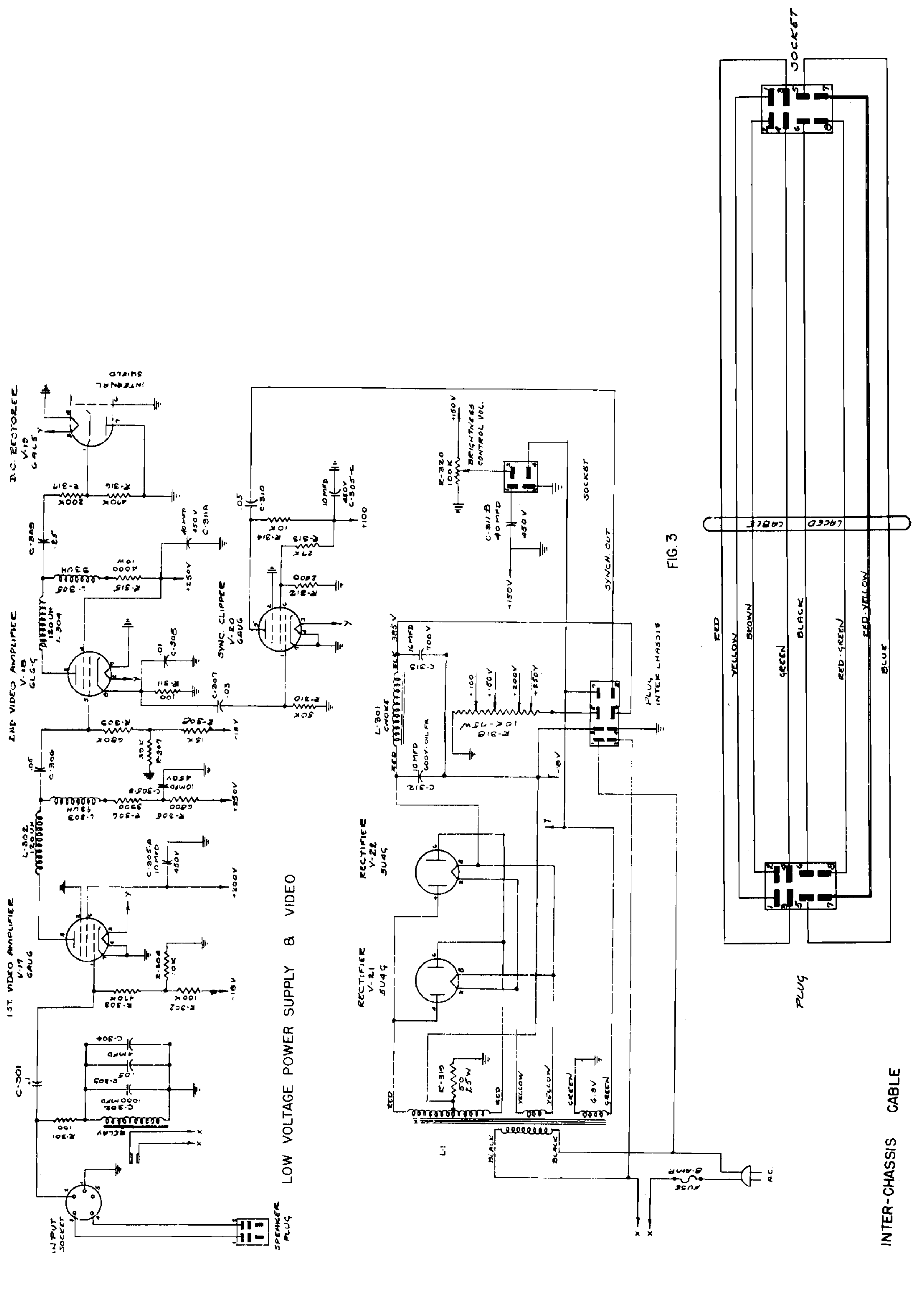

LOW VOLTAGE POWER SUPPLY & VIDEO

FIG. 3

INTER-CHASSIS CABLE

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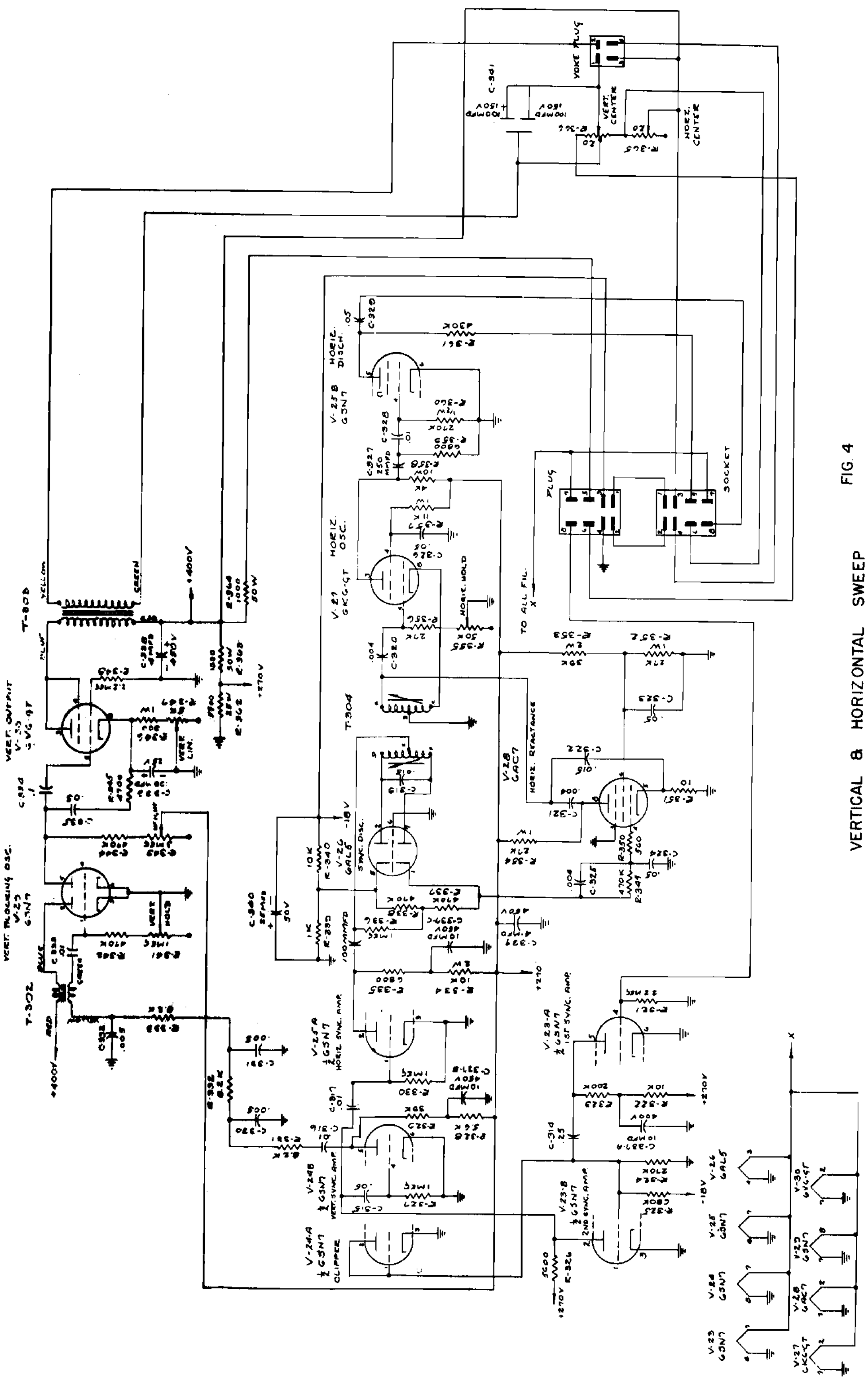

FIG. 4

VERTICAL & HORIZONTAL SWEEP

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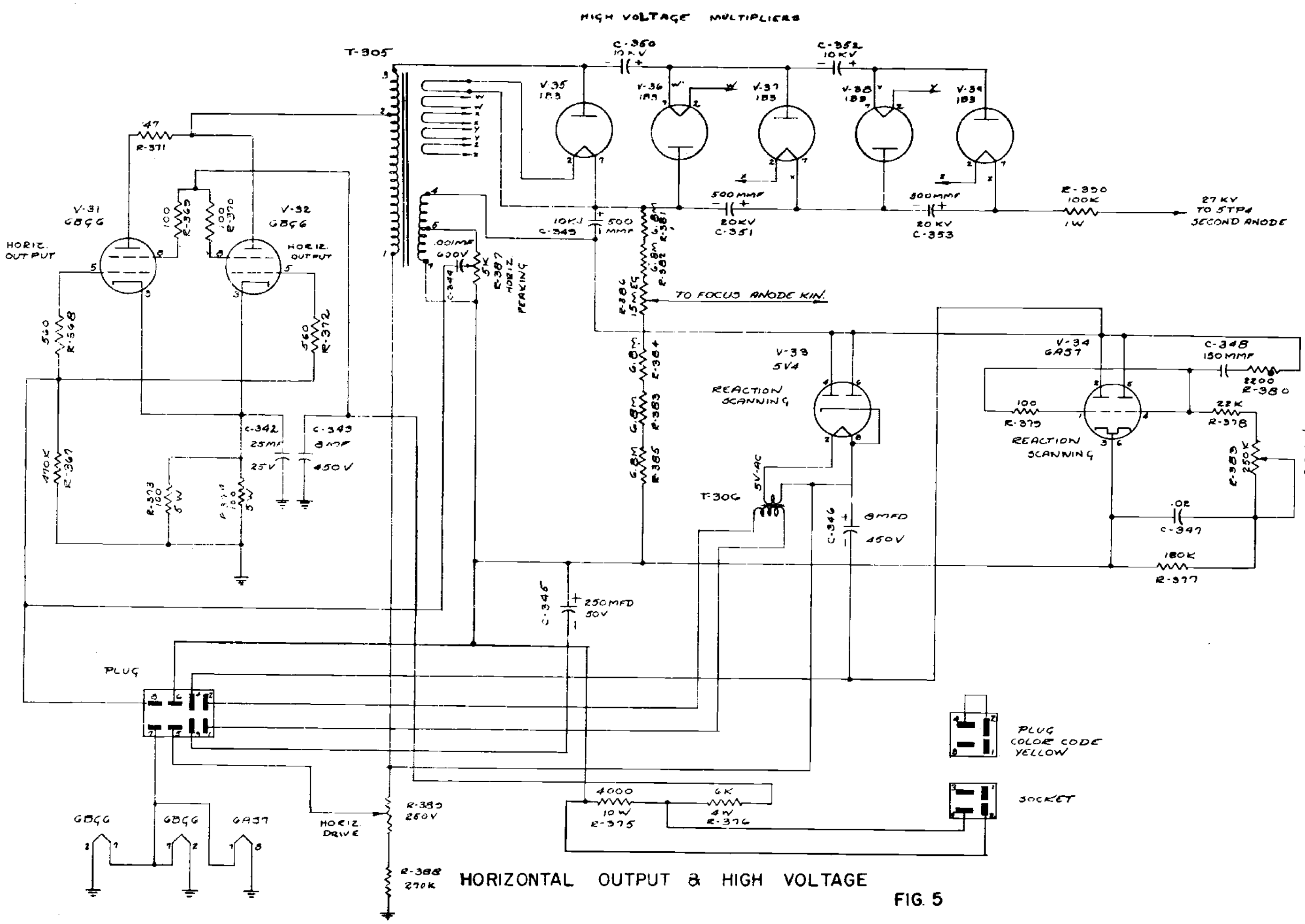

HORIZONTAL OUTPUT & HIGH VOLTAGE

FIG. 5

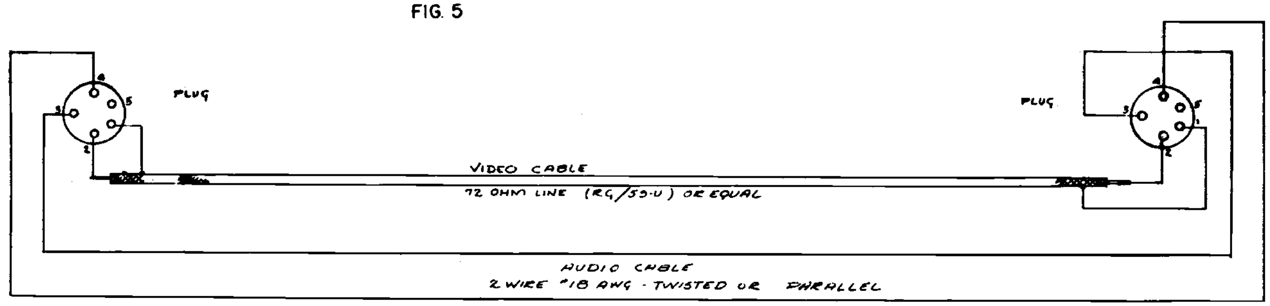

FIG. 16

REMOTE CONTROL CABLE

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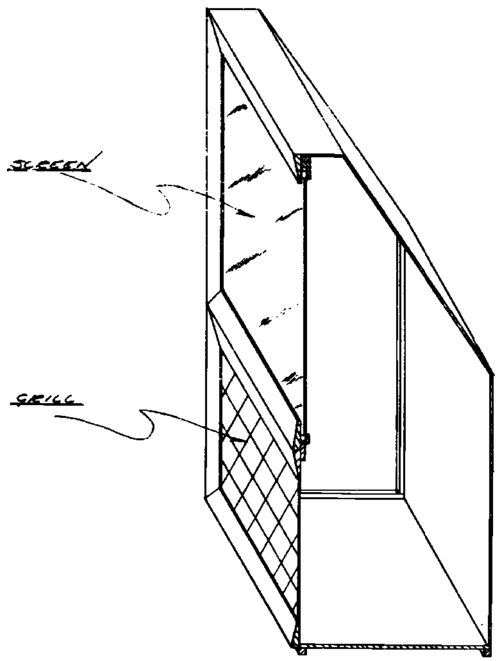
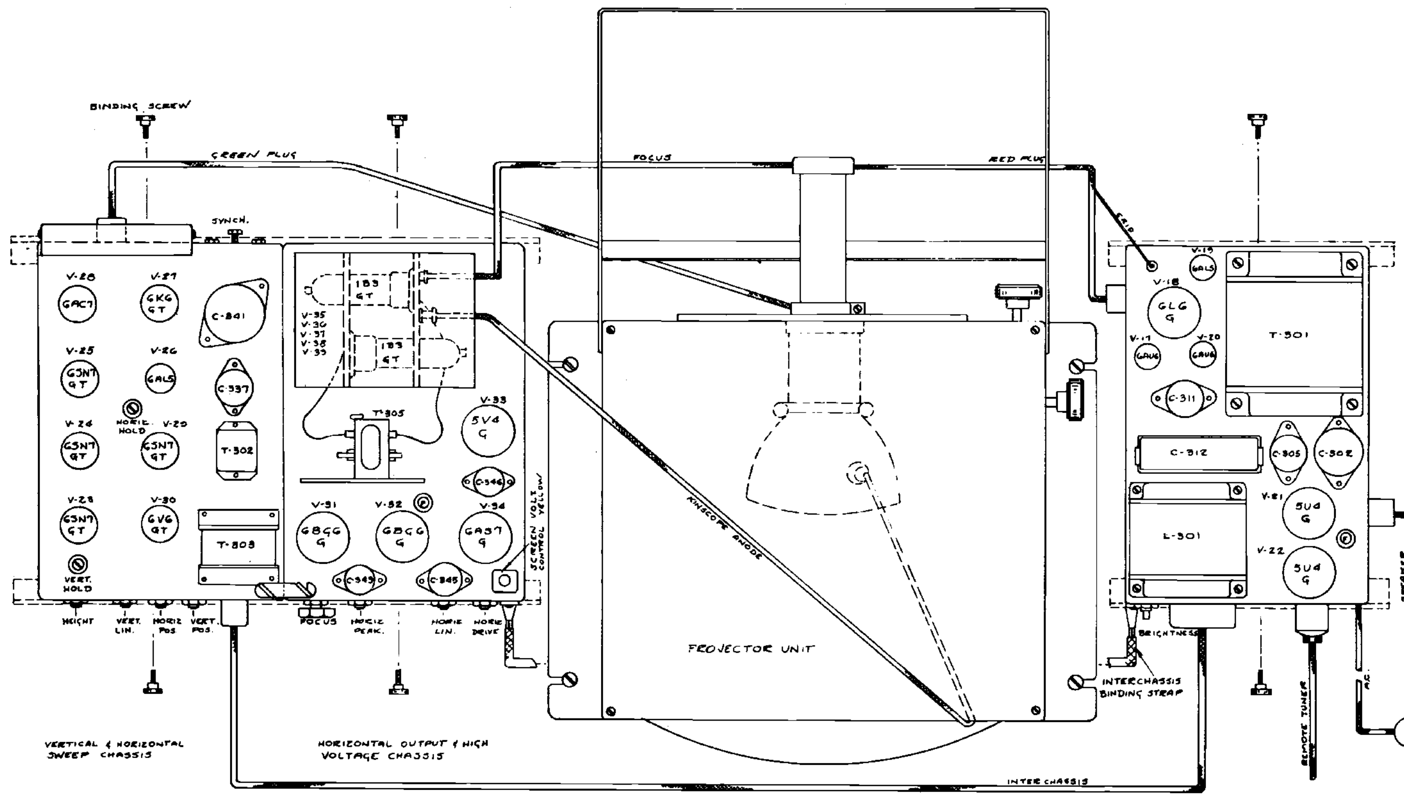
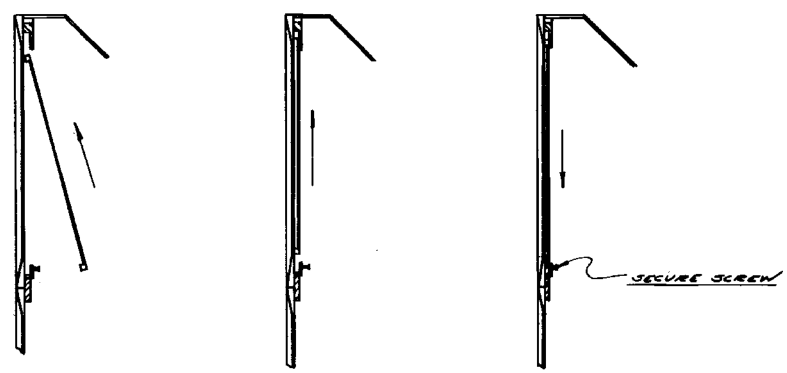




CHASSIS & PROJECTOR LOCATION

FIG. 6

— SEQUENCE OF OPERATIONS - SCREEN —



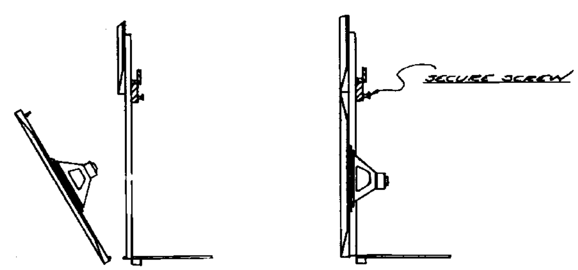
1ST OPERATION
SLIDE SCREEN THRU REAR OF CABINET TO TOP GUTTER.

2ND OPERATION
SLIDE SCREEN UP INTO GUTTER FLUSH WITH FACE OF CABINET.

3RD OPERATION
SLIDE SCREEN DOWN INTO LOWER GUTTER. CENTER SCREEN & SECURE INTO POSITION WITH SCREW.

CABINET OPERATION

— SEQUENCE OF OPERATION — FRONT GRILL —



1ST. OPERATION
PULL FORWARD & SLIDE OUT FROM DETACHABLE HINGE

2ND OPERATION
SLIDE TO HINGE, SNAP SHUT & SECURE WITH SCREW.

FIG. 7

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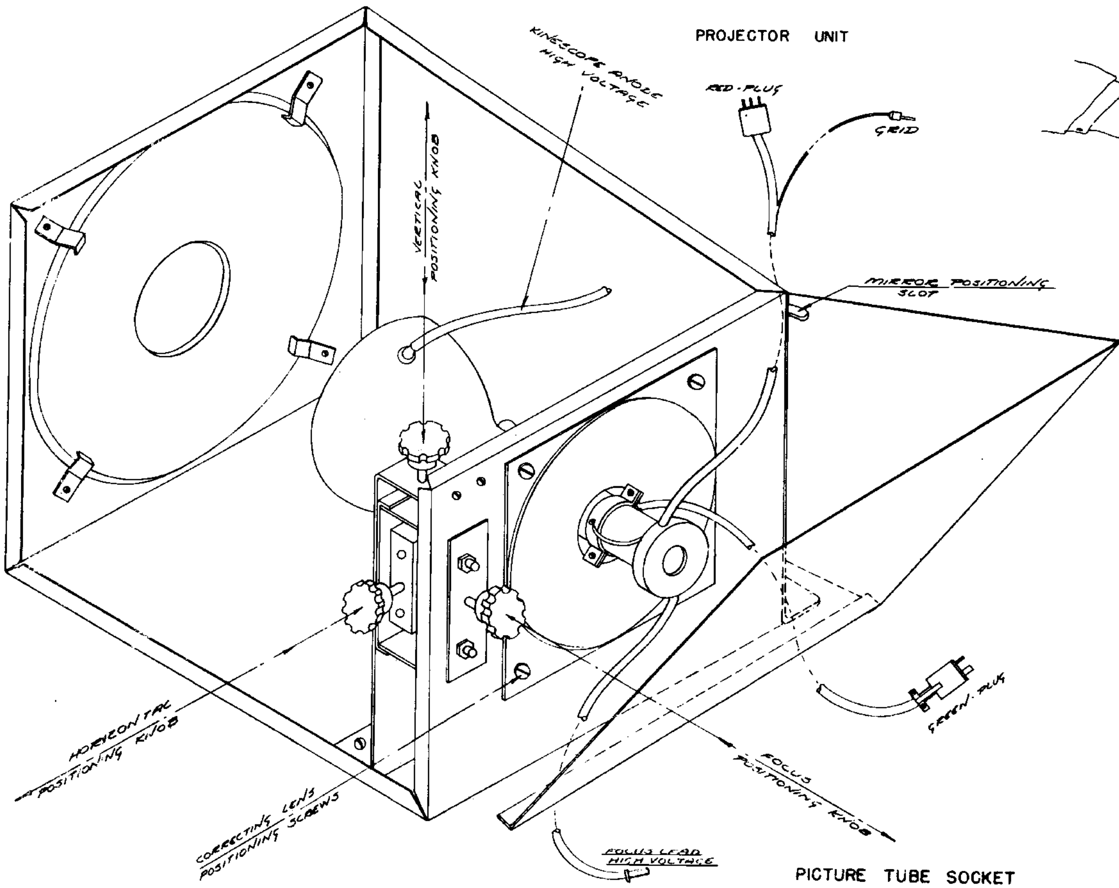
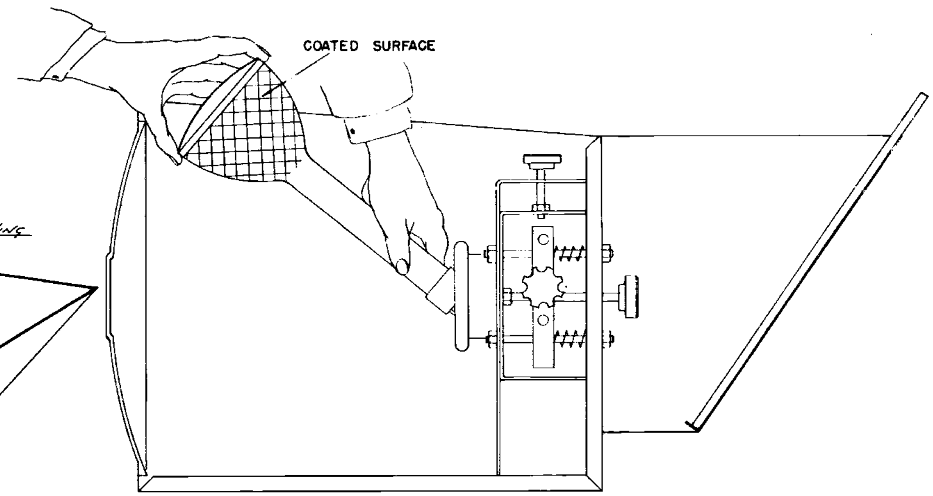
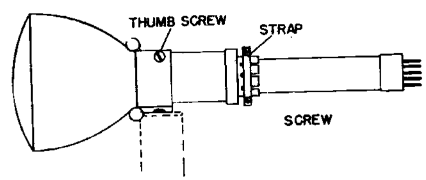
PROJECTOR UNIT





PROJECTOR - "A"

INSERTION OF PICTURE TUBE

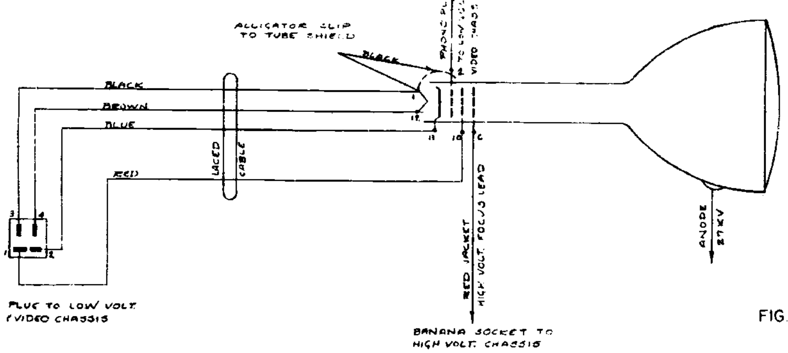


TUBE IN YOKE - 'B'

FIG. 10

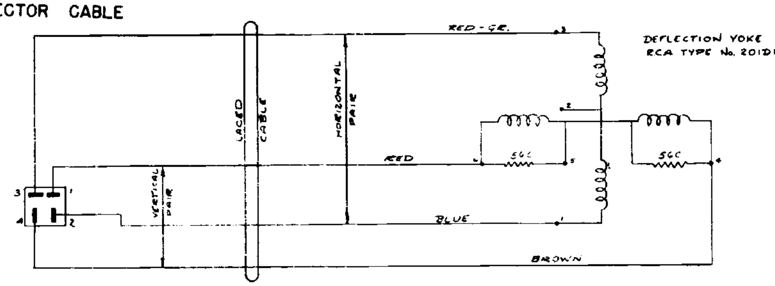
1. INSERT KINESCOPE IN PROJECTOR AS SHOWN IN "A", HOLDING NECK & FACE PLATE, BEING CAREFUL NOT TO HANDLE COATED SURFACE.
2. PLACE TUBE AS FAR INTO YOKE AS POSSIBLE, BEING SURE NECK OF TUBE IS SEATED FLUSH IN YOKE.
3. TIGHTEN NECK STRAP AS SHOWN IN "B".

PICTURE TUBE SOCKET & CONNECTOR CABLE



PLUG - CONNECTS TO SOCKET ON HIGH VOLT. CHASSIS - COLOR CODE GREEN.

FIG. 15



DEFLECTION YOKE CABLE

FIG. 9

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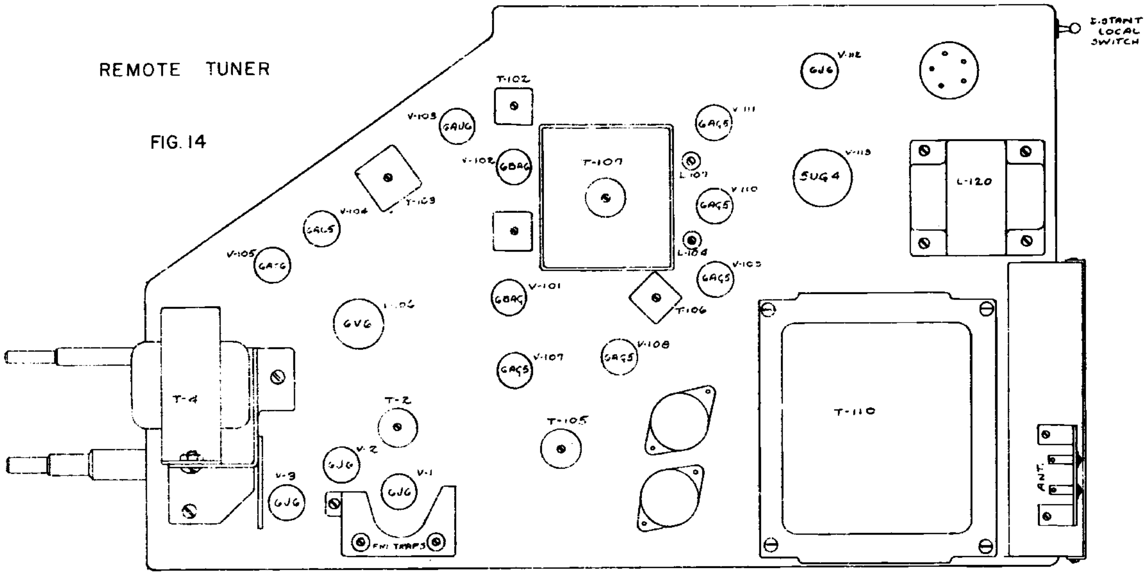
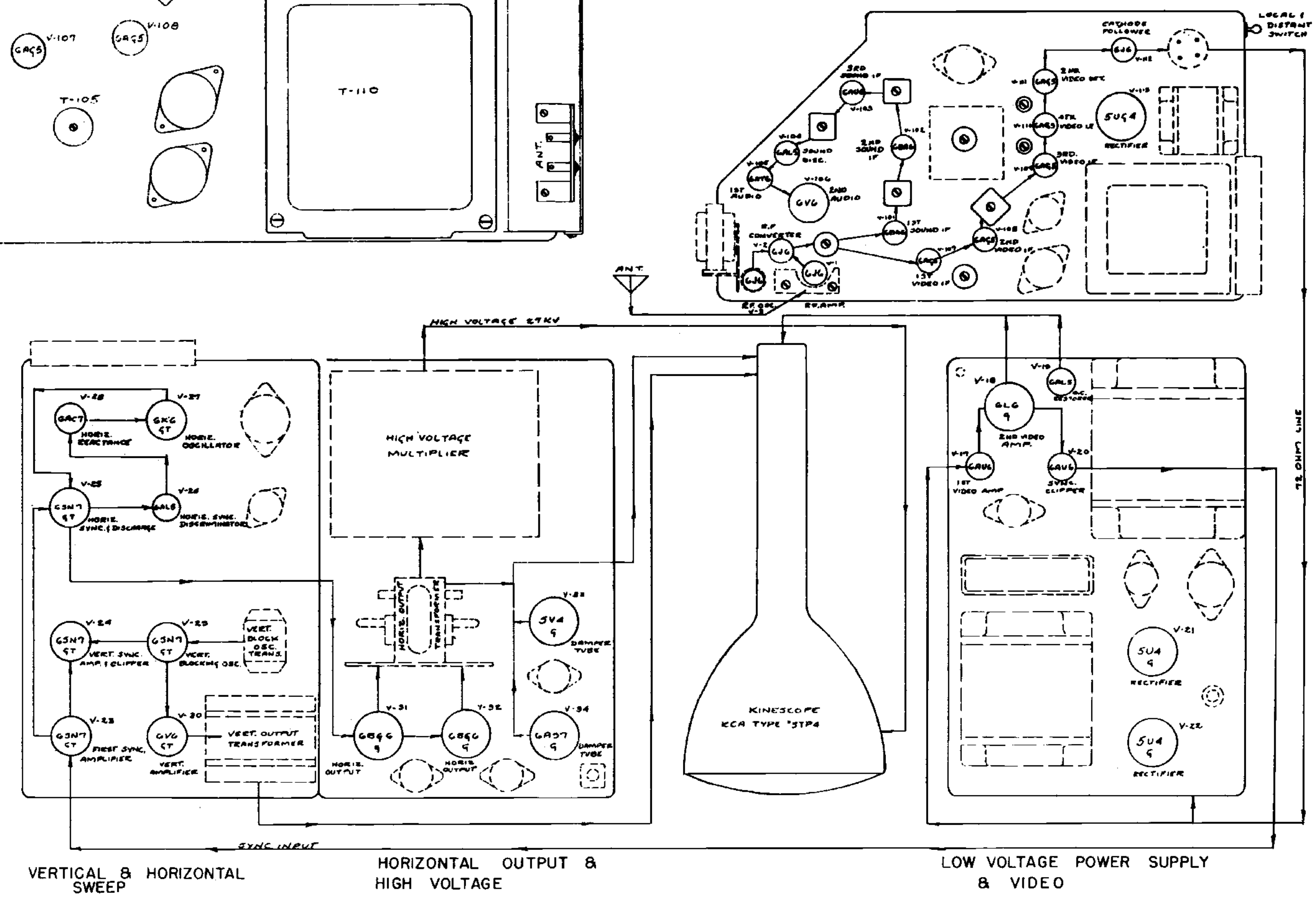
REMOTE TUNER

FIG. 14





FUNCTIONAL BLOCK DIAGRAM

FIG. 13

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