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Television

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Introduction

This manual of factory data on all popular 1948 television receivers will 1) introduce you to new television developments, 2) teach you how to adjust, test, and repair all types of modern television sets, and 3) give you specific instructions on alignment and repair to make you an expert in television work. The material presented here has been prepared by engineering staffs of the leading American television set manufacturers and has been selected to give a cross-section of useful and instructive information. Some of the sets listed in this manual under a given manufacturer have also been sold by other firms under their own name or trade mark. In some cases, the identical tuner has been used by several manufacturers in sets that do differ in other respects.

For fifteen years SUPREME PUBLICATIONS has served radio servicemen in issuing on-the-job type radio manuals at such low prices that these book-values are the talk and wonder of all thrifty radio technicians. This new television volume is a worthy addition and also represents remarkable value.

To the television set manufacturers whose products are described in these pages, we extend our sincere thanks and appreciation for their fine cooperation that made this manual possible.

M. N. Beitman

October 1, 1948
Chicago.

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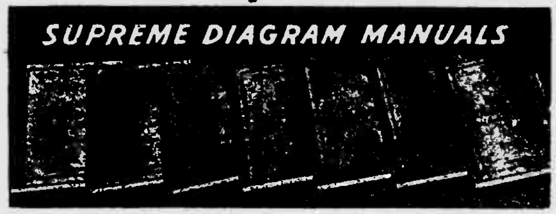

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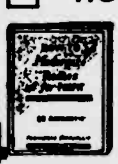

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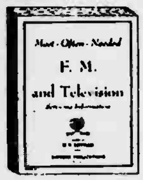

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MOST-OFTEN-NEEDED **1948 TELEVISION** RECEIVERS

Admiral Corporation 30A1 CHASSIS

SECTIONAL CIRCUIT FUNCTION

A sectional diagram of the five major sections in the Admiral television receiver circuit is shown in Figure 25. The RF section (Section 1) amplifies the Audio and Video carriers and converts them to their respective intermediate frequencies. The audio section (Section 2) consists of a conventional IF, FM ratio detector and audio amplifier circuit. The video section (Section 3) consists of a stagger-tuned broadband IF amplifier, video detector and video amplifier circuit. The sweep section (Section 4) contains the horizontal and vertical sweep generators and the sync circuits. The power supply section (Section 5) supplies the necessary voltages for operation of the various tubes and circuits

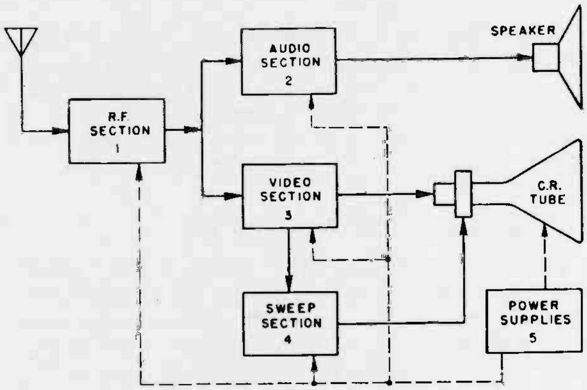


Fig. 25. Sectional Block Diagram

in the other sections of the receiver. A functional block diagram indicating the various stages in the first four sections is shown in Figure 26.

RF SECTION 1 (Figure 77)

RF Amplifier V101 (6J6). An FM interference trap is connected across the 300-ohms balanced input of the receiver. This trap consists of L184, L185, C121 and C122. The trap is adjustable throughout the frequency range from 93 to 109 MC.

A center-tapped choke (L127) and two coupling condensers (C104 and C106) form a high-pass filter for the input of the receiver. This is done to improve the rejection of low-frequency interference signals.

Two 150-ohm resistors (R103 and R104) are used in the grid return circuit of the push-pull RF amplifier. They also serve as a load to match the 300-ohm input circuit in order that standing waves will not appear on the transmission line. Contrast control bias is supplied to the common return of these resistors in order to control the gain of the stage. Neutralization, provided by condensers C102 and C103, is necessary since a triode tube is used as an RF amplifier.

The equivalent of a quarter-wave line, made up of inductances L101 to L126, is used to tune the plate circuits of the RF amplifier. Switch S101A is used to short out sections of the line in order to tune it to any one of the thirteen channels (the tuner is designed to cover thirteen separate channels as assigned by the FCC for television). Condensers C107, C108 and C109 provide capacitive coupling between the RF amplifier plate line and the tuned line in the converter grid circuit. Condenser C107 is connected between opposite sides of the two tuned lines in order to improve the symmetry of the circuit on the three lower channels. Inductive coupling link L183 provides additional coupling on the six lower channels.

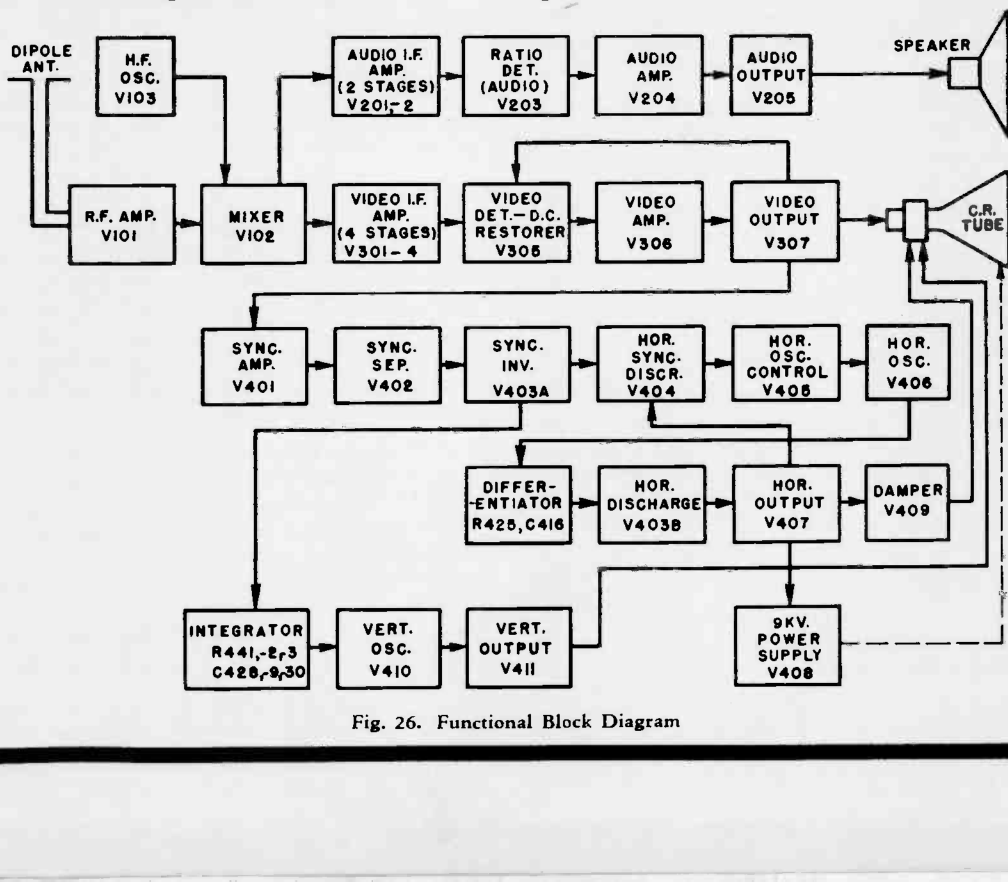


Fig. 26. Functional Block Diagram

Converter: V102 (6J6). An equivalent quarter-wave line (L129 to L154), is used to tune the push-pull grid circuit of the converter. This tuned line is similar to the one used in the RF amplifier (V101) plate circuit. Both the RF amplifier and converter tuned lines (as well as the tuned line in the oscillator circuit) are assembled on the wafers of the channel switch (S101). Their close proximity to each other results in mutual coupling. Added capacitive and inductive coupling is used as described in the preceding paragraph. Over-coupling, plus the loading effect of resistor R108 on the eight lowest frequency channels, results in the required six megacycle bandwidth in the RF and converter circuits.

Resistor R107 furnishes grid-leak bias due to the oscillator injection voltage. The high resistance value of R107 makes the converter grid circuit susceptible to interference signals at the audio and video intermediate frequencies. A series trap consisting of coil L128 and condenser C110 is connected across resistor R107 to reject such interference signals.

The converter plates are connected in parallel and feed the primary of IF transformer T101. The primary is tuned to the video IF pass-band. Capacitive coupling (C111) is used between the primary and the first video IF (V301) grid. The secondary is tuned to the audio IF and directly coupled to the first audio IF (V201) grid. Transformer T101 performs the first separation of the audio and video IF signals. Audio IF rejection traps are still necessary in the video IF amplifiers.

Oscillator V103 (6J6). An equivalent quarter-wave line, consisting of inductances L156 to L181, is used as an oscillator tank. A split-stator condenser (C117), is effectively connected across the plate end of the oscillator-tuned line and serves as a sharp tuning adjustment. The oscillator is fundamentally a Hartley circuit, using a combination of grid-leak and cathode bias.

Slug-tuned coils L180 and L181 permit alignment of the oscillator on Channel 13. Channels 7 through 12 are each aligned by a single adjustment on one side of the tuned line. No serious unbalance results since only a slight change in inductance is necessary to effect alignment. Coils L166 and L167 are both adjusted for alignment on Channel 6. Channels 1 through 5 are aligned by adjustment of a single inductance for each channel as was the case with Channels 7 through 12. The slug adjustments just described and the sharp-tuning condenser assure accurate oscillator alignment.

The RF and Converter tuned lines are not as critical as the tuned line in the oscillator. Only two adjustments are used in each of the RF and Converter tuned lines for the seven high frequency channels, and two more adjustments are used in each line for the six low frequency channels. If more than one low frequency channel is used, a compromise adjustment of the two low frequency slug adjustments in the RF and Converter tuned lines must be made. The same thing applies to the high frequency channels. It is often desirable to make the adjustment on the channel having the weakest signal in order that it might be favored.

AUDIO SECTION 2 (Figure 77)

Audio IF Amplifiers V201, V202 (6AU6). Two broad-band IF stages of conventional circuit design are used ahead of the FM detector V203 (6AL5). Since no AVC voltage is applied and maximum gain is desired per stage, high Mu, sharp cut-off pentode tubes are used.

FM Detector V203 (6AL5). The FM detector used in the 30A1 television chassis is the same type of ratio detector circuit used in the Admiral FM receivers. Since it is inherently insensitive to amplitude modulated noise signals, it is used without the limiter stage required by a discriminator type FM detector. Full details can be found in the Admiral 9A1 chassis Service Manual.

Audio Amplifiers V204 (6SJ7), V205 (6Y6G). The audio amplifier system consists of a voltage amplifier V204 (6SJ7) and a power amplifier V205 (6Y6G). These two stages provide the necessary audio power to drive the speaker. The circuit is of conventional design.

VIDEO SECTION 3 (Figure 77)

Video IF Amplifiers V301, V302, V303 (6AG5) and V304 (6AU6). Four stages of stagger-tuned video IF amplification are used. Self-resonant, slug-tuned coils are used in the impedance coupling networks between stages. Parallel-resonant traps are inductively coupled to these coils in the second, third and fourth video IF stages (T301 to T303). These traps provide rejection of the sound carrier and adjacent channel sound and video carriers, respectively.

The contrast control bias on the RF stage V101 (6J6) is adjustable from approximately -1 to -8 volts. This is obtained from the arm of R306A. Contrast control bias is supplied to the first three video IF stages (V301, V302, V303) through a voltage divider (R304 and R305). Contrast bias on these stages is adjustable from approximately -1 to -6 volts.

Video Detector V305 (6AL5). The video detector diode (one diode section of V305) connections are reversed from those commonly used in broadcast receiver circuits in order to obtain positive picture phase across the load circuit. The two phase inversions that take place in the video amplifier stages then results in a positive picture phase for application to the grid of picture tube V308 (10BP4).

A "constant K filter (L306, L307, R321 and R322)" is used as a load for the video detector. The resistive and inductive elements of this load circuit are so chosen that a flat frequency response characteristic is obtained over the entire video frequency range. The upper limit is approximately 4 megacycles. Condenser C318 serves as the usual RF bypass and removes the video IF carrier from the detected video signal. Capacitive coupling is used between stages in the video amplifier system.

Video Amplifier V306 (6AU6). The video amplifier is a pentode voltage amplifier with a constant K filter for a plate load. The fixed bias voltage is obtained from a voltage divider (R324 and R325) across the -8 volt bias supply. Sufficient bias is used to provide noise limiter action in this stage.

Video Output V307 (6K6GT). A pentode power amplifier is used in the video output stage. Fixed bias is obtained from the -8 volt bias supply. Cathode bias is also used and the cathode bypass condenser is omitted to introduce inverse feedback. A constant K type of filter is also used as a plate load for this stage. The coupling between this plate load circuit and the grid of the picture tube V308 (10BP4) is a modification of the usual circuit. This is due to the DC restorer diode (one section of V305) and the circuit for sync pulse output to the sync and sweep circuits of the receiver. The sync is taken from R334. R335 is used to isolate the coupling circuit as well as to attenuate the higher video frequencies. The picture tube (V308) grid return circuit consists of R336, R337 and R338.

The DC restorer diode (one section of V305) is across R337. The video signal appearing across R338 contains an accentuated sync pulse due to the action of the DC restorer diode. This provides the input signal for the sync amplifier.

SWEEP AND SYNC SECTION 4 (Figure 77)

Horizontal Oscillator V406 (6V6GT). A beam tetrode tube is used as an electron-coupled horizontal oscillator. Horizontal oscillation transformer T401 is slug-tuned. This slug adjustment is the horizontal lock control. The horizontal hold control R421A on the front of the set is in the oscillator grid-leak circuit.

The plate current of V406 (6V6GT) is driven to cutoff and saturation giving a "squared" output waveform. This squared output is fed to a differentiator made up of R425 and C416. The differentiator delivers a peaked waveform.

Horizontal Discharge V403B (6SN7GT). The peaked waveform from the differentiator is used to trigger discharge tube V403B. Horizontal drive control R429 and resistor R428 are connected in series with discharge tube condenser C419 in order to give a large negative grid swing during the retrace interval.

Horizontal Output V407 (6BG6G). A beam tetrode is used in the horizontal output amplifier in order to obtain the required driving power for the horizontal deflection coils and the 9 KV rectifier circuit. The circuit is conventional with the exception of the plate load circuit.

The output of the horizontal amplifier is transformer-coupled (by T402) to horizontal deflector coils T403A. Width control L401 shunts a portion of the output transformer (T402) secondary, making the inductance variable for width control.

The Damper V409 (5V4G) is connected in such a way as to give an effective increase in the plate voltage of the horizontal output amplifier V407 (6BG6G) The plate current of V407 flows through V409 for the major portion of the trace. Condensers C424 and C425 are fully charged during this period and supply the V407 (6BG6G) current during the time the V409 (5V4G) is not conducting. An average voltage due to damper tube (V409) current is developed across the network C424, L402 (horizontal linearity adjustment) and C425. This voltage gives approximately 60 volts boost to the V407 plate voltage. The network (C424, C425, L402) provides linearity control by adjusting the cathode waveform (bias) of the V409 damper tube. R435 in conjunction with C425 gives some RC damping in the output circuit. It may be necessary to change the tap on R435 if it is not possible to effect satisfactory linearity with R429 (horizontal drive) and L402.

Blocking condenser C426 prevents DC flow through deflection yoke T403.

9 KV Power Supply. The horizontal output amplifier V407 (6BG6G) is the source of power for the 9KV power supply. The plate voltage for the 9KV rectifier V408 (1B3GT/8016) is obtained from the horizontal output transformer T402 by auto-transformer action. A separate secondary winding supplies filament power to the rectifier tube (V408).

Due to the high-frequency power source and the relatively light load, an RC filter is sufficient for filtering the 9KV power supply. The external coating of the picture tube V308 (10BP4) serves as the output filter capacitor.

Vertical Oscillator V410 (6SN7GT). A cathode-coupled multivibrator is used as a vertical oscillator. The vertical hold control R421B is a variable resistor in the grid circuit of the discharge section of the multivibrator. Resistors R449 and R450 form a voltage divider circuit. Resistor R449 is a potentiometer and permits plate voltage adjustment on the discharge section of the multivibrator. Resistor R449 serves as a height control adjustment.

Vertical Output V411 (6K6GT). A triode-connected pentode tube is used as a vertical output amplifier. Variable resistor R455 is in the cathode circuit and serves as a vertical linearity control. The plate of this stage (V411) is transformer-coupled to the vertical coils of deflection yoke T403. Damping resistors R457 and R458 are connected across the vertical coils (T403B) in the deflection yoke.

Sync Amplifier V401 (6BA6). The sync amplifier is an RC coupled circuit with fixed bias supplied by the selenium bias rectifier M502. An RC plate decoupling filter consisting of R405 and C403 provides low-frequency boost. High-frequency attenuation results from plate bypass condenser C402. Low-frequency boost and high-frequency attenuation in the sync amplifier (V401) plate circuit removes some of the unwanted video and noise from the sync pulses. Further noise limiting occurs in the grid circuit of V401 (6BA6).

Sync Separator V402 (6AU6). An RC coupled circuit is used in the sync separator. Fixed bias is supplied by the selenium bias rectifier M502. The use of a sharp cutoff pentode tube, low plate voltage and a rather high bias voltage results in plate clipping of the negative (video) portions of the input cycle. All traces of the video signal are removed from the sync pulses by this stage.

Sync Inverter V403A (6SN7GT). A triode sync inverter circuit is used to obtain a push-pull feed for the horizontal sync discriminator.

A tap on the cathode load of the sync inverter V403A provides a feed to the integrator for vertical synchronization. The vertical integrator consists of a three-section, RC filter network (R441, R442, R443, C428, C429, C430).

Horizontal Sync Discriminator V404 (6AL5). The sync discriminator is also an RC coupled circuit. A push-pull, sync signal input is supplied by the sync inverter, as previously mentioned. An RC voltage divider circuit (R415, R416, C409) is used to supply a portion of the horizontal sweep output voltage to the horizontal sync discriminator V404 (6AL5). Condenser C409 is necessary in the divider circuit for DC blocking purposes.

The discriminator (V404) delivers a DC output voltage that is proportional to the phase difference between the sync pulse and horizontal sweep voltage inputs. When the frequency and phase relationship between these two voltages is correct, the discriminator circuit develops its normal output voltage. This voltage, combined with cathode bias voltage, is equal to the normal operating bias of the horizontal oscillator control tube V405 (6J6). When the horizontal sweep circuit in the receiver is not locked in with the transmitter, the frequency or phase relationship between the sync pulses and the horizontal sweep voltage is abnormal. The DC output of the horizontal sync discriminator V404 (6AL5) changes accordingly.

The DC output of the horizontal sync discriminator is fed to the grid of the horizontal oscillator control tube V405 (6J6) through an RC filter network. The filter is necessary to keep sync pulses and noise from reaching the grid of the horizontal oscillator control tube (V405).

Horizontal Oscillator Control V405 (6J6). A triode reactance modulator circuit is used for horizontal oscillator control. The horizontal oscillator tank condenser C413 is returned to the cathode of the oscillator control tube. This control tube input voltage is out of phase with and leads the oscillator tank voltage by approximately 90 degrees. Due to the inverted input circircuit, the signal on the plate of the control tube also leads the oscillator tank voltage by the same amount. Coupling this amplified leading voltage back to the oscillator tank makes the horizontal oscillator control tube V405 appear as a shunt inductance across the oscillator tank. The oscillator tank is made to resonate at the correct sweep frequency with this shunt inductance effect.

The DC output of the horizontal sync discriminator V404 (6AL5) supplies a portion of the bias for the horizontal oscillator control tube V405 (6J6); the other source of bias being cathode resistor R419. Any shift in phase difference between the transmitter sync pulses and the horizontal sweep voltage in the receiver causes the sync discriminator (V404) DC output to change. This changes the bias on the horizontal oscillator control tube V405 (6J6) and changes the amplitude of the reactive voltage appearing in the plate circuit. The effective shunt inductance across the horizontal oscillator tank then changes. This, in turn, shifts the horizontal oscillator (V406) phase sufficiently to correct for the original phase shift. The horizontal hold circuit in the Admiral television receiver is actually an automatic frequency-control circuit.

POWER SUPPLY SECTION 5 (Figure 77)

9 KV Power Supply V408 (1B3GT/8016). Since this supply is an integral part of the horizontal output amplifier circuit, a circuit description of this supply is given in paragraph 26.

High Voltage Power Supply V501 (5U4G). A full-wave rectifier and pi-type LC filter are used in this power supply to obtain the plate and screen voltages required by the tubes in sections 3 and 4 of the receiver. A separate winding on the power transformer T501 in this power supply furnishes heater power to the tubes in these sections. A separate heater winding is necessary for the damper tube V409 (5V4G) due to the presence of the DC supply voltage on the damper tube heater circuit.

Low Voltage Power Supply V502 (5Y3GT). Aside from the fact that the low voltage power supply delivers a lower DC output voltage and current, it is of the same general type as the one described in the preceding paragraph. The speaker field serves as a filter choke in some models.

Bias Supply. The heater winding on the low voltage power transformer T502 supplies the input power for the selenium bias rectifier M502. A single filter condenser C502 provides adequate filtering due to the light load. The -8 volt output provides sufficient bias for contrast control and normal operating bias on the various stages in the receiver.

RC decoupling filters are used in the plate and screen supply leads of various stages in the receiver in order to isolate them from a common power supply. LC decoupling filters are also used for isolating purposes in the heater circuit.

ALIGNMENT

VIDEO IF RESPONSE

A theoretical video IF response curve is shown in figure 27. The broad-band characteristic and signal rejection at the three trap frequencies is also shown. The necessity for this type of response curve can be shown by reference to figure 28. Figure 28 shows the video and audio carriers for channel 3 along with the video and audio carriers of the adjacent channels. The difference frequencies produced by the 87 MC oscillator (for channel 3 reception) beating with the audio and adjacent channel carriers are equal to the trap frequencies shown in figure 27.

The method of obtaining the necessary video IF bandpass by "stagger-tuning" is illustrated in figure 29. Individual response curves for the stagger-tuned circuits are shown in solid lines. The overall video IF response curve, as modified by the effects of the traps, is shown by the dotted curve.

In dealing with RF and IF response curves, it is well to remember that an inverted or mirror image may result, depending on the sweep generator and oscilloscope used. The general waveform should still be identical.

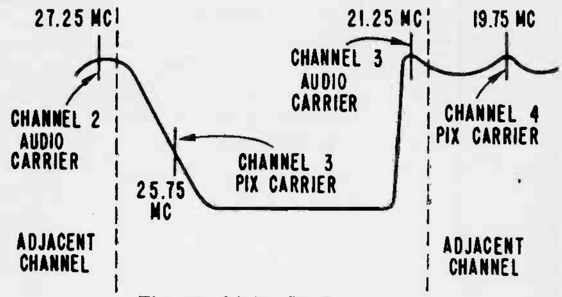


Fig. 27. Video IF Response

29. TEST EQUIPMENT

The following is a list of test equipment used in aligning a television receiver:

Signal Generator

10 MC to 225 MC frequency range (minimum). Low impedance output. Calibrated output attenuator.

Marker Generator

10 MC to 30 MC and 45.25 MC to 215.75 MC frequency ranges. Extreme accuracy or crystal calibrator. Low impedance output. Output attenuator.

Sweep Generator

10 MC to 30 MC and 44 MC to 216 MC (sweep IF's and channels 1 to 13) frequency range. 300-ohms balanced output. Output attenuator.

Vacuum Tube Voltmeter

3 volt DC, low range desirable.

Oscilloscope

Essentially flat vertical amplifier frequency response up to at least 200 KC. Calibrator and step attenuator on input of vertical amplifier.

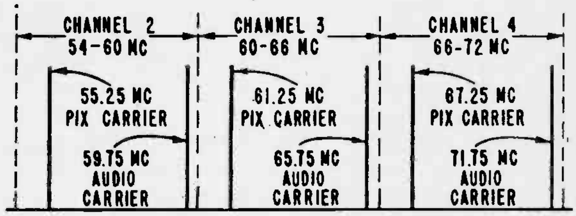


Fig. 28. Television Channel Makeup

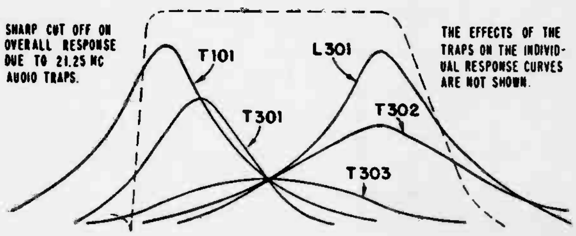


Fig. 29. Stagger-Tuned Band Pass Characteristic

ALIGNMENT ADJUSTMENT IDENTIFICATION

Adj.	Sym.	Adj.	Sym.	Adj.	Sym.	Adj.	Sym.	Adj.	Sym.
A1	T101	A8	T303	A16	L153	A24	L179	A32	L165
A2	T301	A9	L301	A17	L154	A25	L177	A33	L163
A3	T201	A10	T101	A18	L111	A26	L175	A34	L161
A4	T201	A11	T301	A19	L112	A27	L173	A35	L159
A5	T202	A12	T302	A20	L139	A28	L171	A36	L157
A6	T202	A13	T303	A21	L140	A29	L169	A37	L184
A7	T302	A14	L125	A22	L180	A30	L166	A38	L185
		A15	L126	A23	L181	A31	L167		

IF AND TRAP ALIGNMENT

Connect signal generator to one antenna terminal and ground. Alignment adjustment locations are shown in figure 36. Response curves are shown in figures 30, 31 and 32.

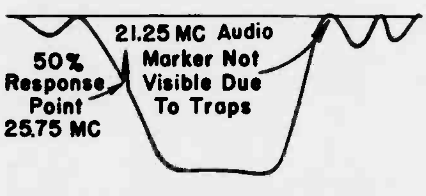


Fig. 30. Overall Video IF Response

Fig. 31. De-tuned Overall Video IF Response

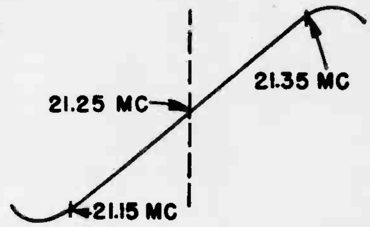
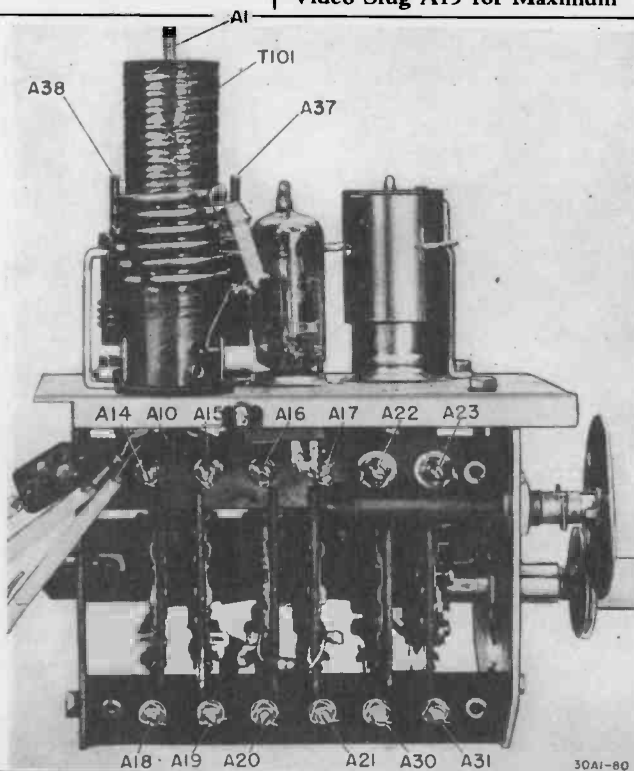


Fig. 32. Ratio Detector Curve

Step	Signal Gen. Frequency (MC)	Connect VTVM to	Test Connections and Instructions	Adjust
1.	21.25	Point "X", junction of L306 and L307 in video detector.	Set contrast control for -3 volts (read at arm of control) and retain for all IF adjustments. Set signal generator output at high output for trap alignment. Connect RC filter of 10,000 ohms and 330 mmf. in series from point "X" to ground, condenser to ground. Connect VTVM across condenser and read negative voltage.	Adjust A1 for Minimum. Detune A1 by shorting a couple turns of the coil with your finger or a clip lead. Adjust A2 for minimum. Remove the short on the coil associated with A1.
2.	21.25	Point "Y", negative side of electrolytic condenser in ratio detector.	Reduce signal generator output to minimum required to override noise. Read negative voltage when peaking audio IF's.	Slugs A3, A4 and A5 for maximum reading on meter.
3.	21.25	Point "Z", junction of R205 and R210 in ratio dectector.	Use zero center VTVM for this reading.	Slug A6 to zero on VTVM betweeen maximum positive and maximum negative voltages found nearest fully withdrawn slug position.
4.	27.25	Point "X"	Signal generator output high, connection same as Step 1.	Slug A7 for Minimum
5.	19.75	Point "X"	"	Slug A8 for Minimum
6.	25.0	Point "X"	Reduce signal generator output as required.	Video Slug A9 for maximum
7.	21.8	Point "X"	"	Video Slug A10 for Maximum
8.	22.3	Point "X"	"	Video Slug A11 for Maximum
9.	25.25	Point "X"	"	Video Slug A12 for Maximum
10.	23.5	Point "X"	"	Video Slug A13 for Maximum

Fig. 34a. RF Tuner A1582, Left Side



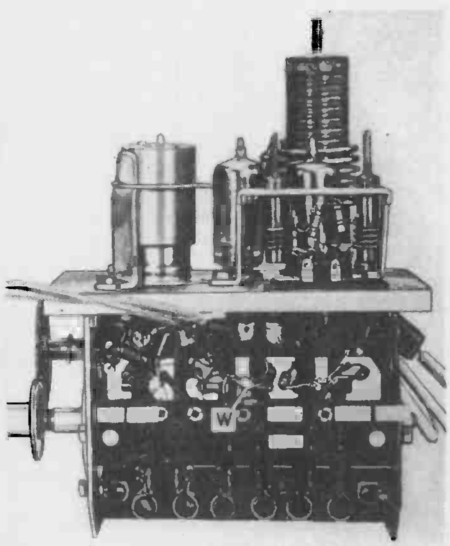


Fig. 34b. RF Tuner A1582, Right Side

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

RF AND CONVERTER ALIGNMENT

Connect sweep generator to the antenna terminals. Connect marker generator to the sweep generator (to obtain marker pips). Alignment adjustment locations are shown in figure 34a. The RF response curve is shown in figure 33.

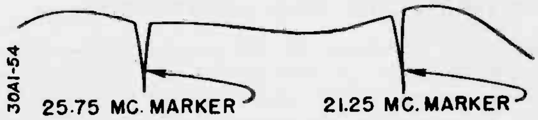


Fig. 33. RF Selectivity Curve

Step	Marker Gen. Frequency (MC)	Sweep Gen. Frequency	Connect Oscilloscope to	Test Connections and Instructions	Adjust
1.	211.25 215.75	Sweeping Channel 13	Through 10,000 ohms to point W (See Figures 34b and 36) Junction of R107 and C110.	Set contrast control to 1.5 volts (read at arm of control). Center sharp tuning adjustment.	A14, 15, 16 and 17 for flat top response curve.
2.	205.25 209.75	12	"	"	*Check response as above.
3.	199.25 203.75	11	"	"	"
4.	193.25 197.75	10	"	"	"
5.	187.25 191.75	9	"	"	"
6.	181.25 185.75	8	"	"	"
7.	175.25 179.75	7	"	"	"
8.	83.25 87.75	6	"	"	A18, 19, 20 and 21 per step 1.
9.	77.25 81.75	5	"	"	*Check response per step 1.
10.	67.25 71.75	4	"	"	"
11.	61.25 65.75	3	"	"	"
12.	55.25 59.75	2	"	"	"
13.	45.25 49.75	1	"	"	"

*Do not make adjustments unless optimum reception is desired on a specific high or low band channel. Adjustment on a specific channel can then be made.

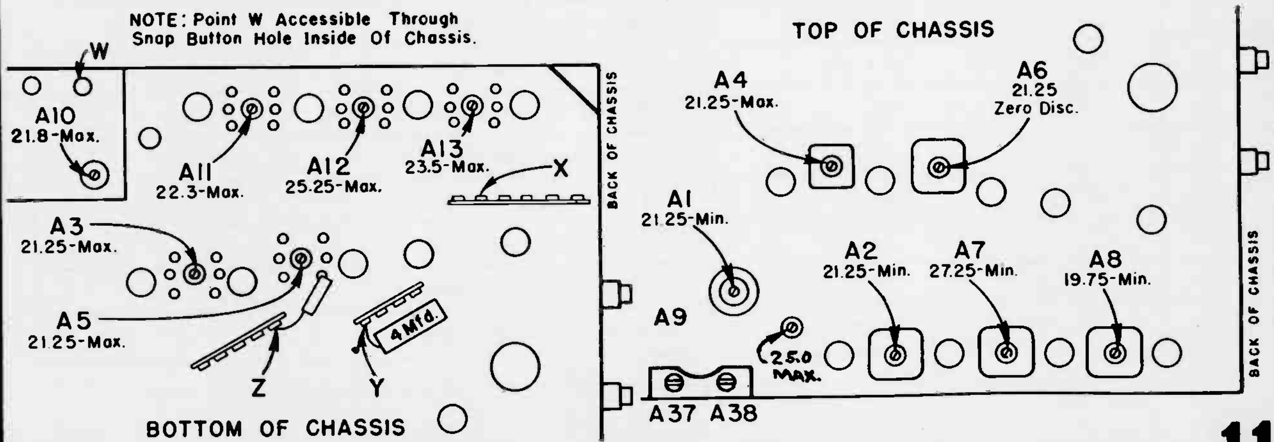


Fig. 36. Trimmer Location

INTERFERENCE TRAP ADJUSTMENT

Due to the prevalence of FM interference on some television channels, an interference rejection trap is mounted on top of RF tuner A1582 as shown in figures 34a and 34b. It covers the frequency range from 93 to 109 MC.

Inter-channel interference may result from a dual-conversion effect that results from oscillator voltage feeding through to the grid of the RF amplifier. Channel 10 interference on channel 6 is an example of this condition. The local oscillator frequency for channel 6 reception is 109 MC. 193.25 and 197.75 MC are the picture and audio carrier frequencies for channel 10. Combining these with the 109 MC oscillator signal, results in a conversion to 84.25 and 88.75 MC, respectively. These frequencies are close enough to the 83.25 and 87.75 MC carrier frequencies of channel 6 to cause serious interference. The 93 to 109 MC interference trap can also be used to eliminate inter-channel interference of the above type by trapping out the oscillator voltage on the grid of the RF amplifier.

In the event that FM interference; or inter-channel interference of the type described above, is experienced; set the television receiver for reception of the station that is being interfered with. Adjust trap adjustments A37 and A38 (Figures 34a, 36) for minimum interference.

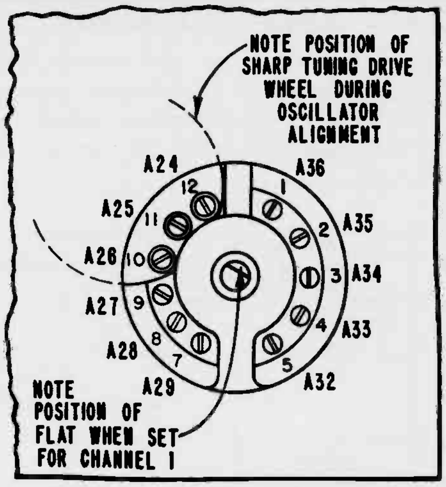
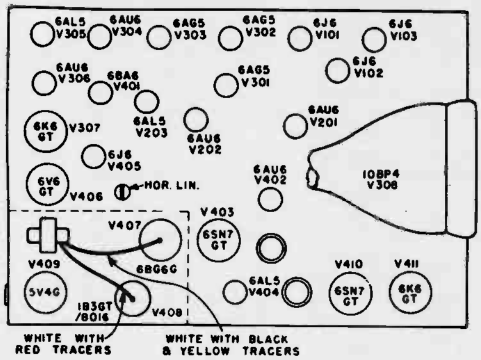


Fig. 35. Channel Switch Detail



HIGH-FREQUENCY OSCILLATOR ALIGNMENT

Connect signal generator to one antenna terminal and ground. Connect VTVM to point "Z" (Fig. 36). Center sharp tuning control on receiver. Zero-center VTVM. See Figures 34a and 35. Proceed as follows.

Step	Channel	Generator Frequency (MC)	Adjust
1.	13	215.75	**A22 and A23 for zero VTVM reading between a positive and a negative peak with sharp tuning control centered.
2.	12	209.75	A24 as described above.
3.	11	203.75	A25 as described above.
4.	10	197.75	A26 as described above.
5.	9	191.75	A27 as described above.
6.	8	185.75	A28 as described above.
7.	7	179.75	A29 as described above.
8.	6	87.75	**A30 and A31 as described above.
9.	5	81.75	A32 as described above.
10.	4	71.75	A33 as described above.
11.	3	65.75	A34 as described above.
12.	2	59.75	A35 as described above.
13.	1	49.75	A36 as described above.

**These slug adjustment screws should protrude approximately the same distance out of the coil forms.

TROUBLE SHOOTING

TELEVISION TROUBLE-SHOOTING CHART

Symptoms	Check	Remarks
Dead receiver.	AC Power line circuit.	
No sound or picture. Raster OK.	a. Tubes V101, V102, V103 and V502. b. Low voltage power supply (V502). c. RF tuner. (1) RF amplifier (V101). (2) Converter (V102). (3) Oscillator (V103). d. Contrast control circuit.	
No sound. Weak video (insufficient contrast).	a. RF tuner alignment.	Oscillator (V103) alignment most probable cause
No sound. Picture OK.	a. Audio section tubes (V201 to V205). b. Audio IF (V201 and V202). c. Ratio detector (V203). d. Audio amplifier (V204 and V205) e. Audio plug and jack (M201 and M202). f. Speaker.	
Weak sound. Picture OK.	a. Audio section tubes (V201 to V205). b. Audio IF alignment. c. Audio IF's (V201 and V202). d. Ratio detector (V203). e. Audio amplifier (V204 and V205).	
Noisy sound. Picture OK.	a. Audio section tubes (V201 to V205). b. Discriminator transformer alignment (T202). c. Audio IF's (V201 and V202). d. Ratio detector (V203). e. Audio amplifier (V204 and V205). f. Speaker.	
Intermittent sound. Picture OK.	a. Audio section tubes V201 to V205). b. Audio IF's (V201 and V202). c. Ratio detector (V203). d. Audio amplifier (V204 and V205). e. Speaker.	
No raster. Sound OK.	a. Tubes V308, V403, V406, V407, V408, V409 and V501. b. Ion trap adjustment. c. High voltage power supply (V501). d. 9 KV power supply (V408). e. Horizontal Oscillator (V406). f. Differentiator. g. Horizontal discharge (V403B). h. Horizontal output (V407). i. Damper (V409). j. Focus coil circuit (open). k. Picture tube cathode circuit.	Failure of horizontal oscillator (V-406), differentiator or horizontal discharge (V403B) will result in loss of drive to the horizontal output stage (V407), and the horizontal output tube (6BG6G) will show color due to excessive plate dissipation. Check waveforms at TP15 to TP18 (Figures 62 to 65).
Intermittent raster. Sound OK.	a. Tubes V308, V403, V406, V407, V408, V409 and V501. b. High voltage power supply (V501). c. 9 KV power supply (V408). d. Horizontal oscillator (V406). e. Differentiator. f. Horizontal discharge (V403B). g. Horizontal output (V407). h. Damper (V409). i. Focus coil circuit (intermittent open). j. Picture tube (V308) cathode circuit.	Check for arc-over or corona discharge in the 9 KV power supply (V408). Check waveforms at TP15 to TP18 (Figures 62 to 65).

TELEVISION TROUBLE-SHOOTING CHART (Cont'd)

Symptoms	Check	Remarks
Insufficient raster brilliance.	a. Ion trap adjustment. b. Tubes (V308 and V408). c. 9 KV power supply (V408).	
Rounded corners on raster. Brilliance OK.	a. Deflection yoke (too far back on picture tube neck). b. Focus coil (too far back on picture tube neck). c. Ion trap adjustment.	
Rounded corners on raster. Insufficient brilliance.	a. Ion trap adjustment.	
Tilted raster.	a. Position adjustment of deflection yoke.	
Raster not centered.	a. Position adjustment of focus coil.	
Excessive raster size (too large a picture for the picture tube mask).	a. Height and width adjustments (R449 and L401). b. 9 KV power supply (V408). c. Horizontal drive control (R429) setting. See Installation and Service Adjustments, Section IV.	Low secand anode potential increases the deflection sensitivity of the picture tube (V308). Check V408 by substitution.
Trapezoidal or non-symmetrical raster.	a. Deflection yoke. b. Position adjustment of focus coil. c. Ion trap adjustment.	
Insufficient raster width.	a. Width adjustment (L401). b. Tubes V403 and V407. c. Horizontal discharge (V403B). d. Horizontal output (V407).	
Insufficient raster height.	a. Height adjustment (R449). b. Tubes V410 and V411. c. Vertical oscillator (V410). d. Vertical output (V411).	
Bright horizontal line. No vertical deflection, no raster.	a. Tubes V410 and V411. b. Vertical oscillator (V410). c. Vertical output (V411).	Check waveforms at TP11 and TP12 (Figures 58 and 59).
Bright vertical line. No horizontal deflection, no raster.	a. T402 secondary circuit.	
Raster too small (insufficient height and width).	a. Height and width adjustments (R449 and L401). b. Tubes V308 and V501. c. High voltage power supply (V501). d. AC line voltage (low).	Gas content will decrease the deflection sensitivity of the picture tube V308 (improper focus will also result).
Excessive raster brilliance. Brightness control has no effect.	a. Picture tube (V308). b. Picture tube cathode circuit	
Bunching of several trace lines appearing as a white band across raster.	a. Vertical amplifier tube (V411).	Replace tube (V411 and V307 can be switched to correct this difficulty.)

TELEVISION TROUBLE-SHOOTING CHART (Cont'd)

Symptoms	Check	Remarks
Vertical lines or "wrinkles" on left side of raster.	a. Spurious oscillations in horizontal output (V407). b. Deflection yoke (T403). c. Horizontal drive (R429) setting.	If trouble is "a", replace tube V407.
Light and dark vertical bars. Bad horizontal linearity.	a. Damper tube (V409).	Replace tube V409.
Two heavy black horizontal bars covering picture tube screen.	a. High voltage power supply (V501) for open filter (C501).	
No picture. Raster and sound OK.	a. Video section tubes (V301 to V307). b. Video IF's (V301 to V304). c. Video detector (V305). d. Video amplifier (V306 and V307).	Check waveforms at TP1 to TP5 (Figures 39 to 48).
Intermittent video. Sound and raster OK.	a. Video section tubes (V301 to V307). b. Video IF's (V301 to V304). c. Video detector (V305). d. Video amplifier (V306 and V307).	
Intermittent video and sound. Raster OK.	a. Tubes V101, V102, V103, and V502. b. RF tuner. (1) RF amplifier (V101). (2) Converter (V102). (3) Oscillator (V103). c. Low voltage power supply (V502). d. Contrast control circuit.	
Weak video (insufficient contrast). Sound and raster OK.	a. Video section tubes (V301 to V307). b. Video IF alignment. c. Video IF's (V301 to V304). d. Video detector (V305). e. Video amplifier (V306 and V307). f. Contrast control circuit.	Check waveforms at TP1 to TP5 (Figures 39 to 48).
"Snow" in picture background.	a. For weak signal input. b. Noisy tubes in RF tuner (V101 to V103). c. 9 KV power supply (V308) for corona discharge.	Weak signal from station, receiver antenna and/or transmission line difficulties.
No vertical sync. Horizontal sync. OK.	a. Integrator network.	Check waveforms at TP9 and TP10 (Figures 55 to 57).
Improper vertical sync. Split-framed picture.	a. Leaky sync inverter (V403A) coupling condensers (C407, C408). b. Sync inverter (V403A) coupling condensers (C407, C408) connections switched.	
No horizontal sync. Vertical sync OK.	a. Tubes V404 and V405. b. Horizontal sync discriminator circuit (V404). c. Horizontal oscillator control circuit (V405).	Check waveforms at TP8, TP13 and TP14 (Figures 53, 54, 60 and 61).
No horizontal or vertical sync.	a. Tubes V305, V401, V402 and V403. b. DC restorer (V305). c. Sync amplifier (V401). d. Sync separator (V402). e. Sync inverter (V403A).	Check waveforms at TP4 to TP8 (Figures 45 to 54).

TELEVISION TROUBLE-SHOOTING CHART (Cont'd)

Symptoms	Check	Remarks
Picture jitter.	a. Horizontal hold and/or lock adjustment. b. Change horizontal output V407) if regular sections of the picture are displaced. c. For noisy tube(s) in the RF, video and sweep sections of the receiver.	
Horizontal non-linearity.	a. Horizontal drive control setting (R429). b. Horizontal linearity control setting (L402). c. Horizontal discharge (V403B). d. Horizontal output (V407). e. Damper (409).	Check waveform at TP17 (Figure 64).
Vertical non-linearity.	a. Vertical linearity control setting (R455). b. Vertical oscillator (V410). c. Vertical output (V411).	Check waveforms at TP11 and TP12 (Figures 58 and 59).
Improper focus (best at extreme control position).	a. Focus coil (L403). b. Focus control circuit. c. For circuit defect causing either excessive or low current drain from power supply.	
Improper focus (control has no effect).	a. Focus coil (L403). b. Focus control circuit. c. Picture tube (V308).	If trouble is "a", check for open, shorted turns or incorrect position adjustment. If trouble is "c", picture tube (V308) may be gassy.
Engraved or bass-relief effect in picture.	a. Video output amplifier (V307). b. First video amplifier (V306). c. Video detector (V305). d. Peaking chokes.	Output load and coupling circuit is common source of this difficulty.
Smeared effect in picture (poor low frequency video response).	a. Video detector (V305). b. First video amplifier (V306). c. Video output amplifier (V307). d. Peaking chokes (open).	
Poor picture detail (poor definition).	a. RF and video IF band-pass. b. Video amplifier high-frequency response.	
Vertical bars on right side of picture.	a. Horizontal oscillator tube (V406).	
Sound bars in picture.	a. Alignment of video IF sound traps. b. Alignment of T101 secondary. c. Oscillator alignment (V103). d. IF trap (L128 and C110).	
Herringbone pattern superimposed on picture.	a. FM, diathermy or other forms of RF interference.	
Brown or yellowish-brown spot on picture tube screen.	a. Picture tube (V308) by substitution.	Burned phosphor on picture tube screen. Replace tube if objectionable.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

Belmont Radio

TELEVISION

Table Models 22A21 - 22AX21
Console Model 22AX22

Model 22A21 or 22AX21

I. SPECIFICATIONS

The Model 22A21 (or 22AX21) Television Receiver is a 22-tube, AC-operated, direct-viewing, 7-inch table model. The receiver is complete in one unit and is operated by the use of seven front-panel controls. Features of the receiver include: full continuous coverage of the thirteen television channels; FM sound system; and reduced-hazard high voltage supplying 5000 volts to the second anode of the picture tube.

The Model 22AX22 Receiver is a 10-inch console model which uses a chassis electrically identical with that of the 7-inch set.

TELEVISION FREQUENCY RANGES

(All figures represent megacycles)

Channel	Channel Frequencies	Picture Carrier Frequency	Sound Carrier Frequency	Receiver RF Oscillator Frequency
Low Band				
1	44-50	45.25	49.75	72
2	54-60	55.25	59.75	82
3	60-66	61.25	65.75	88
4	66-72	67.25	71.75	94
5	76-82	77.25	81.75	104
6	82-88	83.25	87.75	110
High Band				
7	174-180	175.25	179.75	202
8	180-186	181.25	185.75	208
9	186-192	187.25	191.75	214
10	192-198	193.25	197.75	220
11	198-204	199.25	203.75	226
12	204-210	205.25	209.75	232
13	210-216	211.25	215.75	238

Sensitivity at the Antenna
Video — 100 microvolts (400 with full contrast).
Audio — 100 microvolts for 50-milliwatt output.

Power-Supply Rating
110 volts AC, 60 cycles, 180 watts.

Audio Power Output Rating
Undistorted — 1.5 watts.
Maximum — 4 watts.

Antenna Impedance Requirements
Balanced 300-ohm.

Speaker
Type — Electrodynamic.
Size—6-inch (22A21 or 22AX21); 8-inch (22AX22)
Voice Coil Impedance (400 cycles) - 3.2 ohms.

Picture Size
5½ x 4¼ inches (22A21 or 22AX21).
8¼ x 6¼ inches (22AX22).

Dimensions
Cabinet (Table Model) — 14½ x 21 x 16 inches.
Cabinet (Console Model) — 38 x 26 x 21 inches.
Chassis (Either Model) — 12½ x 19¼ x 15½ inches.

Tube Complement

Function	Tube	Schematic Sym.
R-f Amplifier	6AK5	1
Converter	6AK5	2
R-f Oscillator	6C4	3
1st Video I-F Amplifier	6AH6	4
2nd Video I-F Amplifier	6AH6	5
Video Detector	6AL5	6
Video Amplifier	6AU6	12
Video Output	6K6-GT/G	13
1st Audio I-F Amplifier	6BA6	7
2nd Audio I-F Amplifier	6BA6	8
Audio Detector	6AL5	9
Audio Amplifier	6AU6	10
Audio Output	6K6-GT/G	11
Sync. Amplifier-Limiter	6SL7-GT/G	15
Horz. Multivibrator	6SN7-GT/G	16
Horz. Output	6SN7-GT/G	17
Vert. Multivibrator	6SN7-GT/G	20
Vert. Output	6SN7-GT/G	21
High-Voltage Oscillator	6V6-GT/G	18
High-Voltage Rectifier	1B3GT/8016	19
Low-Voltage Rectifier	5U4	14
Picture Tube	7JP4 (22A21, 22AX21) 10HP4 (22AX22)	22

II. OPERATION OF THE RECEIVER

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program — both picture and sound — are located on the front of the receiver. On the rear of the set are several controls which are preset at the factory and may need slight re-adjustment at the time of installation. After installation they should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions. The function of each of the controls is described below.

On Front of Set

Volume—Adjusts sound volume.

Contrast—Varies contrast between light and dark portions of pictures.

Tuning—Tunes set to desired channel (station) as indicated on dial.

Low-High Bandswitch—Permits tuning on either the low television band (channels 1 through 6) or high television band (channels 7 through 13).

Hold—A dual control. Vertical hold control (knob closer to panel) stops picture from moving up or down. Horizontal hold control stops picture from moving left or right.

Off-Brilliance—Turns set on or off and adjusts brilliance of picture.

On Rear of Set

Vert. Size—Changes size of picture vertically. Does not affect horizontal size.

Horz. Size—Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

Vert. Cent.—Moves entire picture vertically.

Horz. Cent.—Moves entire picture horizontally.

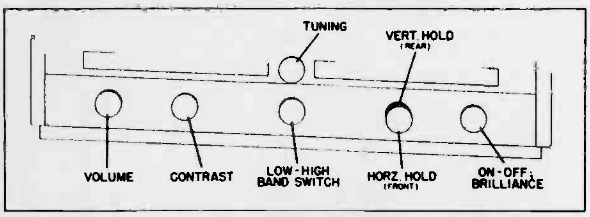


Figure 1. Front Controls (22A21 or 22AX21)

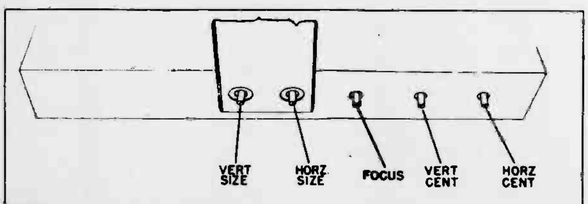


Figure 2. Rear Controls

TUNING PROCEDURE

1. Turn the BRILLIANCE control slightly clockwise to turn the set on. Allow one minute for the set to warm up.
2. If the set was simply turned off and no other controls had been disturbed from previous operation, merely set the volume to the desired level and re-adjust the tuning slightly for best sound quality.

   If a different station is desired, or if the control settings have been changed, use the following procedure:
3. Turn the CONTRAST control fully counter-clockwise.
4. Rotate the TUNING control until the desired channel is indicated on the dial. The bandswitch should be on LOW for channels 1 through 6 and on HIGH for channels 7 through 13.
5. As the desired position on the dial is approached, sound will be heard in the speaker. *Read the note below; then adjust the* TUNING *control for best sound quality* and the VOLUME control for the desired sound level.

   NOTE

   For any particular channel, the sound can be heard at three separate *but closely adjacent* positions on the dial. The center position is the correct one; here the sound is loudest and of the best quality.

   Under normal operation, the video modulation of the picture carrier will be heard as the indicator moves over a particular portion of the dial to the left of the channel being tuned in.
6. Turn the BRILLIANCE control to the extreme clockwise position and then turn it slowly counter-clockwise until the picture tube just becomes dark.
7. Turn the CONTRAST control clockwise until the desired contrast between blacks and whites is obtained. If necessary make a fine re-adjustment of the BRILLIANCE control.

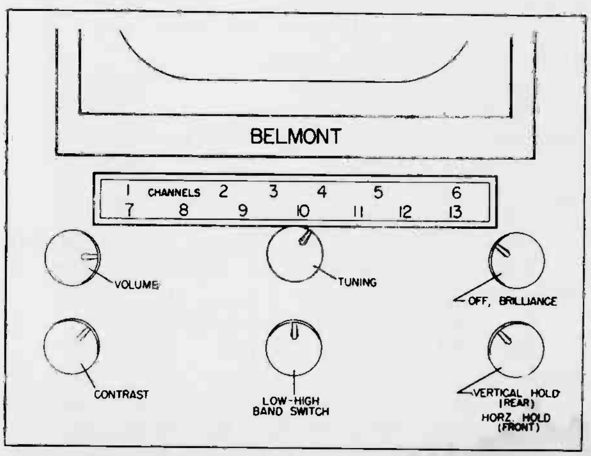


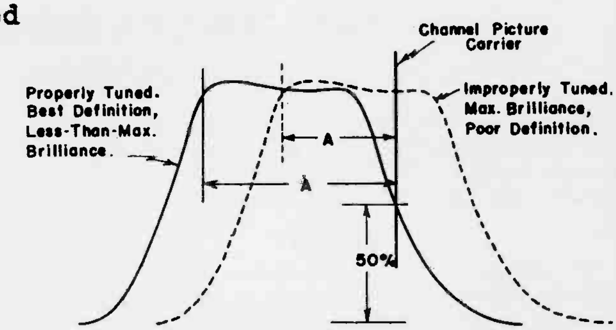
Figure 3. Front Controls (22AX22)

Belmont Radio Television, continued

8. Adjust the FOCUS control (on rear of set) until the picture is as sharp as possible.

IMPORTANT!!

It is possible, by slightly mis-tuning the sound, to get a *brighter* picture on the face of the picture tube. However, this brighter picture contains less detail and is of generally poorer quality. Therefore be sure that the television program is tuned in by *sound only*. The drawing (right) illustrates the reason for this effect.

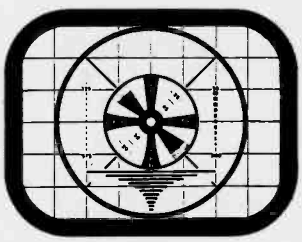


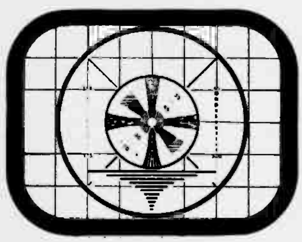
Distance "A" Determines Picture Quality and Definition

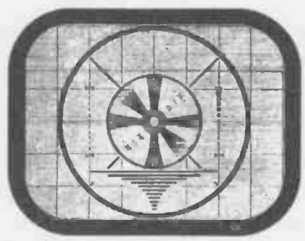
TEST PATTERN

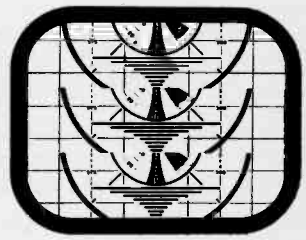
A test pattern of the type illustrated here is usually broadcast for about 15 minutes before a program commences. This is offered as a convenience to you so that the receiver may be properly tuned in for reception of the entire program. When the picture is correctly adjusted, the circles are round, the lines are straight, and the various shades of gray are easily discernible.

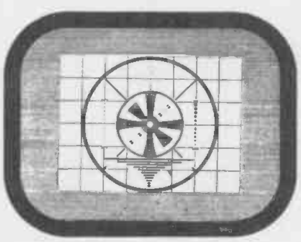
The following drawings represent, as well as can be illustrated, the picture effects which may occur during tuning. Underneath each picture is the correction to be made, if one is available.

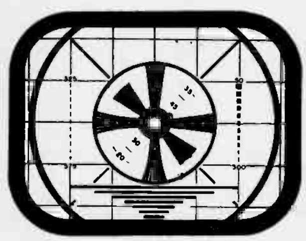

CORRECTLY ADJUSTED — Pattern is clear, steady. Proper contrast between black, white and various shades of gray.

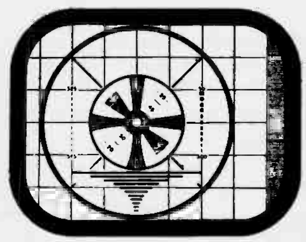

TOO LIGHT — Repeat steps 6 and 7 of tuning procedure.

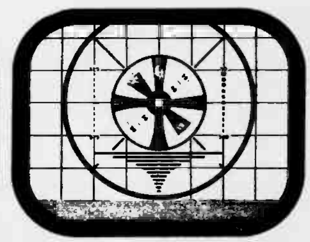

TOO DARK — Repeat steps 6 and 7 of tuning procedure.

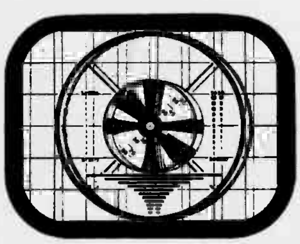

VERTICAL MOVEMENT (fast) UP OR DOWN — Adjust vertical hold control on front of set.

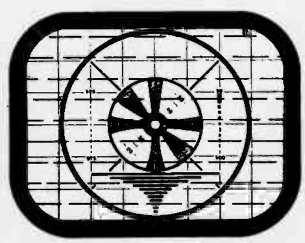

TOO SMALL HORIZONTALLY AND VERTICALLY — Adjust both HORZ. SIZE and VERT. SIZE controls on rear of set.

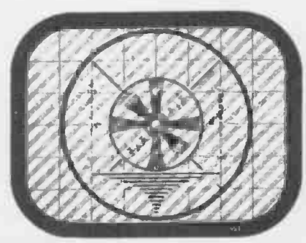

TOO LARGE HORIZONTALLY AND VERTICALLY — Adjust both HORZ. SIZE and VERT. SIZE controls on rear of set.

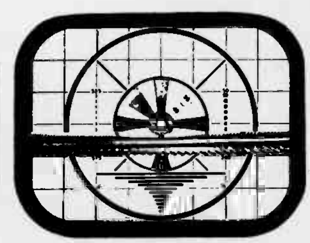

OFF CENTER HORIZONTALLY - Adjust HORZ. CENT. control on rear of set.


OFF CENTER VERTICALLY — Adjust VERT. CENT. control on rear of set.


MULTIPLE IMAGES (Ghosts)—Due to signals reflected from tall buildings, mountains, etc. Condition can be minimized by proper orientation of the antenna.


IGNITION INTERFERENCE—Caused by automobile ignition systems or by electrical motor-driven appliances in vicinity.


R-F INTERFERENCE—Caused by high-powered radio transmitting equipment in vicinity.


DIATHERMY INTERFERENCE — Due to certain electrically operated medical equipment. This herring-bone pattern may move vertically or may remain stationary as shown.

For other effects see Trouble-Shooting Chart, pages 21 to 23.

III. TELEVISION ANTENNAS

Because the antenna is such an important factor in the proper operation of a television receiver, it is thought that a brief general discussion of television antennas might properly be included here.

HEIGHT

The characteristics of transmission at the high frequencies assigned to television differ considerably from those encountered at the lower frequencies. The most important difference is that the straight-line travel of television signals, called line-of-sight propagation, does not follow the curvature of the earth as do broadcast signals. Television transmission can thus be intercepted by a hill or other obstruction, preventing reception by a receiving antenna located behind the obstruction. For this reason it is necessary that the antenna be located high enough to clear intervening obstructions.

GHOSTS

Another peculiarity of television transmission is that re-radiations from conducting structures act as secondary transmissions and may arrive at the receiving antenna at different times, thus repeating video modulation already broadcast. These repetitions appear as "ghosts" or multiple images offset slightly to the right of the true image on the face of the picture tube. When ghosts are caused by reflections from directions other than an angle close to the source of transmission, it is possible to minimize the condition by proper orientation of the receiving antenna.

LEAD-IN

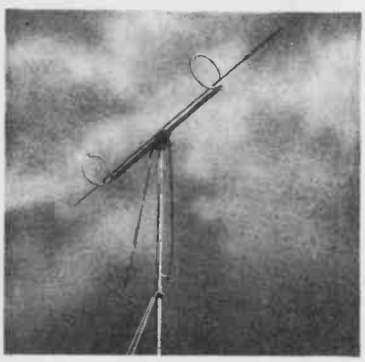
The antenna is connected to the receiver through a transmission line having a characteristic impedance equal to the impedance of the antenna and to the input impedance of the receiver. Improper termination matching of a transmission line will cause reflections of energy to travel back and forth, causing ghosts if the line is long enough. However, even a short length of mismatched transmission line will cause poor definition of the picture and increase energy-transfer losses.

The 300-ohm transmission line used with this receiver is balanced to ground and should be kept as far as possible away from metal objects, including the mast of the antenna structure itself. Also, to reduce the amount of noise pick-up, the lead-in should have the shortest possible horizontal runs and should be twisted about one turn per foot. While the attenuation in this transmission line is fairly low (about 1 db per 100 feet at 90 megacycles), it is recommended that the line be kept as short as possible, with the excess cut off.

On the Model 22A21 or 22AX21 receiver, the antenna plug-in socket is located at the rear of the chassis on the picture-tube support bracket. The antenna socket on the console model (22AX22) is fastened to the inside of the cabinet wall below the chassis support shelf.

Lengths of Folded Dipole Antennas (Air Dielectric) Required at Various Frequencies

Channel	Frequency (mc)	Folded Dipole Total Length (ft.)
Low Band		
1	44-50	9.00
2	54-60	7.38
3	60-66	6.75
4	66-72	6.12
5	76-82	5.31
6	82-88	4.95
High Band		
7	174-180	2.40
8	180-186	2.30
9	186-192	2.23
10	192-198	2.16
11	198-204	2.09
12	204-210	2.03
13	210-216	2.00



Model 300
Allwave Television-FM Antenna

MODEL 300 ALLWAVE TELEVISION-FM ANTENNA

The advanced design of this outstanding antenna gives you:

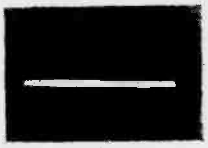
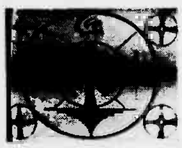
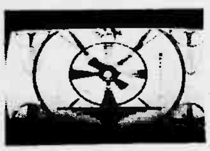
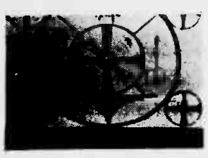
- Full coverage of both television bands and the permanent FM band.
- Maximum reduction of noise.
- Low standing-wave ratio.
- Ease of installation. Can be erected on flat roof, slanting roof, or wall.
- Completely weatherproof metal construction.
- Mounting hardware, 65 feet of 300-ohm twin-lead transmission line, and installation instructions included.

Belmont Radio recommends this antenna for use with all television receivers having 300-ohm input. This antenna is available from all Belmont dealers.

IV. TROUBLE-SHOOTING CHART

Symptom	*Procedure*	*Reference*
No picture **Sound normal** **Raster normal**	a. Check for defective tubes 5, 6, 12, 13. b. Check resistances and voltages at tubes 5, 6, 12, 13. c. Check couplinq capacitor C65. d. Check tubes 12, 13. Connect audio generator across the contrast control. A pattern should appear on the picture tube. e. Use a sweep generator to check the video detector and video i-f amplifiers.	a. Fig. 17 b. Fig. 18 c. Fig. 12 d. Figs. 12, 17 e. Fig. 8
No raster **Sound normal**	a. Check output of high-voltage supply (approximately 5000 volts is normal). b. Check voltage between grid and cathode of picture tube. Should be only 45 volts with brilliance control fully clockwise. c. Check picture tube. d. Check resistances and voltages at picture-tube socket.	a. Fig. 10 b. Fig. 12 c. Par. 15, d. Fig. 18
No picture **No sound** **Raster normal**	a. Check antenna and lead-in. b. Check for defective tubes 1, 2, 3, 4. c. Check band switch. d. Check oscillator circuit. e. Check resistances and voltages of tuner and 1st video i-f tubes. f. Check alignment.	a. Sec. III b. Fig. 17 c. Par. 3 and Figs. 5, 7 d. Fig. 7 e. Fig. 18
No sound **Picture normal**	a. Check for defective tubes 7, 8, 9, 10, 11. b. Connect audio generator across resistor R25, with gain control fully clockwise, and check for sound from speaker. c. Check resistances and voltages at sockets of tubes 7, 8, 9, 10, 11. d. Check alignment of audio i-f stage.	a. Fig. 17 b. Fig. 9 c. Fig. 18
No sync. 	a. Check for defective tube 15. b. Check wave shapes at tubes 6, 12, 15, 16. c. Check resistances and voltages at sockets of tubes 6, 12, 15, 16.	a. Fig. 17 b. Figs. 8, 13, 15 c. Fig. 18
No vertical sync. **Picture normal** 	a. Check wave shapes at pin 1 of tube 20. b. Check frequency of vertical multivibrator. c. Check resistors R83 and R84 and capacitors C88 and C91.	a. Fig. 14 b. Par. 11 c. Fig. 14
No horizontal sync. 	a. Check wave shape at pin 1 of tube 16. b. Check frequency of horizontal multivibrator. c. Check resistor R67 and capacitor C73.	a. Fig. 15 b. Par. 12 c. Fig. 15

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

Symptom	*Procedure*	*Reference*
No vertical sweep 	a. Check for defective tubes 20 and 21. b. Check wave shapes at tubes 20 and 21. If OK, check coupling capacitors C94, C96, C97, C99. c. Check socket voltages and resistances of picture tube and tubes 20 and 21.	a. Fig. 17 b. Fig. 14 c. Fig. 18
No horizontal sweep 	a. Check for defective tubes 16 and 17. b. Check wave shapes at tubes 16 and 17. If OK, check coupling capacitors C75, C78, C80, C82. c. Check socket voltages and resistances of picture tube and tubes 16 and 17.	a. Fig. 17 b. Fig. 15 c. Fig. 18
Bunching at side of picture 	a. Check socket voltages and resistances of multivibrator and output tubes 16 and 17. b. Check coupling capacitors C75, C78, C80, C82 for value and leakage.	a. Fig. 18 b. Fig. 15
Bunching at top or bottom of picture 	a. Check socket voltages and resistances of multivibrator and output tubes 20 and 21. b. Check coupling capacitors C94, C96, C97, C99 for value and leakage.	a. Fig. 18 b. Fig. 14
Audio in picture 	a. Check value of capacitors C40-B, C44-C. b. Check alignment.	a. Fig. 17
Picture cannot be centered vertically 	a. Check for leak in capacitors C96 and C99. b. Check resistance and voltage range of vertical centering control. c. Check resistors R102 and R105. d. De-magnetize the picture-tube shield. (Models 22A21 and 22AX21 only).	a. Fig. 14 b: Figs. 10, 18 c. Fig. 14 d. Par. 15
Picture cannot be centered horizontally 	a. Check for leak in capacitors C78 and C82. b. Check resistance and voltage range of horizontal centering control. c. Check resistors R102 and R105. d. De-magnetize the picture-tube shield. (Models 22A21 and 22AX21 only).	a. Fig. 15 b. Figs. 10, 18 c. Fig. 15 d. Par. 15

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

Symptom	*Procedure*	*Reference*
Insufficient vertical sweep size 	a. Check to see that high voltage is not too high. b. Check for defective tubes 20 and 21. c. Check capacitors C94, C96, C97, C99. d. Check socket resistances and voltages of tubes 20 and 21. e. Check value of capacitors C92 and C93.	a. Par. 8 b. Fig. 17 c. Fig. 14 d. Fig. 18 e. Fig. 14
Insufficient horizontal sweep size 	a. Check to see that high voltage is not too high. b. Check for defective tubes 16 and 17. c. Check capacitors C75, C80, C78, C82. d. Check socket resistances and voltages of tubes 16 and 17. e. Check value of capacitors C74 and C76.	a. Par. 8 b. Fig. 17 c. Fig. 15 d. Fig. 18 e. Fig. 15
Inability to focus picture	a. Check resistances of high-voltage divider. b. Check B+ voltage (300 volts).	a. Figs. 10, 18 b. Fig. 18
Poor picture detail	a. Check antenna and lead-in. b. Check for defective converter tube 2. c. Check alignment of i-f and r-f circuits. d. Check video peaking coils L3, L4, L5. e. Check range of focus control.	a. Page 4 b. Fig. 17 c. d. Fig. 12 e. Figs. 10, 18
120-cycle hum in picture	a. Check filter capacitors in low-voltage supply. b. Check capacitor C36-B. c. Check tube 6 for cathode leakage.	a. Fig. 20 b. Fig. 12 c. Fig. 8
Dark spots on picture tube	a. Replace tube.	a. Fig. 17
Streaks in picture 	a. Check lead dress in high-voltage supply to prevent corona or arcing. b. Check antenna system to minimize effects of external electrical disturbances. c. Check for noisy or gassy tubes.	a. Fig. 18 c. Fig. 17

OTHER CONDITIONS

Oscillation in audio or video i-f system	a. Check alignment. b. Check for defective by-pass capacitors.	Figs. 8, 9
High voltage below normal	a. Check tube 18. b. Replace tube 19 with a tube known to be good. c. Check sweep output coupling capacitors C78, C82, C96, C99 for leakage. d. Check wiring and circuit of high-voltage supply and high-voltage divider network.	a. Fig. 17 b. Fig. 17 c. Figs. 14, 15 d. Fig. 10
No high voltage	a. Check tubes 18 and 19. b. Check for short in capacitor C89 or C90. c. Check circuit of high-voltage supply and leads on high-voltage oscillator coil.	a. Fig. 17 b. Fig. 10 c. Fig. 10

V. DESCRIPTION OF CIRCUITS

All electrical components of this television receiver are assembled on one main chassis, making for optimum ease of adjustment and service. The chassis comprises several complete sub-chassis assemblies, each of which can be readily removed. (Refer to figures 17 and 19.)

A brief description of the operation of each sub-chassis assembly and stage is furnished in the following paragraphs. These descriptions cover both the mechanical and electrical techniques used in this receiver. In the partial schematics which accompany the descriptions, circled capital letters indicate the points at which the illustrated wave shapes are taken. Lower case letters correspond to the letters on the associated coils (also illustrated). The wave shapes were obtained with a DuMont type 241 Oscilloscope.

1. BLOCK DIAGRAM

Figure 4 below is a block diagram which will be found useful in signal tracing and in visualizing the operation of the receiver as a whole. Wave shapes at critical points in the circuits are illustrated in the descriptions of the circuits themselves.

Numbers in parentheses within the blocks correspond to the reference symbols of the associated tubes in the schematic diagram.

2. TUNER ASSEMBLY

The tuner sub-chassis assembly combines the r-f amplifier, converter, and oscillator stages, using slugs to tune coils continuously through the high and low television bands. A ganged switch assembly changes each stage from the high to the low band. The entire tuner is rubber-mounted to the main chassis to eliminate microphonics.

To inspect and service the tuner wiring from the top, it might be necessary to remove picture tube, shield, and tuner cover.

Complete removal of the tuner chassis from the main chassis requires the following operations:

1. Remove the picture tube and shield (see figure 17 for Model 22A21 or 22AX21).
2. Loosen the flexible dial coupling with a No. 4 Allen wrench.
3. Remove the dial scale assembly.
4. Remove the wiring of the tuner at the main chassis tie points.
5. Remove the tuner mounting screws.
6. Lift the front of the tuner in an arc toward the back of the set as if it were hinged.

Replacement of coils and other parts in a congested area of the tuner may require dismantling the tuner. Instructions for dismantling are as follows:

1. Remove the tuner from the chassis.
2. Remove the tubes and tighten the trimmer adjustment screws to prevent breaking.
3. Remove the push-on type grip washer at the back end of the tuning shaft by inserting a pointed tool under the grips and lifting off.
4. Take out the four self-tapping screws, holding the case, and gently separate the case from the tube panel.

The illustration of the ribbon tuning coils and the specifications for setting the slugs, shown in figure 5, will be useful when replacements are necessary.

The tuning shaft should make 12½ complete revolutions from stop to stop. The stops may be re-set by

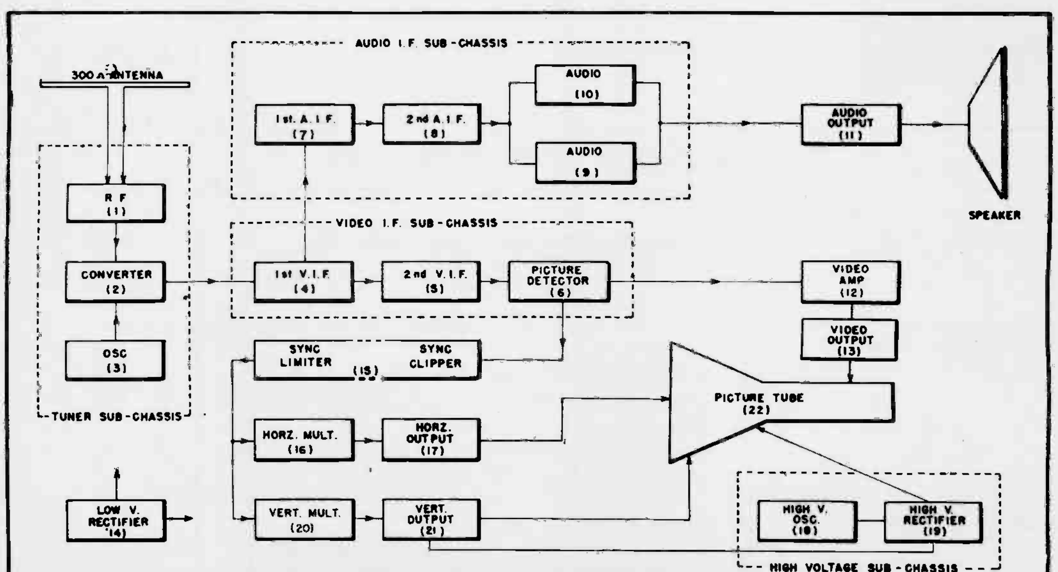


Figure 4. Block Diagram of Complete Receiver

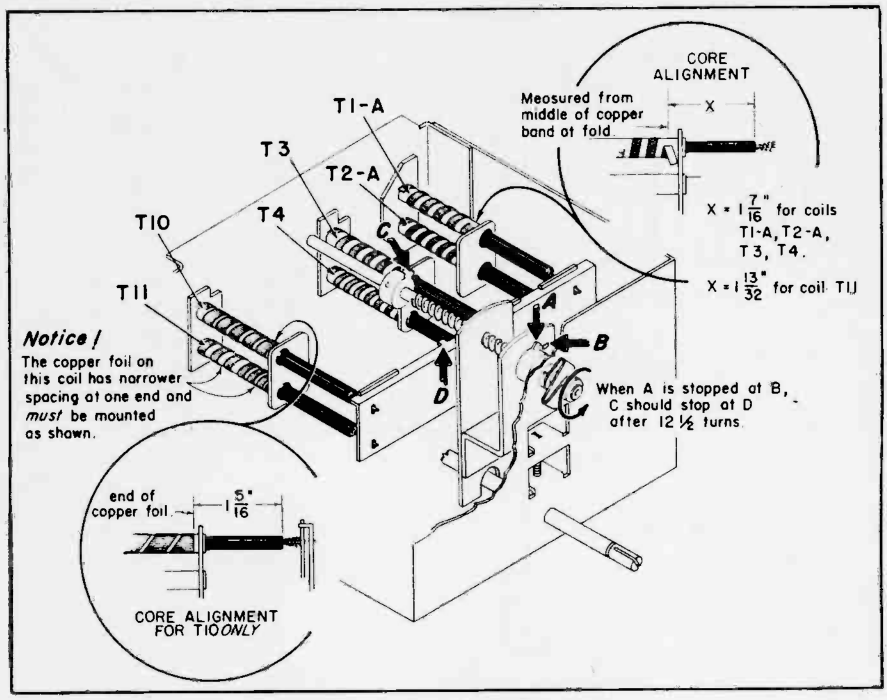


Figure 5. Tuner Core Adjustment

first loosening them with a No. 6 Allen wrench, and then rotating and re-tightening them. The stop adjustments are indicated by arrows in the illustration.

The procedure used to set the red dial indicator slide with relation to the rest of the dial assembly is shown in figure 6.

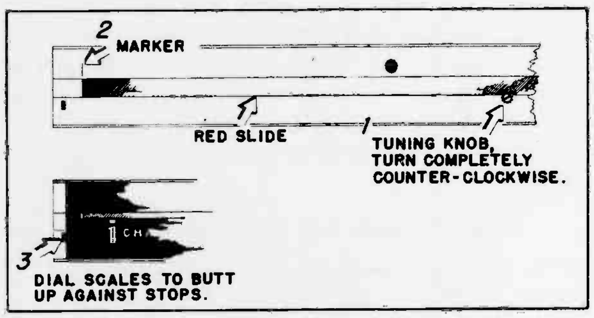


Figure 6. Dial Alignment

3. R-F Amplifier

The r-f amplifier (see figure 7) makes use of a type 6AK5 tube (1) employing higher-than-normal bias in order to reduce input loading on the high-band coils. However, resistor R2 is used to damp low-band coil T1-A.

The gain of the r-f amplifier is controlled by the AVC voltage developed by the video detector current.

The antenna is transformer coupled to the input of the r-f amplifier, and is connected to a balanced coupling coil to provide a substantially constant input impedance of 300 ohms to the antenna throughout each band. Band switch S1-A and S1-B connects the antenna to coupling coil T1-B on the low band and to coil T2-B on the high band.

Varying the inductance of coils by means of slugs to cover a wide band requires that the shunt capacitance be small with respect to the size of the coil. On the high band, the shunt capacitance (the inter-electrode capacitance of the tube) is large with respect to the coil, and in order to increase the size of the coil and maintain the same effective reactance, a trimmer is connected in series with the coil. The coils employing this arrangement are T2-A with series trimmer C3, and T3 with series trimmer C6.

4. Converter

The converter (see figure 7) makes use of a type 6AK5 tube (2) biased by both cathode bias (R10 and C13) and the oscillator voltage appearing on the grid causing rectification and charging the grid resistor-and-capacitor combination of R9 and C46.

The output of the r-f amplifier is coupled to the converter through a single tuned plate load 6 megacycles wide.

The converter grid is coupled to the oscillator by means of capacitor C46.

The converter i-f transformer T5 is double-tuned to a center frequency of 25.25 megacycles and over-coupled to provide a band width of 3.5 megacycles.

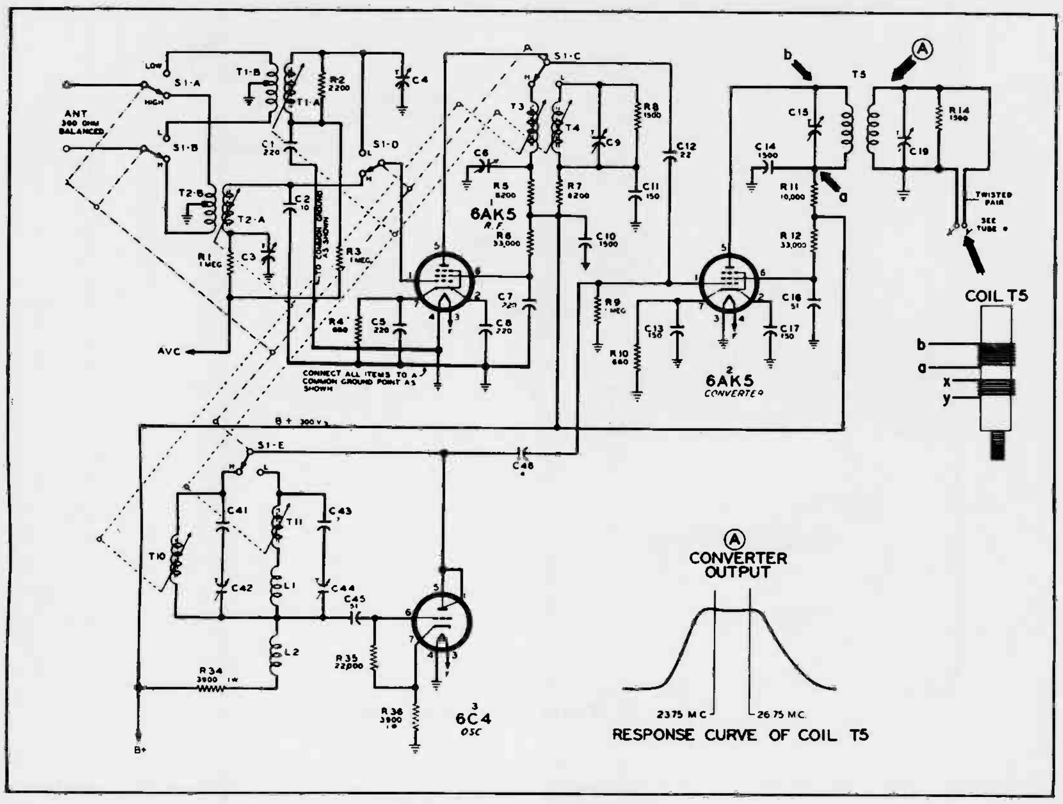


Figure 7. Tuner Section

Resistor R8, connected across coil T4, and resistor R14, connected across the secondary of coil T5, provide loading to give a flat response. A twisted pair (X, Y) connects the secondary of coil T5 to the input of the 1st video i-f amplifier (tube 4) at points X and Y.

5. Oscillator

The oscillator (see figure 7) makes use of a type 6C4 tube (3) connected as a modified Colpitts using the cathode-to-grid and cathode-to-plate inter-electrode capacities to maintain oscillation.

The slug-tuned low-band coil uses inductance L1 to adjust band coverage. Increasing the inductance of L1 by pressing the winding closer together will reduce the effective range of coil T11. Likewise, spreading the winding of coil L1 will increase the effective range of coil T11.

Resistors R34 and R36 isolate the oscillator, permitting it to operate as a Colpitts over the full television bands. Choke coil L2 is needed to isolate further the oscillator tuned circuits, providing a d-c path to the plate circuit.

The oscillator is tuned 26.75 megacycles above the picture carrier. Oscillator trimmers C42 and C44 are connected in series with the fixed capacitors C41 and C43 both to limit the range of adjustment and to place the adjusting screw at a point cool with respect to ground. However, it is recommended that a well-insulated alignment tool designed for high frequencies be used for this adjustment. The oscillator is biased by the feedback voltage appearing on the grid, rectifying and charging the resistor-capacitor combination of R35 and C45.

6. VIDEO I-F SUB-CHASSIS

The video sub-chassis assembly combines the first and second video i-f amplifiers and the video detector stages, employing double-tuned circuits overcoupled to have a 3½-megacycle bandwidth with a 25.25-megacycle center frequency. Resistor R42 and contrast control R47 damp the secondaries of i-f coils T12 and T13 to provide a flat-topped response curve. A third winding is provided on i-f coil T12 to absorb the 22¼-megacycle sound i-f, and to provide rejection of this frequency and thus prevent it from entering the second video i-f stage.

The first video i-f amplifier (see figure 8) is connected to the tuner sub-chassis assembly through a twisted pair, X and Y. The first and second video i-f amplifiers make use of type 6AH6 tubes (4 and 5) with

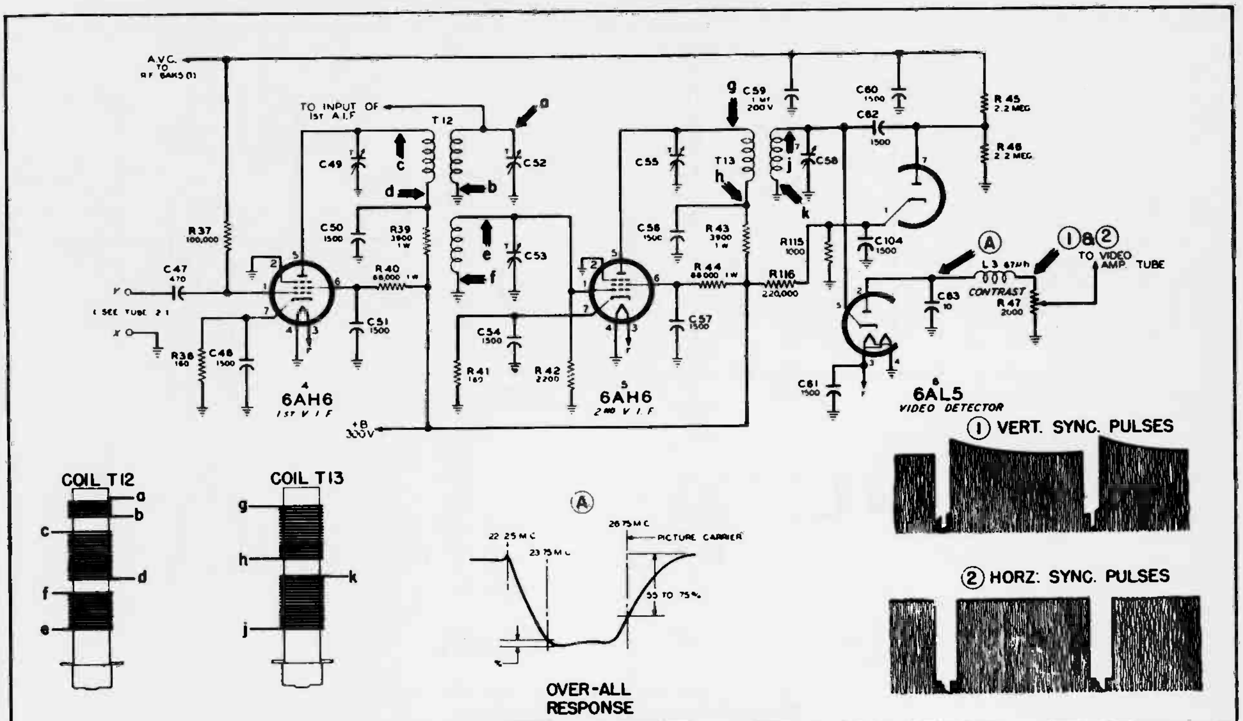


Figure 8. Video I-F Section

the first video i-f tube AVC controlled by the video carrier appearing at the video detector. Trimmers C49, C53, C55, and C58 provide adjustment of the i-f coils.

The second video i-f stage feeds one diode of a 6AL5 tube (see figure 8) as a conventional AM detector, while capacitor C62 couples the other diode to provide AVC to the r-f and first video i-f amplifiers.

Peaking coil L3 and capacitor C63 act to maintain a flat frequency response (see figure 12).

An electrostatic shield between video i-f coils T12 and T13, grounded at three points, helps prevent interaction between the sound and the video.

7. AUDIO I-F SUB-CHASSIS

The audio i-f assembly combines the first and second audio i-f amplifiers and the audio detector and amplifier, using single-tuned i-f coils peaked at 22.25 megacycles with an FM detector. The first and second audio i-f amplifiers make use of type 6BA6 tubes (7 and 8, figure 9), the tubes being AVC-controlled by voltage developed in the audio detector. The absorption winding of coil T12 is connected to coupling capacitor C18 at the grid of the first audio i-f tube through a twisted pair.

The plate circuit of the first audio i-f amplifier tube is tuned to resonance at 22.25 megacycles (by capacitor C22 and adjusted with coil T6) and capacitively coupled (C28) to the grid of the second audio i-f amplifier. The plate circuit of the second audio amplifier tube is also tuned to resonance at 22.25 megacycles (by capacitor C25 and adjusted with coil T7-A.) A pick-up coil on T7-A provides coupling to the balanced tuned input (C29 adjusted by T7-B) of the FM audio detector. Coil T7-B is adjusted to provide a balanced FM response curve with AM rejection at 22.25 megacycles.

The audio detector makes use of a type 6AL5 tube (9) which serves as both the FM detector and AVC tube for the audio i-f tubes. The audio detector diode currents develop equal and opposite voltages across resistors R23 (negative) and R22 (positive) with respect to ground when an unmodulated sound carrier is present. The negative voltage is used for AVC with resistor R24 and capacitor C100 filtering out the audio. Conversely, when the sound carrier is FM-modulated, the voltages developed across resistors R23 and R22 change in amplitude and produce an audio voltage drop across resistor R25.

The output of the detector is coupled to the audio amplifier through capacitors C33 and C35 and volume control R26. Capacitors C33 and C35 not only provide coupling but also prevent DC from creating noise in the volume control.

The audio amplifier makes use of a type 6AU6 tube (10) which is also located on the sound i-f chassis. This tube is connected as a conventional screen-grid type voltage amplifier with capacitors C34 and C101 acting both to prevent secondary detection and to set the audio-frequency response to provide ideal highs and lows.

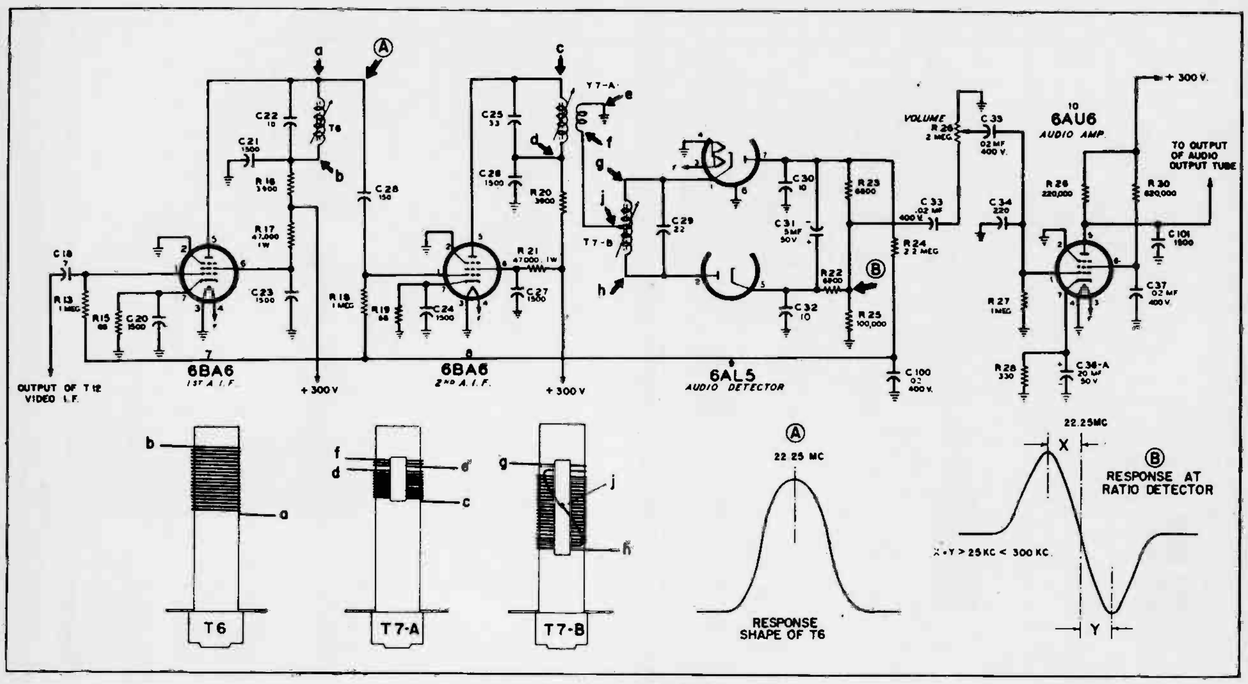


Figure 9. Audio I-F Section

8. HIGH-VOLTAGE SUPPLY

The high voltage supply (see figure 10) combines the high voltage oscillator, rectifier, and filter on a separate chassis mounted on the main chassis.

This assembly makes use of a type 6V6-GT/G tube (18) as a tuned-plate r-f oscillator with two additional windings on oscillator coil T15 to provide high a-c voltage and filament voltage for the type 1B3GT/8016 rectifier tube (19).

A perforated shield reduces radiation of the oscillator coil, eliminating communication interference, and at the same time guards the coil from undue handling.

All wiring accessible from the top of this sub-chassis is safe to handle while the set is in operation; however, a minor r-f burn may be experienced when approaching the cap of the rectifier tube. The lead from the secondary coil to the cap of tube 19 should be dressed as far from the tickler winding and shield as possible to prevent arcing.

Since there is no way to measure the heating efficiency of the filament of the rectifier tube (19) by r-f means, a visual test comparing the brilliance with that obtained by the use of a 1.6-volt dry cell battery on a similar tube must be applied.

Resistor R82 and capacitors C89 and C90 filter the

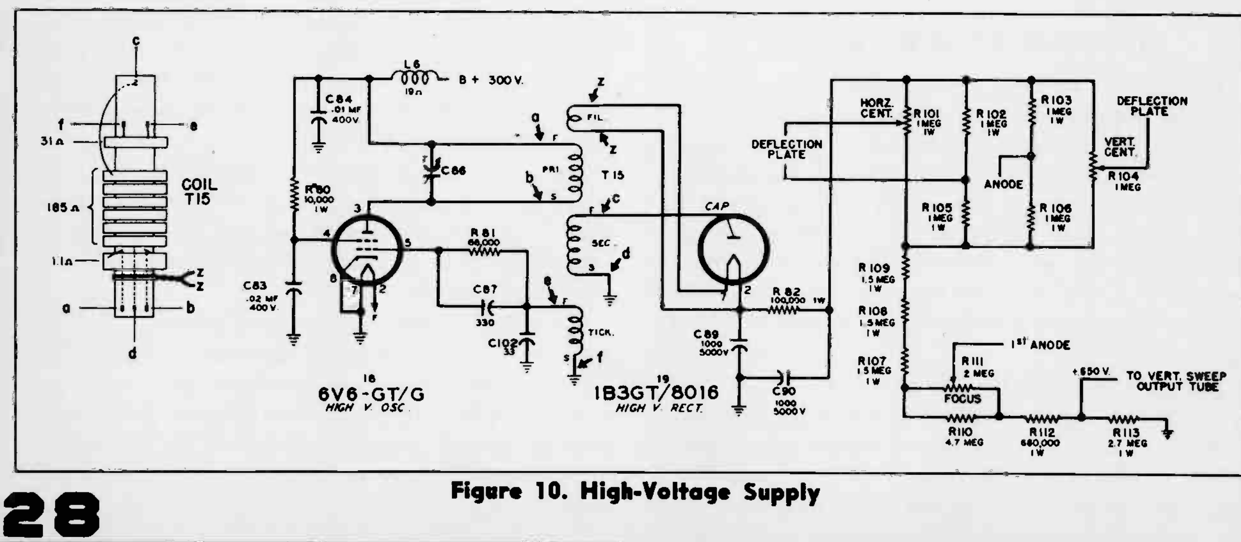


Figure 10. High-Voltage Supply

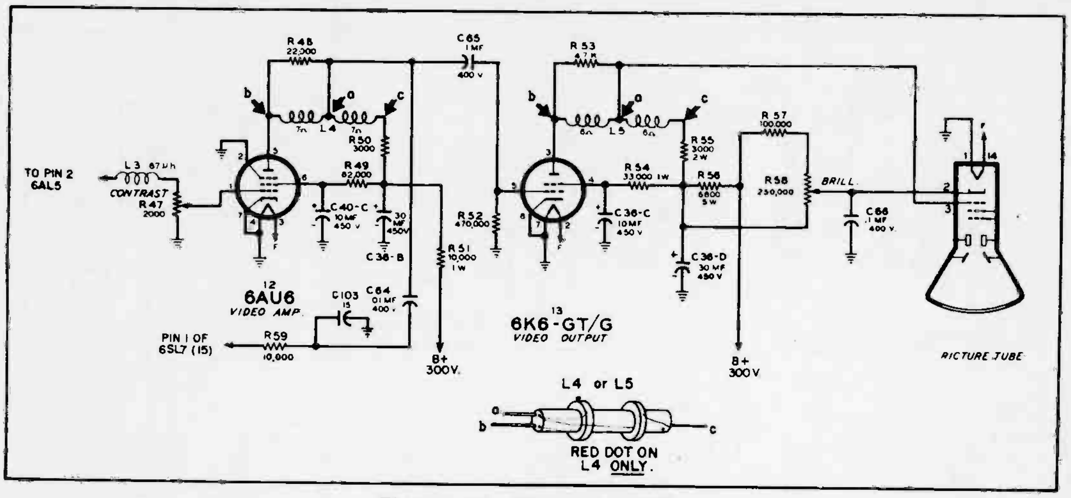


Figure 11. Video Amplifier

r-f from the d-c output. This supply is capable of supplying 5,000 volts dc across a 9.5-megohm load at approximately 550 microamperes. Trimmer C86 provides primary tuning of coil T15 to resonate with the secondary. This trimmer can adjust the output of the high-voltage supply to produce in excess of 5000 volts, but for proper operation of the set this voltage should be reduced to 5000 by a *clockwise* rotation of the trimmer after peaking.

9. VIDEO AMPLIFIER AND OUTPUT STAGE

The video amplifier (see figure 11) uses a type 6AU6 tube (12) biased only by the negative video detector currents appearing in contrast control R47. The video amplifier supplies signal to both the sync amplifier tube (15) and the video output tube (13). The video detector biases the video amplifier at proper contrast level so as to clip off noise peaks appearing in the sync.

The video output uses a type 6K6-GT/G tube (13) which is self-biased by rectification of the positive blanking pedestals appearing on the grid. The high time constant of capacitor C65 and resistor R52 holds the bias constant, independent of changes in picture composition. This method of bias, along with direct current coupling to the grid of the picture tube, provides proper d-c restoration.

Brilliance control R58 biases the picture tube to obtain the proper black level by changing the cathode return relative to the voltage drop across resistor R56. Resistor R57 limits the effective range of this control.

Peaking coils L3, L4 and L5, damping resistors R48 and R53, and low-value load resistors R47, R50 and R55 provide the necessary compensating network to maintain a frequency response flat to within 3 db out to 3½ megacycles with a voltage gain of approximately 50 (see figure 12).

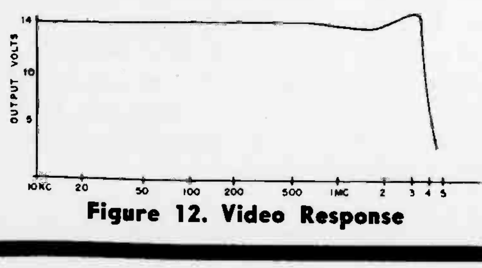


Figure 12. Video Response

10. SYNC AMPLIFIER AND LIMITER

The sync amplifier and sync limiter (see figure 13) share a type 6SL7 tube (15). The first section amplifies the sync signal obtained from the output of the video amplifier tube (12) through coupling capacitor C64 and isolating resistor R59. The sync amplifier is self-biased by resistor R60 and operates at a low plate voltage obtained from resistance dividing network R61 and R63. The use of low plate voltage enables this stage to clip off video appearing on the sync signal.

The second section acts as a limiting cathode follower which clips off noise peaks and supplies constant sync voltage to the multivibrators.

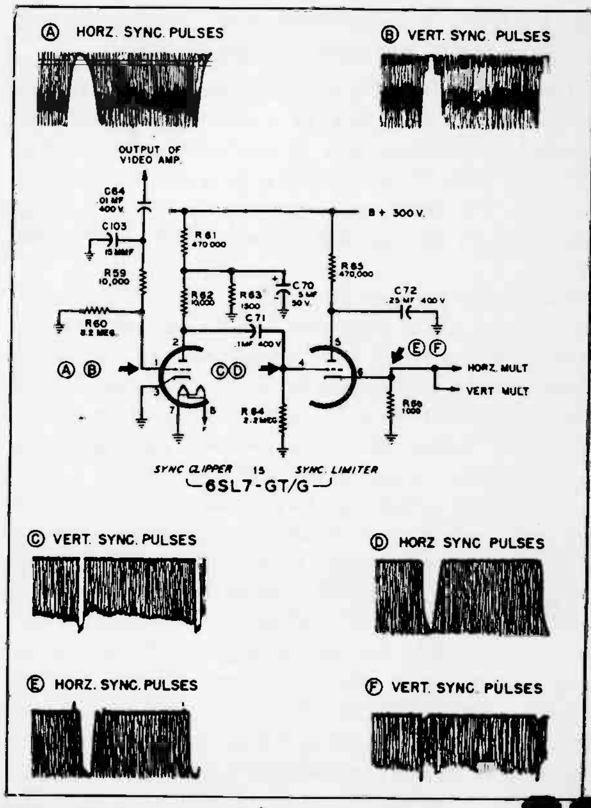


Figure 13. Sync Amplifier and Limiter

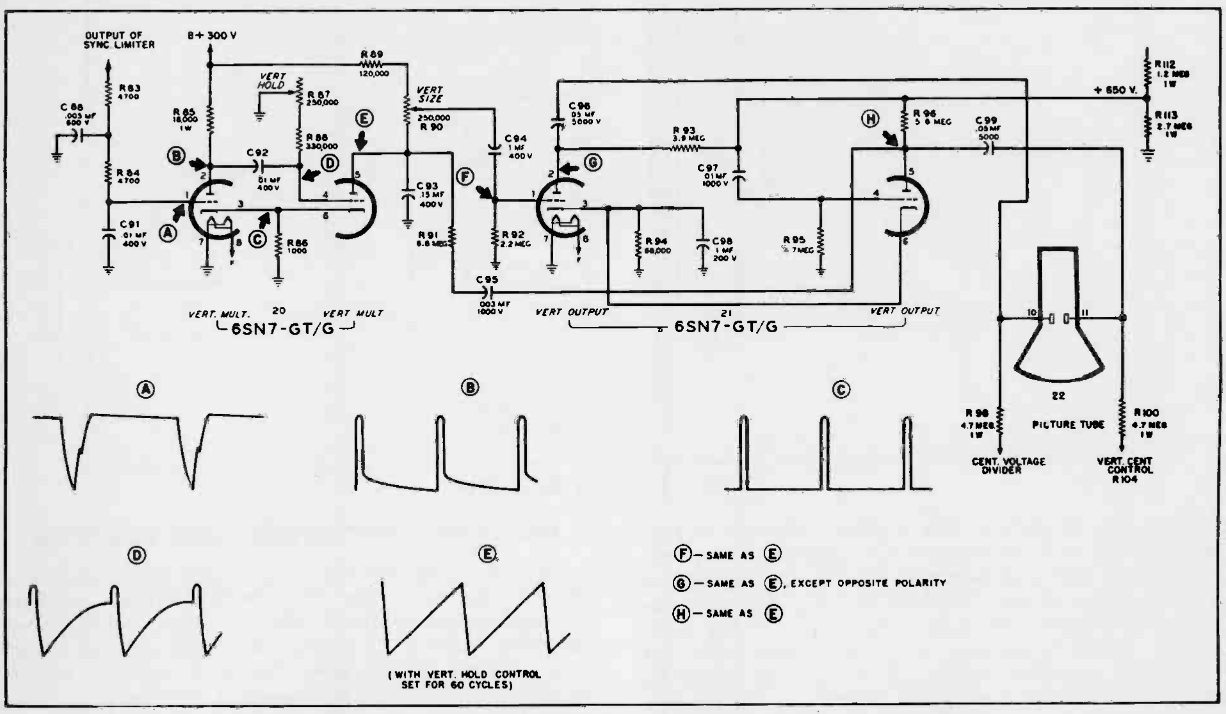


Figure 14. Vertical Sawtooth Generator and Sweep Amplifier

11. VERTICAL SAWTOOTH GENERATOR AND SWEEP AMPLIFIER

The vertical sawtooth generator (see figure 14) uses a type 6SN7 tube (20) as a conventional cathode-coupled multivibrator with an intergrating circuit (R83, C88 and R84, C91) feeding sync pulses to the first grid (pin 1). The vertical multivibrator can be easily adjusted with vertical hold control R87 to sync at 60 cycles.

The second plate of the multivibrator acts as a discharge tube across capacitor C93 to form a sawtooth output. The value of this sawtooth-forming capacitor, along with the series charging resistors R89 and R90, is such as to permit use of the linear portion of the charging curve. Vertical size control R90 acts as a gain control to change the size of the picture vertically.

The vertical output uses a type 6SN7 tube (21) as a push-pull deflection plate driver. The phase inversion to drive the second section of this tube is obtained by using the small differential sweep voltage appearing across both resistor R113 and resistors R112 and R111. The required B+ voltage to supply sufficient drive from this stage is obtained from the high-voltage bleeder resistor R113. In addition, this stage is biased higher than normal to reduce the current drain from the high-voltage supply (approximately 250 microamperes).

12. HORIZONTAL SAWTOOTH GENERATOR AND SWEEP AMPLIFIER

The horizontal sawtooth generator (see figure 15) uses a type 6SN7 tube (16) as a conventional cathode-coupled multivibrator with a differentiating circuit, capacitor C73 and resistor R67, feeding sync pulses to the first grid (pin 1).The horizontal multivibrator can be easily adjusted with horizontal hold control R71 to sync at 15.75 kilocycles. The second plate of the multivibrator acts as a discharge tube across capacitor C76 to give a sawtooth output. A small change in the value of this capacitor C76 greatly affects the size of the sawtooth output. The value of sawtooth forming capacitor C76, with charging resistors R74 and R72, is such as to permit use of the linear portion of the charging curve. Changing the value of horizontal size control R74 changes the size of the picture horizontally.

The horizontal output uses a type 6SN7 tube (17) as a push-pull deflection plate driver. The phase-inversion network (R78, R114, and C79), together with resistor R79 and capacitor C80, is so designed that the second grid voltage is self-compensated to give equal outputs from both sections. The plates of the output tube connect to the B+ 300-volt line through chokes L7 and L8, providing a balanced a-c load.

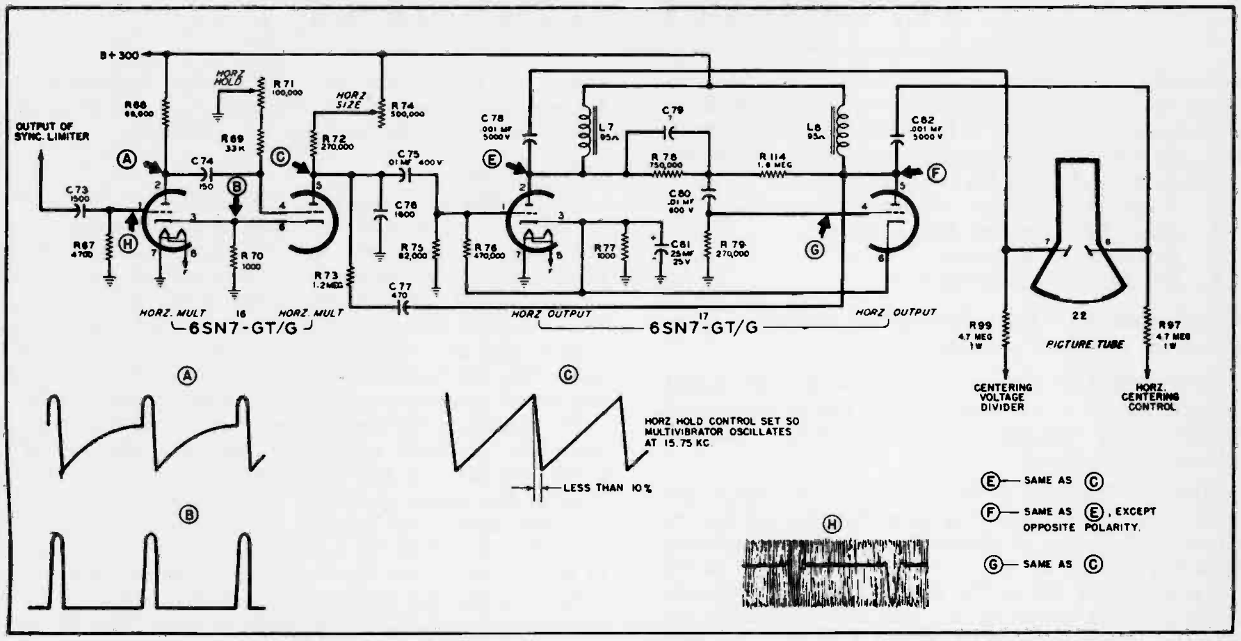


Figure 15. Horizontal Sawtooth Generatór and Sweep Amplifier

13. AUDIO OUTPUT STAGE

The audio output stage (see figure 16) employs a conventional single-ended 6K6-GT/G output tube (11) driving a 6-inch electrodynamic speaker with a 3.2-ohm voice coil. The overall distortion is less than 5% at 1½ watts and starts to break up at slightly over 3 watts. Resistor R33 and capacitor C40-B filter out 120-cycle ripple from the low-voltage supply and prevent audio current changes from modulating the 300-volt d-c supply to the rest of the receiver.

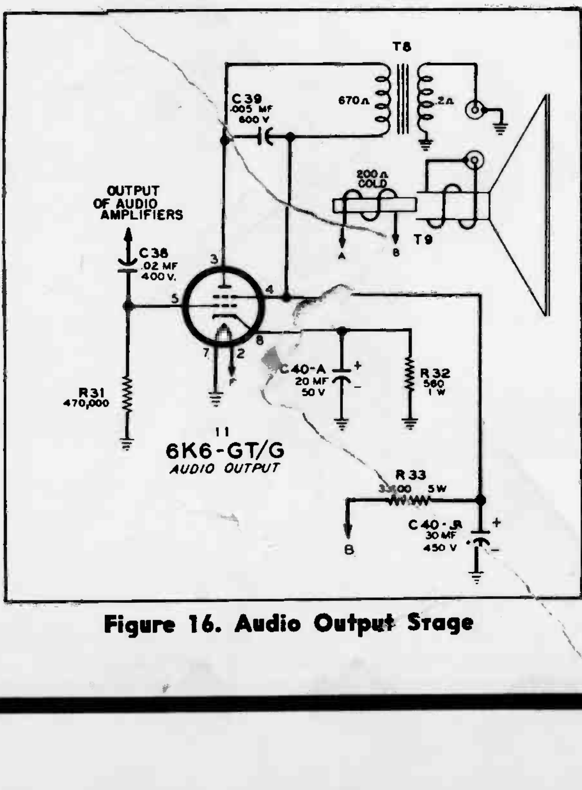


Figure 16. Audio Output Stage

14. LOW - VOLTAGE POWER SUPPLY

The low-voltage supply uses a 5U4 full-wave rectifier tube (14) and supplies 300 volts DC at approximately 200 milliamperes. The speaker field offers approximately a 4-henry filter at 200 milliamperes and is used with electrolytic capacitors C69-A, C69-B, C69-C, and C40-D to provide proper B+ filtering. The resistance of the speaker field is approximately 220 ohms when cold.

The primary resistance of the power transformer is 1.8 ohms and the resistance of the total secondary is 86 ohms.

15. PICTURE TUBE

The picture tube is operated with the heater grounded and with the second anode at a +5000-volt potential.

Caution: On the Model 22A21 or 22AX21 receiver, care must be exercised in keeping magnetic material away from the shield. Should the shield become magnetized, a demagnetizer can be made by removing the laminations from one side of a filter choke, wiring the choke coil to the a-c line, and passing the open end over the surface of the shield.

If a test is to be made to determine whether or not the picture tube is defective, either install it in a set known to be operating properly, or replace the tube with another known to be good.

VI. CIRCUIT ALIGNMENT

General. A complete alignment of this television receiver consists of the following individual alignment procedures, listed below in the correct sequence. However, any one alignment may be performed without the necessity of re-aligning the other sections.

1. Video I-F Amplifier Alignment.
2. Audio I-F Amplifier Alignment.
3. Oscillator Adjustments.
4. R-F Amplifier Alignment.

Test Equipment. The following test equipment is required for alignment purposes:

CATHODE-RAY OSCILLOSCOPE.—This unit should preferably have a 5-inch screen and should have good high-frequency response, useful in making waveform voltage measurements.

MARKER SIGNAL GENERATOR.—This signal generator must have good frequency stability and be accurately calibrated. It should be capable of covering frequency ranges of 20 to 30 megacycles, 44 to 88 megacycles, and 174 to 216 megacycles. The generator should have an output of 0.1 volt with adjustable attenuation. Tone modulation is useful in checking AM rejection of the audio FM detector.

SWEEP GENERATOR.—This generator should give approximately 0.1 volt output with adjustable attenuation. The output should be flat over wide frequency variations of the sweep. The frequency coverage should be 20 to 30 megacycles, 40 to 90 megacycles, and 170 to 220 megacycles, all with a 10-megacycle sweep width. It is preferable that this generator have a sweep output to deflect the test oscilloscope horizontally. However, a sync sweep output or a 60-cycle line phasing sweep system may be used for this purpose.

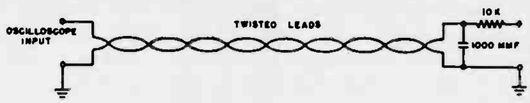
Other Notes.

Use a 1000-mmf capacitor, with small clips, to shunt the primary winding of the stage to which the signal generator is connected. This will prevent absorption which would alter the shape of the response curve.

Although all trimmers are on top of the chassis, it is recommended that the chassis be removed from the cabinet and set on its side with the transformer end down. This will facilitate connection of the oscilloscope and signal generator to the proper points in the circuit.

The outputs of the marker generator and of the sweep generator are both applied to the same signal-input point described in the alignment tables. Adjust the level of the marker generator so that the shape of the response curve is not "pulled" or changed. Connect the signal to the grid of the tube preceding the transformer to be aligned. Adjust the frequency of the sweep generator to center the response curve on the screen of the oscilloscope, and the sweep width to more than cover the band width.

It is recommended that the output of the audio and video detectors be connected to the input of the oscilloscope with a pair of twisted leads having an isolating network at the receiver end (see below).



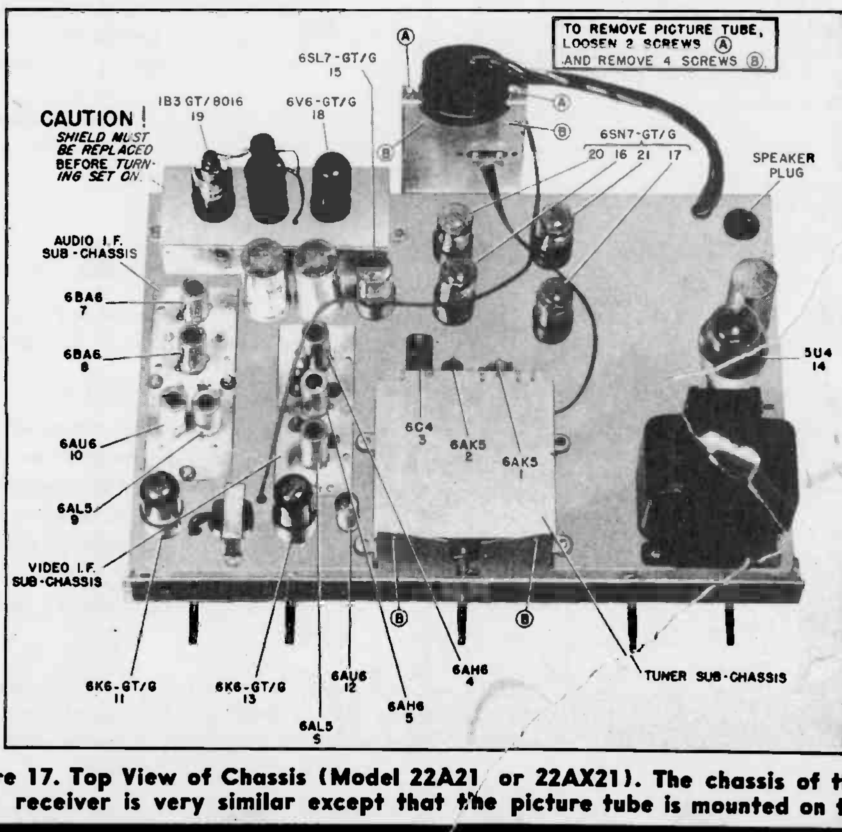
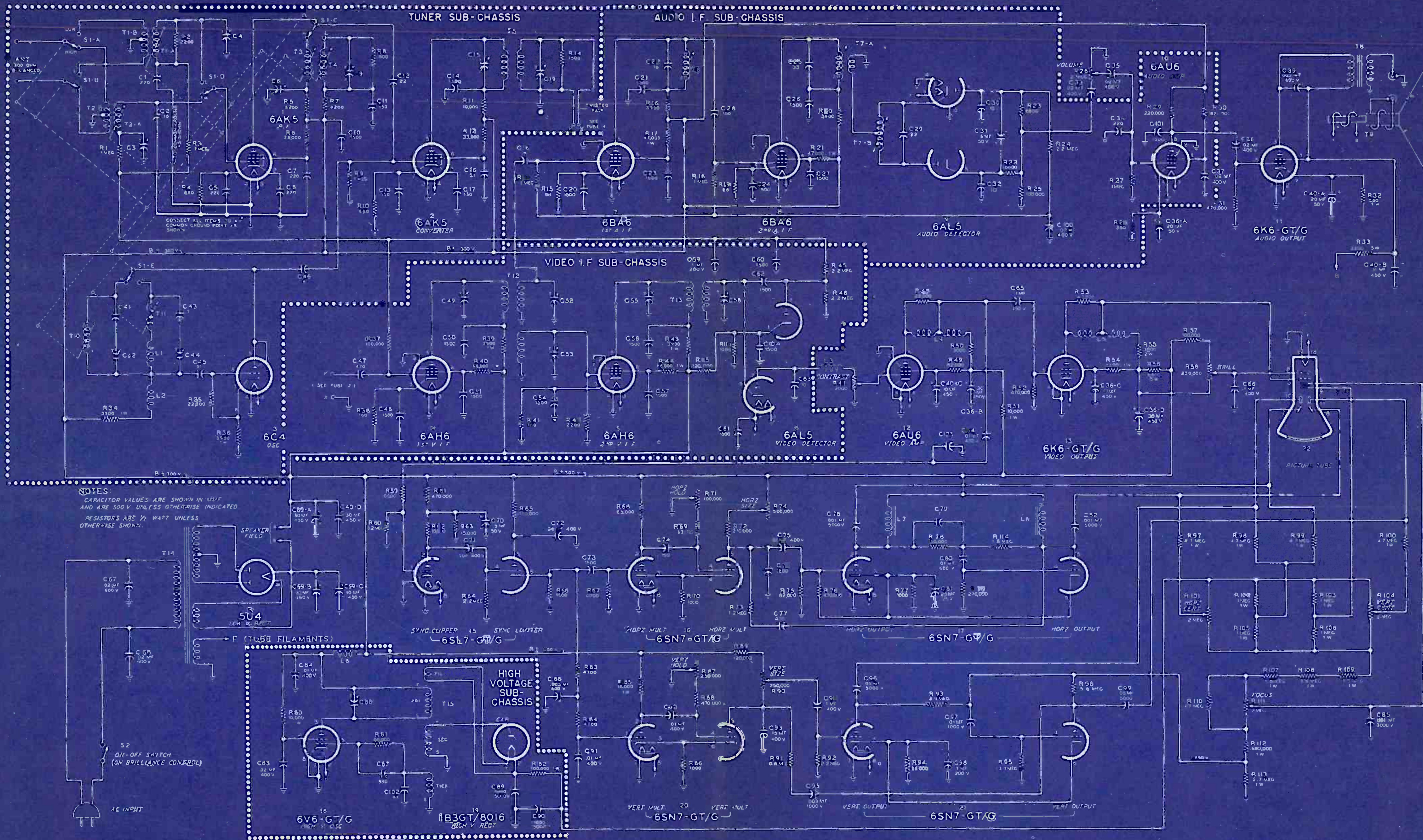


Figure 17. Top View of Chassis (Model 22A21 or 22AX21). The chassis of the Model 22AX22 receiver is very similar except that the picture tube is mounted on the cabinet.



NOTE: On some earlier sets R110 was 1 megohm and R112 was 1.2 megohms. The new values increase the range of the focus control.

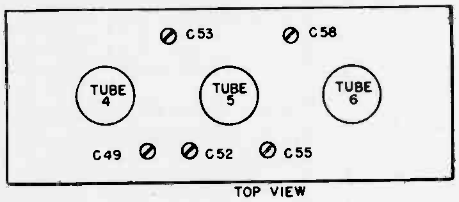
Figure 19. Schematic Diagram of Complete Receiver

Belmont Radio, Models 22A21, 22AX21, 22AX22

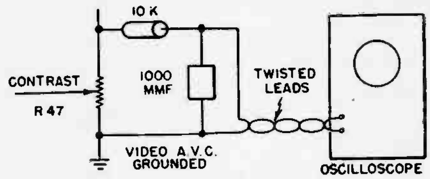
VIDEO I-F AMPLIFIER ALIGNMENT

Connect the oscilloscope to the output of the video detector using test leads as shown in the illustration below. Ground the video AVC. The overall response curve might be improved slightly by careful adjustment of each stage while observing the curve. Because the video AVC is grounded, it is recommended that the input signal level be such as to produce a 0.5-volt peak-to-peak detector output. This will prevent over-loading.

Adjustment of the sound frequency absorption trap, capacitor C52, is best done by turning off the sweep generator and using the tone-modulated 22.25-megacycle marker generator to adjust capacitor C52 for minimum AM at the output of the video detector.



TOP VIEW

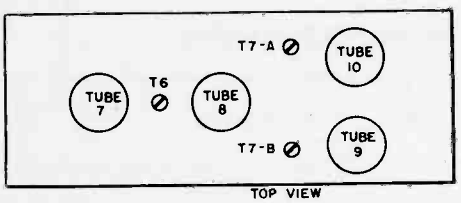


AUDIO I-F AMPLIFIER ALIGNMENT

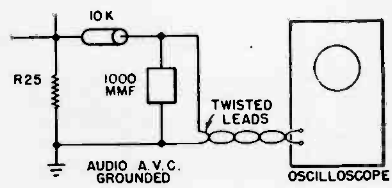
Connect the oscilloscope to the output of the audio detector (across resistor R25) using test leads as shown in illustration below. Ground the audio AVC.

The ratio detector secondary coil T7-B should be adjusted to give a marker at 22.25 megacycles as indicated in the detector response curve. The shape of the response curve should be such as to provide the minimum vertical voltage slope 25 kilocycles to each side of the 22.25-megacycle marker.

The audio i-f amplifiers are adjusted to produce the maximum total vertical size of the ratio detector response curve.



TOP VIEW



OSCILLATOR ADJUSTMENTS AND R-F AMPLIFIER ALIGNMENT

Oscillator

Connect the oscilloscope to the output of the audio detector (across resistor R25) using leads as illustrated in the Audio Alignment information above. Ground the audio and video AVC.

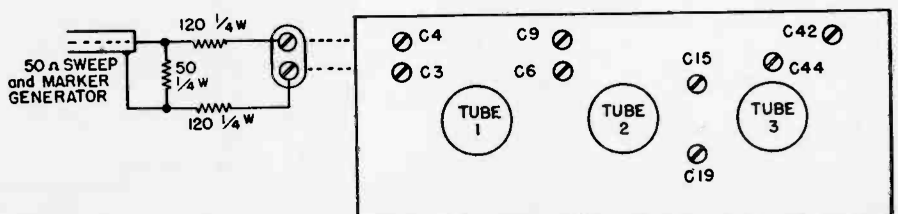
The primary purpose of this alignment is to provide proper oscillator tracking over each band. When the dial indicator is set at a given channel, the oscillator operating frequency, mixing with the sound carrier, should provide a 22.25-megacycle intermediate frequency as indicated by the marker position on the ratio detector response curve. On the low band, the oscillator coverage coil L1 provides means of increasing or reducing oscillator tracking coverage. Compressing the windings of this coil reduces the oscillator tracking range.

The dial indicator should come within one channel mark width of either side of the channel to which it is tuned. For these measurements the dial indicator must conform with instructions furnished in figure 6.

R-F Amplifier

Connect the oscilloscope to the output of the video detector using the test leads as illustrated in the Video Alignment information above. Ground the video and audio AVC.

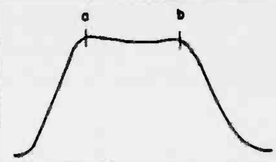
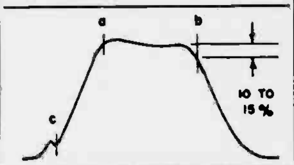
The overall video response curve will be influenced by both the r-f and converter adjustments. These adjustments are primarily set for maximum output. However, being single peaked although of broad band, they will provide a means of obtaining the response curve limits shown in the alignment table. It is necessary to stay within the response curve specifications at each channel throughout each band.



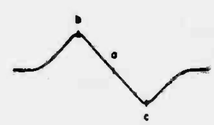
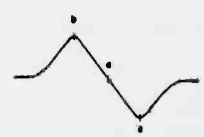
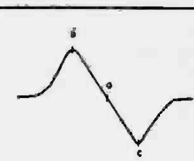
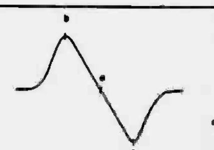
REAR VIEW OF TUNER

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

VIDEO I-F AMPLIFIER ALIGNMENT

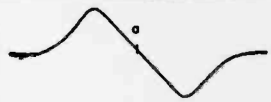
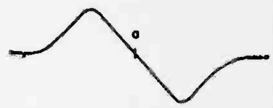
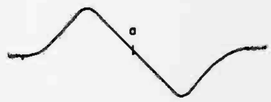
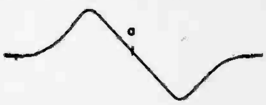
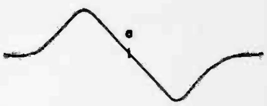
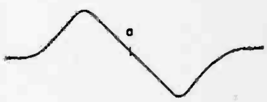
Step No.	Marker Generator Freq. (mc)	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve Across R47 (inverted)
1	(a) 23.75 (b) 26.75	20-30 mc 10-mc sweep	Tube 5 Pin 1	C55 C58	Shunt primary of T12 with 1000 mmf. Turn C52 in	
2	(a) 23.75 (b) 26.75 (c) 22.25	20-30 mc 10-mc sweep	Tube 4 Pin 1	C49, C53, C52 } T12	Remove shunt of step 1. Disconnect lead at point Y. Adjust C52 last	
3	(a) 23.75 (b) 26.75 (c) 22.25	20-30 mc 10-mc sweep	Tube 2 Pin 1	C15, C19 } T5 in tuner	Reconnect point Y.	

AUDIO I-F AMPLIFIER ALIGNMENT

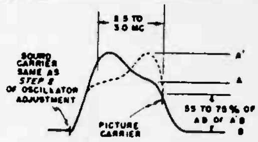
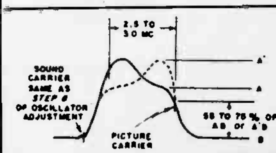
Step No.	Marker Generator Freq. (mc)	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve (across R25)
1	(a) 22.25 (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 8 Pin 1	T7-A T7-B	b to c greater than 50 kc and less than 600 kc	
2	(a) 22.25 (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 7 Pin 1	T6	b to c greater than 50 kc and less than 600 kc	
3	(a) 22.25 (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 4 Pin 1	C52	b to c greater than 50 kc and less than 600 kc T12 aligned per Video I-F Alignment	
4	(a) 22.25 (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 2 Pin 1	C52	b to c greater than 50 kc and less than 600 kc T5 and T12 aligned per Video I-F Alignment	

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

OSCILLATOR ADJUSTMENTS

Step No.	Marker Generator Freq. (mc)	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve Across R25 (inverted)
1	(a) 87.75	40-90 mc 10-mc sweep	Antenna input	C44	Set dial indicator at center of mark at channel 6	
2	(a) 49.75	40-90 mc 10-mc sweep	Antenna input	Adjust compression of L1	Tune dial to place marker "a" as illustrated. Indicator to be within mark width at channel 1	
3 4 5 6	(a) 59.75 (a) 65.75 (a) 71.75 (a) 81.75	40-90 mc 10-mc sweep	Antenna input	Adjust C44 and L1 alternately for best tracking	Indicator to be within mark width at channel 2 (for step 3) channel 3 (for step 4) channel 4 (for step 5) channel 5 (for step 6)	
7	(a) 203.75	170-220 mc 10-mc sweep	Antenna input	C42	Set dial indicator at center of mark at channel 11	
8	(a) 179.75	170-220 mc 10-mc sweep	Antenna input	C42	Tune dial to place marker "a" as illustrated. Indicator to be within mark at channel 7	
9 10 11 12 13	(a) 185.75 (a) 191.75 (a) 197.75 (a) 209.75 (a) 215.75	170-220 mc 10-mc sweep	Antenna input	Set C42 for best tracking	Indicator to be within mark width at channel 8 (step 9) channel 9 (step 10) channel 10 (step 11) channel 12 (step 12) channel 13 (step 13)	

R-F AMPLIFIER ALIGNMENT

Step No.	Generator Frequency	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve (across R47)
1	Sound Carrier Video Carrier	40-90 mc 10-mc sweep	Antenna input	C4 C9	Adjust for maximum amplitude and response as shown across low band.	
2	Sound Carrier Video Carrier	170-220 mc 10-mc sweep	Antenna input	C3 C6	Adjust for maximum amplitude and response as shown across high band	

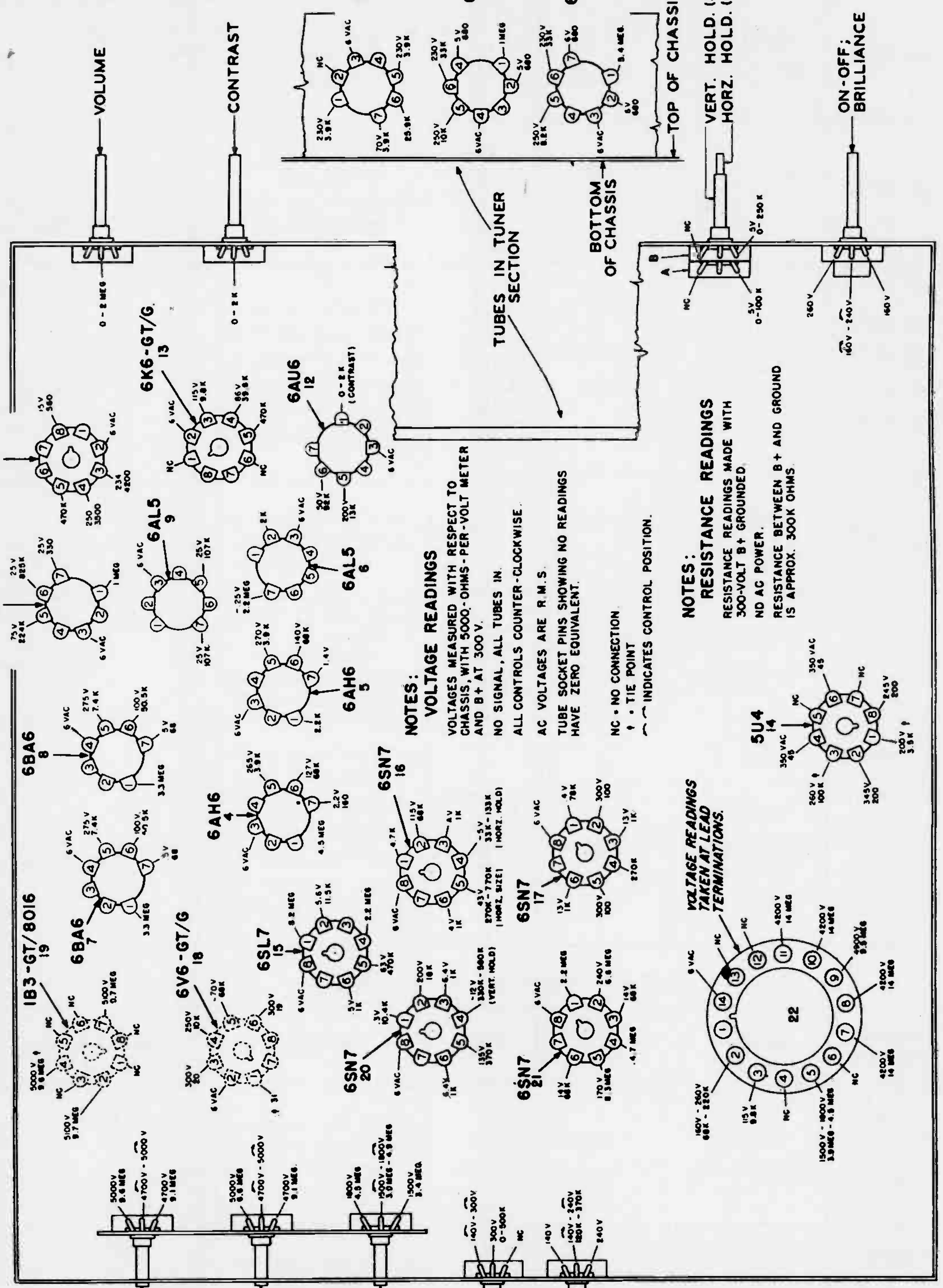


Figure 18. Voltages and Resistances at Tube Sockets and Controls

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

DU MONT TELESET

Model RA-103

1. GENERAL DESCRIPTION

The Du Mont RA-103 Teleset models Chatham, Stratford, and the Savoy all use essentially the same television receiver chassis to provide excellent television and frequency modulation reception. The chassis incorporates twenty-seven vacuum tubes including rectifiers and the twelve-inch direct view Teletron* which is mounted on the chassis. The two table models, Chatham and Stratford, use the same chassis (Type 7040A1). The only difference between the Chatham and Stratford is in their cabinet design. The Stratford is easily recognized by its doors which cover the front panel. The Savoy model utilizes the Type 7040A2 television receiver chassis which differs from the Type 7040A1 chassis only in the audio amplifier characteristics. The Savoy model contains, in addition to the television receiver chassis, a separate amplitude modulation broadcast band receiver, a record changer, and a record storage compartment. A separate record player can be plugged into the table models.

The most modern scientific advances in circuit design and construction have been incorporated in the Chatham, Stratford, and the Savoy, including the following noteworthy design features: continuous coverage wide range tuning (44-216 megacycles), flywheel synchronization circuits, and flyback type of high voltage power supply.

These telesets are designed to operate from a 115 volt, 60 cycle AC power source and are so designed as to operate satisfactorily over a range of 105 to 129 volts. The power consumed when operated from a 115 volt, 60 cycle source averages 290 watts on television and 160 watts on FM. The Savoy model averages 60 watts on AM.

The Model RA-103 Telesets are capable of delivering 3 watts of undistorted audio power into the loudspeaker. The Type 12JP4 Teletron* cathode-ray tube is used on all models and provides a high quality picture, 7-1/2 inches by 10 inches in size.

The front panel controls of the RA-103 Telesets are the Focus Control, Service Selector, On-Off and Volume Control, Brightness Control, Contrast Control and Tuning Dial. The tuning of the RA-103 teleset is simplified considerably by the addition of the tuning eye indicator which is located on the front panel. The following controls are located on the rear fold of the television receiver chassis: Horizontal Drive, Vertical Hold, Vertical Linearity, Vertical Size, Horizontal Positioning, Vertical Positioning, and Vertical Positioning Switch. The Horizontal Hold Control is an adjustment at the top of the shield and can be located on top of the chassis at the rear. It is accessible through an opening in the perforated back. In addition, the Savoy Console Model has on the front panel an AM Volume Control, AM Off-On Switch, AM Tuning Dial and Tone Control. The Horizontal Linearity Control is located on the underside of the chassis directly below the high voltage supply compartment and can be adjusted with a small screwdriver. The Horizontal Size Control is located above the Deflection Yoke and is fastened to the Focus Coil Mounting Bracket. The cathode-ray tube bias control is located at the left hand front corner of the chassis. See Figure 1 for a block diagram of the television receiver.

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*Trade Mark.

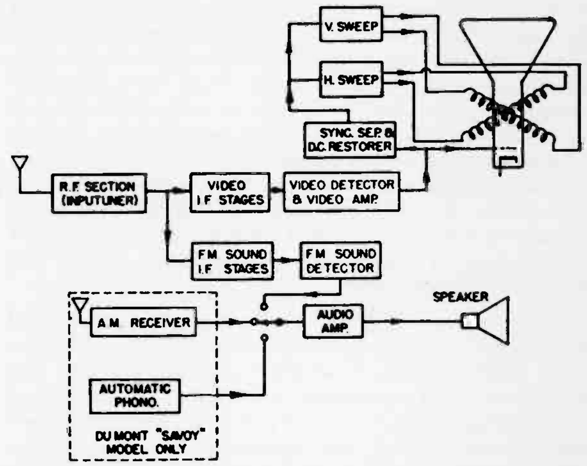


Figure 1. Block Diagram of Du Mont RA-103 Telesets

The following vacuum tubes are used in both the Type 7040A1 and Type 7040A2 television receiver chassis:

Tube Symbol	*Tube Type*	*Tube Function*
V101	6J6 (miniature)	R.F. Amplifier
V102	6AK5 (miniature)	Mixer
V103	6J6 (miniature)	V.H.F. Oscillator
V201	6AG5 (miniature)	1st Video IF
V202	6AG5 (miniature)	2nd Video IF
V203	6AG5 (miniature)	3rd Video IF
V204-A	6AL5 (miniature)	Video Detector
V204-B	Part of V204-A	D.C. Restorer and Sync Takeoff
V205	6AC7	Video Amplifier
V206	12JP4 (Teletron)	Picture Tube
V207	6AU6 (miniature)	Ist Sound IF
V208	6AU6 (miniature)	FM Sound Limiter
V209	6AL5 (miniature)	FM Sound Detector
V210	6SJ7	1st Sound Amplifier
V211	6V6GT/G	Sound Power Amplifier
V212-A	6SN7GT	Sync Clipper
V212-B	Part of V212-A	Horizontal Saw Generator
V213	6SJ7	Sync Clipper
V 214	6AL5 (miniature)	Sync Discriminator
V215	6K6GT/G	Horizontal Oscillator
V216-A	6SN7GT	Vertical Buffer
V216-B	Part of V216-A	Vertical Saw Generator
V217	6SN7GT	Vertical Deflection Amp.
V218	5U4G	Low Voltage Rectifier
V219	5U4G	Low Voltage Rectifier
V220	6AC7	Reactance Tube (Horz. sync)
V221	6BG6-G	Horizontal Deflection Amp.
V222	1B3-GT/8016	High Voltage Rectifier
V223	5V4G	Horizontal Damping
V224	6AL5 (miniature)	Time Delay Relay Tube

2. CIRCUIT DESCRIPTION OF THE MODEL RA-103 TELESET

2.01 Inputuner. (For schematic see Figure 9.)

The incoming signals picked up by the antenna are conducted to the input of the television receiver by means of a 73 ohm, low-loss transmission line (co-axial cable). The transmission line is terminated by the cathode input circuit of the grounded-grid RF Amplifier V101. This input circuit is capacitively coupled to the transmission line by means of capacitor C101. The untuned input circuit has been designed so that it presents the proper impedance match to the transmission line over the entire tuning range from 44 to 216 megacycles. The inductance L106 in parallel with the antenna input, provides a high-pass, radio-frequency filter to suppress broadcast-band or other low-frequency, cross-modulation interference which may arise when the television receiver is located in an extremely intense field of a local AM broadcast station or other radiator. The parallel combination C116 and R111 are placed in the grid return lead to ground in order to suppress parasitic oscillations.[1]

The plates of the Type 6J6 RF Amplifier (V101) are coupled to the grid of the Type 6AK5 mixer tube (V102) by means of a six megacycle wide broad-band coupling network. The variable series coil combinations consisting of L101-L102A and L104-L102B tune to the desired signal frequency in conjunction with the associated tube capacities and the coupling network consisting of C105, C106 and C107. Resistors R110 and R104 reduce the "Q" of the respective coils considerably in order for the coupling network to maintain the very wide pass band.

The VHF oscillator utilizes one section of the twin triode Type 6J6 (V103) in a modified Colpitts Oscillator circuit. The feedback voltage from the plate to the grid of the oscillator tube is accomplished by means of the interelectrode capacity of the vacuum tube. The oscillator frequency is adjusted by movement of the tap on the coil L102C which short circuits a portion of the coil. The oscillator circuit is factory aligned to track with the signal circuits located in the plate of the RF Amplifier V101 by adjusting the inductance of L103 and capacitance of C111.

The oscillator output is coupled to the grid of the mixer tube V102 by means of capacitor C112. Both the incoming signal and the oscillator voltages are fed into the grid of the mixer tube V102. The plate of V102 feeds into the first video IF transformer.

[1] On the later models C116 and R111 have been eliminated.

2.02 Video IF Amplifier

The video IF amplifier chain consists of three stages using the type 6AG5 sharp cutoff high gain pentode (V201, V202 and V203.) See Figure 2. Each video IF coupling network consists of two adjustable coils which are resonant with their respective tube capacities and coupling networks. The first video IF coupling network utilizes shunt inductive coupling, the second and fourth video IF coupling networks use the series type of inductive coupling, and the third network is a specially terminated "M" derived bandpass filter network. The two parallel resonant traps in the series arm of the pie network in the third coupling network provide a high degree of attenuation to the sound carrier of the station being received and to the sound carrier in the adjacent channel.

The grid of the first and second video IF stages, V201 and V202, are returned to a variable negative bias provided by the Contrast Control, which thus varies the gain of the IF amplifier. The third video IF amplifier stage is operated at maximum gain. The input to the FM sound IF amplifier system is taken from the plate of the first video IF amplifier V201.

The output of the fourth video IF coupling network is fed into one diode section of the 6AL5 video detector V204A and the diode load which consists of resistor R219 and peaking coils L213 and L214.

2.03 Video Amplifier.

The grid of the video amplifier tube V205 is directly connected to the diode load. A fixed bias of –3 volts (when no signal is present) is maintained on the grid of the video amplifier V205 by returning the low potential end of the diode load resistor R219 to the –3 volt point of the bleeder resistor network consisting of R216, R220 and R233.

The plate of the video amplifier is coupled to the Type 12JP4 Teletron, V206, by means of the resonant trap consisting of L216 and C217, and capacitor C218. This resonant trap is tuned to 4.5 megacycles and provides the video amplifier section with an extremely sharp cutoff characteristic thereby contributing to the elimination of interference from the sound carrier of the incoming television station.

2.04 DC Restorer and Sync Separator.

The plate of the video amplifier is also coupled to the second section of the Type 6AL5 vacuum tube V204B and the

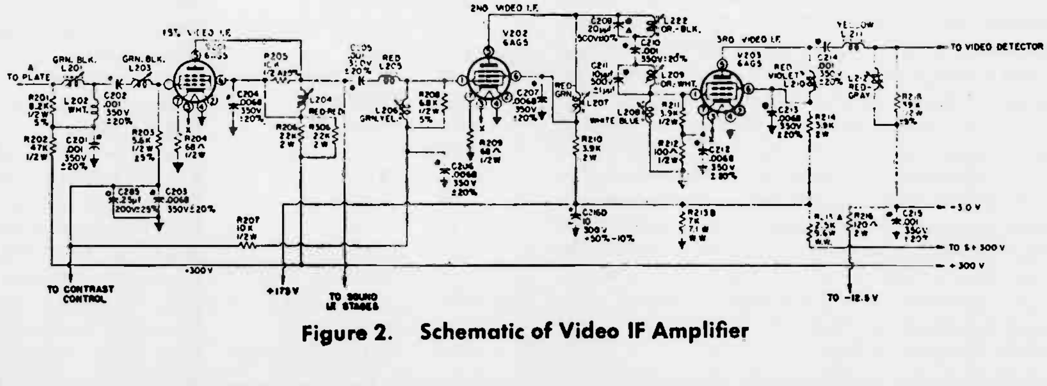


Figure 2. Schematic of Video IF Amplifier

diode load consisting of R256, R225 and C282. This circuit rectifies the composite video signal and reinserts its DC component on to the grid of the Teletron V206. The diode section of V204B also serves as a sync separator since negative composite sync pulses appear across R225.

2.05 Teletron Controls.

The Brightness Control, R227, varies the positive DC bias on the cathode of the Teletron so as to vary the picture background brightness. The Teletron *Bias Control,* R229 (one of the non-operational controls located on the chassis) varies the positive voltage on the second grid of the Teletron. The purpose of this control is to adjust individual Teletrons so that they all have a standard grid control characteristic when used in the Teleset.

2.06 Sync Clippers.

The composite sync pulses developed across R225 and C282 are coupled into the two sync clipper stages consisting of V212A and V213. The clipper stages amplify and clip both top and bottom of the sync pulses. The sync pulses developed on the plate of the second stage remain substantially constant in amplitude over a wide range of input signal level.

2.07 Vertical Deflection.

The output of the second sync clipper is fed into the vertical buffer V216A, the plate load circuit of which consists of an integrating network and one winding of the vertical blocking oscillator transformer T201. The vertical buffer amplifies and integrates the serrated vertical sync pulses and provides sharp vertical sync pulses which trigger the vertical blocking tube oscillator V216B (see Figure 14). The *Vertical Hold Control,* R275, adjusts the free running frequency of the blocking oscillator.

A sawtooth voltage is generated by charging capacitor C257 through the series resistances consisting of resistor R276 and the *Vertical Size Control* R277. The time constant of this network controls the amplitude of the sawtooth voltage.

The vertical deflection amplifier V217 converts the sawtooth voltage to the linear sawtooth current required for deflection. The vertical linearity control R281 varies the cathode bias of the vertical deflection amplifier V217 which in turn controls the degree of curvature over the operating portion of the E_g-I_p curve of this tube. This curvature compensates for an opposite curvature produced by the output transformer and vertical deflection coils, resulting in a linear change in current in the deflection coils.

The plate current of the vertical deflection amplifier V217 is fed into the vertical deflection coils by means of the vertical output transformer T202. The *Vertical Positioning Control* R284, in conjunction with the *Vertical Positioning Switch* S203 adjusts the amount and polarity of DC current in the vertical deflection coil to center the picture properly on the screen of the Teletron tube V206.

2.08 Horizontal Sync and Deflection.

The horizontal sweep is triggered by the sine wave electron coupled oscillator V215. The free running frequency of approximately 15,750 kc. is determined primarily by the oscillator winding in transformer Z204 and by capacitor C267. The Horizontal Hold Control is a powdered iron movable slug in this winding which varies its inductance. The exact frequency, however, is controlled by the repetition frequency of the incoming horizontal sync pulses. Sychronization is accomplished as follows:

The output of the horizontal oscillator is compared with the incoming horizontal sync pulses in the discriminator circuit of V214. The resulting DC "error" voltage which is developed across the discriminator load resistors R263 and R264 will vary in amplitude and polarity depending upon the relative difference in phase between the sine wave oscillator and the incoming sync pulses. The DC error voltage which is impressed upon the grid of the reactance tube V220 causes the plate current and transconductance of the reactance tube V220 to vary accordingly. The capacitive reactance which the reactance tube V220 presents to the tuned circuit is, therefore, varied, causing the oscillator to shift phase in proportion to the amount of the error voltage, and in the direction to bring the oscillator into phase with the incoming sync pulses. Thus, the oscillator is locked to the sync pulses.

The actual phase relationship between sync pulses and oscillator can be varied by means of the *Phasing Control,* a powdered iron slug in the discriminator winding of Z204, so as to make the picture start at just the right place horizontally on the raster.

The output from the plate of the horizontal oscillator is fed into the differentiating network consisting of capacitor C251 and resistor R268. The sharp tips of the differentiated positive pulses shown in Figure 5I cause the horizontal sawtooth generator V212B to discharge the sweep generating capacitor C271, thereby initiating the return trace of the horizontal sweep. The charging time constant network consisting of R296, R315, C271 and the *Horizontal Drive Control* R297 is returned to the most negative point in the power supply through the cathode bias resistor R300 controlling the amount of sweep voltage impressed upon the grid of the horizontal deflection amplifier V221, the horizontal drive control adjusts the linearity of the beginning and end of each horizontal trace.

2.09 Horizontal Output Amplifier and High Voltage Power Supply.

The high voltage required to accelerate the electron stream in the Teletron V206 is generated by a "fly back" type of power supply. During the return trace of the sweep the energy which is stored in the horizontal deflection coil circuit is fed back into the primary winding of the horizontal output transformer T204 in the form of a very sharp negative pulse. This pulse is increased in amplitude by auto-transformer action in the primary winding and is rectified by the high voltage rectifier V222. The rectified energy which is stored in the high voltage capacitor C277 is used to accelerate the electron stream in the teletron.

The horizontal damping tube V223 and the damping resistor, R304, critically dampen the ringing in the horizontal deflection yoke which occurs during the line retrace period. Part of the energy so absorbed is utilized to "boost" the plate trace of V221 by feeding the B supply in series with the voltage developed across the damper tube V223 on to the plate of the horizontal deflection amplifier V221. The horizontal linearity network consisting of L219, C275 and C276 is used to shift the phase of the booster voltage. By shifting the phase of this booster voltage with respect to the plate current requirements of V221, slight variations of plate characteristics are obtained. The *Horizontal Positioning Control,* R305, controls the DC current through the horizontal deflection coils.

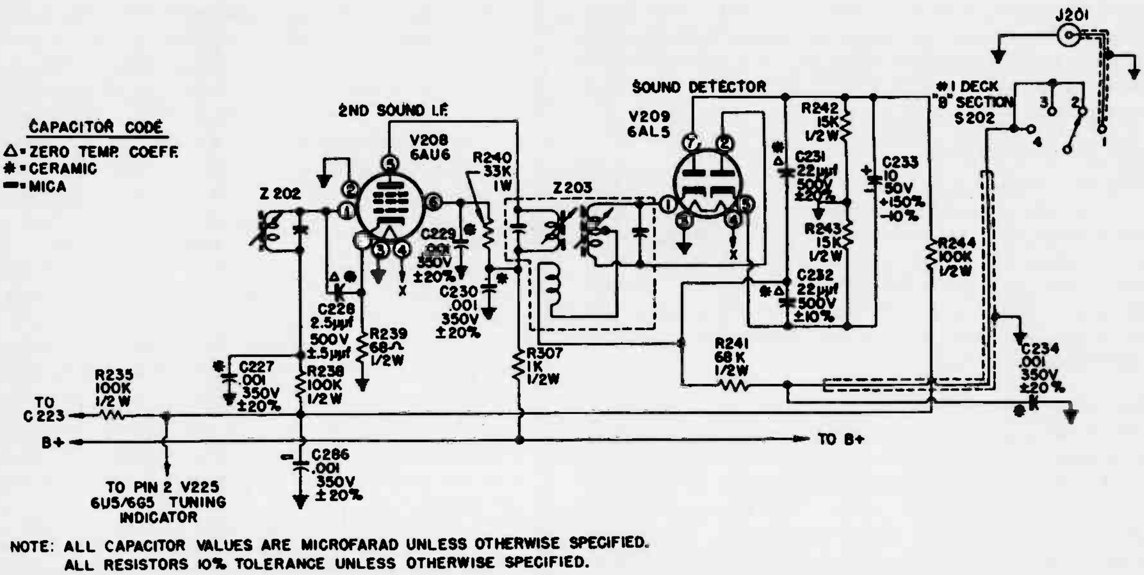


Figure 3. Schematic of Ratio Detector (Used in First Production Run of Model RA-103 Telesets)

2.10 Sound IF Channel.

In sets which were produced in the earliest production run, the television sound channel has two IF stages, V207 and V208, using critically coupled IF transformers. The second IF stage feeds into an FM ratio detector which converts the frequency modulated IF carrier to audio frequencies, suppresses amplitude modulation interference, and also provides AVC for the sound IF stages. This circuit is shown in Figure 3.

The sound taken from the junction of capacitors C231 and C232 is passed through the de-emphasis network consisting of R241 and C234 to the front section of the selector switch. The audio amplifier consists of one stage of high gain audio amplification V210 and the audio output stage V211 which feeds into the permanent magnet speaker.

Sets produced in later runs are connected with V207 as an IF stage, V208 as the limiter, and V209 as a conventional FM discriminator. See Figure 11 at back of book. R244 and C234 make up the de-emphasis network.

2.11 Power Supply.

The low voltage power supply of the television receiver is obtained from a pair of 5U4G rectifiers connected for full wave, high current rectification, with conventional filtering.

The low voltage power is applied to the receiver by the closing of the time delay relay K201. This relay is energized by the diode current of V224. The relay circuit has been designed so that the relay is energized approximately ten seconds after the power is applied to the television receiver. In this way all capacitors and other components are protected from the high surge voltage which otherwise would occur before the tubes heated up and started to draw plate current.

2.12 Focus Coil and Control.

The focus coil, L218, is in series with the section of the power supply which delivers 300 volts to most of the circuits. The current drain of these circuits provides more than enough current for proper focus. The focus current is adjusted to bring the Teletron to precise focus by means of the *Focus Control* R288, which is a variable resistor shunted, together with R286B, across the focus coil.

3. INSTALLATION OF THE TELESET

The RA-103 television receiver has been designed to operate from an unbalanced transmission line (co-axial cable) whose characteristic impedance is 73 ohms. This shielded type of cable, when properly utilized, provides a greater degree of noise immunity than a parallel wire balanced type of transmission line. The inner conductor of the 73 ohm co-axial cable is connected to the antenna input terminal marked "A" and the shield is connected to the antenna input terminal marked "G." In order to avoid a discontinuity in the transmission line it is important to bring the shielded cable as close to the terminals as possible, cutting back only enough of the shield to make the connection (not over 1/2 inch), and keeping the ground lead as well as the center lead as short as possible (not over 1/2 inch).

A broad band antenna, providing satisfactory reception on all thirteen channels and on the FM band, with a matching stub or other suitable means for matching the balanced output of the antenna to the unbalanced transmission line should be used. The matching arrangement is particularly important where the signal is weak and the local noise level high. In such instances the extra directional sensitivity of an antenna with reflector, properly oriented, also may be desirable. This antenna, too, must have a matching device if maximum discrimination against noise is to be achieved. An antenna with reflector will also be useful when there is a "ghost" image produced by a reflection from a hill or other object on the opposite side of the antenna from the transmitting station.

It should be noted that many types of antennas which operate satisfactorily on the lower frequency channels cannot provide satisfactory reception on all channels due to their wide variations in sensitivity and bandwidth characteristics with frequency.

The RA-103 receivers have been designed with adequate ventilation to insure operation of all components well within their temperature ratings, ensuring long, trouble-free operation. *Care must be taken in installing the receivers not to obstruct the ventilation openings at the top, at the back, and, in the case of the table model, at the bottom. The back should be kept at least an inch away from a wall or other obstructing surface.*

4. SERVICE NOTES

4.1 INITIAL ADJUSTMENTS OF THE RA-103 TELESET.

All controls with the exception of Horizontal Linearity, Horizontal Phasing and Teletron Bias Controls are accessible without removing the receiver chassis from its cabinet. The horizontal linearity, and horizontal phasing controls have been factory aligned and are sufficiently broad in adjustment to eliminate the need for field adjustment. The Bias Control only needs to be adjusted if the Teletron is replaced.

Normal Operation.

With the service selector switch turned to the television position in which the pilot light is on, turn the audio volume control to the right about half of its range, thus turning on the receiver. Turn the Brightness Control almost completely clockwise and turn the contrast completely counterclockwise. Approximately ten seconds after the power is turned on, a "click" will be heard indicating that the surge protection relay is energized.

Subsequently, a raster will appear on the picture tube. Adjust the Brightness Control for a moderate brightness, below the point at which the raster size increases due to excessive drain on the high voltage power supply. Adjust the focus control for greatest clarity of the lines at the center of the raster.

Turn the brightness control counterclockwise until the raster just becomes invisible. Turn the illuminated tuning dial to a television broadcast station by adjusting the tuning eye indicator for the maximum closing of the luminescent screen. Turn the contrast control to the right until the proper contrast is obtained.

Adjustment of Non-Operational Controls.

If the picture does not remain stationary, determine which hold control needs readjustment. The horizontal hold control is adjusted by means of the threaded screw protruding from the aluminum can at the back of the receiver. Determine the two extreme positions in which the picture falls INTO synchronism (not out of synchronism) and set the control half way between these two positions. Set the vertical hold control in the middle of its lock-in range if readjustment is needed.

The horizontal phasing control is located on the bottom of the same aluminum can which contains the horizontal hold control and can be manipulated only from the bottom of the chassis. Readjustment of this control will seldom be necessary.

In case it should be necessary, however, the procedure is as follows:

Position the raster to the left by means of the horizontal positioning control. Increase the picture brightness and decrease the contrast so that the entire raster is visible including the area at the right which is normally "blanked out." There should be a vertical gray strip of about 1/4" wide at the right of the raster adjacent to the right edge of the picture. Still further to the right there may be a still darker vertical strip or there may not. If the darker strip is present, and is more than 3/16" wide, or if the first lighter gray strip is not present, the phasing is not correct. The phasing control should be adjusted until the left edge of the darker strip is located at the extreme right edge of the raster (so that the dark strip almost disappears).

Adjust the brightness and contrast of the picture so that the "blanked" edges of the raster disappear, and then adjust both horizontal and vertical positioning controls so that the picture is centered with respect to the picture frame of the cabinet. The *Vertical Positioning Control* controls the amount of vertical positioning and the *Vertical Positioning Switch* controls the direction (up or down).

Adjust the vertical size control so that the height of the picture equals the height of the picture frame opening. Readjust the vertical positioning control to center the picture.

Adjust the horizontal size of the picture with the aid of a screwdriver so that the width of the picture equals the width of the picture frame opening. This adjustment is located above the focus coil and is mounted on the same bracket assembly as the focus coil. Readjust the horizontal positioning control to center the picture.

Observe any non-linear sweep distortions and determine if either the horizontal or vertical sweeps, or both, need adjustment. The horizontal drive control has the effect of spreading or compressing right side of the picture with respect to the left side of the picture. This control has been preset at the factory on a special test pattern and should not require field alignment. The horizontal linearity adjustment has the effect of expanding or compressing the middle portion of the picture with respect to the sides. Readjust the horizontal size control after the horizontal drive control has been turned.

The vertical linearity control has the effect of expanding the picture at an increasing rate from the bottom to the top of the picture. Adjustment of this control has the greatest effect on the top portion of the picture, some effect on the middle of the picture, and very little effect on the bottom of the picture. The vertical size and centering controls will need readjustment as a result of the change in position of the vertical linearity control.

When replacing the Teletron, the Teletron Bias Control may be adjusted as follows: Turn the contrast control to the extreme left so no picture appears. Adjust brightness control so that the arm of the control reads plus fifty volts with respect to ground using a high resistance DC vacuum tube voltmeter. Adjust the Teletron *Bias Control* to the position where the raster just becomes invisible.

4.2 REMOVAL OF TELEVISION RECEIVER CHASSIS FROM CABINET.

1. Remove the knobs on the front panel. The small knobs are of the "push-on" type. The large tuning knob has set screws.

2. Remove the screws fastening the back grill to the cabinet.

3. Without turning the cabinet on its side or on its back, remove the four bolts fastening the receiver chassis to the bottom panel of the cabinet.

4. Turn the receiver so that the back of the cabinet can be observed and slide the chassis until it is fully removed from its cabinet.

5. To reinsert the television receiver in its cabinet repeat the above steps in reverse order.

4.3 REMOVAL AND REPLACEMENT OF THE TELETRON.

1. Remove the television receiver chassis from its cabinet as outlined in the preceding paragraph.

2. With the aid of a spintite wrench, remove the screws that fasten the Teletron bracket to the chassis.

3. Disconnect the socket and high voltage lead from the Teletron.

4. Remove the corrugated paper around the neck of the Teletron within the focus coil.

5. Grasp the Teletron firmly with both hands along its outer edge and gently slide it out of the focus and deflection coils.

CAUTION

Never grasp the Teletron by its neck or allow pressure to be exerted on the neck.

6. Place the Teletron, face down, on a flat surface covered by a clean soft cloth, in a location where it will not be disturbed.

7. When the Teletron is ready to be replaced in the receiver chassis, slide the tube gently back into the deflection coils until the center of its face surface extends about 3/16" beyond the front edge of the chassis. Move the deflection yoke and focus coil forward as far as possible. Adjust the screws which fasten the Teletron bracket to the chassis so that the center of the Teletron screen is 7-1/2 inches from the bottom edge of the chassis. Also, see that the neck of the Teletron is centered in the focus coil. This centering must be accomplished by proper seating of the front part of the Teletron. *Do not allow pressure to be exerted on the neck.* Replace the corrugated strip of paper.

8. Adjust the focus coil so it is perpendicular to the axis of the Teletron. The focus coil should be located 1/8" from the deflection yoke.

REMOVAL AND REPLACEMENT OF THE INPUTUNER.

1. Unsolder four power leads coming out of the inputuner to the receiver chassis. *Do not cut the leads; keep them full length.* Denote the color coding of the wires and the terminals from which the wires were removed.

2. Unsolder the inputuner antenna cable leads at the antenna terminals.

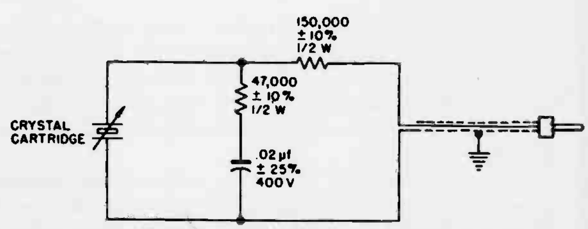
3. Remove the five screws which fasten the inputuner to the chassis.

4. Lift the inputuner from the chassis.

5. To put in the new inputuner, reverse the steps above.

4.4 TEST EQUIPMENT NEEDED FOR SERVICING THE RA-103 TELESETS.

Equipment Needed	*Required Characteristics*
A. *Trouble Shooting*	
Oscillograph (5-inch CRT preferable) (Du Mont Type 241 or equivalent)	Very high input impedance. Must readily synchronize with "Y" axis signal. Amplifier response must be satisfactory up to at least two megacycles. Must not compress input signal until a reasonably sized waveform appears. Wide range input attenuator.
Voltage Calibrator (Du Mont Type 264-A or equivalent)	Suitable for calibrating the amplitude of the waveshapes on the "Y" axis of the oscillograph.
Electronic volt-ohmmeter	Very high input impedance for d.c. voltage measurements.
Vacuum Tube Tester	Any good commercial instrument.
B. *IF and Video Alignment*	
Wobbulator	Center frequency of 25 megacycles (approx.); sweep width of 10 megacycles (adjustable); Output voltage up to 0.10 volt; adjustable attenuator. Frequency range from 20 to 100 mc. minimum.
Signal Generator	Frequency calibration reliable to better than 100 kc. per dial division. Attenuator should be adjustable and very accurate; modulation up to 30%.
Probe Detector	See Note 7. for schematic diagram.
Oscillograph (Du Mont Type 208-B or equivalent)	A high gain "Y" axis amplifier with good square wave 60 cycle response.



Schematic Diagram of Record Changer Assembly (Savoy Console Model Only)

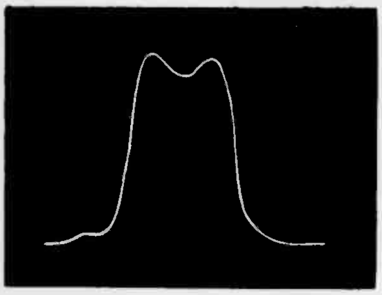
MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

TABLE OF VOLTAGES

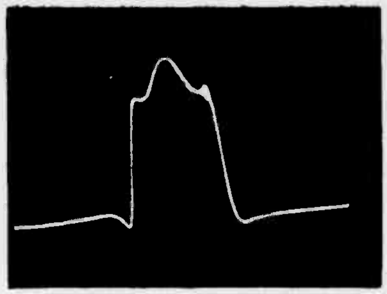
Pin Voltages Measured to Ground with no Signal, Maximum Contrast

Symbol	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V201 (1)	6AG5	0	1.0	A.C. 6.3 V	GND	145	145	1.0	....
V202 (1)	6AG5	0	1.0	6.3	GND	135	135	1.0	....
V203	6AG5	0	1.1	6.3	GND	135	135	1.1	....
V204	6AL5	0	-3.0	6.3	GND	-3.0	GND	0	....
V205	6AC7	GND	A.C. 6.3	GND	-3.0	GND A.C.	175	GND	240
V206	12JP4	GND	0	Pin 10	Pin 11	Pin 12	....	....	....
	6AU6	-0.5	GND	310 V	35 V	6.3 V	170	.90	....
V207				GND	A.C. 6.3	290			
V208 (1)	6AU6	0.5	GND	GND	A.C. 6.3	290	170	.90	....
V209	6AL5	0	0	GND	A.C. 6.3	0	NC	0	....
V210	6SJ7	GND	GND	GND	-2.13 V	GND	60 V	A.C. 6.3 V	190 V
V211	6V6	GND	GND	250 V	-265	-12.5	....	A.C. 6.3 V	GND
V212	6SN7	0	20V	250 V	-45	80	GND	A.C. 6.3 V	GND
V213	6SJ7	GND	GND	250 V	0.0	GND	53.0	A.C. 6.3 V	300 V
V214	6AL5	-1.5	-1.75	250 V	A.C. 6.3 V	-1.5	NC	-1.8	....
V215	6K6	GND	GND	220	227	-4.5	NC	A.C. 6.3 V	-0.5
V216	6SN7	-65	200V	220	0	143	7.5	GND	A.C. 6.3 V
V217	6SN7	0	350	15 V	0	350 V	15	A.C. 6.3 V	GND
V218	5U4	....	440	....	A.C. 390 V	....	A.C. 390	....	440
V219	5U4	....	440	....	A.C. 390 V	....	A.C. 390 V	....	440
V220	6AC7	GND	GND	GND	-1.9 V	0	-115	A.C. 6.3 V	240 V
V221	6BG6	GND	GND	-3.0	....	-22	....	A.C. 6.3 V	250
V222	8016	....	....	....	....	....	....	....	....
V223	5V4	....	A.C. 5 V	....	410	....	415	....	A.C. 5 V
V224	6AL5	45	-12.5	A.C. 6.3 V	A.C. 6.3 V	45	NC	-12.5	....
V101	6J6	120	120	A.C. 6.3 V	GND	GND	GND	1.85	....
V102	6AK5	-1.25 (1)	.12	GND	A.C. 6.3	190	50	.12	....
V103	6J6	150 (1)	GND	A.C. 6.3	GND	GND	-8.6 (1)	GND	....

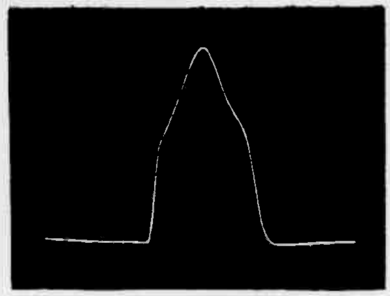
(I) These voltage readings will be influenced by capacity to ground of measuring equipment.



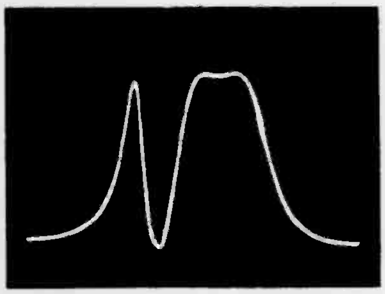
A—4th Coupling Network L210, L212



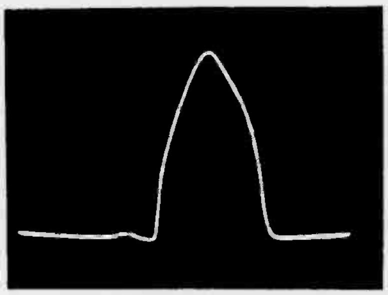
B—3rd Coupling Network L207, L208, L209 and L222



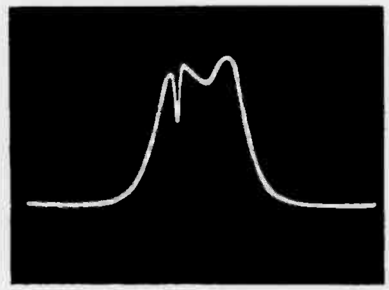
C—2nd, 3rd, Video I.F. Stages



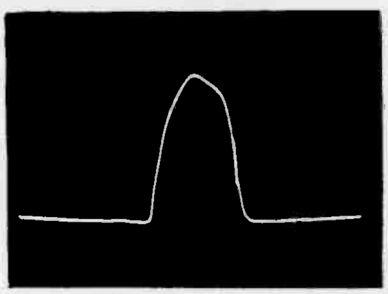
D—2nd Coupling Network L204, L206



E—2nd, 3rd and 4th Video IF Stages



F—1st Coupling Network L201, L203



G—All Video IF Stages

Figure 4. Alignment Waveforms for Model RA-103 Telesets

4.5 ALIGNMENT AND ADJUSTMENT NOTES.

1. The sound IF and video IF carriers in the model RA-103 television receiver are 21.9 megacycles and 26.4 megacycles, respectively.

2. When the television receiver is repaired or aligned, always turn the chassis on its side so that the power transformer is located on the bottom. Never turn the receiver on its end or other side.

3. Always place a piece of sponge rubber or block of wood between the power transformer and the work bench. Failure to observe this precaution will result in the crushing of one or several of the vacuum tubes in the inputuner section.

4. Never disconnect the loudspeaker while the power is turned on. If it is necessary to operate the receiver without the loudspeaker, remove the audio output tube, V211.

5. If the television receiver must be operated with the picture tube removed from the chassis, tape or cover the exposed end of the high voltage lead.

6. Always reconnect the high voltage lead so that the wire runs along the underside of the neck of the Teletron.

7. Always mount the television receiver chassis on a metal top work bench so that good contact between the receiver chassis and the metal top is maintained.

8. Connect the metal cabinets of all test equipment to the metal top work bench by means of heavy ground wires.

9. All lead connections from the signal generators and wobbulators must be shielded. Keep the exposed ends and ground leads as short as possible (about one inch).

10. Always locate the ground lead connections as close as possible to their respective "hot" leads in the television receiver chassis.

11. The wobbulator or signal generator output must be kept low enough to prevent overloading the television receiver circuits. The limiting action produced by overloading causes incorrect response curves.

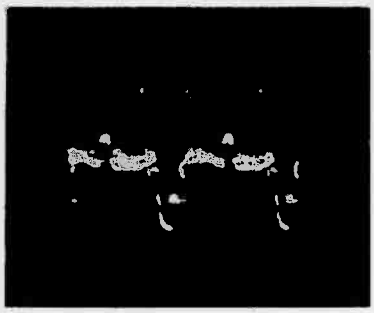
12. The alignment procedure must be followed in the order shown in the alignment chart.

A. IF AND VIDEO ALIGNMENT TABLE

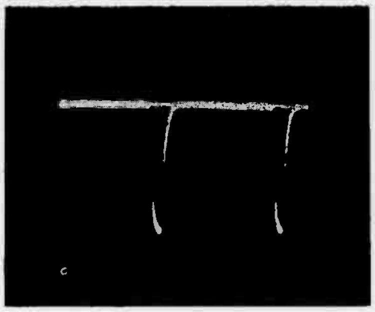
Step No.	To Adjust	Types of Input Signal Required	Connect Generator Leads Across (see note 1)	Connect Output Leads Across (see note 1)	Feed Output Leads Directly Into Oscillograph or Into Oscillograph Via Probe Detector (See Note 8, page 20)	Adjust Coils to Conform to Response Pattern Shown In	Remarks
1	L210 L212	Wobbulator & unmodulated RF signal	Pin 1 (grid), V203 and chassis	Pin 2 (grid), V206 and chassis	Direct	Figure 4A	
2	L222	30% mod. signal at 21.9 mc.	Pin 1 (grid), V202 and chassis	Pin 2 (grid), V206 and chassis	Direct	None	Adjust coil for a minimum deflection on the oscillograph
3	L209	30% mod. signal at 27.9 mc.	Pin 1 (grid), V202 and chassis	Pin 2 (grid), V206 and chassis	Direct	None	Adjust coil for a minimum deflection on the oscillograph
4	L207 L208	Wobbulator & unmodulated RF signal	Pin 1 (grid), V202 and chassis	Pin 5 (plate), V203 and chassis	Probe Detector	Figure 4B	Readjust L209
5	Check 2nd & 3rd video IF stages	Wobbulator & unmodulated RF signal	Pin 1 (grid), V202 and chassis	Pin 2 (grid), V206 and chassis	Direct	Figure 4C	If necessary readjust L207 and L208
6	Z201 pri. (top coil)	30% mod. signal at 21.9 mc.	Pin 1 (grid), V201 and chassis	Pin 2 (grid), V206 and chassis	Direct	None	Adjust coil for minimum deflection on the oscillograph
7	L204 L206	Wobbulator & unmodulated RF signal	Pin 1 (grid), V201 and chassis	Pin 5 (plate), V202 and chassis	Probe Detector	Figure 4D	
8	Check 1st, 2nd & 3rd video IF stages	Wobbulator & unmodulated RF signal	Pin 1 (grid), V201 and chassis	Pin 2 (grid), V206 and chassis	Direct	Figure 4E	If necessary readjust L204 and L206
9	L201 L203	Wobbulator & unmodulated RF signal	Pin 1 (grid), V102 and chassis	Pin 5 (plate), V201 and chassis	Probe Detector	Figure 4F	See note 2
10	Check all video IF stages	Wobbulator & unmodulated RF signal	Pin 1 (grid), V102 and chassis	Pin 2 (grid), V206 and chassis	Direct	Figure 4G	If necessary readjust L206. See note 2
11	Z202	Wobbulator & unmodulated RF signal at 21.9 mc.	Pin 1 (grid) V207 and chassis	Pin 5 (plate), V208 and chassis	Probe Detector	None	Adjust for a symmetrical response
12	Z203 (primary)	Unmodulated RF signal at 21.9 mc.	Pin 1 (grid) V207 and chassis	Junction R320 & R321	Use high impedance DC voltmeter instead of oscillograph	None	Adjust primary (bottom coil) for maximum reading
13	Z201 sec. (bottom coil), Z203 sec.	Unmodulated RF signal at 21.9 mc.	Pin 1 (grid) V201 and chassis	Junction R320 & R321	Use high impedance DC voltmeter instead of oscillograph	None	Align secondary (top coil) for zero meter reading, *i.e.*, so that the meter will swing through zero. Voltmeter should be set on lowest DC scale
14	L216	Unmodulated RF signal at 4.5 mc.	Pin 4 (grid), V205 and chassis	Pin 2 (grid), V206 and chassis	Use high impedance DC voltmeter instead of oscillograph	None	Adjust coil for maximum voltmeter reading

PRECAUTIONARY NOTES:

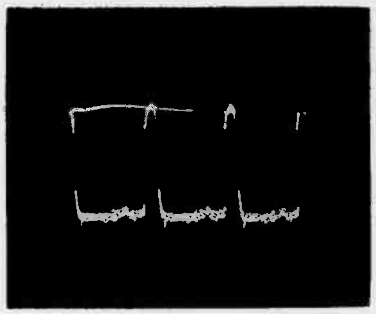
1. Locate all ground lead connections as close as possible to their respective "hot" leads.
2. Remove the Type 6AK5 mixer and carefully solder a comparatively fine wire on to pin 1. Examine connection to make certain that the wire is not shorted to any other prong. Reinsert the tube into its socket and connect the inner conductor of the signal generator lead to this wire. (See note 7)



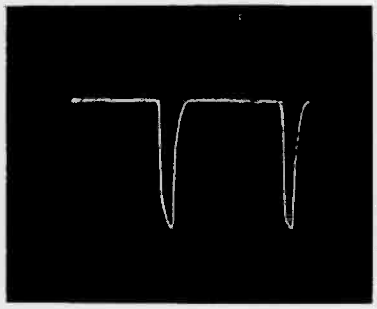
A—Grid of CRT, Pin 2, V206. 17 Volts p.p. (Adjusted by Contrast Control)



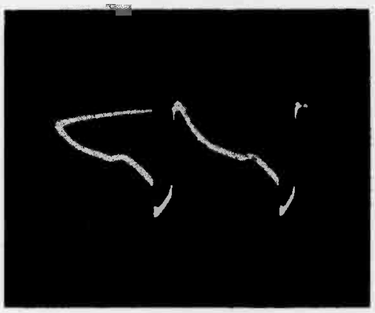
B—Sync Takeoff, Pin 1, V212A. 4 Volts p.p.



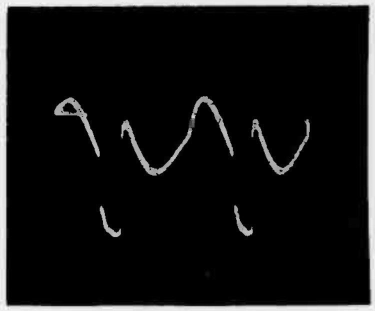
C—Plate of 1st Sync Clipper, Pin 2, V212A. 6 Volts p.p.



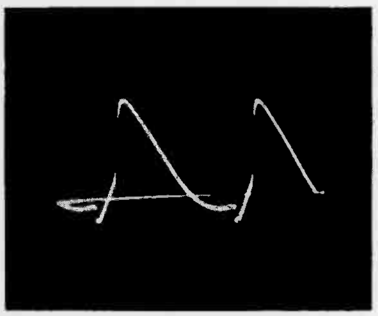
D—Plate of 2nd Sync Clipper, Pin 8, V213. 37 Volts p.p.



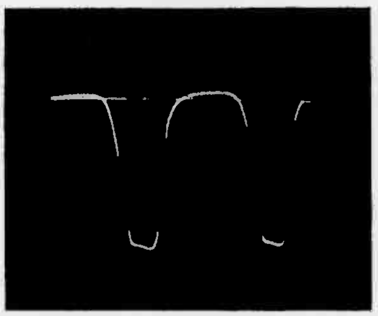
E—Sync Input White Lead, Z204. 10 Volts p.p.



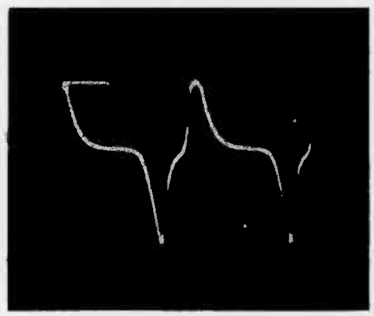
F—Sync Plus Sine Wave, Pin 1, V214. 16 Volts p.p.



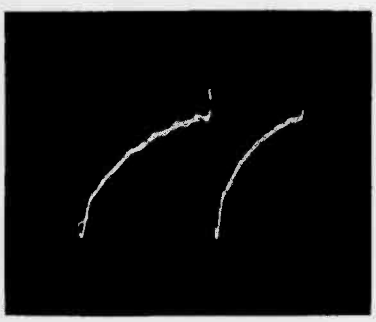
G—Sync Plus Sine Wave, Pin 5, V214. 19 Volts p.p.



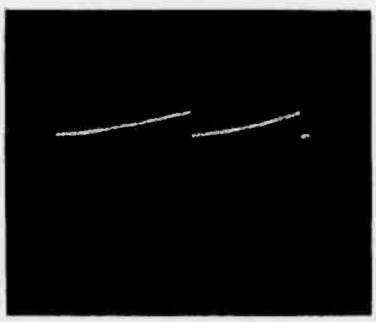
H—Horiz. Osc. Output, Pin 3, V214 210 Volts p.p.



I—Horiz. Osc. Differentiated. 105 Volts p.p.



J—Vertical B.T.O. Pulse, Pin 1, V216B. 185 Volts p.p.



K—Vertical Saw Pin 1 & 4, V217. 100 Volts p.p.

L—Horizontal Saw Pin 5, V212B. 110 Volts p.p.

Figure 5. Typical Sweep Waveforms of Model RA-103 Telesets

4.51 Inputuner Alignment Procedure.

I. TEST EQUIPMENT REQUIRED

Equipment	*Required Characteristics*
Wobbulator	High frequency wobbulator; bandwidth 10-12 mc.; center frequency variable over the complete television spectrum of channels 1-13; output variable to maximum of 0.1 volt; output impedance 72 ohms.
Signal generator	High frequency signal generator; minimum frequency range 40-250 mc.; 72 ohm output.
Oscillograph	Having a high gain Y axis amplifier with good 60 cycle square wave response (such as Du Mont Model 208-B).
Non-capacitive screwdriver	Made of 1/4" fiber rod having screwdriver chisel ends.
Dummy shield	Made specially to fit readily over unit to reproduce shielded conditions, allowing ready access to trimmers and end coil adjustments.
Voltmeter	High impedance having at least one megohm of DC resistance on the 3 volt scale.

II. OSCILLATOR ALIGNMENT

A. Set up:

1. Solder a 3" insulated lead to the screen pin of the 6AK5 mixer tube socket (V102 pin 6), passing this lead through the shield cover at the same point the plate lead passes through.
2. Connect the Y axis of the oscillograph to the screen lead through a shielded cable to minimize extraneous pick-up.
3. Connect the X axis of the oscillograph to the wobbulator sweep output. (If no external output for sweep voltage is provided on the wobbulator use the regular sawtooth sweep of the oscillograph, noting that two traces will appear for each complete sweep if the oscillograph time base is set at 60 cycles.
4. Connect the output of the signal generator to the antenna post of the receiver, keeping all connecting leads as short as possible.
5. Connect a high impedance vacuum tube voltmeter to the cathode, Pin 5, of the discriminator, V209.

B. Adjustments:

CAUTION

The following presupposes that the sound IF system and the discriminator are correctly aligned.

1. Set the inputuner dial exactly to channel 4. With modulation on the signal generator, set the signal generator to 71.75 mc. Rotate C111 to a maximum audible signal, then set more accurately by means of a null on the voltmeter. (The voltmeter will swing both positive and negative while this adjustment is being made, and a higher scale should be used for initial settings, reducing the scale and eliminating modulation for finer adjustments to guard against damage to the voltmeter.)

2. The high frequency setting of the oscillator is made with the receiver dial set to channel 13, the signal generator, with modulation, set at 215.75 mc.; adjustment is made by pulling or squeezing the end coil L104 with similar procedure as above. (Squeezing the end coil together reduces frequency; spreading the turn apart increases frequency.) Be careful not to short the coil.

3. Check all low frequency channels to make sure that the sound is received at the correct dial setting. In each case the signal generator should be set to the sound frequency allocated to the particular channel under test. If the shield cover has been removed to make any adjustments, all the oscillator settings must be rechecked with the cover in place.

Channel	1	2	3	4	5	6
Sound Freq. (MC.)	49.75	59.75	65.75	71.75	81.75	87.75
Channel	7	8	9	10	11	
Sound Freq. (MC.)	179.75	185.75	191.75	197.75,	203.75	
Channel	12	13				
Sound Freq. (MC.)	209.75	215.75				

III. BAND PASS ALIGNMENT

A Set up:

1. Retain steps 1, 2, 3 and 5 of Part II.

2. Connect the output of the wobbulator through 72 ohm coaxial to the antenna and ground posts of the receiver, keeping all connecting leads as short as possible (under 3/4 inch).

3. Connect the signal generator between the shielded side of the input cable and chassis ground. (This will allow sufficient signal injection across the stray inductance between the two grounds to obtain a birdie for checking the bandpass frequencies without causing any discontinuity to the input impedance.)

B. Adjustments:

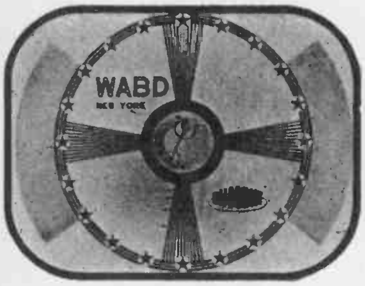
1. When the oscillator has been correctly set, the bandpass circuits can be aligned. The low frequency adjustment is made by means of C107, C105, and C106, which are adjusted to give a bandpass of 4.5 mc. on channel 3. With the teleset dial set on channel 3, sound should be obtained with the signal generator set at 65.75 mc., and a "birdie" should appear on the high frequency peak of the passband. With the signal generator set at 61.25 mc. (no change in Teleset tuning) the "birdie" should fall on the low frequency peak. The peak to valley ratio should not exceed 30%.

2. High frequency adjustments.—The high frequency adjustment is done by means of end coils L101 and L105. The bandwidth should not exceed 6 mc. nor be less than 4.5 mc. With the Teleset dial set at channel 13, sound should be obtained with the signal generator set at 215.75 mc. and a birdie should appear within the passband. With the signal generator set at 211.25 mc. (no change in teleset tuning) a birdie should appear within the passband also. (This holds true when a maximum bandwidth of 6 mc. is obtained. If the bandwidth should be 4.5 both birdies would appear on the bandpass peaks.)

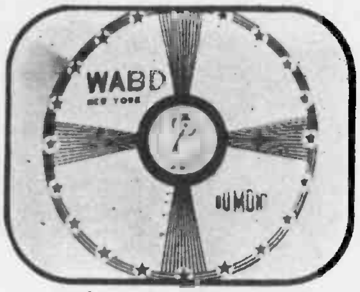
CAUTION

All station channels should be checked with nothing but the signal generator connected to the antenna terminals using amplitude modulation in a point to point check to eliminate possibility of error in impedance matching with varying types of wobbulating equipment.

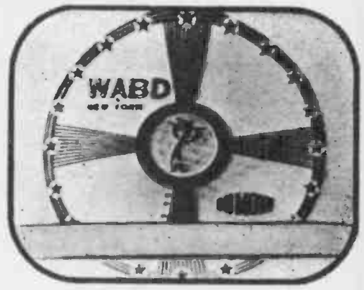
MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS



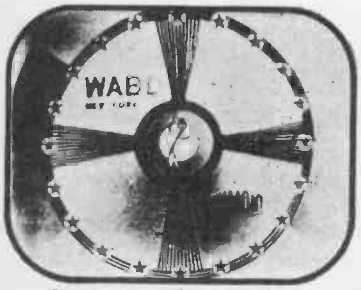
Normal Picture



Brightness Control Misadjusted



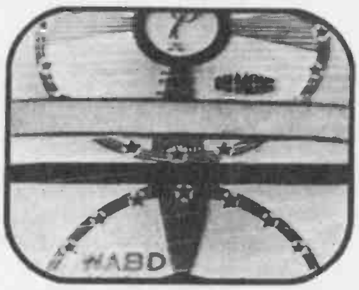
Focus Control Misadjusted*

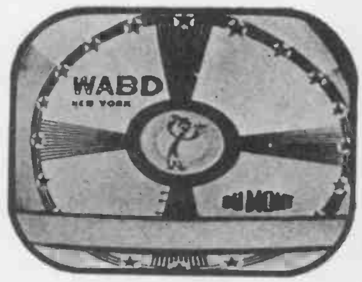

Contrast Control Set Too High

Contrast Control Set Much Too High*

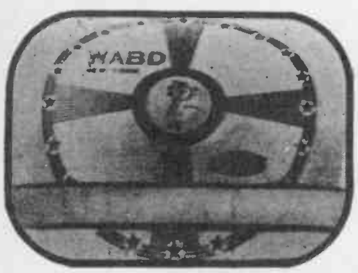
Contrast Control Set Too Low


Horizontal Frequency Control Misadjusted*


Vertical Hold Control Misadjusted*



Horizontal Linearity Control Misadjusted*


Vertical Linearity and Size Controls Misadjusted*

Horizontal Size Control Misadjusted*

Outside Interference Caused By Diathermy

* Test patterns taken with INS news tape.

Figure 7

Typical Test Patterns

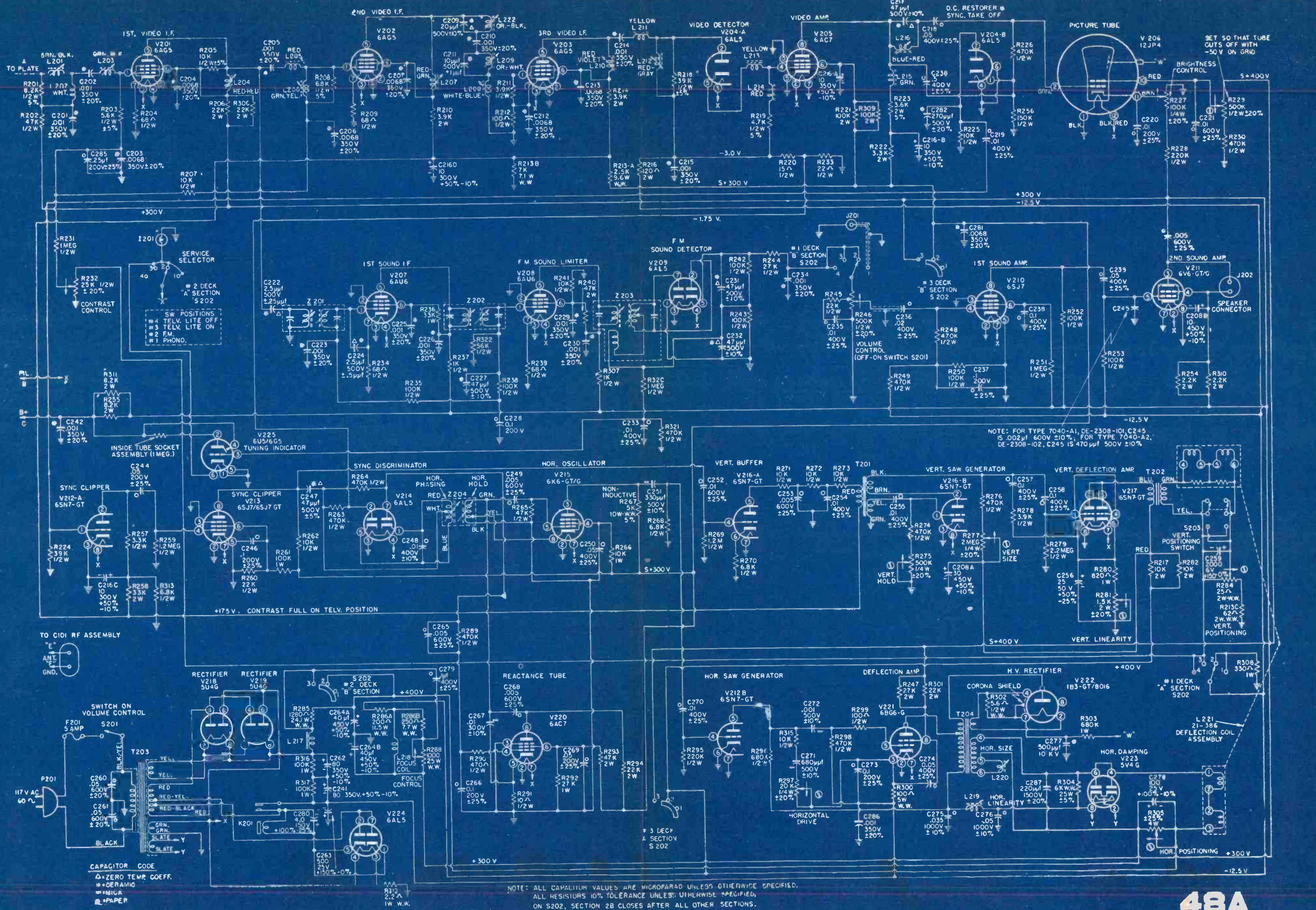
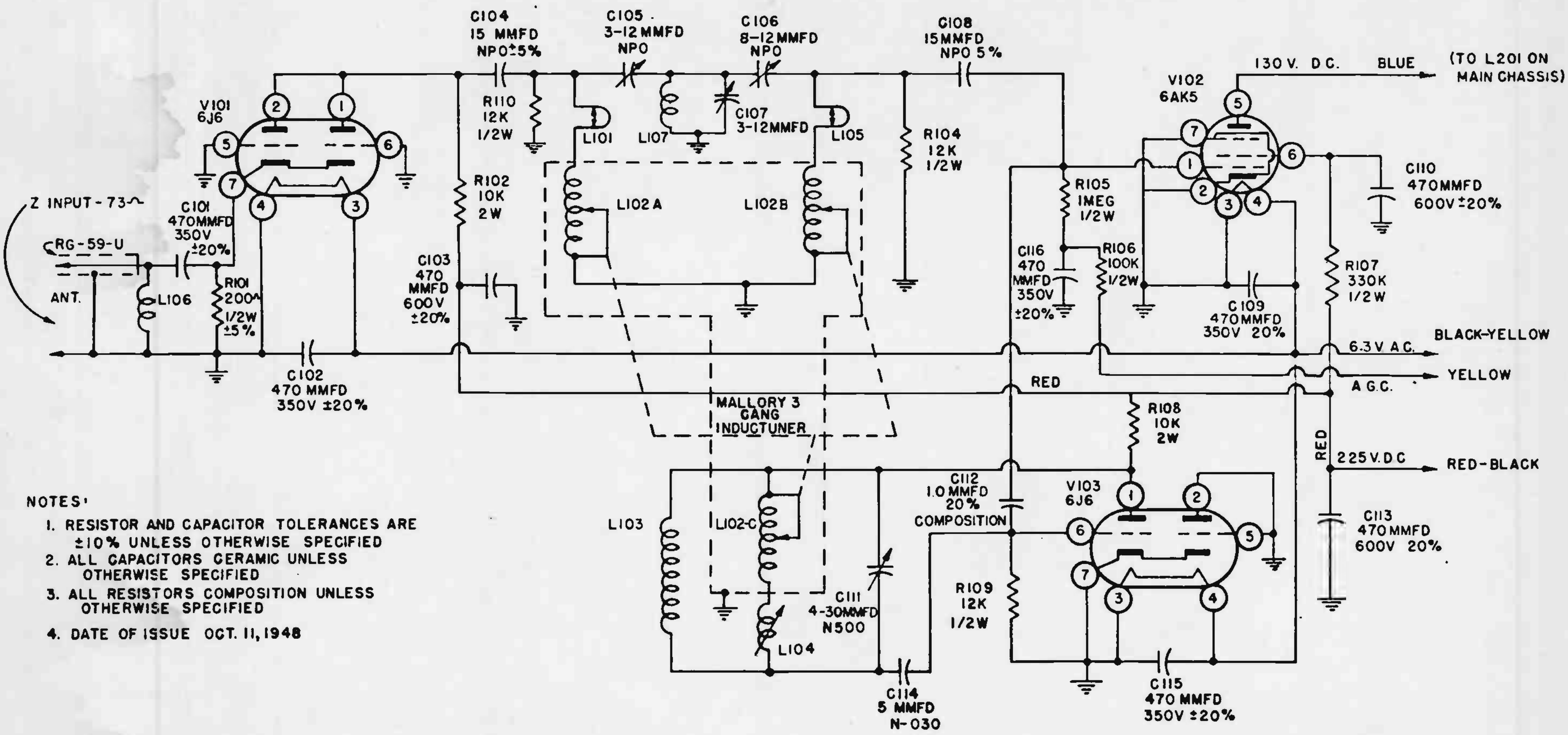


Figure 11. Schematic of Main Chassis for Du Mont Model RA-103 Teleset



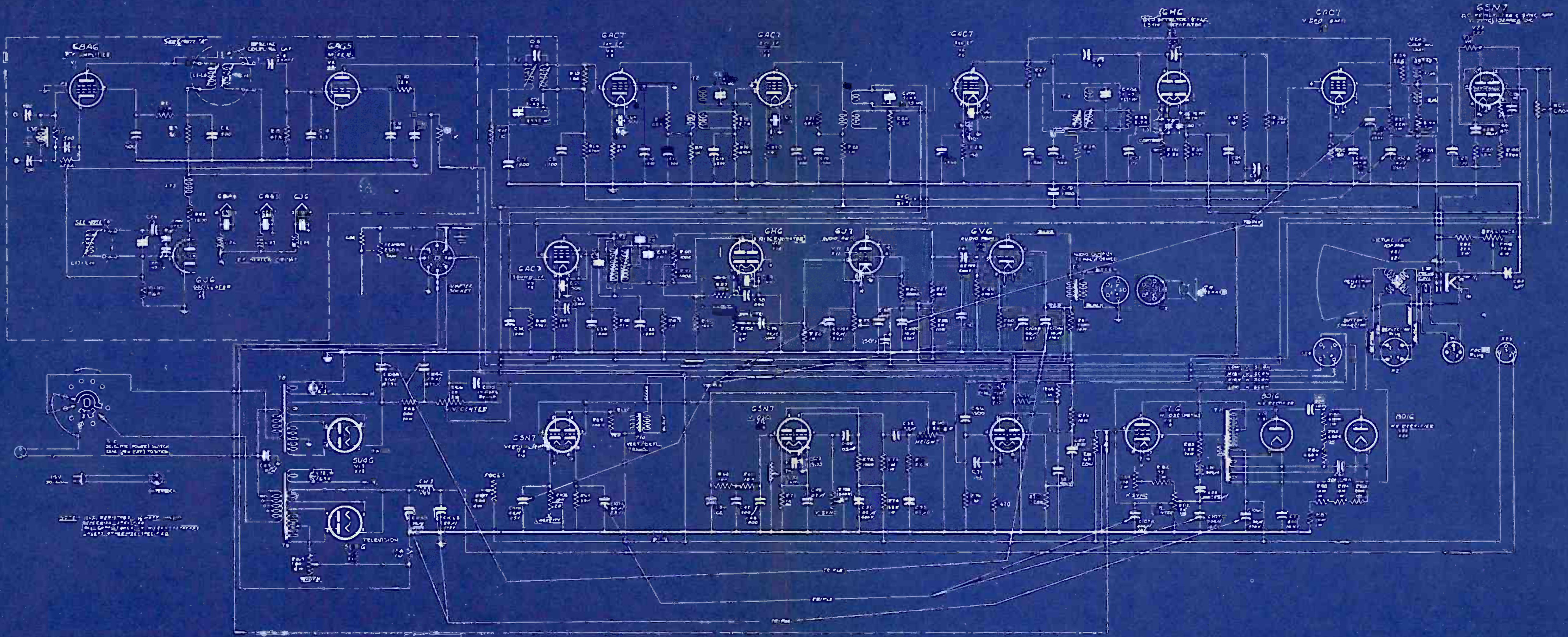
NOTES:

1. RESISTOR AND CAPACITOR TOLERANCES ARE ±10% UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS CERAMIC UNLESS OTHERWISE SPECIFIED
3. ALL RESISTORS COMPOSITION UNLESS OTHERWISE SPECIFIED
4. DATE OF ISSUE OCT. 11, 1948

MODEL RA-105 TELESET
R.F. TUNER CHASSIS

Figure 9.

ALLEN B. DU MONT LABORATORIES INC.
TELESET SERVICE CONTROL DEPT.
2 MAIN AVE. PASSAIC, N.J.



NOTE-A

Farnsworth Television

SCHEMATIC OF THE GVZ60 RECEIVER

49A

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

FARNSWORTH TELEVISION & RADIO CORPORATION

MODEL GV-260 TELEVISION RECEIVER

FREQUENCIES

Television .... any 8 of 13 channels
Intermediate Frequency, Television .... 26.25 M. C.
Intermediate Frequency, Sound .... 21.75 M. C.

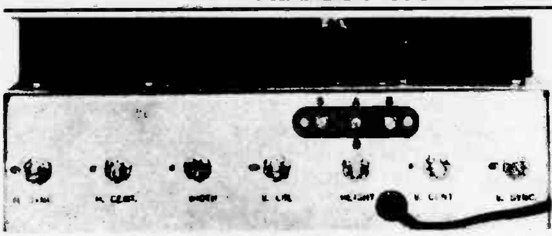
THE CHANNEL SELECTOR

The receiver is aligned in production to cover the assignments of the area to which it is to be shipped. Destined for the New York area, for example, it would contain an RF unit set up for channels 1, 2, 4, 5, 7, 9, 11 and 13. All receivers are aligned on channel No. 1. Receivers for the Philadelphia area, where but four channels exist, are aligned also on channels 1, 4, 7, and 8.

Should the receiver inadvertently find its way into an area to which it was not intended, it may be necessary to exchange RF units.

	ALIGNMENT CODE						
SECLECTOR POSITIONS	A	B	C	D	E	F	G
1	1	1	1	1	1	1	1
2	2	3	2	2	2	3	2
3	4	4	4	4	3	4	3
4	5	6	6	5	5	5	6
5	7	7	7	7	7	7	7
6	9	8	8	8	8	9	9
7	11	10	10	11	10	11	11
8	13	12	13	12	13	12	13

ADJUSTING THE REAR-CHASSIS CONTROLS



29a Rear-chassis view showing controls

The rear-chassis controls of the receiver are shown in Fig. 29a. Those at the rear of the receiver are known as serviceman's controls and should never be tampered with by the layman. The two controls commanding close adjustment are the horizontal and the vertical sync. controls. Mal-adjustment may result in picture deterioration.

HORIZONTAL SYNC. CONTROL

There are two major lock-in points of this control. One will cause a vertical black bar in the center of the picture; the other, being the correct point, gives a clear picture. The two limits of proper setting of this control are: One limit gives unstable synchronization. Operation may be normal for a few minutes, then it will break synchronization. The other limit is a slight condition of fuzziness in the picture, particularly noticeable in the transmitted test pattern.

Between these limits is the correct setting of the horizontal sync. control. By close inspection of the picture tube, the serviceman may discern the individual scanning lines in the picture. These must be, for proper setting of this control, quite stable and evenly-spaced from the top to the bottom of the picture.

HORIZONTAL AFC OSCILLATOR CONTROL

This control is accessible through a hole in the rear of the cabinet, a screw-driver adjustment. This adjustment is to be such that, after the receiver has warmed up, rotation of the framing control (on front of receiver) from extreme clockwise to extreme counterclockwise position does not cause horizontal scanning to break sync.; rather, that between these limits, the picture remains stable, moving from side to side.

VERTICAL SYNC. CONTROL

The vertical sync. control does not necessitate as precise setting as does the horizontal control. It may be adjusted to the center of the portion of control rotation where vertical synchronization occurs.

HORIZONTAL AND VERTICAL CENTERING CONTROLS

The centering controls are used to locate the image in the center of the picture tube screen. Adjustment of the horizontal centering control may require slight readjustment of the horizontal synchronizing control.

WIDTH CONTROL

The width control is to be rotated to a position which will cause the picture to just overlap the screen in the horizontal direction.

HEIGHT AND VERTICAL LINEARITY CONTROLS

The action of these controls is somewhat interlocked. A transmitted test chart should be used when making adjustments. The controls should be so positioned that the screen is just filled in the vertical direction and the vertical linearity is correct. When the linearity is correct, a circle in the test pattern should not appear to be oval or out of round. See also the section of this manual dealing with linearity checking.

THE FUNCTIONAL DIAGRAM

Analysis of the receiver circuits is introduced by a consideration of the functional diagram, Fig. 31a. The transmission line is coupled into a 6BA6 RF amplifier over an inductive network. The local oscillator tube (6J6) operates at a frequency which is 26.25 mc higher than the incoming video carrier and 21.75 mc higher than the incoming sound carrier. Thus arise the two intermediate frequencies which pass into the IF amplifier. After mixing in a 6AG5 mixer tube, the two respective frequencies are fed into the first and second stages of IF amplification whose coupling circuits are sufficiently broad to pass these widely-separated frequencies. Each IF stage employs a 6AC7 tube. The two intermediate frequencies are then separated and undergo further separate amplification in two channels; one video IF stage and an audio IF stage, each stage employing a 6AC7 tube.

Audio sound detection is accomplished in a 6H6 discriminator which is followed by two stages of audio amplification; a 6SJ7 tube and a 6V6 power amplifier which drives the permanent-magnet dynamic speaker.

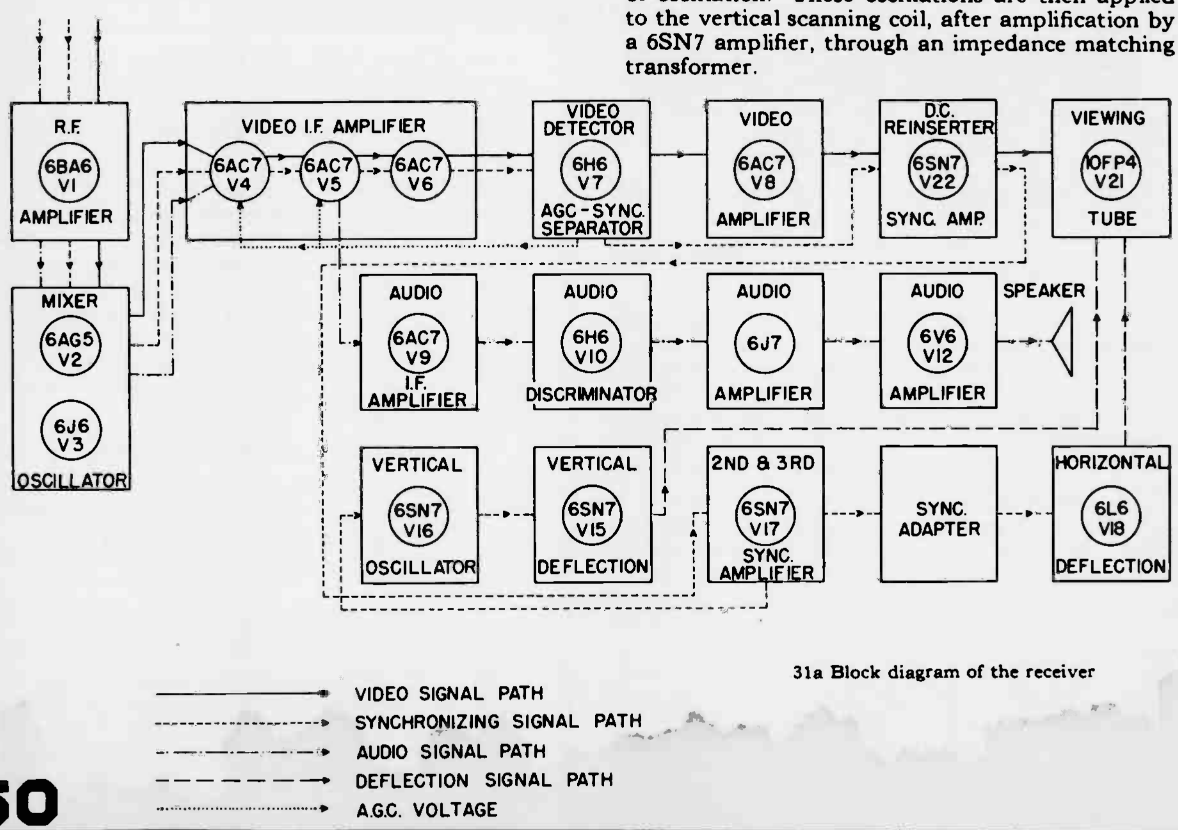
Following its final amplification in the third IF stage, the video signal is impressed upon a 6H6 tube which performs three functions—video detection, synchronizing pulse separation and A.G.C. (automatic gain control).

Considering each of these functions in turn, the video signal is fed, after detection, to a 6AC7 wide-band video amplifier, then to the control-grid of the 10FP4 viewing tube. Its average amplitude level is determined by the 6SN7 (section #1) DC reinserter to control the average brightness (background) of the reproduced image in accordance with that of the image being viewed in the studio.

Sync. pulses derived from the 6H6 sync. separator are passed through one section of V22, a 6SN7 amplifier tube. Horizontal pulses are then separated from the combined sync. wave-form in a differentiating circuit and applied to the horizontal AFC circuit whose frequency they control. Coupling to V18, the 6L6 horizontal oscillator, provides synchronization at the horizontal (line) frequency.

In addition to providing scanning potentials, V18 supplies high potentials which are rectified by a half-wave voltage-doubling circuit, filtered, and applied as operating potential (8,000 volts) to the viewing tube.

Vertical sync. pulses are separated in an integrating circuit, then impressed upon V16, the 6SN7 vertical oscillator, to properly time its period of oscillation. These oscillations are then applied to the vertical scanning coil, after amplification by a 6SN7 amplifier, through an impedance matching transformer.



31a Block diagram of the receiver

The third-mentioned function of V7 provides A.G.C. to the first, second and third IF amplifier stages, giving control to both picture and sound signals.

RF CHASSIS

The RF section of the receiver is an assembly complete in itself except for plate and heater supplies. Although this type of construction is primarily intended to enhance the overall performance and stability of the receiver, it also facilitates the replacement of any parts in servicing. The RF unit includes RF amplifier, local oscillator and mixer circuits.

Laboratory analysis has indicated that, having made the proper selection of circuit components, optimum stability of frequency in the local oscillator is had in the familiar col pitts circuit.

Stability is further enhanced by the use of negative temperature-coefficient condensers and by slotting of the bakelite condenser mounting strip. Shunt feeding is here employed to reduce the number of switching contacts.

Bandswitching is accomplished through a compact and highly stable turret assembly as employed in many war-time radar applications. This assembly carries all tuning inductances, slug-tuned, and the necessary resistors. It is in three sections. Counting from the front of the chassis, section 1 includes the plate circuit associated with the RF amplifier, V2. Section 2 carries the grid coils of V2, while the third section contains oscillator tuning inductances.

It will be recognized that circuit components are as found in the familiar broadcast receiver. These are screen voltage dropping resistors and filter condensers, cathode-bias and plate filter elements, etc. Therefore, the usual voltage-resistance measurement procedures are to be followed in case of RF circuit failure.

The frequency response curves of the RF section vary slightly from one channel to another as shown in Fig. 39e.

THE VIDEO IF AMPLIFIER

The requirements of the video IF amplifier are quite stringent. In addition to providing the necessary amplification, it must give a pass-band of several megacycles which is very sharply defined.

Although the three IF stages personify simplicity in design and in alignment, they adequately fulfill the requirements: A wide pass-band is afforded by loading resistors across the overcoupled transformer secondaries, adjacent channel suppression is by trap circuits in each transformer.

Examining in turn the three video IF stages and the detector, it is seen that coupling between stages and to the mixer is entirely conventional as encountered in the broadcast type receiver. Apparent departures from low-frequency practice are (1) the presence of trap circuits and of loading resistors and (2) the absence of variable tuning between stages 1-2 and 2-3. The trap circuits tuned by C201 and C202 are for purposes of adjacent television channel supression as will be noted in the alignment procedures. Those tuned by C203 and C204 are for the suppression of the sound carrier in the television channel being received which would, if allowed to enter the detector, cause bars or herringbone patterns across the picture screen. The second aforementioned departure, loading resistors, broaden the pass-band by lowering the Q of the tuned circuits. Of course, they bring about a lowered amplification per stage which is characteristic of all wide-band amplifiers. These resistors will seldom, if ever, require replacement but, should the need for replacement arise, it must be diligently observed that exact replacement is necessary as regards resistance value, resistor size and physical placement of the unit.

Thirdly, the absence of tuning adjustment in two of the coupling transformers is contributory to high gain, simplicity and ease of alignment, yet fulfilling every need of the television IF amplifier. Resonance is afforded by the distributed coil capacity, the tube input capacity and the wiring capacity which simulate a lumped capacity in the untuned stages. For this reason the serviceman should carefully guard against the displacement of wires in the IF stages, particularly in the stages not equipped for slug-tuning.

The remaining IF circuit consideration which may be construed to differ from broadcast receiver practice lies in the un-bypassed cathode resistor. It affords degeneration, which the serviceman has encountered in audio amplifier work, resulting in improved frequency and amplitude response. The derivation of proper screen potentials, the application of automatic "volume" control and the plate filtering (decoupling) networks are strictly conventional.

It is to be noted that the first two stages are employed for both video and sound carrier amplification. A resonant circuit in T3, tuned to the sound carrier frequency (21.75 mc), separates the sound from the video and introduces it into the sound IF amplifier for further amplification.

VIDEO DETECTOR

The video intermediate frequency appearing across section 2 of the 6H6 tube, rectification takes place, causing the demodulated signal to pass through R101 which is the contrast control. Signal path for the high intermediate frequencies (but not for the lower frequency demodulated video signal) back to the tube is afforded by C21 whose reactance is low at high frequencies but high at low frequencies.

The composite video signal, which contains the picture producing variations in potential, the blanking and the synchronizing pulses, is then fed to the video amplifier in variable magnitude, as determined by the contrast control.

An antiresonant trap appears in the cathode circuit of the video demodulator which serves to reject a 4.5 mc beat-note from the control grid of the picture tube. This 4.5 mc signal arises from heterodyne action between the picture and sound carriers.

Its tuning is as follows: Feed a signal generator at 4.5 mc between second detector plate and ground. Adjust the slug of the trap for minimum brilliancy of the cathode-ray tube.

If a precise check on the trap is to be made, a vacuum-tube voltmeter reading may be made at the grid of the cathode-ray tube. Rejection should be approximately 22DB at 4.5 mc ± 50 KC. This is a voltage ratio of about 26 to 1.

VIDEO AMPLIFIER

The video amplifier finds its analogy in the audio amplifier of the broadcast receiver. Except for broad-band considerations in the plate circuit, it is identical to the audio amplifier. Mention should be made concerning the choice of tube types, giving reason why type substitution should never be made as is sometimes done in the broadcast receiver. Due to the high frequencies involved and the very wide pass-band, it is necessary that low output impedance be employed.

Such low impedances are, of course, conductive to low output voltage. In order that a reasonably high gain be had from any stage of amplification, it is necessary to use a tube with very high transconductance, since the gain is expressed by: $G = GmxZo$, where G is the gain, Gm is transconductance in mhos (one million micromhos) and Zo is the output (load) impedance. As an example, compare two tubes, having Gm of 1000 and 4000 micromhos respectively, working into a load impedance of 3000 ohms. The first tube will provide voltage amplification of $1000\,10x - 6x3000$ equals 3.

That of the second will be $4000 \times 10^{-6} \times 3000$ equals 12. A ratio of 4 to 1, a result of the substitution of the first-mentioned tube in a circuit designed for the second, would undoubtedly impair the receiver operation. An additional aspect is the difference in tube capacities. Since the capacity which tunes the IF amplifiers is determined largely by the tube input capacity, tube type substitutions may seriously detune these circuits.

Grid bias and screen potentials are afforded in the usual manner. It should be here noted that C101, the cathode bypass condenser, is rated in ohms of reactance; rather than in capacity. This conversion

$$C = \frac{159 \times 10^{-9}}{f \times X_c}$$

where C is capacity in microfarads, f is frequency in cycles per second and Xc is the capacitive reactance in ohms.

High frequency response is extended to cover the necessary 5 mc by the proper selection of the values of inductance and resistance. R36 provides damping to the inductance which in the absence of such a resistor, would cause a serious "hump" or sharp rise in response at some frequency near the upper frequency limit of the amplifier. These high frequency compensation components must never be altered from prescribed values and physical replacement.

Low frequency compensation is through R38 and C102B.

The composite video signal is passed on to the control grid of the cathode-ray tube through C27. In addition, a portion of its energy is rectified in one half section of V22 used for the DC reinserter whose analysis follows:

DC REINSERTER

Even as a photographic exposure meter determines the iris setting of a camera and involuntary muscular action sets the proper iris opening of the eye, the DC inserter circuit establishes an average value of the intensity of the received signal which value control the grid-bias upon a viewing tube. The reinserter is the "exposure meter" and the bias voltage which it produces is the "iris."

Initial bias to the grid of the cathode-ray tube is fed to the tube through R39. Through this resistor also flows the rectified portion of the video signal which, of course, is direct current. This direct current establishes a potential across R39 which subtracts from the initial grid bias. Therefore, a strong signal produces a relatively high potential across R39 which, being positive, subtracts from the initial tube bias whereas a weak signal, or none at all, contributes little or no potential, increasing (opening the iris) the bias potential.

Even as an A.V.C. circuit should have correct time constant, the effect of DC reinsertion must be properly timed. Too short a time required for it to "take hold" would produce surges of light upon the screen, whereas too long a time would cause the background illumination from one scene to carry over into the next. This proper timing of the effect of the reinserter is accomplished by R40, C28 and R42. R42 serves also to provide direct potential continuity to the grid.

CATHODE-RAY TUBE

The video signal has been traced from the antenna to the control grid of the cathode-ray tube. It remains now for it to produce a visible image corresponding in all details to the original transmitted scene. The derivation of high voltage for C.R.T. operation will be subsequently reviewed but at this time it is pointed out that a lower voltage is needed, connected into the first anode of the tube, which is supplied by the low-voltage power supply and taken off at the video plate decoupling, low-frequency correction network. There is also a series combination of R62 and R104 to ground. R104, a potentiomenter connecting to the cathode, is the brilliance control which, placing a variable positive potential upon the cathode, effects grid bias for control of the picture brilliancy. C43 acts as by-pass for the signal currents.

There is, then, upon the control-grid of the cathode-ray tube a steady negative voltage (with respect to the cathode) plus a varying positive voltage from the reinserter plus the signal components which produce the picture light and shade variations and the blanking of the tube during scanning retrace.

SOUND IF AMPLIFIER

Following amplification in a portion of the video IF amplifier, the sound carrier is injected into a 6AC7 sound IF amplifier. Here, the video frequencies are discriminated against by L-C circuits resonant to the sound IF frequency, 21.75 mc.

SOUND DETECTOR

The sound carrier which accompanies the video (picture) carrier is frequency modulated, requiring the use of a discriminator as second detector. A voltage having been developed across the primary of T5, it is applied to the discriminator via two paths; magnetically between transformer windings and capacitively through C63. The resultant sum of the voltages derived from these two "sources" is applied to the two plates of the 6H6 rectifier which produces currents in R52 and R53. When the potential, the instantaneous sum of the potentials from the two "sources" is alike on both plates, the current through R52 is equal and opposite in direction to that through R53, which produces zero potential across their extremities.

It is the potential which appears across their extremities which constitutes the audio signal, appears across the volume control R102 and is passed on to the audio amplifier.

The above-stated identity of potentials upon the two 6H6 plates occurs at the carrier frequency. At some frequency removed from resonance, the phase of the potential appearing across the tuned secondary winding changes. Since both phase and magnitude go to determine the resultant sum of two voltages, a phase shift accounts for a difference in potentials at the two plates. The shift causes the capacitively connected voltage from the primary winding to add to the magnetically developed voltage across the two halves of the secondary winding in varying amount. The amount of addition depends upon the amount of shift; the amount of displacement of incoming frequency from the resonant frequency of the transformer.

Having established a greater potential at one 6H6 plate than is at the other, the current through one of the resistors (R52 or R53) will be greater than through the other, with non-zero overall potential.

There is, then, a voltage across the volume control which varies as the frequency shift at the transmitter which, in turn, varies as the amplitude of the original sound-produced electrical signals.

The frequency-amplitude output curve of the discriminator is the familiar S curve which appears in Fig. 39b.

AUDIO AMPLIFIER

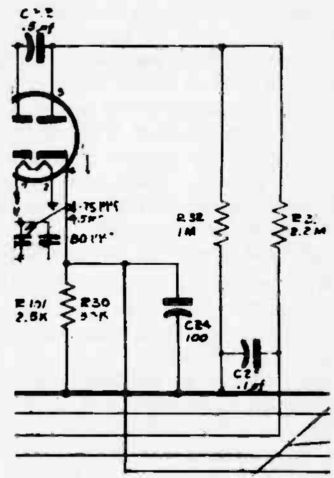
Audio signals derived from the frequency discriminator are passed on to the audio amplifier through C39, developing a potential across R54, and to the grid of the 6SJ7 amplifier. For improved operation, the 6SJ7 amplifier stage, as well as the following 6V6 stage, is operated conservatively at reduced potentials. Grid bias is afforded by the potential drop across R55 which is filtered by C103A. Screen potential is applied through R56, filtered by C40. The audio signal is developed across R57 and delivered to the 6V6 stage for final amplification through C41, over R59.

Following its final amplification in the audio power stage, the signals are fed to a permanent magnet type dynamic speaker through T7, connection to the speaker being made by X26 and P3.

SYNC. SEAPARATION AND A.G.C.

The Farnsworth receiver incorporates sync. separation at V7, the 6H6 tube which serves also as demodulator.

It must be remembered, however, that this in itself does not entirely separate either the horizontal or the vertical pulses from the combined sync. waveform—differentiating and integrating circuits do that separation.



31b Schematic of the sync. separator—A.G.C.

Reference to Fig. 31b shows that it really is another detector which is connected in parallel with the video detector, coupling being made by C22. If we first consider R32 to be of a low value (or replaced by an RF choke for DC return path to the plate), it is then a conventional detector but it would not serve its intended purpose. Potential developed across R32 would be a function of the *average* value of current.

Now let us assign the high value (one megohm) to R32. A potential will be developed across this resistor which is a direct function of the *peak* value of the current passing through the resistor.

This is because a charge upon C22 cannot be appreciably discharged between charging pulses. It is identical to a conventional plate power supply in that, with very high load resistor, the output voltage across that resistor is very nearly equal to the peak of the charging wave.

The potential is a negative one, placing the diode plate at a potential which is negative with respect to the cathode. Then it is evident that, since the plate must be positive with respect to the cathode before current may flow, only the positive peaks of the incoming signal will be rectified (detected). These are the synchronizing pulses which constitute the most positive portion of the wave. They, alone, appear in the cathode circuit of the tube and so has sync. separation been accomplished. The pulses appear across R30 and C24.

The potential across R32 was seen to be nearly equal to the peak value of the incoming signal. This peak (sync. and blanking pulses) is the only portion of the waveform which is constant with constant field strength, for the picture-producing portion of the wave undergoes change with changing scenes being televised. Therefore, this peak value, appearing across R32, is employed for automatic gain control of the receiver. It is applied to the IF stages through a filter network consisting of R33 and C25.

SYNC. AMPLIFIERS

Sync. pulses appearing in the output circuit of the sync. separator must be amplified prior to insertion into the deflection oscillators. This is done by one section of V22, a 6SN7 double-triode tube.

The amplifier output appears across R67, thence to two stages (two sections of V17) of increase and differentiation prior to direct utilization of the horizontal sync. pulses. These two stages will be partially discussed now, partially when we investigate the differentiation circuits. Vertical sync. pulses are derived from an integrating network which also is driven by the output of V17 (section 2).

The sync. pulses from the sync. separator are of positive polarity which means that, after one stage of amplification (V22) they are negative. Since they are negative as applied to V17, this first amplifier stage may be operated with little grid bias. Appearing in the plate circuit of section #2 of V17, the sync. pulses are passed on to section #1 through C57. Amplification here is afforded, after which they are applied to the horizontal control circuits.

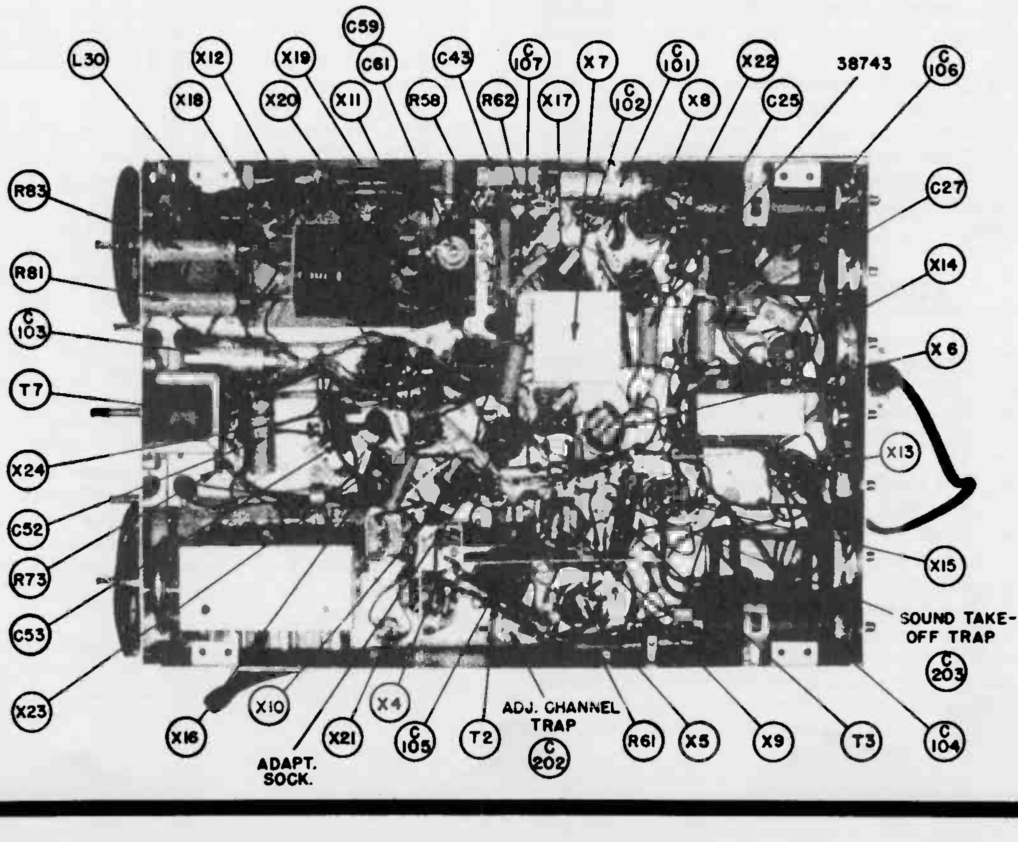
INTEGRATION CIRCUIT, VERTICAL OSCILLATOR AND AMPLIFIER

Returning now to vertical sync. separation, we see that the signal is applied to an RC circuit known as an integration circuit. It is the purpose of this circuit to remove the vertical synchronizing pulse from the combined sync. pulse waveform for synchronization of the vertical deflection circuit. This integration circuit consists of three sections of the simple type for greater integration effect, in the output of which appears the train of vertical synchronizing pulses which control the vertical oscillator.

V16, with its associated RC components, comprises a multivibrator operating at 60 cps. R74 and C51 form a decoupling network which restricts the oscillations from the plate supply. Frequency is under control by the V. Sync. control and output is from the plate of section #2. The output waveform undergoes correction by R75-C53 and is taken off in R110, the height control.

The variable (in amplitude) vertical deflection pulses are then applied to V15, the vertical amplifier, after which they pass through T10, the centering circuit V and X24 to the deflection yoke. In V15, they are further corrected in wave-form to give a sawtooth waveform of current in the deflection yoke (not a sawtooth of potential) which correction is obtained by the intentional introduction of distortion which is opposite to the distortion present in the incoming wave. This introduced distortion is the result of working upon the curved

BOTTOM VIEW OF RECEIVER CHASSIS



portion of the $I_p - E_g$ characteristics of the tube. The amount of distortion is a function of the fixed bias upon the tube which is determined by R108. C103C gives cathode-resistor bypass to the signal.

T10 is an impedance-matching transformer, matching the high-impedance plate circuit to the low impedance of the vertical deflection coils. R65 across the primary of T10 serves as a damping resistor to give correction to the pulse-shape and therefore improved linearity to the sweep.

Centering potentials, which are applied to the deflection yoke for purposes of centering the picture on the screen, are obtained as a voltage drop across R106 through which passes plate-screen currents. This potential, as applied to the vertical deflection coils, is reversible in polarity, working from either side of a center tap. Bypass of the deflection pulse currents around the centering resistive network is accomplished bv C105.

DIFFERENTIATION CIRCUIT, HORIZONTAL CONTROL CIRCUIT, BEAM RELAXOR

Returning to the last two stages of horizontal sync.-pulse amplification (V17), we find several uncommon values of R and C between the two stages. These are C57, C56, R80, R78 which form two tandem simple differentiating circuits. These serve to separate the high frequency (horizontal) sync. pulses from the combined sync.-pulse waveform.

SYNC. ADAPTOR

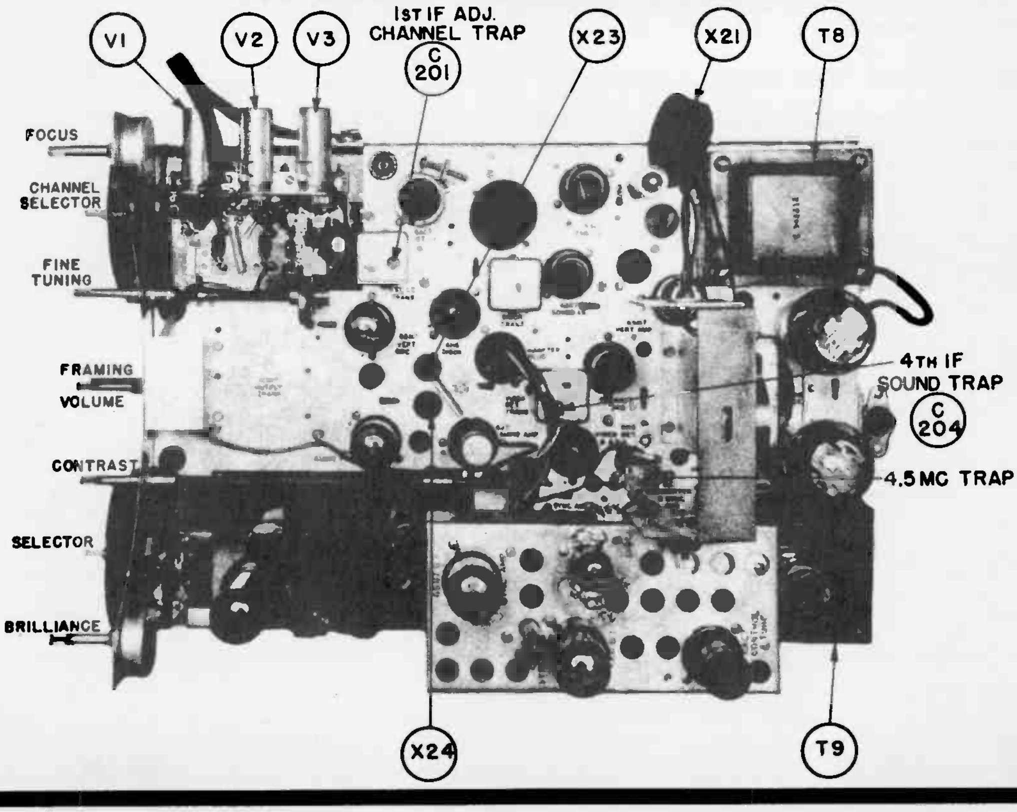
The Farnsworth receiver incorporates an automatic frequency control circuit which maintains horizontal deflection rate constant in the presence of normal bursts of interference. Inspecting Fig. 37a we find that the sync. pulses appearing in the output of V17 are transmitted to V4, one-half of a 6SN7 tube, through X25, pin #3. There, they are amplified to appear as positive pulses, then injected into the AFC circuit.

V2 is seen to be in the familiar Hartley oscillator in which sustained oscillation is had. The natural period of this oscillator is nominally near 15,750 cps; that of the incoming sync. pulses.

Connected into the inductive circuit of this oscillator is a reactance tube, V3, which operates in the familiar manner of reactance tubes in the AFC circuits of electronic sweep circuits, broadcast receivers, etc. Signals are presented to the grid of the reactance tube by injection into the cathode circuit over R217. The reactance of the cathode coupling capacitor is considerably higher than the 10 ohm cathode resistor through which the oscillator currents flow. Therefore, the current leads the voltage by almost ninety degrees. Potential and current associated with a resistor being always in phase, the potential injected into the cathode of V3 is essentially ninety degrees ahead of the potential at the grid of the oscillator. This injected potential appears at the plate of the reactance tube in like phase—leading—and is injected into the oscillator. This is the same phase difference that would be expected from an inductance—the potential leading the current. Therefore, the reactance tube and associated circuit appears to the oscillator be an inductance, and frequency shift is had even as though an inductance were attached across the oscillator coil.

Direct potential upon the grid of the reactance tube determines the amount of amplification within

TOP VIEW OF RECEIVER CHASSIS



the tube. Highly negative, amplification is reduced—and the amount of out-of-phase potential is reduced. Thereby, it appears to the oscillator that the size of our hypothetical inductance varies.

Now—this direct control potential must be a function of the oscillator frequency, so that as the frequency tends to deviate from its correct value, a change in control potential will restore correct frequency through the action of the reactance tube.

It is seen that magnetically coupled to the oscillator winding of the transformer is a discriminator circuit quite similar to the detection circuit of an FM receiver. The analysis is here omitted for that reason—reference may be made to section 31 for an analysis of the sound circuits of the receiver. Suffice here to say that the sync. pulses, along with the local oscillator pulses from V2, are injected into the discriminator. Therein, comparison is made between the two frequencies and a direct control potential is derived. Frequency is maintained constant, despite sudden temporary bursts of interference, because of the long time constant in the control-voltage circuit.

Differentiation of the pulses from the local oscillator is by C212 and R219, injection being to a clipper tube, one-half section of V4. Plate current flows only during the positive portions of the incoming pulses because the grid is quite highly negative. Some negative potential is from the cathode resistor; more due to grid current flowing through R219. This assures that, should the pulse amplitude change over a period of time, still only the positive portion of the sync. pulse will pass.

One additional component will be considered, after which we shall follow the sync. pulse from the AFC circuit on to the horizontal deflection circuits. C215 is purposed to neutralize some of the Beam Relaxor pulse which is picked up in the AFC circuits which might otherwise interfere with proper syncronization.

ADJUSTING THE SYNC. ADAPTOR

1. Set internal adjusting screw so that it extends approximately 1/4" from the Tinnerman clip.

2. Adjust screw marked HORIZONTAL SYNC. OSC. FREQ. until picture synchronizes at any position of the FRAMING control.

3. Set sync. signal level to 0.1 volt peak to peak.

4. Reduce picture contrast so that retrace lines are visible.

5. Slowly rotate FRAMING control several times from one extreme to the other and adjust HCRIZONTAL SYNC. OSC. FREQ. screw so that the picture folds over as much on the left edge as on the right edge.

6. If step 5 cannot be accomplished without breaking sync., it will be necessary to adjust the internal adjusting screw.

NOTE: Withdraw screw if picture folds too much on the right edge.

Turn screw inward if picture folds too much on the left edge.

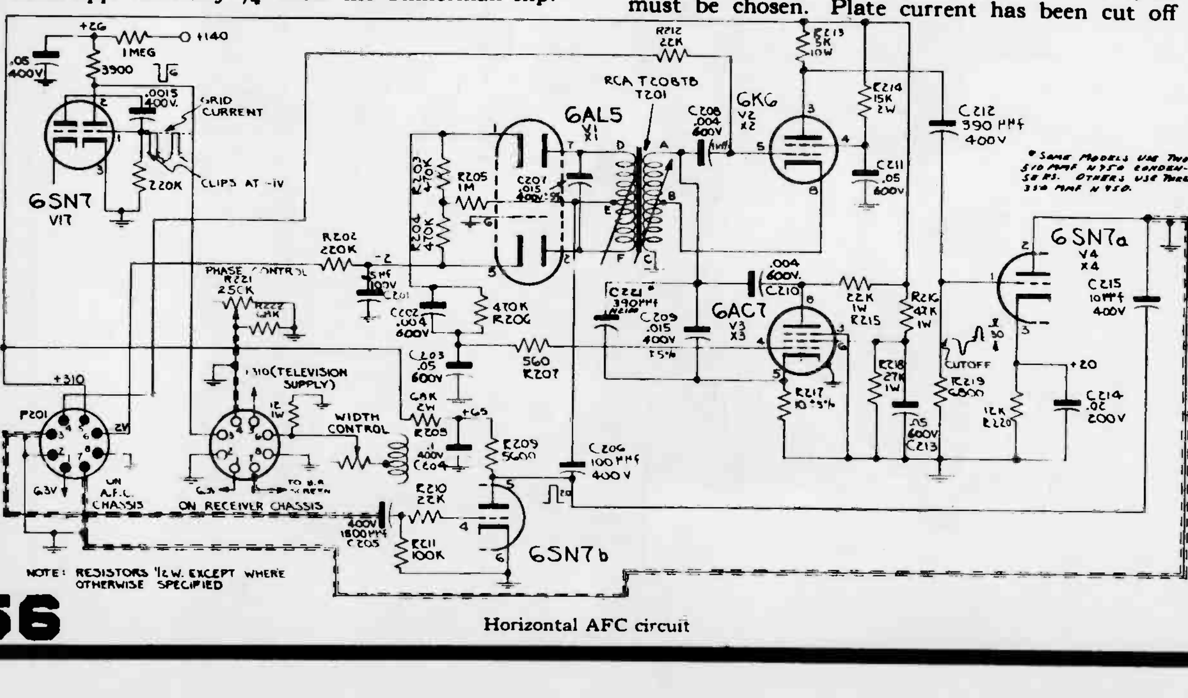
7. Rotation of the FRAMING control from one extreme to the other must shift the picture a total of 1/2" or more. If the amount of shift is inadequate, adjust internal screw slightly to give a compromise between step 5 and step 7.

BEAM RELAXOR

The "Beam Relaxor" horizontal oscillator is a product of the Farnsworth Research Laboratories. Its features include simplicity and dependable operation, combined oscillator and high-voltage generator in one tube, light weight and compactness. Such circuits were employed, during the war, in air-borne television equipments where these features are of paramount importance.

In analyzing the function of the beam relaxor, it must be borne in mind that the E_p-I_p characteristics of the beam power tube (6I6) show a sharp "knee", as inspection of these curves will indicate.

Now consider that the grid-cathode voltage is highly negative, the result of high induced voltage in the grid winding of T11 during retrace of the scanning spot. This initial condition is chosen purely because some single portion of the cycle must be chosen. Plate current has been cut off



Horizontal AFC circuit

and the magnetic flux of the transformer is collapsing, inducing high potentials to the grid (negative) and to the plate (positive). After the field has collapsed and the induced negative potential on the grid has decreased, the tube begins to conduct current, the rate of flow of which is limited by (1) the plate resistance and (2) the inductance, self and reflected, in the plate winding of the transformer. The flux is now building up and a voltage of reversed potential is being applied to the grid—a positive voltage which causes low plate resistance.

This positive voltage causes a saturation of the plate current, which saturation is accentuated by low voltage upon the plate (most of the supply potential now appears across the inductance). As time progresses, the plate potential rises and the grid-cathode potential becomes less positive due to increased plate current through the cathode resistor.

We return to the knee of the characteristic curve and, passing over it rapidly, find the tube to be no longer saturated and in an "operative" condition, whereupon an oscillation starts due to the plate-grid feedback circuit of T11. In this oscillation, a negative induced potential is applied to the grid, which being cumulative, drives the grid to plate current cutoff. We have thus completed the cycle.

A tube not of the beam power type would operate in similar manner but, not characterized by the sharp knee, the retrace time would not be as rapid and induced potentials not so great. In addition, individual pulses of its free oscillation would not be as consistently evenly spaced, leading to less positive synchronization.

The free-running speed, and therefore synchronization, is determined by R111, the cathode resistor. Across a portion of the total cathode resistance, R112, appears a potential which is a function of the average plate current and which is employed for centering of the picture on the viewing tube screen. One side of the deflection coil being center-connected to R112, the DC potential applied to the other side in either positive or negative polarity. Thus, the picture may be shifted to the right or to the left upon the screen. In order that the signal path shall not be affected by R112, bypass is provided in C107B and C107C.

Scanning potentials which drive the horizontal scanning coils are taken from across the grid winding of T11. Also across this winding are connected R83, L30 and C58 which effect linearity of sweep in the horizontal direction and, should at any time the horizontal scan be non-linear, these three components should be inspected for defect.

HIGH VOLTAGE RECTIFIERS

V19 and V20 are diode rectifiers whose filaments are lighted by a portion of the energy developed in the beam-relaxor circuit. These tubes are very conservative of filament power requirements, drawing but 50 milliamperes. The rectifier section comprises a voltage-doubling circuit which charges C59 and C61 in parallel, discharging them in series. Therefore, approximately 6000 volts of pulse potential being developed across the extremities of the high-voltage winding of T11, the output of the supply is about 8000 volts at normal load. Should the loading (the viewing tube) be removed, the potential will rise to about 12000 volts.

LOW VOLTAGE POWER SUPPLIES

Low voltage power supplies are two in number, one supplying plate and screen potentials to vertical oscillator and amplifier and to the horizontal oscillator. The second supply furnishes these potentials to all other tubes. Both of these supplies are quite conventional in design, using 5U4D rectifiers in full-wave. Supply #1, that feeding the deflection circuits, incorporates a tapped primary wherewith large deficiency or excess of line voltage at any given receiving location may be compensated by the serviceman when installing the set.

TEST EQUIPMENT NECESSARY

Following is a list of test equipment which we recommend to television receiver servicing. Item 1 is not an absolute necessity, since receiver alignment may be accomplished by the use of a vacuum-tube voltmeter and a signal generator covering the IF and RF frequencies. The signal generator method is a lengthy process, however, and impractical for use by the serviceman. It is to be noted that items 7 and 8 may be combined into one instrument.

1. Sweep generator with incorporated marker circuits. Frequency range approximately five to 230 mc, with adjustable sweep width up to 8 mc.
2. Oscilloscope. Dumont 208 B or equal. A high gain wide-band instrument is necessary.
3. Signal generator. Frequency two mc to 250 mc.
4. Vacuum-tube voltmeter whose operation extends into the high frequencies used.
5. Tube checker.
6. Mirror for viewing the front of the screen while making rear chassis adjustments.
7. High voltage meter, range to thirty KV, fifty microampere movement.
8. Volt-ohmeter, 20,000 ohms per volt.
9. Miscellaneous tools (drill, iron, small tools, alignment tools, etc.).

The following equipment is very useful to the serviceman who does antenna installations:

10. Small intercommunication system with 200 ft. reel and wire.
11. Rotatable antenna with necessary coaxial cable and control wire.
12. A compass—a very useful instrument for properly orientating the antenna.
13. Electric hammer with star drills.
14. Extension cord for operating drill and soldering iron.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

MALFUNCTION—ITS CAUSE

Section 38 is presented as an aid to the serviceman in the analysis of defective receiver operation. Although it is fairly comprehensive, it of course cannot include every defect whigh might appear. It will, nevertheless, establish a pattern of trouble shooting which will be of assistance to the technician. In the following table of faults and check points, tube checking is seldom mentioned. Tubes should be checked in the suspected portion of the receiver prior to investigating the other components or circuits.

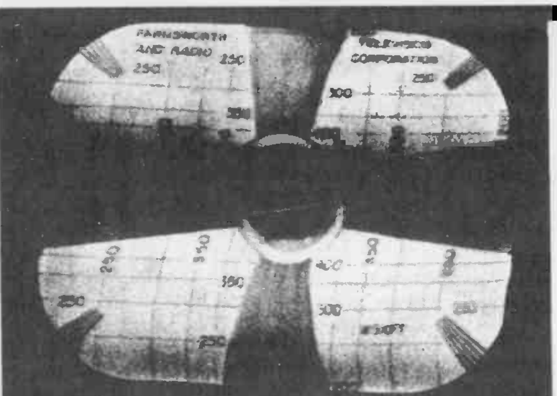
FAULT	PROBABLE CAUSE
Deflection Circuits	
Picture non linear horizontally	A. Check R83, L30, C58 in Beam Relaxor grid circuit. B. Shorted turns in horizontal deflection coils.
Picture non-linear vertically	A. Check linearity control. B. Shorted turns in vertical deflection coils or transformer. C. Defective component in vertical amplifier circuit.
Improper aspect ratio	A. Adjust height, width and linearity controls. B. If unable to achieve proper aspect ratio, some circuit component in either horizontal or vertical oscillator—amplifier (depending upon whether horizontal or vertical is deficient). Check high voltage power supply components.
Bright bar toward top of picture. Poor vertical linearity	A. Check adjustment of height and linearity controls. B. Vertical sweep circuit components.
Single horizontal bar of light on the picture tube	A. Check vertical sweep circuits—oscillator, amplifier, deflection coil and connections. Centering control, transformer.
Single vertical bar of light on the picture tube	A. Horizontal oscillator is operating, since there is light (indicating high voltage present). Check horizontal deflection coil and connections, transformer, centering control.
Picture sides are curved	A. Defective power supply components, introducing hum into horizontal deflection or centering networks.
Letter in picture reversed	A. Horizontal deflection coil leads reversed.
Picture upside-down	A. Vertical deflection coil leads reversed.
Narrow white line at top of picture	A. Vertical sync. control not set properly.
"Stretch" at top of picture. This is a wide spacing of several lines	A. Defective (open) capacitor in vertical oscillator circuit, possibly C53—or open resistor, R75. Check other components. B. Open cathode bypass condenser, vertical amplifier. Can not grounded. C. Bad vertical output transformer.
Low vertical sweep amplitude	A. Some component in Vertical oscillator. Check C53, R75.
Black vertical bar(s) at left side of picture	A. Spurious oscillation in horizontal oscillator. Change 6L6 tube.
Poor horizontal sync. lines in picture similar to auto ignition	A. High voltage corona which upsets the sync. May be caused by (1) tube socket lugs (8016) bent together. (2) wire dressing near the high voltage bleeder.
Horizontal sync. drifts	A. Bad 6SN7, V17. B. Check A.F.C. circuit associated with horizontal sweep oscillator.
Vertical centering control does not function properly	Picture size changes when control is rotated or only the central portion of the picture moves with a "jumpy" motion. A. Bad centering condenser, C105.
Similar condition, horizontal centering. Picture may move to only one side of "normal."	A. Bad centering condenser, C107B, 107C.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

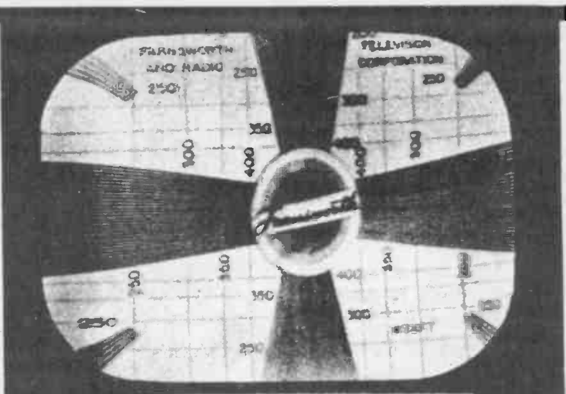
FAULT	PROBABLE CAUSE
Synchronizing Circuits	
Both vertical and horizontal sweeps will not stay synchronized	A. Weak signal. B. Misalignment of RF or IF sections. C. V22 or circuit component.
Horizontal sweep not synchronized, vertical sweep is synchronized	A. Interference. B. Weak signal or misalignment. C. Tube or circuit components through the chain of horizontal sync. circuits—V17, A.F.C. circuits.
Vertical sweep not synchronized, horizontal sweep is synchronized	A. Low signal strength or misalignment. B. Input circuit of V16 (integrating network). Check components.
Unstable Picture	
Picture jumps or bounces	A. Interference. B. This may be a function of poor sync. as outlined above. C. Microphonic or noisy tubes. D. Noisy resistor or capacitor in either the sync. circuits or the picture circuits. E. Cold solder connection (tap components and connections with a fibre rod).
Lines in picture appear to ripple	A. Interference from high frequency equipment. B. Check antenna orientation. C. Check for pickup of interference by transmission line.
Portions of picture "tear out"	A. If this follows the sound impulses, audio is entering the picture tube grid circuit. Check sound traps in IF amplifier. B. Signal too strong. Rotate antenna or install an "H" pad in transmission line. C. Interference pulses strong enough to upset synchronization.
Horizontal bars in picture which change with sound	A. Check adjustment of the sound traps. B. Microphonic tubes. Tap with fibre rod.
Microphonic. Howls (usually only when in cabinet)	A. Loose fine tuning condenser plates, or improperly formed. These plates must exert constant pressure on the bakelite strip—must never be "free-floating." B. Microphonic tube, particularly in RF section. Most microphonics are traceable to the RF section. C. Bad soldered grounds, RF section.
Defective Picture	
Picture poorly shaded or dark	A. Adjust contrast and brilliance controls. B. If picture is still "washed out" or "flat," this indicates insufficient picture signal at the viewing tube caused by (a) weak received signal (b) misalignment (c) defect in video amplifier tube or circuit. Check viewing tube by replacement.
Stationary bar in picture	A. Hum entering the video chain. Check power supply filter system.
Top to bottom portions of the picture are shaded differently	A. Poor low frequency response of video amplifier, check C26, C27, C101, C102A and C102B for partial or fully open condenser.
Weak signal on all channels, as coidenced by poor contrast and/or "snow"	A. Open or partially shorted transmission line. B. Misalignment of any or all tuned circuits. C. Check 6AC7 video amplifier.
Poor resolution	A. Check "fine tuning" control. B. Misalignment in RF or IF section(s). C. Check video amplifier circuit for loss of high frequency response, particularly the inductive components.
Picture contains noise splotches	A. Interference from outside sources. Check antenna orientation and transmission line. Relocate the antenna. B. Noisy components. Tap with insulated screw driver.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

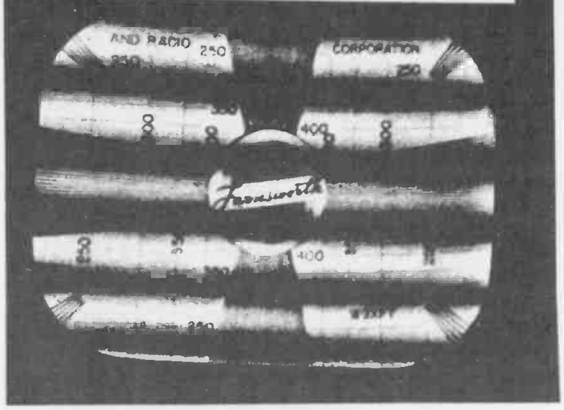
FAULT	PROBABLE CAUSE
Defective Picture	
"Snow" on picture	A. Weak signal strength. B. Misalignment. C. Check antenna for orientation. D. Check antenna—transmission line for open or short.
Double image(s) or "ghosts"	This condition indicates reflections of signal. A. Rotate antenna. B. Relocate antenna. C. Check for misalignment.
Picture blurred	A. Possibly a condition of "ghosts" wherein separation of the two images is small. B. Check vertical and horizontal sync. controls. C. Weak signal. D. Interference. E. Check alignment.
White retrace lines in picture	A. Reduce brilliancy and/or increase contrast. B. Vertical sync. slightly improper.
No focus, picture size changes when focus control is rotated	A. Open focus coil. B. Poor connection at the coil or in connecting plug socket. Poor solder-joint.
No Picture	
No picture. Viewing tube is lighted (raster is present). Sound is present	A. Defective tube or circuit component in the video circuits following first IF amplifier. Check IF amplifier, demodulator, video amplifier circuits. B. If this occurs after changing oscillator tube, the tube is off-capacity. Change 6J6 tube.
No picture, viewing tube dark. Sound is functioning	A. Advance contrast and brilliancy controls. B. Check high voltage. If none, C. Faulty 6L6, 8016 or 5U4G tubes. D. Low voltage power supply which furnished plate potention to beam relaxor. E. Beam relaxor circuit. If oscillating check high voltage circuits. If there is high voltage, F. Replace viewing tube. G. Check bias and first anode potentials on picture tube. NOTE: 8016 tubes may check good, yet have gas content. Check tubes by replacement.
No picture, focus and width controls run hot	A. Arc-over in 6L6 socket, causing carbonization. Replace socket, using a ceramic unit. B. Breakdown of filter condenser or other component or wiring, causing a short of +B to ground. Note. C. The wire dressing around the 6L6 socket.
No picture, no sound, viewing tube not lighted	A. Check entry of 110V supply into the receiver (observe whether pilot lamps and tubes are lighted). B. Check both low-voltage supplies. C. If both are operating, follow a systematic tracing system—operation of deflection circuits and high voltage circuits first to establish light upon the screen. After that, follow a procedure as outlined in the above sections.
Sound Defects	
Picture present, no sound	A. Rotate "fine tuning" control. B. Check audio amplifier—speaker circuits. C. Check sound IF and discriminator tubes and components.
Noisy or poor quality sound	A. Rotate "fine tuning" control. B. Sound IF and discriminator alignment, T5. C. Other circuit components as in the broadcast receiver—speaker voice coil, amplifier circuit tubes and components.



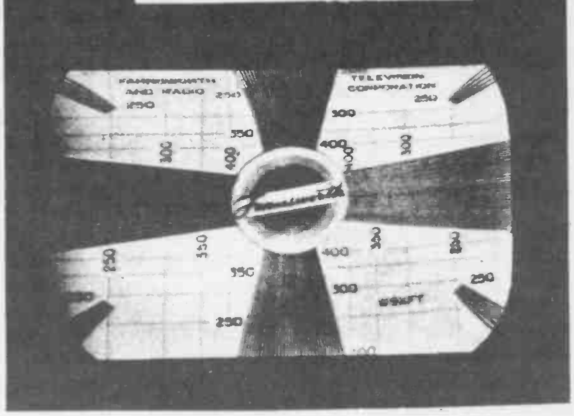
38c 120 cycle hum in video and in H. scan



38d Faulty horizontal linearity



38e Sound bars

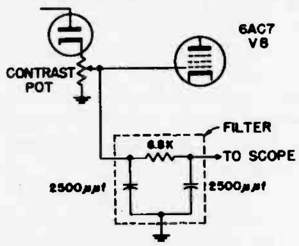


38f Height control too low

ALIGNMENT INSTRUCTIONS

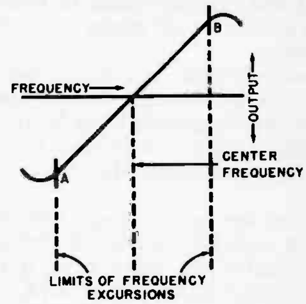
ALIGNMENT OF THE IF SECTION

Equipment needed: Vacuum-tube voltmeter, signal generator covering 20-30 mc, sweep generator, oscillograph, 6-volt battery, clip-leads, alignment tools.

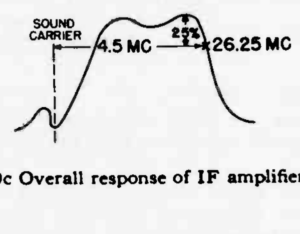


39a Filter for use with oscillograph in alignment

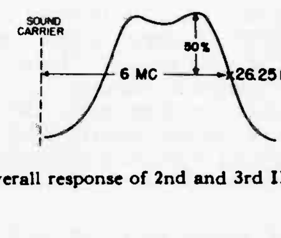
It is convenient to employ a special 6AC7 tube for connection to pin #4 of the IF tubes. This is a good non-microphonic 6AC7 which has had its pin #4 removed Soldered to the stub of the pin



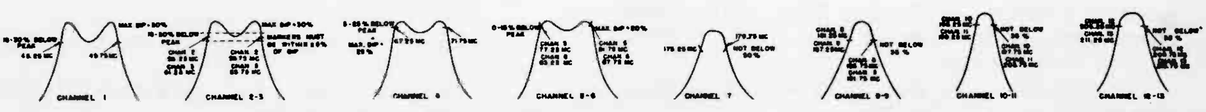
39b "S" curve-output of the discriminator



39c Overall response of IF amplifier



39d Overall response of 2nd and 3rd IF amplifier



39e Response of RF bands

is a short section of bus-wire for connection of the generator clip-lead. This special tube is then inserted in the stage into which generator connection is to be made. It is recommended that another section of bus-wire be soldered to pin #1 for a short, direct ground connection of the generator cable.

At all times a signal from the generators should be used which is no stronger than that necessary to the desired scope pattern or voltmeter reading. The scope and voltmeter should be operated at high gain.

The receiver chassis must be well bonded to all instruments being used, all placed upon a metallic sheet or a metal-topped bench. All chassis and connecting leads must in operation be cold—touching with the hand should produce no change in the reproduced scope pattern or meter reading. If the hand does produce a change, evidently there is present an unstable condition which must be corrected by better grounding together of all chassis and instruments in use.

1. Remove Television 5U4G rectifier tube.
2. Remove Oscillator tube (6J6).
3. Connect filter as shown in Fig. 39a.
4. Apply sweep signal to pin 4 of sound IF amplifier. Set volume control to minimum. Connect scope to the "high" side of volume control. Tune discriminator for the pattern shown in Fig. 39b.
5. Set contrast control about mid range. Connect meter to filter shown in step 3. Connect 21.75 mc to second IF grid (pin 4).
6. Tune trap on third transformer for minimum output.
7. Connect sweep to second IF grid. Connect scope to filter. Tune fourth transformer trap out of pass band. Adjust slugs in fourth transformer until curve has equal peaks with 26.25 mc about 15% down.
8. Connect meter to contrast pot, through filter. Apply 21.75 mc signal. Adjust trap trimmers in third and fourth transformers for minimum output.
9. Repeat steps 7 and 8 for the pattern of Fig. 39c as obtained with the sweep generator and 'scope.
10. Connect a clip-lead from the junction of R13, R14 and C9 to ground the low side of T1. Apply negative six volts from a battery to T2. This is to the junction of R18, R19 and C12.
11. Connect sweep to mixer grid.
12. With scope at contrast pot, through filter, tune traps in first and second transformers outside pass band. Adjust first transformer slugs until peaks are equal and 26.25 mc is about 30% down.
13. Apply 27.75 mc signal to mixer grid. Connect voltmeter to contrast pot. Tune first transformer trap for minimum output.
14. Apply sweep to mixer grid. Connect scope to "high" side of volume control. Adjust second transformer trap for maximum symetrical output. 21.75 mc marker should be at the center of the S curve.
15. Connect sweep to mixer grid. Connect scope to contrast pot through filter. Adjust first transformer for equal peaks with 26.25 mc 30% to 45% down as shown below.
16. Repeat 14, 15 and 16. The response pattern should be as in Fig. 39d.

ALIGNMENT OF THE RF SECTION

Equipment needed:

Sweep generator covering 44-216 mc, oscillograph, alignment tools, cement.

1. Set local oscillator vernier (fine tuning) to the middle of its tuning range.
2. Connect modulated signal generator to antenna terminals. Set the generator to a frequency which is .25 mc lower than the high extremity of the channel being aligned. To align channel #4, for example, which extends from 66 to 72 mc, set the generator to 71.75 mc. Frequency limits of the television channels are:

Channel No.	Frequency, mc.	Sound carrier
1	44-50	49.75
2	54-60	59.75
3	60-66	65.75
4	66-72	71.75
5	76-82	81.75
6	82-88	87.75
7	174-180	179.75
8	180-186	185.75
9	186-192	191.75
10	192-198	197.75
11	198-204	203.75
12	204-210	209.75
13	210-216	215.75

Tune oscillator slug for maximum tone in the speaker. When slug has been properly set, cement in place with a drop of cement.

3. Align other oscillator coils in the same manner.
4. Apply sweep signal to the antenna terminals. If the sweep generator does not incorporate an internal marker, connect also the signal generator to antenna terminals as a marker source.
5. Connect the oscillograph to the screen-grid of the mixer tube, pin #6 of V2.
6. Align the RF transformer slugs of selector position No. 2. The coupling wires on top of the main panel of the oscillator be adjusted so that the markers (Fig. 39e) are down from the peaks by the same percentage as the dip between peaks. These coupling wires are two short sections of wire over which has been placed a length of spaghetti. Adjustment is by slightly spreading the wires at the point of entry into the spaghetti, or crimping closer together. This assembly is the condenser, shown on the schematic, which connects between the primary and secondary coils.

NOTE: It may be necessary to adjust the fine tuning condenser to remove a disturbance in the bandpass curve. The bandpass should approximate that of figure 39e, paying careful attention to limits.

7. Align position #1. The coupling loop mounted on the third switch wafer (counting from the front end) should be adjusted for proper bandpass.
8. Align other switch positions.
9. Since tuning of coils on one position may effect the tuning of adjacent coils, it may be necessary to go back over the curves and to make an readjustment necessary. Cement slugs in place with cement.
10. Remove 'scope and generators, replace 5U4G and picture tubes.
11. Check overall reception by observing a transmitted test pattern.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

GENERAL ELECTRIC

SERVICE DATA

FOR

TELEVISION RECEIVER
MODEL 803

INTERMEDIATE FREQUENCIES:

Television Video (Carrier Freq. Equivalent)	26.4 mc
Television and FM Audio (1st Conversion)	21.9 mc
Television and FM Audio (2nd Conversion)	4.5 mc
Broadcast Radio	455 kc

DESCRIPTION—TELEVISION AND RADIO CIRCUITS

The receiver circuits are divided into the following sections:

1. R-F amplifier, converter and oscillator.
2. Video and audio i-f amplifier.
3. Video detector and amplifier.
4. Sync pulse clipper-amplifier.
5. Horizontal multivibrator and AFC sync.
6. Horizontal sweep output.
7. Vertical multivibrator and sweep output.
8. High voltage power supply (H.V. supply).
9. Low voltage power supply (L.V. supply).

A brief description of the operation of each section is described in the following paragraphs.

A block diagram of the complete receiver is shown in Figure 1 to assist in signal tracing and to better visualize the operation of the receiver as a whole.

1. R-F AMPLIFIER, CONVERTER AND OSCILLATOR (SEE FIGURES 2 AND 3)—The television and FM r-f amplifier makes use of a Type 6AU6 tube connected as a triode grounded-grid amplifier. The antenna is connected into the cathode circuit so as to provide a substantially constant input impedance of 300 ohms to the antenna at all frequencies. With a 300-ohm antenna and transmission line system, this coupling arrangement permits optimum transfer to signal from antenna to r-f amplifier for all 13 channels and also prevents reflections from being set up on the transmission line. R2 is the normal bias resistor. A choke, L_k, is placed in series with this cathode resistor to prevent the input impedance from being lowered by the shunting effect of the total stray capacity to ground of the cathode of the tube. The choke value is changed for different channels.

For television operation, the r-f amplifier is coupled to the converter tube by a wide band transformer consisting of windings L_p and L_s. The windings are overcoupled and self-tuned by

The General Electric Model 803 television receiver is a table model, 25-tube instrument providing reception of all 13 commercial television channels and radio reception in the Broadcast and FM bands. The television picture is reproduced on a 10-inch electromagnetically deflected picture tube.

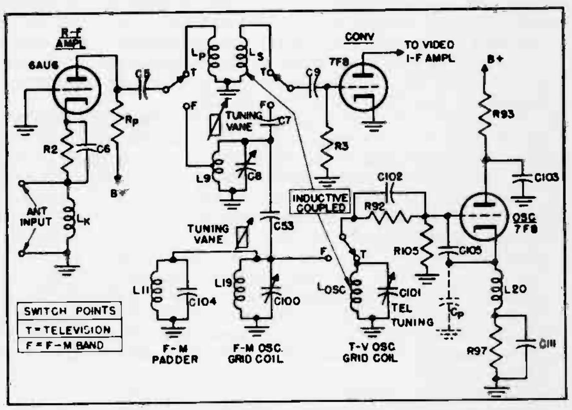


Fig. 2. Television and FM R-F Amplifier, Converter and Oscillator

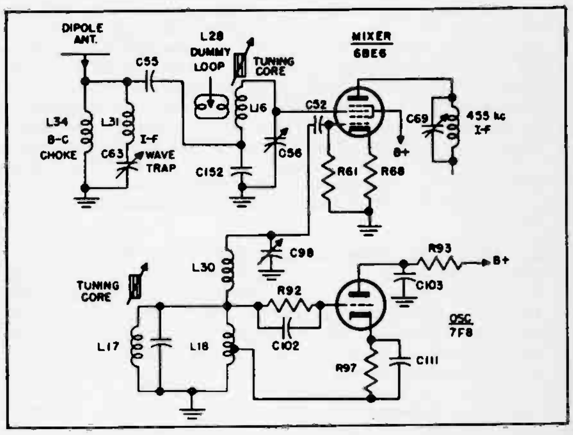


Fig. 3. Broadcast Converter and Oscillator

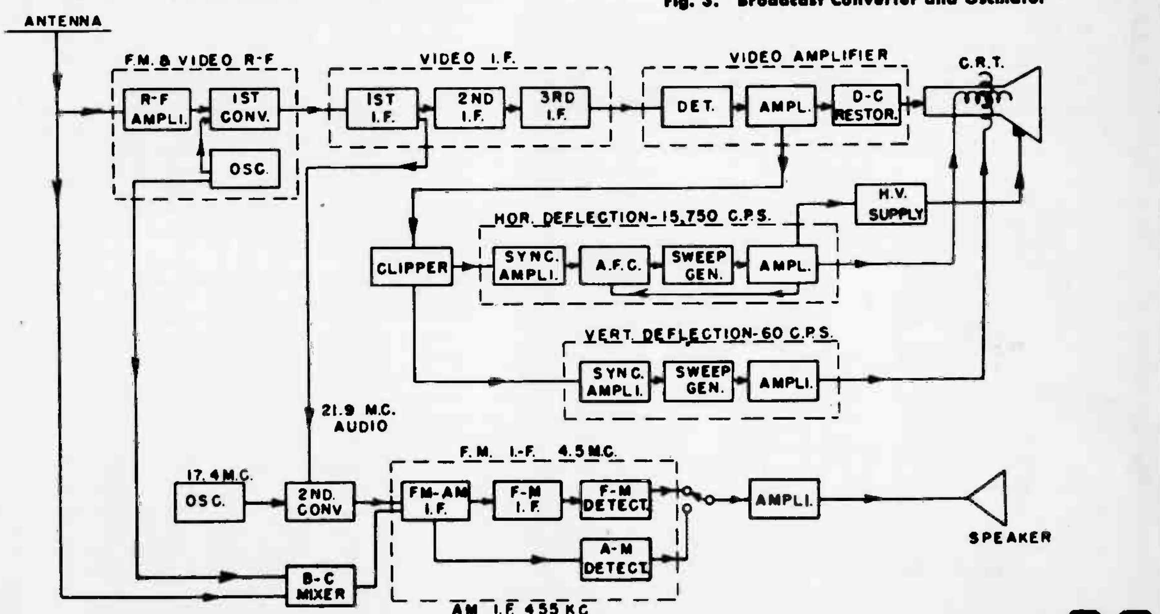


Fig. 1. Block Diagram, Model 803

the distributed and tube capacities to provide optimum gain and band width. On channels No. 1 and No. 2, the transformer is triple tuned to prevent the image frequencies of the 88 to 108 mc FM band from interfering with these two channels. For FM reception in the 88–108 mc band, the r-f amplifier is coupled to the converter through the Guillotine Tuner Unit, L9. This unit operates as an autotransformer, the inductance, and therefore frequency, of which is varied by the tuning vane which travels in and out of L9. L9 is tuned to resonance by the stray and tube capacities, as well as by a trimmer, C8.

The triode converter is one section of a Type 7F8 dual triode, V2. Bias for this tube section is provided by the oscillator voltage appearing in the grid of the converter tube, causing grid rectification charging the grid resistor-condenser combination, R3 and C9.

The oscillator makes use of the remaining half of the Type 7F8 tube, V2B, and for television operation, the oscillator voltage is coupled inductively to the converter grid by locating the oscillator grid coil, L_{osc}, adjacent to the converter grid coil, L_g. For FM operation, the oscillator voltage is coupled through capacitor C53 into the grid circuit tuning circuit, L9. The oscillator is a modified Colpits oscillator, oscillation being produced by the cathode-to-grid, C_g, and cathode-to-plate, C_k, interelectrode capacities of the oscillator tube. C105 shunts C_g to provide uniform operation. The choke, L20, provides, a d-c ground to the cathode of the oscillator tube but maintains the cathode off-ground at the r-f frequencies. The oscillator operates on the high frequency side of the r-f signal on all bands.

For broadcast reception, no r-f amplifier stage is used, the r-f signal being applied directly to a Type 6BE6 mixer, V26. Here the broadcast signal is converted to 455 kc in the plate circuit. The oscillator section of V2 operates as the local oscillator for broadcast, operating on the high frequency side of the incoming signal. The oscillator is connected in a Hartley circuit by taking off the cathode tap on L18 which forms part of the grid tank circuit. The oscillator voltage is capacity coupled to mixer grid through C52. Tuning through the broadcast band is accomplished by moving powdered iron cores in the mixer and oscillator grid tank coils which are ganged to the tuning control and dial scale.

The r-f unit, including the r-f amplifier, converter and oscillator tubes and their associated components, is constructed as a complete unit subassembly which can be demounted from the main chassis.

2. *VIDEO AND AUDIO I-F AMPLIFIERS* (SEE FIGURE 4)—The video i-f amplifier consists of a three-stage band-pass amplifier using three Type 6AC7 tubes. The transformers, T15, T17, and 18, are overcoupled and then loaded with resistance to give adequate (approx 4 mc) band-pass frequency characteristic. A series tuned trap consisting of L32, C127 and C126 tuned to 27.9 mc is connected in the 1st i-f amplifier grid circuit to provide rejection of the adjacent channel sound. T16 is a broad band, single tuned inductance with two 21.9 mc traps coupled to it, which are used to provide rejection of the channel audio. A series tuned 21.9 mc trap is used at the diode stage (T18).

Bias for the video i-f is taken from the horizontal multivibrator. This bias is shorted out on FM to prevent positive voltage from appearing on the grid of V3. The horizontal multivibrator does not operate on FM so that the bias circuit is returned to B+.

The audio i-f frequency is developed by taking the 21.9 mc sound i-f signal from across one of the traps at T16 and applying

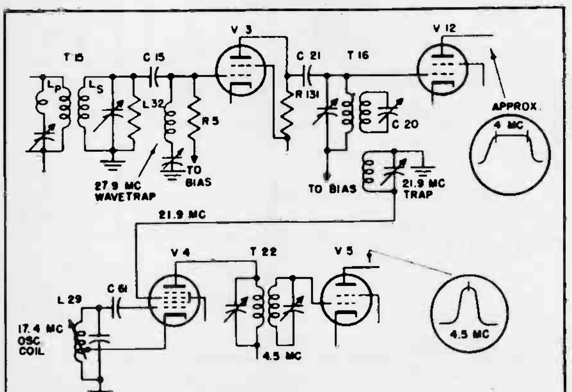


Fig. 4. Video and Audio I-F Amplifier

it to the 2nd converter tube, V4. At this tube, the 17.4 mc local oscillator combines with the 21.9 mc to form a difference frequency of 4.5 mc. At this frequency it is amplified by V5, applied to the limiter tube V6 and then detected. Since the audio channel of the television is frequency-modulated, the transformer T24 functions with sections of V7A as the discriminator. This double conversion used to receive the 88 to 108 mc FM band, provides high gain and selectivity necessary for tuning of the FM stations.

3. *VIDEO DETECTOR AND AMPLIFIER* (SEE FIGURE 5)—The video i-f amplifier output is applied to a diode rectifier, V15A, and the diode load, R18, is connected so as to develop a negative-going signal at this point. This signal is amplified by the pentode amplifier, V14, and then applied to the cathode of the picture tube, V24, through the coupling capacitor C3. The remaining diode section of V15 is used to provide d-c reinsertion to the picture at the picture tube.

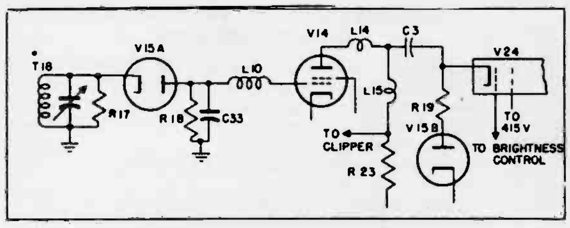


Fig. 5. Video Detector and Amplifier

The chokes L10 and L14 are series-peaking chokes, while L15 is a shunt-peaking choke. These are used to obtain good-high-frequency response. L10 in combination with C33 also prevents harmonics of the i-f frequency from being passed through the video amplifier. R23 is the V14 tube plate load resistor.

Since the cathode of the picture tube is normally at a positive voltage, by the fact that it is returned to a B+ source, a variable positive voltage is also applied to the grid of V24 for control of the brightness or beam current. As long as this grid voltage is less positive than the cathode voltage, the tube beam current will be within its rating. This positive voltage on the grid is controlled by Brilliance control potentiometer, R108B.

4. *CLIPPER AND SYNC AMPLIFIER*—The triode section, V16A, of a Type 6SN7GT tube is used to separate the sync pulses from the composite video signal taken off at the load resistor, R23. The clipper tube, V16A, is operated at a very low plate voltage and its bias is derived by grid rectification of the positive polarity video signal applied to the grid. Thus, conduction in V16A will occur only during the sync pulse intervals which are the most positive component of the video signal.

Tube V16B is a horizontal synchronizing amplifier which operates into the AFC input transformer, T19. This transformer by virtue of its low inductance acts as a differentiator; that is, in the secondary, the original sync signals become positive and negative pips. Only the pip that is representative of the leading edge of the synchronizing pulse is used.

The vertical synchronizing amplifier tube, V18B, receives the sync pulse at its grid circuit through an integrator circuit consisting of R30 and C136. This integrating circuit accepts the wide vertical pulses and further amplifies them while the horizontal pulses do not have sufficient energy to charge the integrating circuits and are, therefore attenuated. The tube V18B is operated as a cathode follower and further integration of the sync signal is provided in its cathode circuit.

5. *HORIZONTAL MULTIVIBRATOR AND AFC SYNC* (SEE FIGURE 6)—The horizontal sawtooth oscillator makes use of a Type 6SN7GT tube, V21, in a conventional cathode-coupled multivibrator circuit. Instead of its frequency being controlled directly by the horizontal sync pulses, it is controlled by a d-c voltage on its controlling grid, the d-c voltage being a resultant of the phase error between the incoming sync signal and a sawtooth voltage derived from the output of the horizontal sweep amplifier. This voltage is called an automatic frequency control (AFC) voltage.

The AFC voltage is developed by the diode-connected triodes V17A and V18A by mixing the horizontal sync pulses at the secondary of transformer T19 with a sawtooth voltage waveform derived at the output of the sweep amplifier tube, V22. When the sync pulse occurs at the time "a" shown in the sawtooth waveform drawing in Figure 6, no voltage will be developed at the output of the filter. However, if the multivibrator runs faster or slower so that the pulse falls at a point other than at "a," a

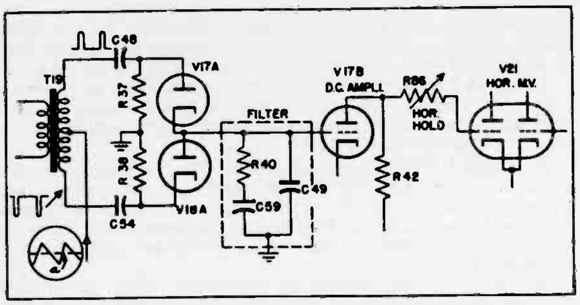


Fig. 6. Hor. Multivibrator and Sync

positive or negative voltage will appear at the filter, which will be amplified by the d-c amplifier V17B and then applied to the grid of the multivibrator. This change in d-c voltage on the grid of the multivibrator will cause it to speed up or slow down so as to cause the sawtooth wave to combine with the incoming sync pulses until the correction voltage becomes zero. With the filter consisting of R40, C59, and C49, the change is relatively slow in controlling the speed, permitting the equivalent of individual frame synchronization instead of each component line. This gives a picture characterized by greater detail than is possible where random noise triggers the directly synchronized sweep generator. The Horizontal Hold control, R86, in conjunction with the cathode tuned circuit C99 and L33, control the free-running speed of the multivibrator. They are adjusted near to the correct frequency during the time when no sync pulses are available.

6. *HORIZONTAL SWEEP OUTPUT* (SEE FIGURE 7)—The horizontal sawtooth voltage generated by the multivibrator, V21, is shaped and then amplified by a Type 6BG6G tube, V22. The output of this tube is coupled to the horizontal deflection coils through an impedance-matching transformer, T25. An oscillatory voltage, as shown in the dotted line in the waveshape at the upper left of Figure 7, which results from the rapid retrace in the transformer T25, is removed by the damping tube, V23. This tube is a dual triode, Type 6AS7G, and by its use the transient may be dampened, linearity controlled, and the positive overshoot voltage retained for use in the high voltage supply. The linearity of the horizontal trace is controlled by varying the voltage waveshape applied to the grid of V23 by potentiometer, R115. The horizontal size is controlled by the adjustable iron core inductance, L23, which is in series with the output to the yoke.

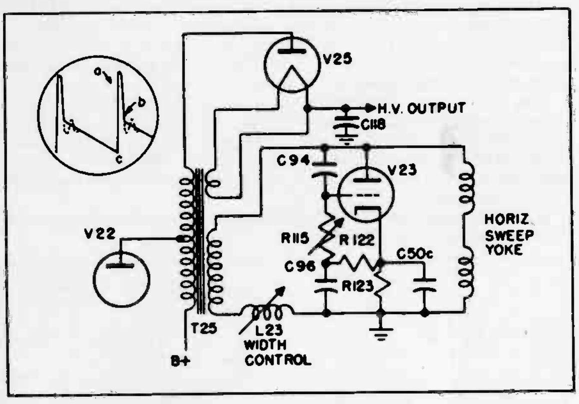


Fig. 7. Horizontal Sweep Output

7. *VERTICAL MULTIVIBRATOR AND SWEEP OUTPUT* (SEE FIGURE 8)—The vertical sawtooth voltage is generated by a Type 6SN7GT tube, V19, connected as a multivibrator. This voltage is coupled directly to a Type 6V6G vertical sweep output tube, V20, and then to the vertical sweep coils through the impedance-matching transformer, T20. Vertical speed is controlled by changing the time constant of the multivibrator grid circuit by the potentiometer, R46. Sweep size is changed by the potentiometer, R49, which changes B+ voltage applied to the charging network of tube V19 simultaneously with the screen voltage on tube, V20. Vertical linearity is controlled by a correction voltage developed in the cathode of V20 being fed back through C92 to

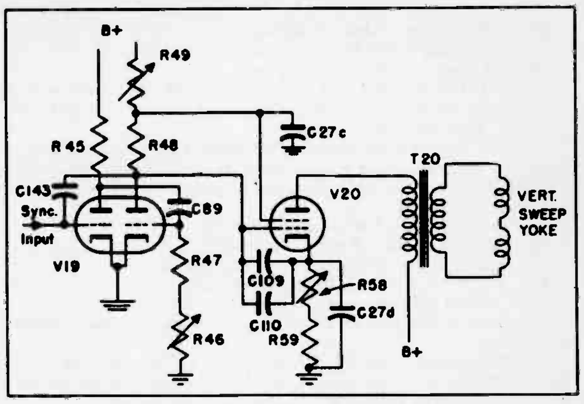


Fig. 8. Vertical M.V. and Sweep Output

the grid of the output tube. The amount of correction voltage is varied by the variable cathode resistor, R58.

8. *HIGH VOLTAGE SUPPLY* (SEE FIGURE 7)—The high voltage is derived by making use of the inductive "kick" voltage produced during retrace in the horizontal output transformer. This "kick" voltage is shown in the waveshape shown as "c to b" in Figure 7. This voltage is generated in the primary winding and is further increased by an additional winding added to the transformer which connects to the rectifier tube plate of V25. The rectifier tube, V25, is a Type 8016 which derives its filament voltage from the horizontal sweep transformer T25 by a single turn around the transformer. Because of the high frequency (15,750 cps) which is rectified, a 500 mmf. capacitor is more than sufficient for filtering purposes.

9. *LOW VOLTAGE POWER SUPPLY*—Two rectifiers are used to supply the required plate current for the television and radio receiver. A Type 5U4G tube, V11, supplies the bulk of the current and makes use of a choke, L21, and capacitor, C106 and C45A filter. Type 5Y3GT, V10, is used to supply higher voltage to the horizontal output, horizontal multivibrator, and the picture tube 1st anode. This is followed by a choke-capacitor filter. All filament supply leads except for tubes V26, V4, V3, V5, V2, V1, V8, V6 and V7 and the rectifier filaments pass through the band switch so that tubes are switched ON or OFF when switching from radio to television.

CIRCUIT ALIGNMENT

GENERAL—A complete alignment of the Model 803 television receiver consists of the following individual alignment procedures. These are listed below in the correct sequence of alignment. However, any one alignment may be performed without the necessity of realignment of any one of the other sectional alignments, provided the signal source for television traps and video i-f amplifier is accurately calibrated.

1. Broadcast i-f amplifier.
2. Broadcast r-f amplifier.
3. FM and television sound i-f amplifier.
4. Video i-f traps.
5. Video i-f amplifier.
6. FM r-f amplifier.
7. Television oscillator adjustments.
8. Television r-f amplifier.

The alignment procedure is in table form on pages 9 through 13. The following paragraphs are important suggestions to be followed when attempting alignment and should be read thoroughly before alignment is attempted.

TEST EQUIPMENT REQUIREMENTS—To provide the over-all alignment as outlined above, the following test equipment is required.

1. Cathode Ray Oscilloscope—This scope should preferably have a 5-inch screen and should have good high frequency response, which will be useful in making the waveform measurements on page 20 and 21. Note—High frequency response is not essential for alignment.

2. Signal Generator—This signal generator must have good frequency stability and be accurately calibrated. It should give good output at the following frequencies with tone modulation where desired.

(a) 455 kc for broadcast i-f.
(b) 550–1620 kc for broadcast.
(c) 4.5 mc for FM and Tel. audio i-f marker.
(d) 21.9 mc for sound i-f marker and trap alignment.
(e) 27.9 mc for trap alignment.

(f) 23.0 mc for video i-f marker.
(g) 25.65 mc for video i-f marker.
(h) 26.4 mc for video i-f marker.
(i) 44–130 mc and 174–238 for FM r-f alignment and for oscillator adjustment and markers for the r-f channel bandwidth measurements.

3. R-F Sweep Generator—This should give at least 0.1 volt output with adjustable attenuation of the output. The output should be flat over wide frequency variations. The frequency coverage should be:

(a) 4.5 mc, with 1.0 mc sweep width.
(b) 21.9 mc with 1.0 mc sweep width.
(c) 20 to 30 mc, with 15 mc sweep width.
(d) 40 to 90 mc, with 25 mc sweep width.
(e) 170 to 220 mc, with 25 mc sweep width.

4. Output Meter—An output meter with a voltage range of 0-2.5 volts a-c.

5. Wavetraps—Accurately calibrated wavetraps may be used to supply markers in place of the signal generator for video i-f and r-f alignment purposes.

ALIGNMENT SUGGESTIONS—All trimmer locations are shown in the drawings of Figures 14 or 17. Remove the chassis from the cabinet and turn it on its side with the power transformer down. This is the only safe position in which the chassis will rest and leave all adjustments accessible. The following suggestions apply to each individual alignment procedure.

1. Broadcast I-F Alignment—(a) Although the oscilloscope is recommended in the table for indicating the output voltage during alignment, an output meter may be connected across the speaker voice coil as an alternate output indicating device. When this is used, the volume control should be set for maximum volume and then attenuate the signal generator output so as not to cause audio overload.

(b) Use a 500 mmf. mica capacitor between the high side of the signal generator and the signal input point, as indicated in the Alignment Table.

2. Broadcast R-F Alignment—Apply signal generator input to one of dipole input terminals (No. 1 or No. 2) through a 500 mmf. mica capacitor or IRE standard dummy antenna. An output meter across the speaker may be used in place of the oscilloscope for indicating output. The moving iron cores of the r-f and oscillator coils are adjusted by the hex head adjusting screw located on the elevator cross-arm to which the cores are mounted.

3. FM and Television Sound I-F Alignment—Amplification of the incoming sound signal is accomplished at 21.9 mc and then through double conversion is reduced to 4.5 mc and then further amplified. The tuned circuit consisting of L29 and C62 is not adjusted to 17.4 mc directly but is tuned to provide the proper output of 4.5 mc when a 21.9 mc signal is applied to the mixer grid of V4.

Since the sound i-f for FM and television makes use of slightly over-coupled transformers, a sweep generator is necessary. For alignment, connect the generator through a 500 uuf. capacitor to the input points as indicated in the table. Connect the oscilloscope across the limiter grid resistor, R69, through a 100,000-ohm resistor for steps 1 through 4. For the discriminator alignment, the oscilloscope is connected across the volume control and the series resistor to the scope is *reduced to 10,000 ohms.*

For steps 1 and 2, insert a 4.5 mc marker signal from an unmodulated signal generator into the same point of input as the sweep generator. This input, however, must be very loosely coupled so that it doesn't affect the response curve. See Figure 9A for curve for step 1.

Keep the input of the sweep generator low enough so that the sound i-f amplifier does not overload. To check for overload; the response curve should increase proportionally as the sweep output is increased. If it flattens off and won't increase in size, the amplifier is overloaded.

The response curve narrows up somewhat as more transformers are aligned and should appear as in figure 9B for steps 2, 3, and 4.

For discriminator alignment, the secondary trimmer C140 of T24 is aligned by using a tone-modulated 4.5 mc signal and listening to the tone at the loudspeaker or observing it on an oscilloscope. The trimmer is adjusted for minimum output. If a sweep is used for the secondary trimmer alignment, the cross-over should be symmetrical about a 4.5 mc marker and should be a straight line between the alternate negative and positive peaks, as shown in Figure 9C. With the same sweep input as in step 1, adjust the primary trimmer, C80 of T24, for maximum peak-to-peak amplitude and symmetry of peaks above and below the baseline, as shown in Figure 9C.

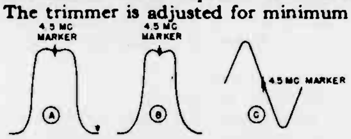


Fig. 9. FM Audio I-F Curves

4. Video I-F Trap Alignment—The video i-f traps are used to attenuate the sound i-f of the same and adjacent channels from being detected and reproduced on the picture tube. Misalignment of these traps results in interference patterns which have the appearance of horizontal bars or as a very fine pattern which spoils the contrast.

Set the Contrast control at maximum. Turn the Service Selector control to channel 13. Connect the oscilloscope through a 10,000-ohm resistor to the top of the video load resistor, R23.

Connect the output of an accurately calibrated signal generator (with tone modulation) to the grid of the converter tube V2A, through a 500 mmf mica capacitor. The alignment frequencies are:

(C127)—27.9 mc
T17 (C29)—21.9 mc
T18 (C34)—21.9 mc

The trap trimmers C20 and C22 were aligned during "FM and Television Sound I-F Alignment" and should not be readjusted.

The trimmers should be aligned for minimum output, care being taken to get the lowest possible indication at the output. The input signal should be attenuated below saturation of the i-f amplifier tubes at start, then raised as signal is attenuated during alignment.

5. Video I-F Alignment—The video i-f amplifier uses transformers which are coupled and loaded to give the proper band-pass characteristics. Before attempting alignment of the video i-f, the sound i-f traps should be aligned as in (4), then do not touch the trap trimmers when making the video i-f alignment.

One-stage-at-a-time alignment should be performed so as to duplicate the curves, as shown in Figure 10. The markers are used to establish the correct bandwidth and frequency limits.

The trap formed by L24 and C131 in the cathode of V12 is tuned to reduce the overshoot which appears at a frequency of approximately 21.4 mc and which is caused by the 21.9 mc traps. Adjust the spacing of turns comprising L24 by either pushing the turns together or separating them so as to give a minimum amplitude to the overshoot.

Connect the sweep generator to the tube grid preceding the transformer to be aligned. Adjust the sweep width for a minimum of 15 mc about the center frequency of the video i-f frequency. The marker frequencies are supplied by a signal generator and sufficient marker signal may be supplied in most cases except at last stage by merely connecting the high side of the signal generator to the television chassis. At last stage couple marker generator through a small capacitor in parallel with sweep.

The primary of the transformer preceding the grid where the signal is applied will act as a tuned trap, putting a hole in the alignment curve as viewed on the scope unless it is short-circuited or detuned. Place a temporary short across the primary as indicated in steps 1, 4 and 5. *Be sure to remove the short after the stage is aligned.*

Keep the input to the sweep generator low so as not to overload the video i-f amplifier.

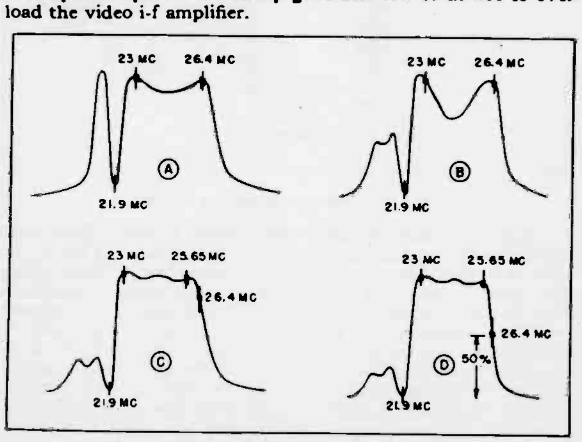


Fig. 10. Video I-F Alignment Curves

The response curves shown in Figure 10 are obtained on an oscilloscope at the junctions of R23 and L15. Use a 10,000-ohm resistor in series with the input lead to the scope for isolation. Set contrast control to position as indicated under "Remarks" for each step.

The Service Selector switch should be in the AM position for all i-f alignment. Use a temporary jumper across Section S1D wafer of the switch so as to keep the television tubes lit while in this position. If a television position is used for i-f alignment, the i-f curve may be affected by the interaction from the r-f coil in the converter tube grid.

In the AM or broadcast switch position, the cathodes (Pins 3 and 6) of V21 are grounded by a section of S1E. In order to develop contrast bias for i-f alignment, it is necessary to disconnect the lead from the selector switch to Pin 3 of V21.

When the sweep input is connected to the converter grid, it is necessary to ground the oscillator coil (L17) in order to "kill" the broadcast oscillator.

6. FM R-F Amplifier—Apply the signal generator input with tone modulation to the antenna dipole terminals. Connect an oscilloscope or output meter across the limiter grid resistor, R69.

The scale is checked at the low and high frequency ends of the band for calibration and alignment. The oscillator range is either expanded or contracted by adjusting the padder coil inductance L11. To spread out the scale, it is necessary to decrease inductance of L11. This is done by moving the shorted turn on L11 towards the color dot. When contracting the scale; that is, when the reference frequencies are off scale, the reverse procedure should be followed. Always recheck and readjust, if necessary, trimmer C100 for 88 mc calibration after adjusting L11.

When installing new tuner vanes in L9 and L19, the vanes should be adjusted to seat at the bottom of travel when the dial pointer is at extreme clockwise position.

7. Television Oscillator Adjustment—The oscillator coils must be adjusted so that the Television Tuning Condenser, C101, will tune the sound carrier of the television signal at the middle of its range. Set the condenser, C101, to mid-position. Then adjust oscillator coil for channels No. 1 through No. 7 by spreading turns to raise frequency or compressing turns to lower frequency. For channels No. 8 through No. 13, the oscillator coil consists of a single turn. Adjust these coils by spreading the gap to lower frequency or closing the gap to raise frequency in the leads of the coil which run to the terminals.

Apply the signal generator with tone modulation to the antenna input terminals and set the generator to the sound carrier frequency for the channel under alignment. The signal generator must be very accurately calibrated. This can be done by beating its output against a known channel carrier or use a station operating on the channel and tune in the souhd.

For output indication, advance the volume control about to mid-position so that the tone modulation or audio modulation on the channel station may be heard through the loudspeaker.

The oscillator coil is located on the coil form or assembly nearest to the front of the switch assembly and is wound of heavier wire than the other coils. This is shown in Figure 11.

8. R-F Coil Alignment—The r-f coil assembly is designed for stable, band-pass operation and under normal conditions will seldom require adjustment. In cases where it is definitely known that alignment is necessary (such as when the present coil is damaged and has been changed), do not attempt the adjustment unless suitable equipment is available. When tubes V1 or V2 are changed, alignment of r-f and oscillator may be necessary.

The minimum requirements for correct r-f alignment is to provide the correct band width, and for the response curve to be centered within the limit frequencies shown for each of the individual bands, as shown in Figure 12. It is also necessary that the curve be adjusted for maximum amplitude consistent with correct band width. To provide these minimum requirements, the r-f coils are overcoupled in a very similar manner to the video i-f transformers. However, instead of adjusting capacity to tune the coils, the inductance is varied by moving a few turns. Coupling is also adjustable by moving the entire coil either away from or toward the adjacent coil on the form.

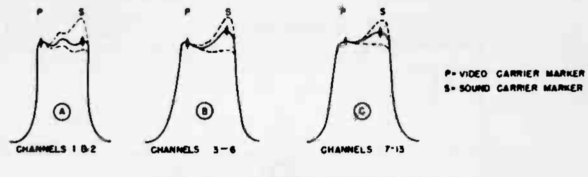


Fig. 12. R-F Alignment Curves

The physical assembly of the coils in the band switch locates the r-f amplifier plate coil at the rear of the switch and the oscillator coil towards the front end. Two types of coils are used—the Channel No. 1 and No. 2 coils have an additional link circuit between the grid and plate coils to provide better image rejection of the FM band (88 to 108 mc) signals on these two channels. These links are tuned by means of two copper rings which are moved along the coil forms for adjustment.

The input sweep signal is applied to the antenna terminal board at the r-f unit. The 300-ohm cable between the antenna terminal board and r-f amplifier input must be disconnected at the r-f unit when making r-f alignment. The marker signal generator may be coupled loosely to the antenna input terminals.

The output r-f response curve is taken off at the junction of R4 and a terminal of the 1st video i-f transformer. The Contrast control should be set for minimum for all r-f alignment.

For Channels No. 1 and No. 2, the r-f coils should be aligned to give approximately the curve shown in Figure 12-A. The "P" marker represents the video carrier marker while the "S" marker is the high frequency or sound marker. As shown in dash lines, the amplitude limits of the curves, with the "P" marker as reference no portion of the curve should be any more than 25 per cent higher or 12 per cent lower than this reference point. The markers should be located on the inside of the humps of the curves. Adjustment of the bandwidth is made by moving the plate coil closer to the grid coil or vice versa. In most cases, the sliding of the copper rings will give both the required bandwidth and the frequency adjustment. Spread or squeeze turns in plate and grid coils if the frequency cannot be obtained by sliding the rings. Spreading turns results in a raising of the frequency; while squeezing turns lowers the frequency.

For the remainder of the channels, the adjustment of the plate coil in relation to the grid coil changes the bandwidth, while the spreading or squeezing of the plate and grid coil results in the raising or lowering of frequency. Only when the plate and grid coils are tuned to the same frequency will the amplitude be greatest with the correct bandwidth. The outside peaks of the r-f response curve should be aligned to the carrier markers.

The upper channel coils (No. 12 and No. 13) have the plate winding reversed from the winding direction of the plate coil of the other transformers. In this case, the bandwidth will be increased by separating the plate and grid coils.

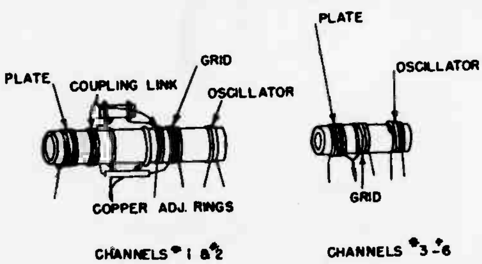


Fig. 11. R-F Coil Assembly

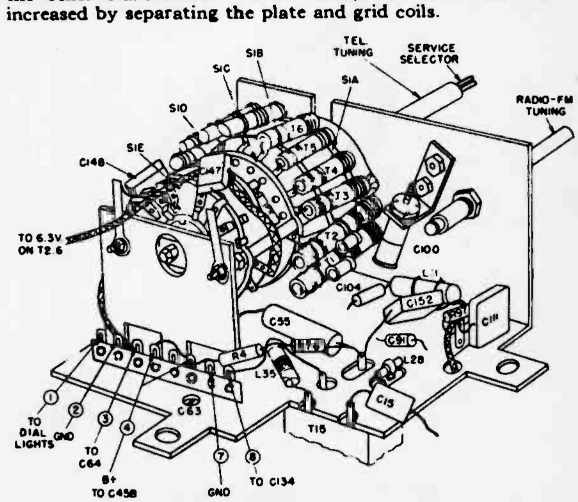


Fig. 13. R-F Head-end Assembly

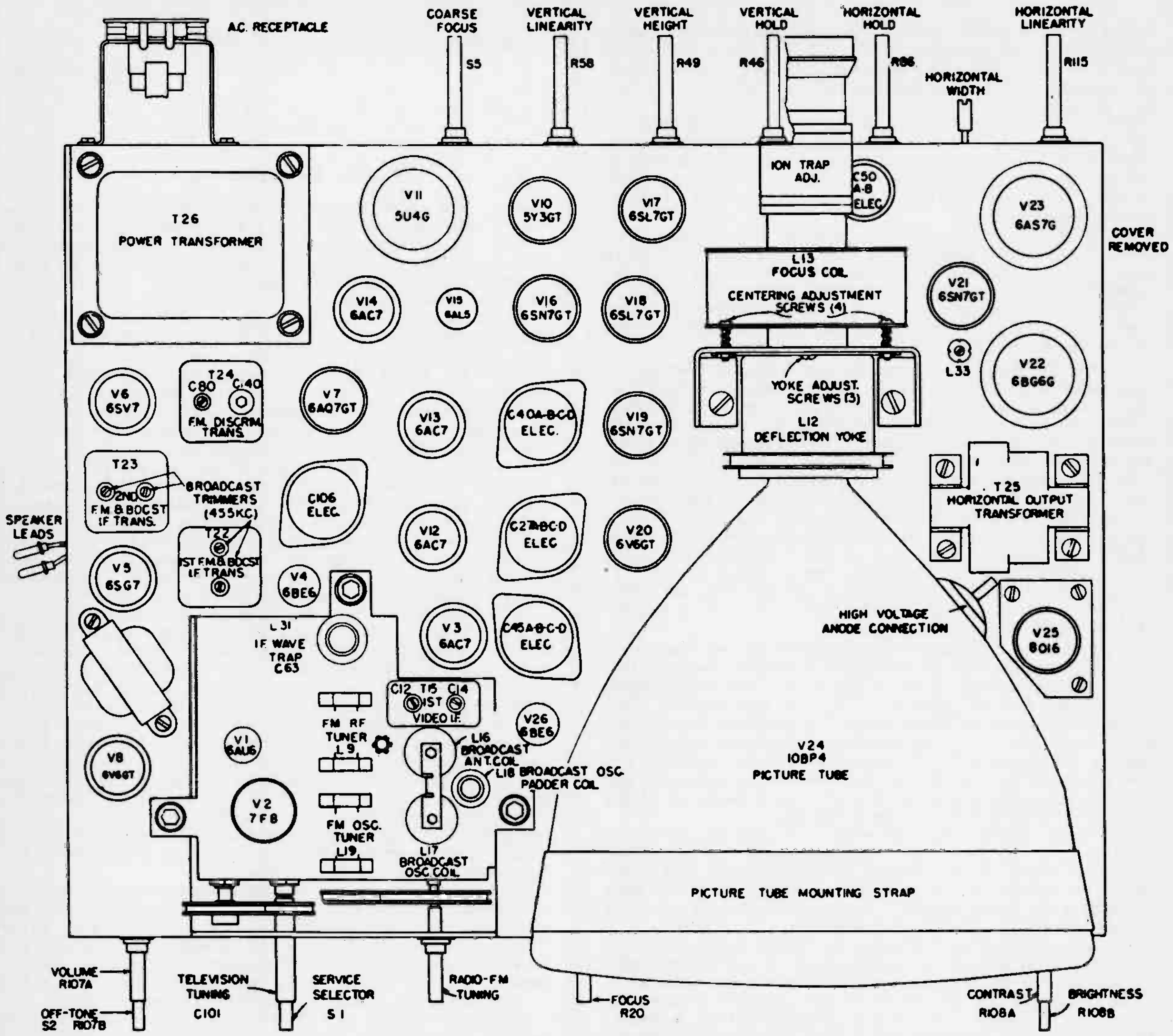


Fig. 14. Component Location, Top View of Chassis

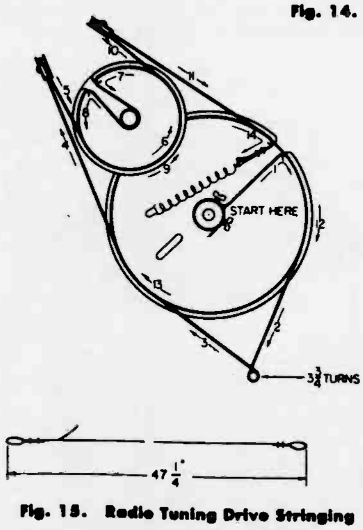


Fig. 15. Radio Tuning Drive Stringing

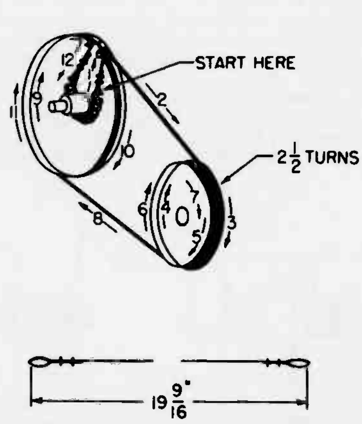


Fig. 16. T-V Tuning Drive Stringing

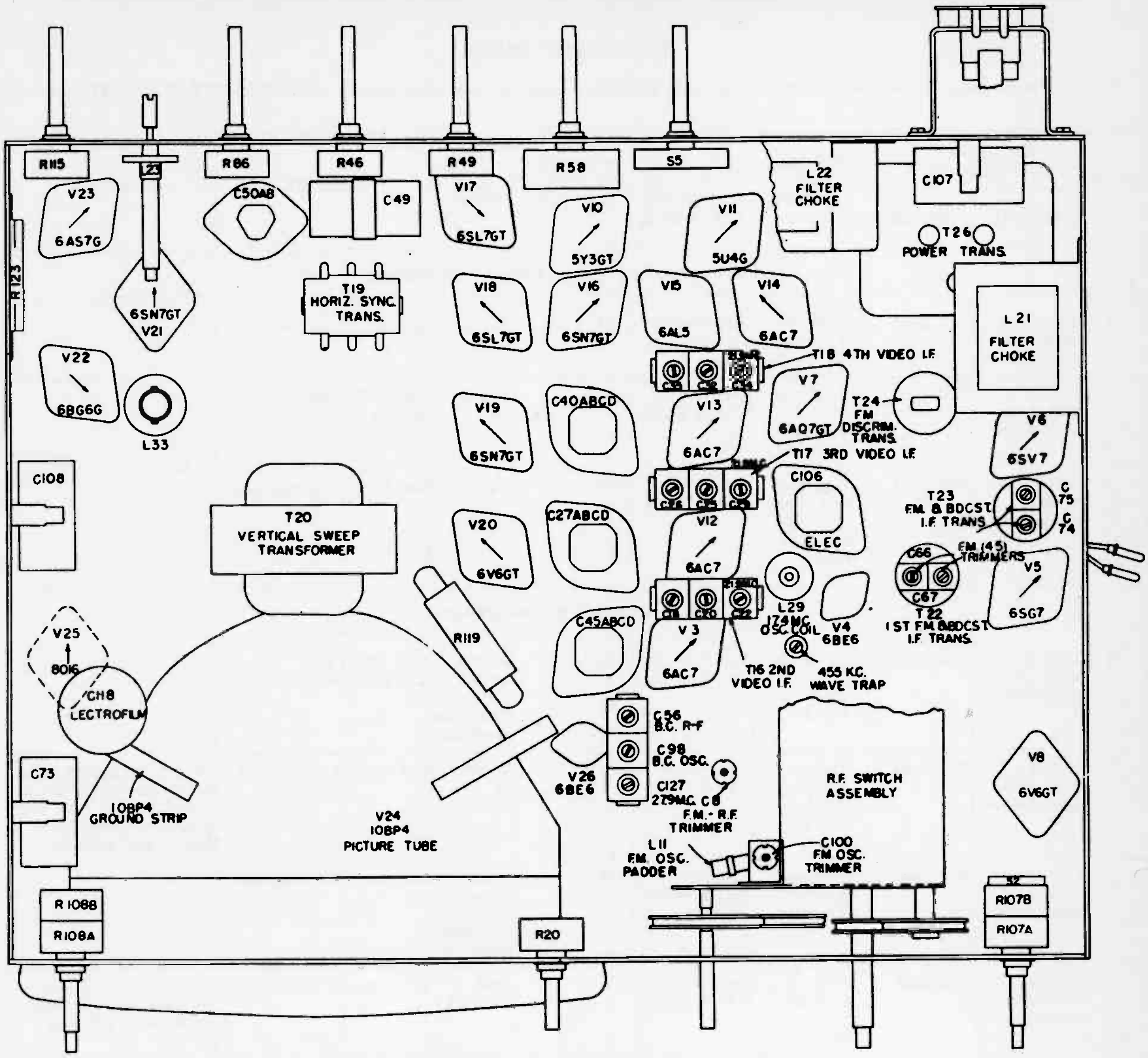


Fig. 17. Component Location, Bottom View of Chassis

REPLACEMENT OF PICTURE TUBE

To remove the picture tube from the television chassis, remove the picture tube socket and then untape and slide off the ion trap adjustment assembly. The ion trap can be removed readily, if the gap in the assembly is pulled apart slightly with the fingers while attempting to slide it. Loosen the two set screws partially that clamp the left side of the picture tube mounting strap, then slide the strap backward from the top-front rim of the picture tube until the rim of the tube is free from the strap. Carefully pull the tube out through the focus and deflection coils.

To replace a picture tube the reverse procedure should be followed, being careful never to force the picture tube if it sticks or fails to slip into place readily. Investigate and remove the source of the trouble. The picture tube should be oriented so that the anode cap is adjacent to the H.V. rectifier, V25, and the high voltage lead.

Wipe the screen surface of the tube to remove finger marks and dust. *PRECAUTION—Do not handle, remove, or install a picture tube unless shatterproof goggles and heavy gloves are worn.*

CENTERING (FOCUS COIL) ADJUSTMENT

The four focus coil adjustment screws should all be tightened sufficiently so that the springs are always under tension. Too loose pressure on the springs will result in the picture centering being unstable and possible neck shadowing. These adjustments are not readily available with the back cover in place unless a long screwdriver is used. Since each screw adjustment reacts in both the horizontal and vertical directions, a maladjustment in the centering may have to be corrected by the adjustment of one to four screws.

DEFLECTION YOKE ADJUSTMENT

Three set screws permit the deflection yoke to be loosened, permitting limited turning in either direction. If the picture does not line up horizontally or square with the picture tube mask, rotate the yoke until this condition is remedied, then tighten the set screws. On late production sets the deflection yoke is prevented from rotating by a clamp secured by two hex head cap screws located at the top center of the yoke mounting bracket. To rotate the yoke, loosen both screws not more than two full turns. Rotate yoke as desired and tighten screws to secure in place.

ALIGNMENT TABLE

Before attempting the following tubular alignment procedure, read the preceding section "ALIGNMENT SUGGESTIONS"

STEP NO.	GENERATOR FREQUENCY SIGNAL	GENERATOR FREQUENCY SWEEP	SIGNAL INPUT POINT	CONNECT OSCILLO-SCOPE TO CHASSIS &	STATION SELECTOR SWITCH	DIAL SET-TING	ADJUST	REMARKS
				(1) BROADCAST I-F AND WAVETRAP ALIGNMENT				
1	455 kc with tone modulation	Not used	Grid (4) of V5 through 500 mmf.	Junction of C84 & R135	AM	550 kc	C77 & C78 for max. output	
2	455 kc with tone modulation	Not used	Grid (7) of V26 through 500 mmf.	Junction of C84 & R135	AM	550 kc	C68 & C69 for max. output	
3	455 kc with tone modulation	Not used	Antenna terminals No. 1 or No. 2 & Gnd.	Junction of C84 & R135	AM	550 kc	C63 for minimum output	
				(2) BROADCAST R-F ALIGNMENT				
1	1620 kc with tone modulation	Not used	Antenna terminal No. 1 or No. 2	Junction of C84 & R135	AM	Pointer at ex-treme clockwise position	C98 (Osc.) & C56 (R-F) for maximum	
2	1500 kc with tone modulation	Not used	Antenna terminal No. 1 or No. 2	Junction of C84 & R135	AM	Pointer at 1500 kc	L17 core for maximum*	*After alignment, check calibration at 600 kc. Adjust L17 for best compromise calibration at 600 kc and 1500 kc.
3	1620 kc with tone modulation	Not used	Antenna terminal No. 1 or No. 2	Junction of C84 & R135	AM	Pointer at ex-treme clockwise position	C98 (osc.) for maximum	
4	1000 kc with tone modulation	Not used	Antenna terminal No. 1 or No. 2	Junction of C84 & R135	AM	*See Remarks	L16 core for maximum	*Rock tuning pointer through approx. 1000 kc point while aligning.
5	Repeat Step 1 and Step 4.							
				(3) FM AND TELEVISION SOUND I-F ALIGNMENT				
1	4.5 mc without modulation for marker	4.5 mc with approx. 1 mc sweep	Grid (4) of V5 through 500 mmf.	Junction R69 & C70 through 100K resistor	FM	—	C74 and C75 for max. amplitude and symmetry at 4.5 mc. See Fig. 9-A.	Remove V7 before making adjustments. Keep input signal low to prevent overload. Couple marker signal loosely.
2	4.5 mc without modulation for marker	4.5 mc with approx. 1 mc sweep	Grid (7) of V4 through 500 mmf.	Junction R69 & C70 through 100K resistor	FM	—	C66 & C67 of T22 for max. amplitude and symmetry* at 4.5 mc. See Fig. 9-B.	*It is usually necessary to readjust C74 to obtain symmetry.
3	21.9 mc without modulation for marker	21.9 mc with approx. 1 mc sweep	Grid (7) of V4 through 500 mmf.	Junction R69 & C70 through 100K resistor	FM	—	L29 for centering of marker and symmetry of curve. See Fig. 9-B.	Same as 1.
4	21.9 mc without modulation for marker	21.9.mc with approx. 1 mc sweep	Grid (4) of V3 through 500 mmf.	Junction R69 & C70 through 100K resistor	FM	—	C20 & C22 of T16 for max. amplitude and symmetry of curve about marker. See Fig. 9-B.	Same as 1.

ALIGNMENT TABLE (Cont'd)

STEP NO.	GENERATOR FREQUENCY — SIGNAL	GENERATOR FREQUENCY — SWEEP	SIGNAL INPUT POINT	CONNECT OSCILLO-SCOPE TO CHASSIS &	STATION SELECTOR SWITCH	DIAL SET-TING	ADJUST	REMARKS
(3) FM AND TELEVISION SOUND I-F ALIGNMENT (Cont'd)								
5	4.5 mc with tone modulation	Not used	Grid (4) of V5 through 500 mmf.	Junction R135 & C84 through 10K resistor	FM	—	C140 of T24 for null point of modulation on scope.	Replace V7. Keep input signal low enough to prevent overload.
6	Not used	4.5 mc with approx. 1 mc sweep	Grid (4) of V5 through 500 mmf.	Junction R135 & C84 through 10K resistor	FM	—	C80 of T24 for max. peak-to-peak amplitude and symmetry of peaks above and below base-line. See Fig. 9-C.	—
7	Repeat Steps 5 and 6.							
(4) VIDEO I-F TRAP ALIGNMENT								
1	21.9 mc with tone modulation	Not used	Grid (4) of V3 through 500 mmf.	Junction L15 & R23 through 10K resistor	Channel No. 13	—	C34 of T18 for minimum response.	Contrast control at maximum. Input low enough to prevent overload.
2	21.9 mc with tone modulation	Not used	Grid (4) of V3 through 500 mmf.	Junction L15 & R23 through 10K resistor	Channel No. 13	—	C29 of T17 for minimum response.	
3	27.9 mc with tone modulation	Not used	Grid (8) of V2 through 500 mmf.	Junction L15 & R23 through 10K resistor	Channel No. 13	—	C127 for minimum response.	
(5) VIDEO I-F AMPLIFIER ALIGNMENT								
1	23.0 mc & 26.4 mc marker	20–30 mc sweep	Grid (4) of V13 through 500 mmf.	Junction L15 & R23 through 10K resistor	AM Position. Disconnect lead from Pin 3 of V21 to selector switch. Use temporary jumper across Section S1D wafer of switch to keep television tubes lit while in this position	—	C32 & C35 of T18 for max. amplitude, band width and correct position of markers. See Fig. 10-A.	Short C25 on T17 primary with jumper.
2	23.0 mc & 26.4 mc marker	20–30 mc sweep	Grid (4) of V12 through 500 mmf.	Junction L15 & R23 through 10K resistor	Same as 1.	—	C25 & C26 of T17 for max. amplitude, band width and correct position of markers. See Fig. 10-B.	Remove short across C25. Contrast control set at mid-position.
3	23.0 mc & 26.4 mc marker	20–30 mc sweep	Grid (4) of V12 through 500 mmf.	Junction L15 & R23 through 10K resistor	Same as 1.	—	L24 for min. overshoot. See Fig. 10-B.	L24 is adjusted by spreading or squeezing turns for min. amplitude of overshoot.
4	23.0 mc & 26.4 mc marker	20–30 mc sweep	Grid (4) of V3 through 500 mmf.	Junction L15 & R23 through 10K resistor	Same as 1.	—	C18 of T16 for flat-top of response curve and position markers as shown in Fig. 10-C.	Short primary of T15 with jumper. Contrast control set at about mid-position.
5	23.0 mc & 26.4 mc marker	20–30 mc sweep	Grid (4) of V3 through 500 mmf.	Junction L15 & R23 through 10K resistor	Same as 1.	—	Readjust L24 for minimum amplitude of overshoot.	Same as Step 3.
6	23.0 mc & 26.4 mc marker	20–30 mc sweep	Grid (8) of V2 through 500 mmf.	Junction L15 & R23 through 10K resistor	Same as 1.	—	C12 & C14 of T15 for max. amplitude, band width and correct position of markers. See Fig. 10-D.	Remove short across T15 primary. Contrast control set at mid-position. Ground L17.

ALIGNMENT TABLE (Cont'd)

STEP NO.	GENERATOR FREQUENCY		SIGNAL INPUT POINT	CONNECT OSCILLO-SCOPE TO CHASSIS &	STATION SELECTOR SWITCH	DIAL SET-TING	ADJUST	REMARKS
	SIGNAL	SWEEP						
	(6) FM R-F AMPLIFIER ALIGNMENT							
1	88 mc with tone modulation	—	Antenna terminals	Junction R69 & C70 through 100K resistor	FM	88 mc	Adjust C100 for max.	
2	98 mc with tone modulation	—	Antenna terminals	Junction R69 & C70 through 100K resistor	FM	Tune carrier.* See Re-marks.	Adjust shorted turn on L11*	*Observe calibration; if pointer falls below 98 mc, move shorted turn on L11 towards color dot; if high, reverse procedure.
3	Repeat 1.							
4	Repeat Step 2.							
5	108 mc with tone modulation	—	Antenna terminals	Junction R69 & C70 through 100K resistor	FM	Check that you can tune through carrier*	No adjustment.	*If not, compress scale by moving shorted turn on L11 away from color dot. If this adjustment is made, repeat Step 1.
6	98 mc with tone modulation	—	—	—	FM	Tune carrier	Adjust C8 for maximum.	
	(7) TELEVISION OSCILLATOR ADJUSTMENTS							
1	49.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 1	—	Turns of osc. coil T1.	Volume control at mid-position. Make sure C101 is at mid-position of travel. Use sound output as indicator.
2	59.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 2	—	Turns of osc. coil T2.	
3	65.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 3	—	Turns of osc. coil T3.	
4	71.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 4	—	Turns of osc. coil T4.	
5	81.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 5	—	Turns of osc. coil T5.	
6	87.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 6	—	Turns of osc. coil T6.	
7	179.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 7	—	Turns of osc. coil T7.	
8	185.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 8	—	Lead gap of osc. coil, T8.	
9	191.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 9	—	Lead gap of osc. coil, T9.	
10	197.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 10	—	Lead gap of osc. coil, T10.	

STEP NO.	GENERATOR FREQUENCY		SIGNAL INPUT POINT	CONNECT OSCILLO-SCOPE TO CHASSIS &	STATION SELECTOR SWITCH	DIAL SET-TING	ADJUST	REMARKS
	SIGNAL	SWEEP						
(7) TELEVISION OSCILLATOR ADJUSTMENTS (Cont'd)								
11	203.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 11	—	Lead gap of osc. coil, T11.	
12	209.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 12	—	Lead gap of osc. coil, T12.	
13	215.75 mc with tone modulation	—	Antenna terminals	—	Channel No. 13	—	Lead gap of osc. coil, T13.	
(8) TELEVISION R-F COIL ALIGNMENT								
1	Markers 45.25 mc & 49.75 mc	Channel No. 1 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 1	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-A for resultant alignment curve.
2	Markers 55.25 mc & 59.75 mc	Channel No. 2 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 2	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-A for resultant alignment curve.
3	Markers 61.25 mc & 65.75 mc	Channel No. 3 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 3	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-B for resultant alignment curve.
4	Markers 67.25 mc & 71.75 mc	Channel No. 4 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 4	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-B for resultant alignment curve.
5	Markers 77.25 mc & 81.75 mc	Channel No. 5 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 5	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-B for resultant alignment curve.
6	Markers 83.25 mc & 87.75 mc	Channel No. 6 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 6	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-B for resultant alignment curve.
7	Markers 175.25 mc & 179.75 mc	Channel No. 7 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 7	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.
8	Markers 181.25 mc & 185.75 mc	Channel No. 8 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 8	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.
9	Markers 187.25 mc & 191.75 mc	Channel No. 9 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 9	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.
10	Markers 193.25 mc & 197.75 mc	Channel No. 10 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 10	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.
11	Markers 199.25 mc & 203.75 mc	Channel No. 11 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 11	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.
12	Markers 205.25 mc & 209.75 mc	Channel No. 12 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 12	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.
13	Markers 211.25 mc & 215.75 mc	Channel No. 13 with 25 mc sweep	Antenna terminals at r-f amplifier	Junction of R4 and T15	Channel No. 13	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 12-C for resultant alignment curve.

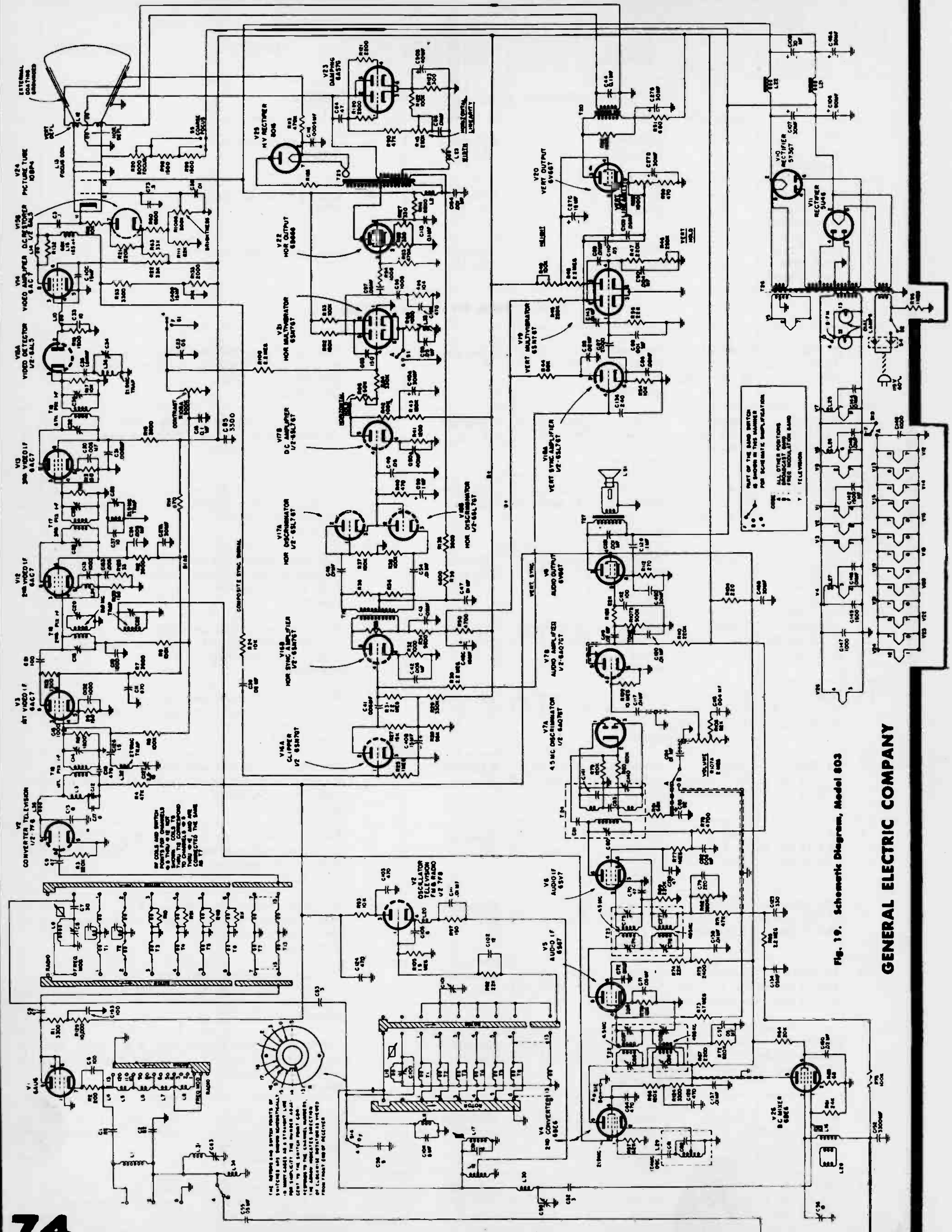


Fig. 19. Schematic Diagram, Model 803

GENERAL ELECTRIC COMPANY

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

the hallicrafters co.

MODELS T-54 AND 505

DISMANTLING FOR KINESCOPE TUBE REPLACEMENT OR ALIGNMENT ADJUSTMENTS

Model T-54

1. Remove the five front panel control knobs and front panel. The control knobs pull straight off their shafts. The panel is fastened to the cabinet with two panel screws accessible from the outside and two screws accessible from the inside of the cabinet. The speaker is fastened to the front panel and must be disconnected at the speaker connector mounted on the speaker frame. Leave the rubber escutcheon fastened to the kinescope tube for additional protection. The kinescope tube may now be removed for replacement. When installing a new tube, the two screws holding the tube socket to the mounting bracket, may have to be loosened to permit rotation of the tube for picture alignment. Note that the oscillator mixer and r-f amplifier adjustments are now accessible. To expose the remaining alignment adjustments, the following dismantling procedure must be carried out.

2. Detach the cabinet interlock receptacle from the cabinet. This is held on with two machine screws.

Continued on the next six pages.

HIGH VOLTAGE WARNING

Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the Model T-54 cabinet cover is lifted or the Model 505 cabinet back is removed. When operating the chassis outside of the cabinet, keep in mind the chassis is connected to one side of the a-c line and must be isolated from ground unless the power plug is correctly polarized so that the chassis is at ground potential with respect to the power source. The HIGH VOLTAGE supply while of low current capacity operates at a 4700 VOLT potential.

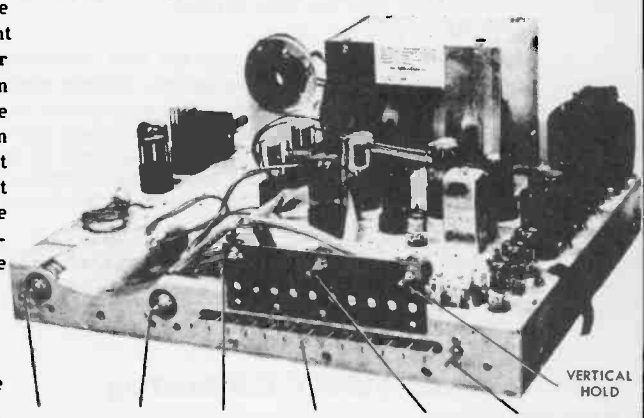
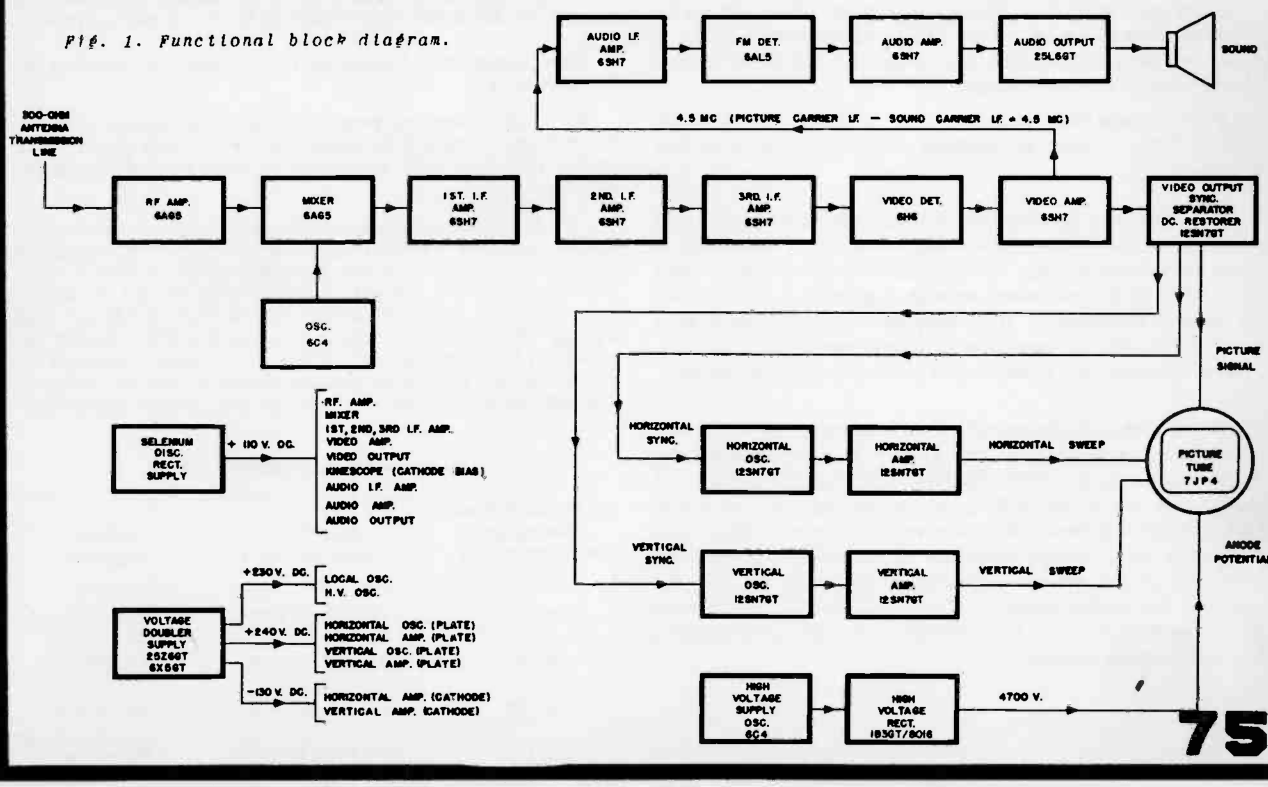


Fig. 1. Functional block diagram.



3. Release the chassis from the cabinet by removing the four rubber mounting feet at the bottom of the cabinet and pull the chassis from the cabinet.

4. Detach the cover half of the interlock connector from the cabinet cover and use it to supply power to the unit while it is being serviced outside the cabinet.

Model 505

1. Remove the five front panel control knobs. They pull straight off their shafts.

2. Remove the back cover. It is fastened with wood screws. The line cord and half of the interlock connector will come along with the back cover.

3. Detach the cabinet half of the interlock connector fastened to the cabinet with two wood screws.

4. Release the chassis by removing the four mounting screws at the bottom of the cabinet and pull the chassis clear of the cabinet. The kinescope tube may now be removed for replacement. When installing a new tube, the two screws holding the tube socket to the mounting bracket, may have to be loosened to permit rotation of the tube for picture alignment. Caution - The rubber escutcheon on the kinescope tube should be left on the tube for additional protection.

5. Reconnect the interlock connector for power while making adjustments on the bench and the receiver is ready for alignment.

HIGH VOLTAGE SUPPLY OSCILLATOR ADJUSTMENTS

Do not use hand held flexible test leads when making the following measurement. Tack solder the resistor string in place and keep the hands clear of the circuit while making measurements or adjustments.

A 5000 V. potential exists in this circuit. Exercise all normal high voltage precautions while working with this circuit.

1. Connect a 50-megohm resistor string in series with a 0-150 microampere meter across the .001 mfd 6000 V. filter condenser (C-82). The resistor string should be made up of 10-megohm resistors or less to provide a safety factor for voltage breakdown. If 10-megohm resistors are used, a total of five will be required to obtain the 50-megohms required. Connect the meter on the ground side of the string.

2. A meter reading of 95 microamperes (4700 V.) should be obtained under normal conditions. To obtain the desired voltage adjust the H.V. OSC. TRIMMER through the adjustment hole in the top of the H.V. power supply housing with a non-metallic screwdriver. The trimmer is a compression type condenser, hence should be set on the maximum capacity side of oscillator resonance, i.e., increasing trimmer capacity decreases the supply voltage. The BRIGHTNESS control must be set at minimum or full counter-clockwise when making the high voltage adjustment.

ALIGNMENT PROCEDURE

EQUIPMENT REQUIRED

Signal generator covering 4 mc to 30 mc.

Signal generator covering 40 mc to 215 mc.

Electronic voltmeter.

Two 150-ohm carbon resistors

One 0.01 mfd. 600 V. tubular paper condenser.

F-M SOUND CHANNEL I-F ALIGNMENT

1. Connect the low frequency signal generator output between the control grid (pin 4) of the 6SH7 VIDEO AMP. tube (V-11) and chassis ground.

2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET tube (V-2) and chassis ground.

3. With the signal generator (unmodulated) set at 4.5 mc, set the 4.5 mc LIMITER GRID ADJ. and FM DET. PRIMARY ADJ. for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid coil (L-23) before adjusting the FM detector transformer (T-1) primary. Use just enough signal generator output to obtain approximately 1 volt at the electronic voltmeter.

4. Connect the electronic voltmeter across the 1000 mmf condenser (C-22) at the output of the FM detector stage and adjust the SEC. ADJ. of the FM detector transformer (T-1) for the null.

5. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRIMARY ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for best results.

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

This resistor is located at the terminal strip next to the 6H6 tube socket.

2. Connect the low frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Use just enough signal generator output (unmodulated) to develop about a volt at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. To avoid the effects of the local oscillator when feeding the i-f signal through the mixer stage, disable the oscillator by triggering out all of the pushbuttons. Do not leave all the buttons out longer than necessary as certain resistors dissipate more heat than normal with the oscillator disabled.

IF AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 2)	Stage Adjusted
24 mc	24 MC IF ADJ.	Video detector
25 mc	25 MC IF ADJ.	2nd IF amp.
23 mc	23 MC IF ADJ.	1st IF amp.
26 mc	26 MC IF ADJ.	Mixer

4. With the local oscillator disabled, check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below 1 volt between the two peaks normally obtained with this i-f amplifier. Should the two peaks be unequal in amplitude, the 25 MC IF ADJ. slug may be readjusted slightly to equalize them.

Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response and the 26.25 mc response will fall approximately 6 db below the peak. Refer to Fig. 3.

The average i-f amplifier sensitivity when feeding the signal generator in through the antenna input as described above will run approximately 8000-10,000 microvolts for the 1.5 volt d-c peaks measured at resistor R-43. (5600 ohms).

STATION CHANNEL ALIGNMENT

1. Due to the broad frequency response of the i-f amplifier, it is necessary to use a 24.5 mc signal generator or oscillator (unmodulated) as a beat frequency oscillator (BFO) is used in conventional superheterodyne receivers in order to locate the center frequency of the i-f amplifier response for the correct local oscillator adjustment. This "BFO" generator should be loosely coupled by means of a wire from the generator output placed in close proximity to the 6H6 VIDEO DET. tube (V-10).

2. Connect the high frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

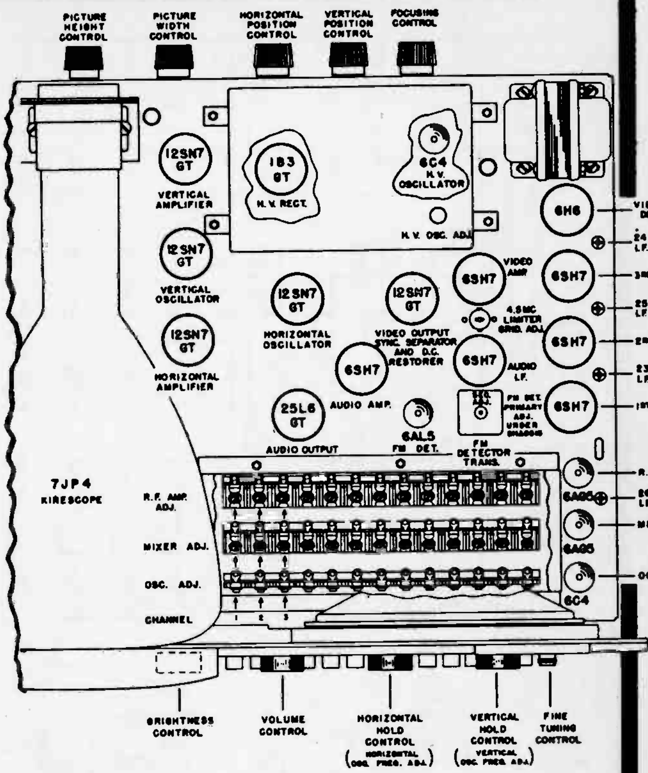


Fig. 2. Top view, alignment points.

CHANNEL ALIGNMENT CHART

Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)	Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)
1	44-50	47 mc	7	174-180	177 mc
2	54-60	57 mc	8	180-186	183 mc
3	60-66	63 mc	9	186-192	189 mc
4	66-72	69 mc	10	192-198	195 mc
5	76-82	79 mc	11	198-204	201 mc
6	82-88	85 mc	12	204-210	207 mc
			13	210-216	213 mc

The overall sensitivity for the receiver will run approximately 200-400 microvolts for 1 volt DC at resistor R-43 when measured in the above manner.

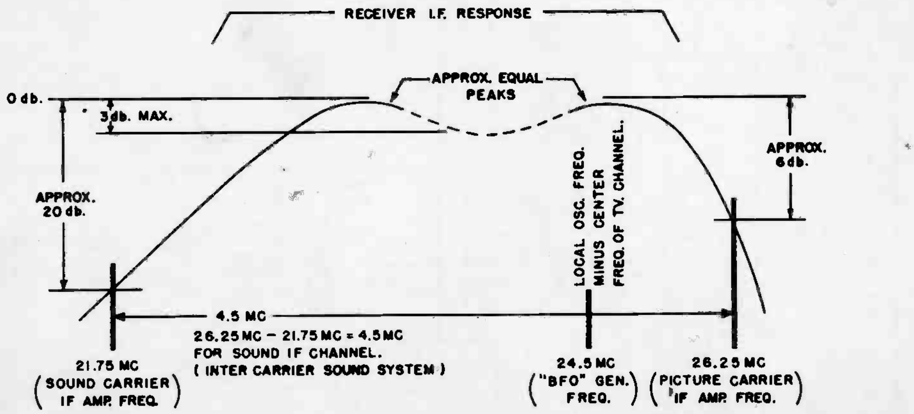
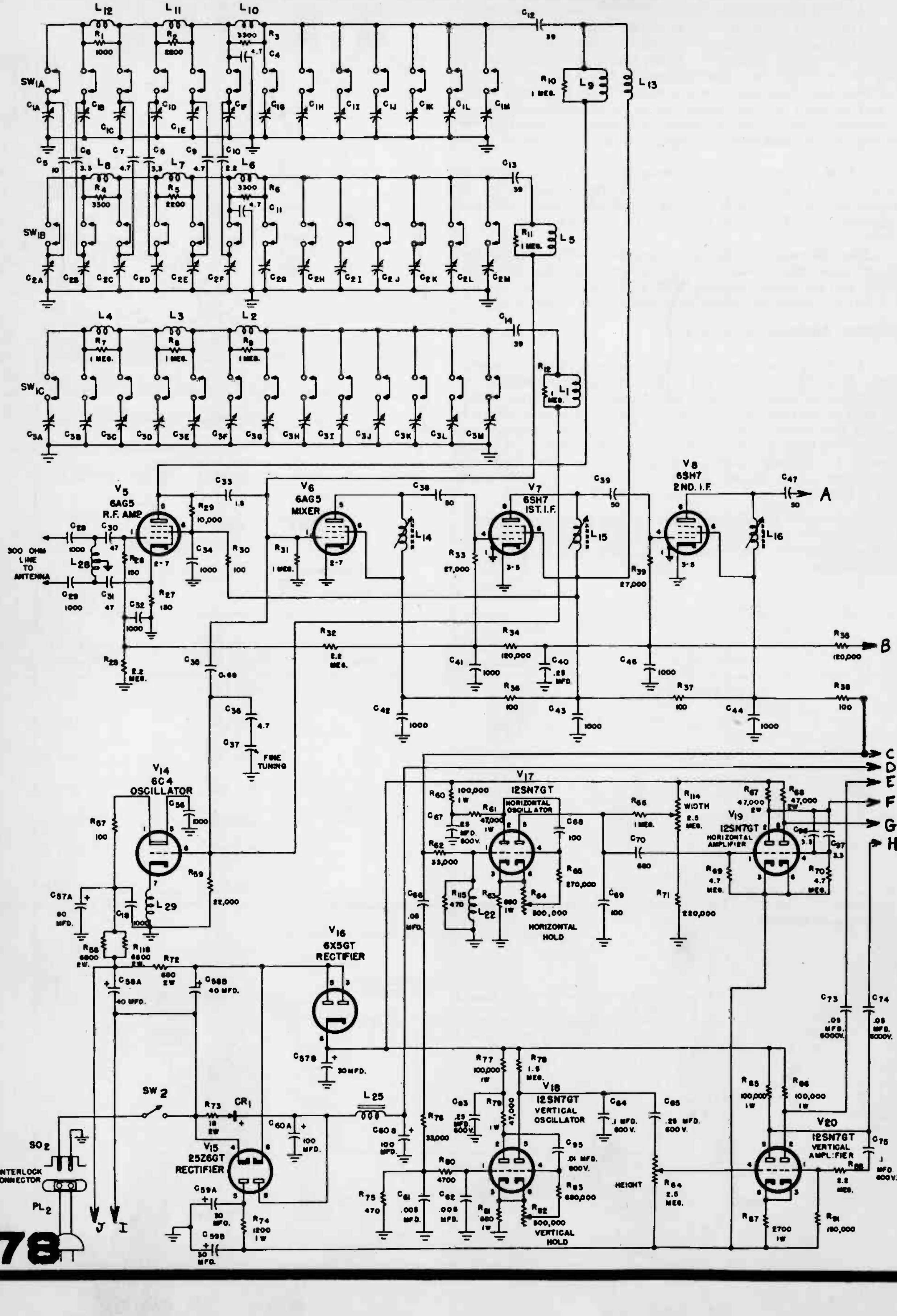
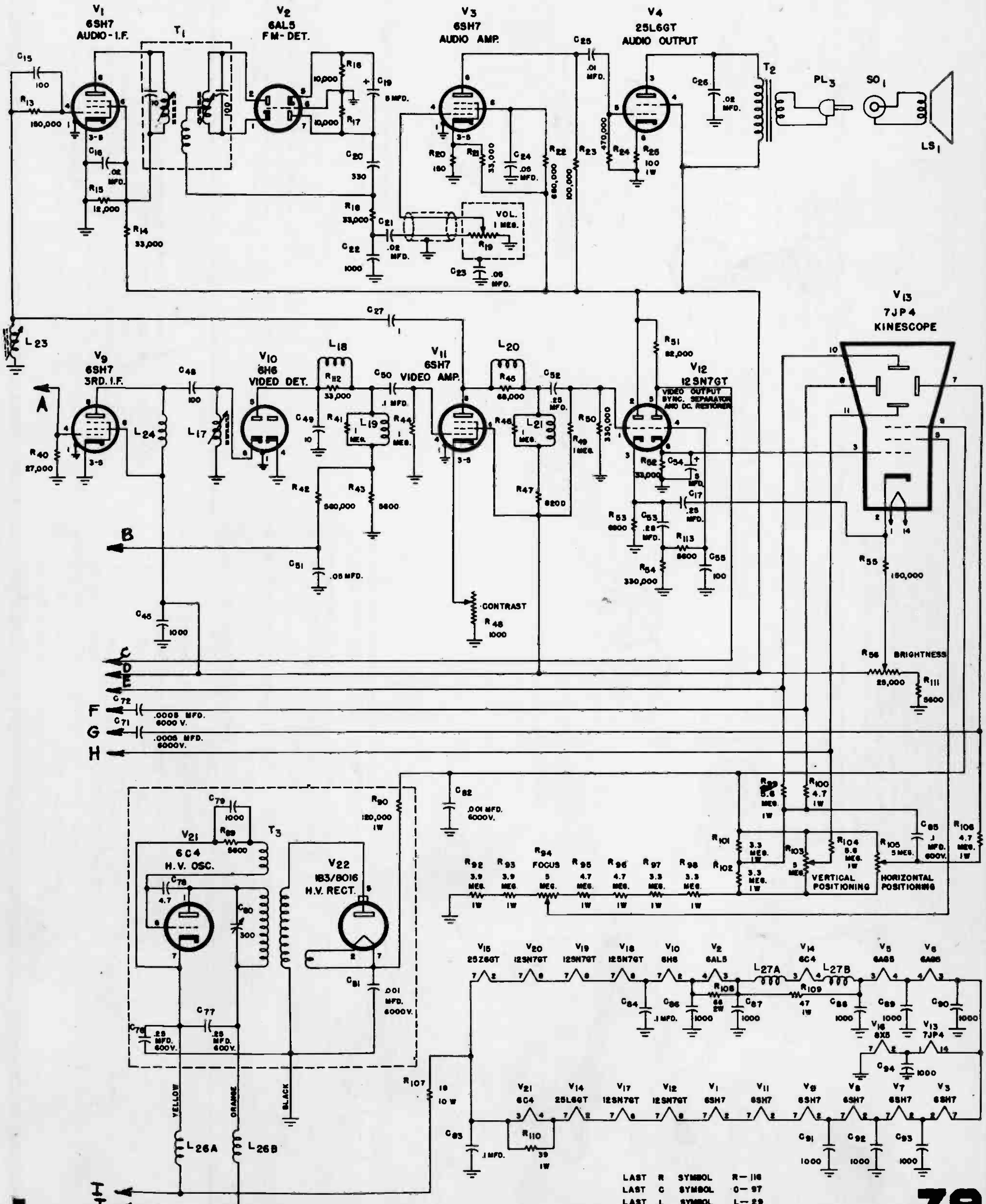


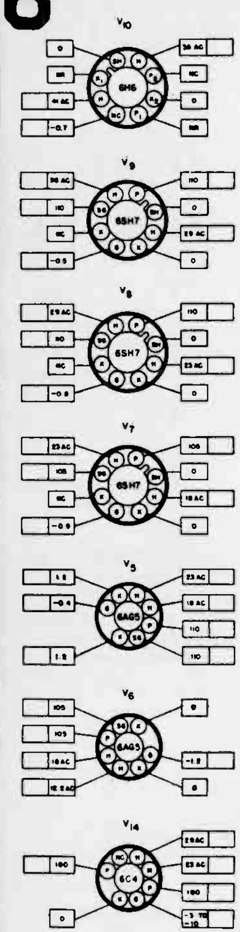
Fig. 3. IF amplifier response.

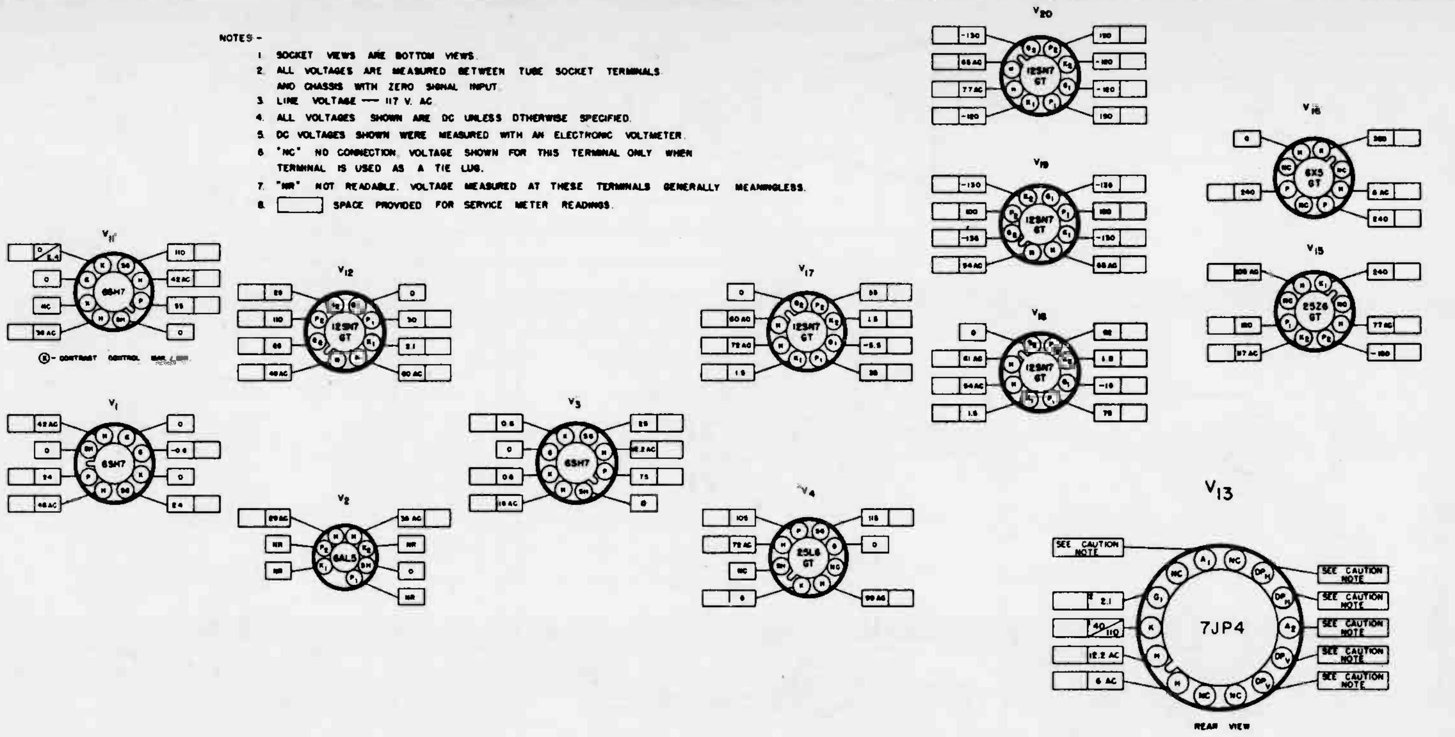

V5
6AG5
R.F. AMP.
V6
6AG5
MIXER
V7
6SH7
IST. I.F.
V8
6SH7
2ND. I.F.
V14
6C4
OSCILLATOR
V16
6X5GT
RECTIFIER
V15
25Z6GT
RECTIFIER
V17
12SN7GT
HORIZONTAL OSCILLATOR
HORIZONTAL HOLD
V19
12SN7GT
HORIZONTAL AMPLIFIER
WIDTH
V18
12SN7GT
VERTICAL OSCILLATOR
VERTICAL HOLD
HEIGHT
V20
12SN7GT
VERTICAL AMPLIFIER
300 OHM LINE TO ANTENNA
FINE TUNING
SW 2
INTERLOCK CONNECTOR
SO2
PL2
A
B
C
D
E
F
G
H
J
I

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

The Hallicrafters Co.
Models T-54 and 505.







7JP4 NOTES -
1 BRIGHTNESS CONTROL — MAX / MIN. MEASURED AT JUNCTION OF C17 AND R55.
2 MEASURED AT PIN 6 OF TUBE V12.

CAUTION - THE POTENTIAL AT THESE POINTS EXCEEDS 1000 V. DC. THE HIGH IMPEDANCE OF THIS CIRCUIT WILL NOT PERMIT AN ACCURATE MEASUREMENT WITH ORDINARY TEST METERS. USE THE OVERALL MEASUREMENT DESCRIBED UNDER THE HIGH VOLTAGE OSCILLATOR ADJUSTMENT PROCEDURE AS AN INDICATION OF PROPER OPERATION.

FRONT APRON

BOTTOM VIEW

3. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

4. Alignment of the individual channels is carried out as follows: Each channel may be aligned independently without affecting the alignment of the others.

(a) Set the FINE TUNING control condenser in the center of its capacity range.

(b) Press the channel button corresponding to the channel number to be aligned.

(c) Set the "BFO" generator at 24.5 mc (no modulation).

(d) Set the high frequency signal generator per the alignment chart. (Generator unmodulated).

(e) Clip on a 0.01 mfd. condenser between pin 3 of the 12SN7GT VIDEO OUTPUT tube (V-12) and pin 4 of the 6SH7 AUDIO AMP tube (V-3) and adjust the OSC. ADJ. trimmer corresponding to the channel being aligned for a rough audio beat note using the speaker output as a detector.

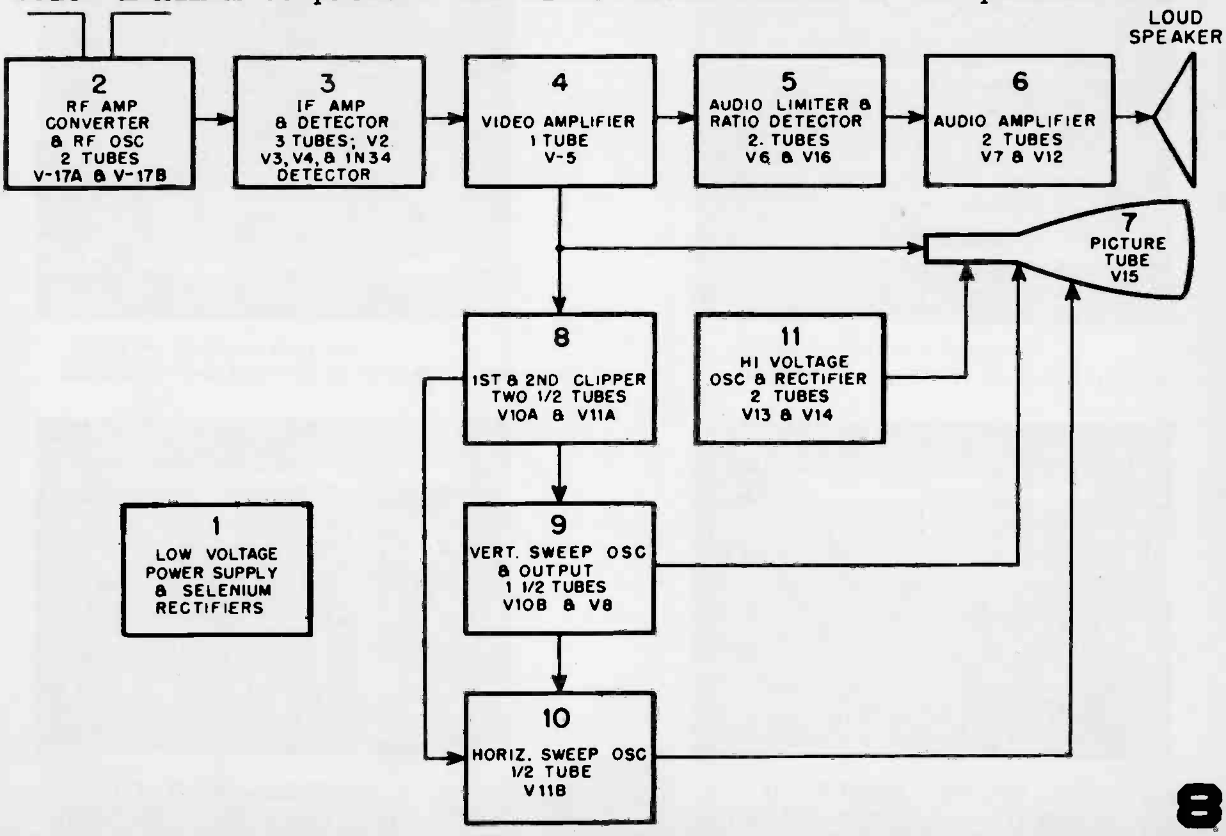
(f) Disconnect the 0.01 mfd. condenser, shut off the "BFO" signal generator, and adjust the MIXER ADJ. and RF AMP. ADJ. trimmers for maximum d-c voltage as measured by the electronic voltmeter. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter. This completes the alignment of any one channel, and all other channels may be treated alike.

MOST-OFTEN-NEEDED **1948 TELEVISION** RECEIVERS

MOTOROLA Table Model VT71 Television Receiver, Chassis TS-4D

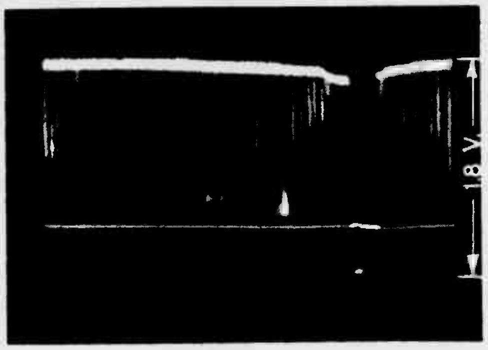
This is a 15-tube, direct viewing, television receiver using a 7" cathode ray picture tube. The set is aligned for 8 or less of the 13 television channels that may be found in any one locality. Block diagram of the circuit is shown below. Antenna input is for either 75 or 300 ohm impedance. Complete circuit diagram is on page 86. Service work may be carried out by making the waveform comparisons as suggested on the next two pages, or following the service hints given on pages 84 and 85.

After a service job, the rear panel controls may require adjustment. The focus control R-74 should be adjusted until the fine horizontal structure of the raster is clearly visible over the picture area. Other adjustments should be made with televised picture on the screen. Turn vertical hold control R-115 until the pattern stops its vertical movement. Adjust the horizontal hold control R-49 until a single stationary picture appears on the tube screen. This control should be centered approximately in its lock-in range after the set has warmed up. Adjust the vertical size control R-53 until the picture substantially fills the entire picture area vertically ($4\frac{1}{2}$"). While adjusting this control R-53, should it appear that the pattern will not fill the area, adjust the vertical centering control R-107, until center of pattern is in the center of picture area. Control R-55 is used to adjust the entire picture area horizontally (6"). While adjusting this horizontal size control, it may be necessary to center the pattern using R-108 horizontal centering control. There is some inter-action between between R-55 and R-108, and readjustment may be necessary. The brightness control R-100 should be set for the most pleasing picture, keeping the brilliance a bit below maximum to protect the fluorescent screen of the picture tube.

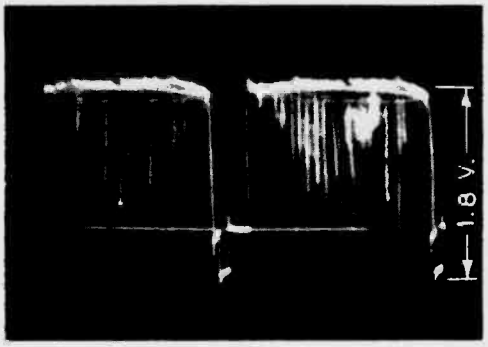


MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

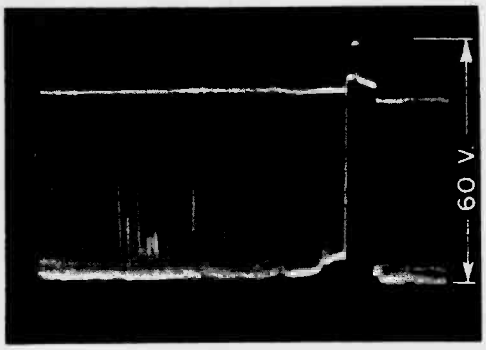
These waveforms can be seen on a cathode ray oscilloscope when an RMA standard video signal is fed into the Motorola Model VT71 set. This may be a regular telecast signal fed into the antenna. The signal should be adjusted to give 1.5 v. peak to peak, at grid of first video amplifier, or about 1 v. average D.C. The composite video signal has components appearing at both the vertical (60 cps) and the horizontal (15,750 cps) repetition rates. Because of the great frequency difference, both of these types of waves cannot be seen at the same time. In the photographs, the vertical and horizontal labels apply to 'scope adjustment to correspond to these rates. Reference points apply to chassis TS-4D. Similar waveforms will be observed on Chassis TS-4B & TS-4C, but the reference points will be different. This material is published through the cooperation of Motorola, Inc.



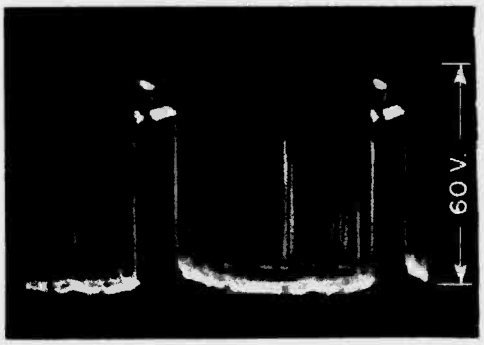
WAVEFORM - VIDEO SIGNAL INPUT TO VIDEO AMPLIFIER (PIN #1 & #2 OF V-5) VERTICAL.



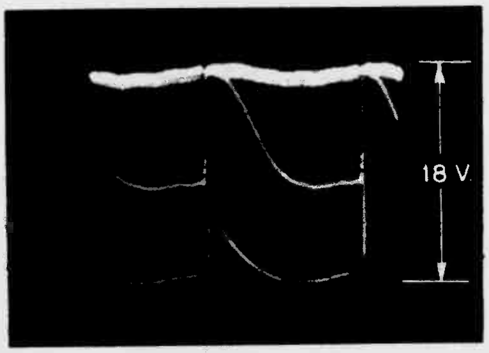
WAVEFORM - VIDEO SIGNAL INPUT TO VIDEO AMPLIFIER (PIN #1 & #2 OF V-5) HORIZONTAL.



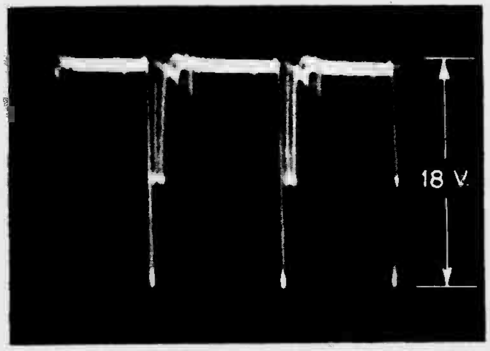
WAVEFORM - OUTPUT OF VIDEO AMPLIFIER (PIN #5 OF V-5 & B-) VERTICAL.



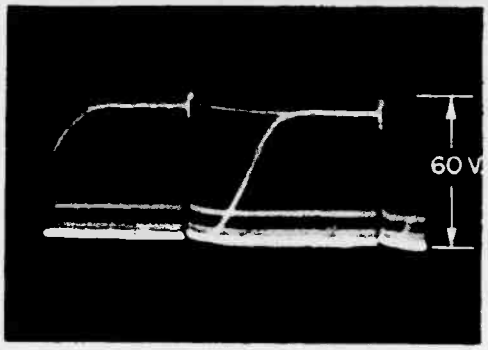
WAVEFORM - OUTPUT OF VIDEO AMPLIFIER (PIN #5 OF V-5 & B-) HORIZONTAL.



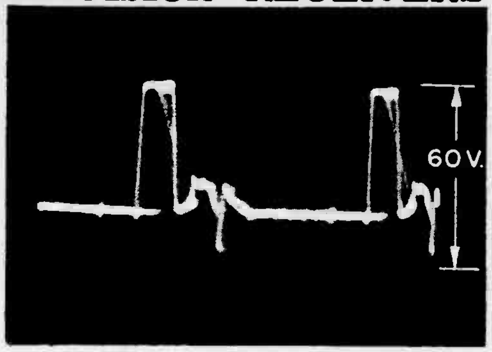
WAVEFORM - OUTPUT OF 1ST CLIPPER (PIN #4 & #6 OF V-11A) VERTICAL.



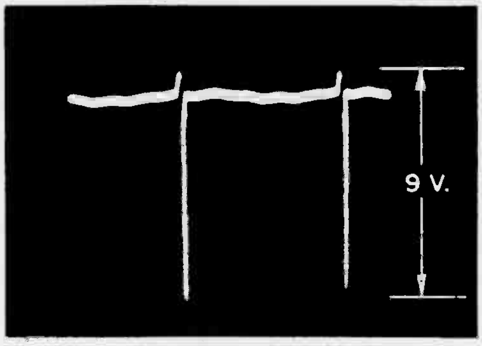
WAVEFORM - OUTPUT OF 1ST CLIPPER (PIN #4 & #6 OF V-11A) HORIZONTAL.



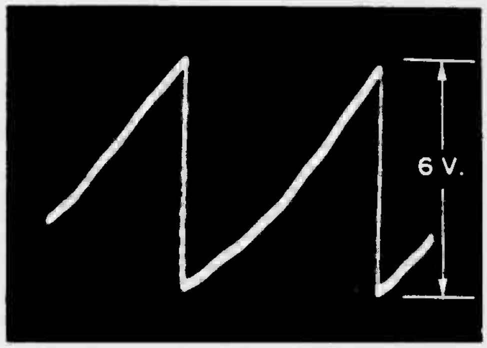
WAVEFORM - OUTPUT OF 2ND CLIPPER (PIN #5 OF V-11A & B-) VERTICAL.



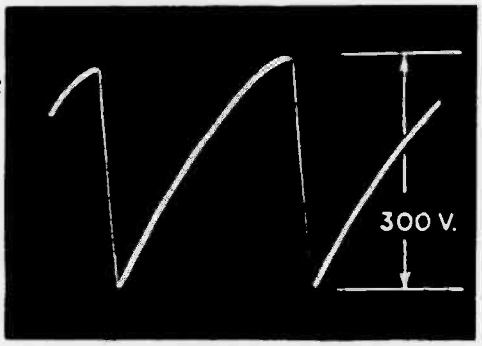
WAVEFORM - OUTPUT OF 2ND CLIPPER (PIN #5 OF V-11A & B-) HORIZONTAL.



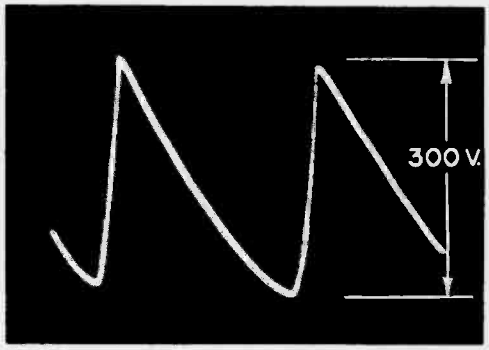
WAVEFORM - OUTPUT OF VERTICAL INTEGRATING NETWORK (JUNCTION OF C-50 & R-50 AND B-)



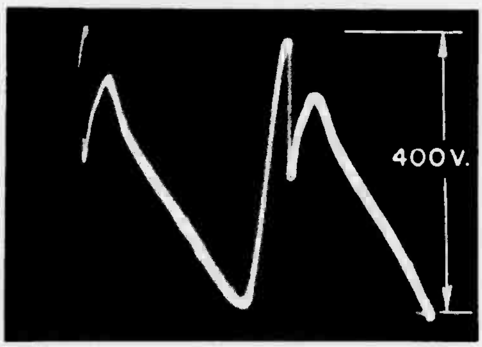
WAVEFORM - OUTPUT OF VERTICAL OSCILLATOR TUBE PLATE (PIN #5 OF V-10B AND B-)



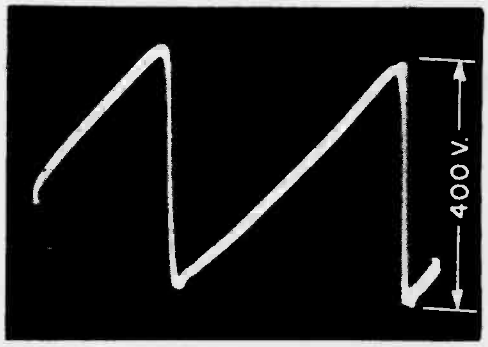
WAVEFORM - OUTPUT OF VERTICAL OSCILLATOR AMPLIFIER TUBE - ONE HALF (PIN #2 OF V-8 AND B-)



WAVEFORM - OUTPUT OF VERTICAL OSCILLATOR AMPLIFIER TUBE - ONE HALF (PIN #5 OF V-8 AND B-)



WAVEFORM - INPUT TO HORIZONTAL OSCILLATOR (JUNCTION OF C-146 AND R-110 AND B-)



WAVEFORM - OUTPUT OF HORIZONTAL OSCILLATOR - UPPER HALF (JUNCTION OF R-46 AND C-137 AND B-)

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

Service Hints for Motorola Model VT 71

In a television receiver, sound response from the speaker and the picture obtained on the cathode ray tube are used to guide the serviceman to probably source of trouble. The human eye is more critical than the ear and can be used to reveal defects in a television receiver. This list applies to TS-4D chassis, but can be used for earlier chassis provided reference is made to similar circuits. Some of the possible troubles that may be encountered, with their effects and causes, are listed below:

No tubes lit --
Defective power switch; open ballast resistors; open V-15 heater; open V-7 (6SQ7) heater; heater-cathode shorts in V-12 or V-13; open 22-ohm R-80E resistor causing V-7 heater to burn out.

One heater string out --
Open 105-ohm resistor (R-80B or R-80D, each in a diff. string); open heater in any tube; open heater choke on either string; heater-cathode shorts in 25L6GT tubes (V-12 or V-13).

No B++ or B+
Open ballast tube resistor R-80A (37 ohms) or R-80C (200 ohms); Open or shorted rectifiers E-2 or E-3; open lead to C-74; defective electrolytic condensers C-74, C-77A, C-78A.

Low B++ voltage (normal value 230-240 v.) --
Low capacity elect. C-74, C-77A (check 140 v. on C-74); Defective rectifiers E-2 or E-3; abnormal load in set (check voltage drop across R-80C, normally 22-24 volts).

No B- in R.F., I.F. section --
Open L-33 choke coil.

No raster on cathode ray picture tube --
No high voltage -- check V-14 and V-13 tubes and circuits; open or shorted turns on high voltage transformer T-7; Improper setting of feedback spring on V-14 (1B3GT); shorted C-65 or C-149; brightness control set at one end; poor V-15 (7JP4) cathode emission, or no heater voltage.

No vertical deflection --
Note: Tube V-8 (6SL7GT) receives high voltage from the same source as the cathode ray tube -- check this.
Defective V-10B or V-8, replace the bad tube; defective charging capacitor C-56, or coupling capacitor C-55; Defective vertical hold or vertical size controls R-115, R-53.

Small raster - vertical --
Defective V-8 (6SL7GT); defective vertical size control R-53; open coupling capacitor C-59 or C-128; shorted condenser C-142; excessive heater voltage on V-8 due to shorted resistor R-80B.

No horizontal deflection --
Defective V-11B (12SN7GT) - replace tube; shorted C-137, C-138; defective blocking oscillator transformer T-8 - check windings; fault in horizontal hold or horizontal size control R-49, R-55; defective hor. out. transformer T-6; bad coupling condenser C-146.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

Raster, but no image --
Open C-63 connections (in this case sound will be present); open coils L-38, L-39, L-42; defective input coil L-57; Poor contact in some miniature tube socket, especially V-5; defective I.F. strip, 2nd detector, or video amplifier - check tubes, D.C. voltage, resistance, and signal path; defective R.F. converter or oscillator stage - check as above.

No synchronization --
Defective clipper tubes V-10A (12SN7GT) or V-11A (12SN7GT); shorted C-47 or C-48, or open C-140 (affects vert. sync. only); open coupling capacitors C-44, C-45, C-146.

Poor vertical synchronization --
Check for corona arcing; open C-47 or C-48; defective C-140; vertical jitter - readjust vertical hold control R-115.

Picture stable, but poor resolution --
Defective video amplifier tube V-5 (6AU6); poor crystal E-1; open compensating coil L-41; misalignment of I.F. strip; local oscillator off frequency; defective input coil L-57; focus range incorrect; lead open to pin #9 of picture tube.

Contrast always too high or contrast control ineffective --
Defective R-84, or R-83, or C-13; open resistor R-96; defective 1st I.F. tube V-2 (6AG5) - replace tube.

Random black lines horizontally in raster --
Corona on various 6 KV points - paint with insulating compound; Defective C-59, C-128, C-147, C-148; corona in picture tube - replace tube; check clearance of all 6 KV leads - 3/8" minimum.

R.F. interference from receiver H.V. power supply in picture --
Open high voltage filter capacitor C-65; H.V. shield not closed; shield grounded; open capacitor C-102 or C-66; loose nuts on T-7.

Low sensitivity --
Defective converter tube V-17 (12AT7); I.F. gain low - check I.F. tubes; open or short at antenna terminal board; open L-57; open antenna, R.F., or I.F. coils; dirty or shorted contacts on station selector switch.

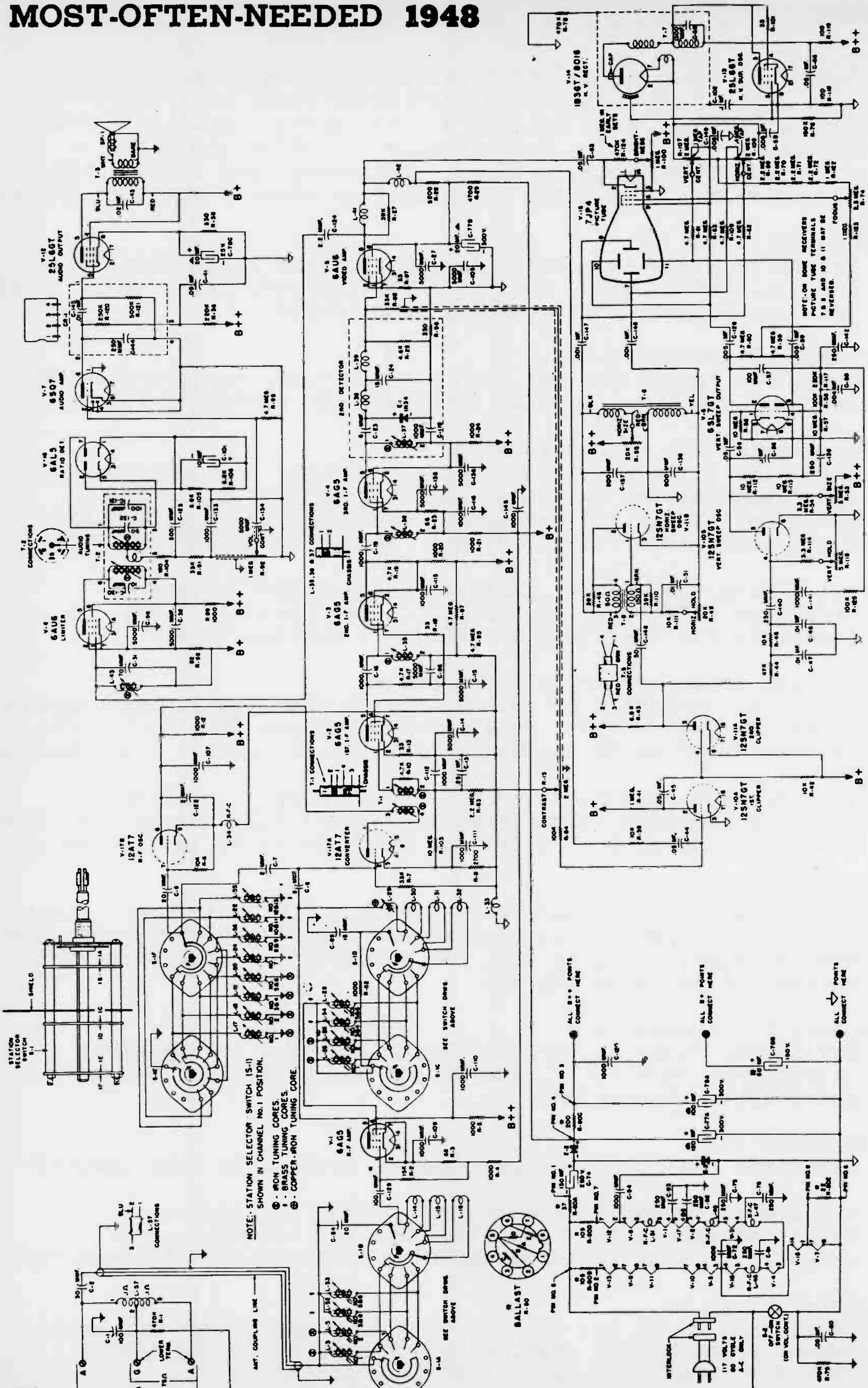
Sound bars in picture --
Oscillator tuned too high; filter C-78B low in capacity; microphonic tubes 6AG5, 12AT7, tap set at minimum volume and observe steady bars.

Hum in audio --
Capacitor C-41 open; heater-cathode leakage in V-12 (25L6GT)

60 cycle hum at minimum audio volume control setting --
Open condenser C-41; Defective tube V-7 (6SQ7); grounded antenna touching chassis; low capacity filter C-78B.

Low audio volume --
Video I.F. curve too narrow - realign; oscillator off tune; heater open on V-7; open ratio detector transformer T-2; defective ratio detector tube V-16 (6AL5).

CHASSIS TS-4D SCHEMATIC DIAGRAM



MOTOROLA
TELEVISION CHASSIS TS-4D
(USED IN VT71 MODEL SERIES)

PHILCO TELEVISION MODEL 48-700

ELECTRICAL-CONTROL FUNCTIONS

A number of controls and adjustments are located on the front, rear, and top of the chassis. The operating instructions furnished with each Receiver explains the use of the controls which are to be operated by the owner. All of the controls are adjusted by the serviceman at the time of installation, or while he is testing and aligning the Receiver. Figure 1 shows the front-panel controls, figure 2 indicates the adjustments on the rear of the chassis. The adjustments on top of the chassis are shown in figure 34. The reference symbol and function of each control and adjustment is given in the following chart:

CONTROL	REFERENCE SYMBOL	FUNCTION
Philco Precision Channel Selector	Z400 Z401	Eight-position rotary turret; connects proper aerial, and r-f, mixer, and oscillator coils for the television channel selected.
OFF-ON VOLUME	S101 R216	Line switch; operated by turning shaft of VOLUME control in clockwise direction from OFF position. VOLUME control adjusts input voltage to audio-amplifier stages.
BACKGROUND	R108	Sets bias level of picture tube. Adjust together with CONTRAST control for pleasing picture. See figure 4.
CONTRAST	R326	Adjusts cathode bias of video-output tube to control output level of video signal. This control primarily determines range of gray shades in picture; however, together with BACKGROUND control, it also determines sharpness (focusing) of picture. Adjust both controls alternately until pleasing picture is obtained. See figure 5.
FOCUS	R104	Determines d-c voltage applied to focusing anode of picture tube. Adjust for best over-all picture clarity. See figure 6.
VERT. HOLD	R518	Controls frequency of vertical-sweep generator. Adjust to center of range over which picture remains vertically stationary. See figure 7.
HORIZ. HOLD	R534	Controls frequency of horizontal-sweep generator. Adjust to center of range over which picture remains horizontally stationary. See figure 8.
HEIGHT	R514	Controls vertical-sweep amplitude. Adjust so that picture fills screen vertically. See figure 9.
WIDTH	R539	Controls horizontal-sweep amplitude. Adjust so that picture fills screen horizontally. See figure 10.
VERT. CENT.	R525	Controls d-c voltage applied to vertical-deflection plates. Adjust for vertically centered picture. See figure 11.
HORIZ. CENT.	R546	Controls d-c voltage applied to horizontal-deflection plates. Adjust for horizontally centered picture. See figure 12.
VERT. LIN.	R523	Controls amount of feedback to vertical-sweep output tubes. Adjust for vertically symmetrical pattern. See figure 13.
HORIZ. LIN.	R545	Controls amount of feedback to horizontal-sweep output tubes. Adjust for horizontally symmetrical pattern. See figure 14.
Oscillator-core Adjustment	L400A	Adjusts oscillator coil for correct inductance. See Alignment Procedure.

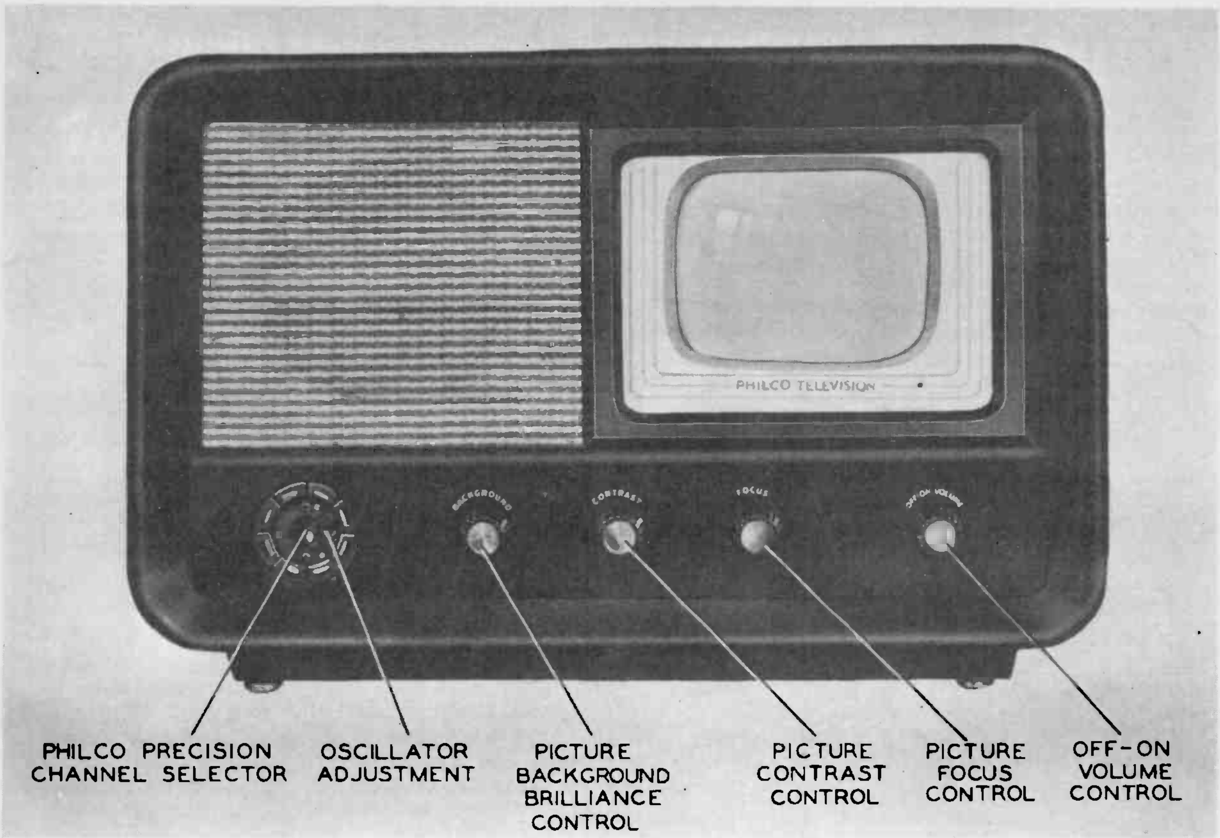


FIGURE 1. MODEL 48-700, FRONT VIEW, SHOWING CONTROLS.

Philco Television Receiver Model 48-700 is a 25-tube, modern-style, mahogany-finish table model. This direct-view Receiver is designed to provide reception of television broadcasts on channels 1 through 13.

The Philco Precision Channel Selector provides for selection of any one of eight television channels, thereby covering all channels allotted to any locality. (The FCC has allotted a maximum of seven channels to any one locality.)

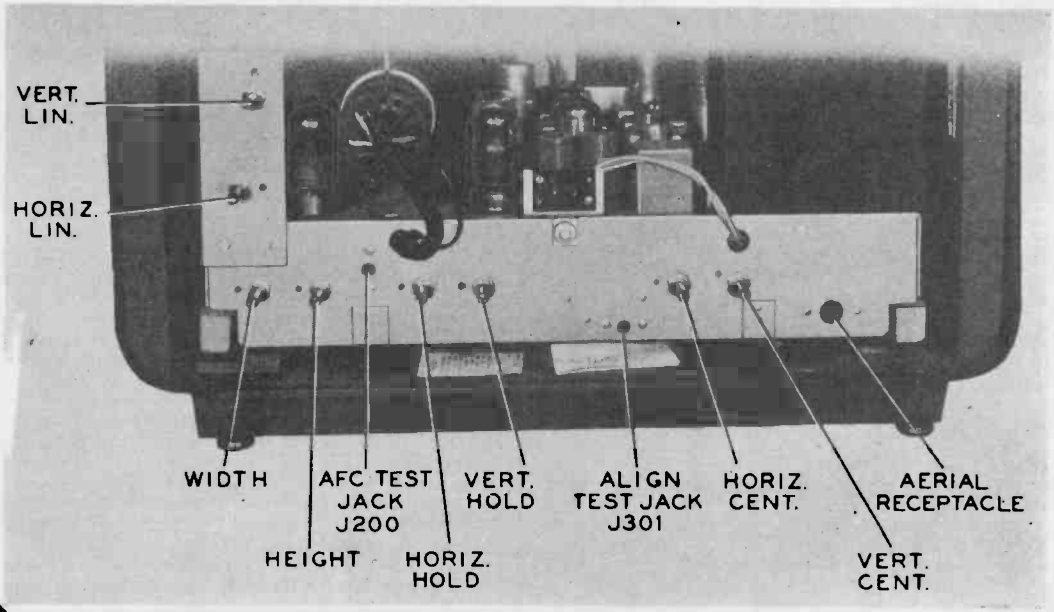


FIGURE 2. MODEL 48-700, REAR VIEW OF CHASSIS, SHOWING CONTROLS.

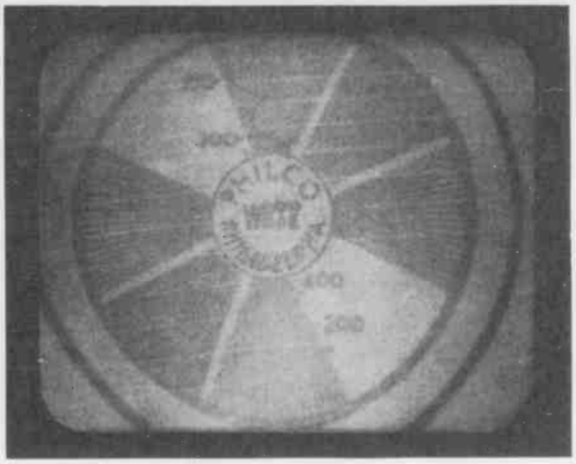


FIGURE 4. BACKGROUND CONTROL REQUIRES ADJUSTMENT.

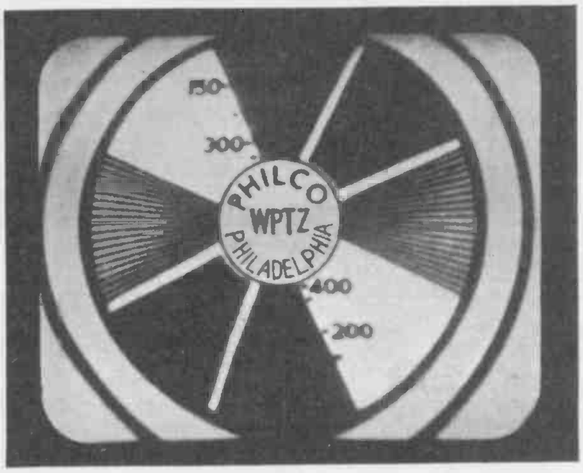


FIGURE 5. CONTRAST CONTROL REQUIRES ADJUSTMENT.

CIRCUIT DESCRIPTION

The Philco Precision Channel Selector employs snap-in coils so that the Receiver may be readily adapted to receive any eight of the thirteen television channels.

Provision is made for the use of two aerials, one for the low-frequency band and the other for the high-frequency band. When the Philco Precision Channel Selector is set to the desired channel, the proper aerial, aerial coil, r-f coil, mixer coil, and oscillator coil are automatically selected. In special installations, as many as four aerials may be used by a simple modification of the aerial input circuit.

The use of Automatic Tuning with Electronic Control (automatic frequency control) insures that the Receiver is properly tuned at all times for the maximum clarity of the picture and sound. The use of Automatic Level Control of Picture and Sound (automatic gain control) prevents fading of the picture and sound.

The schematic diagram of the complete Receiver, shown in figure 33, is divided into five sections: the Radio-Frequency Section, the Video Section, the Audio Section, the Sweep Section, and the Power-Supply Section. The interrelation of circuit functions for these sections is shown clearly in the block diagram, figure 15.

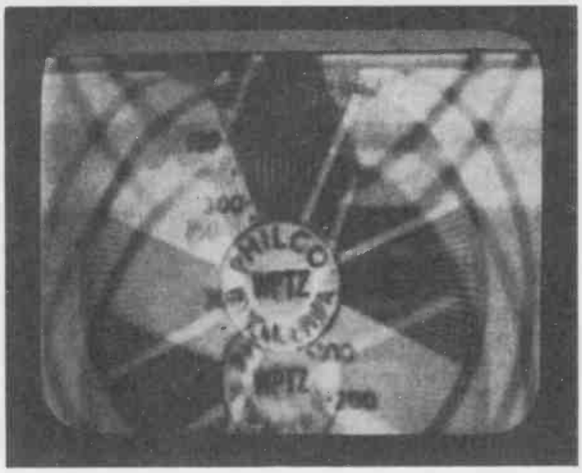


FIGURE 7. VERT. HOLD CONTROL REQUIRES ADJUSTMENT.

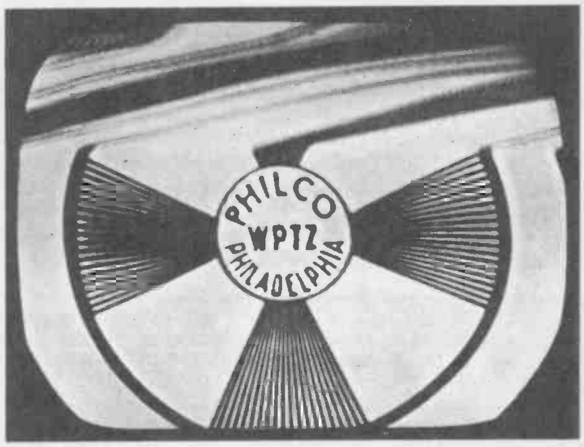


FIGURE 8. HORIZ. HOLD CONTROL REQUIRES ADJUSTMENT.

Radio-Frequency Section

The entire radio-frequency assembly is mounted on a sub-chassis, which is mounted on the main chassis. The Philco Precision Channel Selector is divided into two compartments, Z400 and Z401. Z400 contains the oscillator and mixer coils, and Z401 contains the r-f and aerial coils. The r-f coil and the aerial coil for each channel are wound on the same snap-in coil form, and the two coils are inductively coupled. Condenser C401B is used only on those channels for which the capacitance of C412 is too small to tune the circuit properly. Trimmer condensers C410 and C412 tune the Receiver input, and are adjusted properly at the factory. (Special test equipment must be used for the proper adjustment of C410 and C412. If these adjustments are disturbed, the picture signal will be clipped and distorted.)

The output of the 6AG5 r-f amplifier is impedance-coupled to the 6AG5 mixer. The mixer coil and the oscillator coil for each channel are also wound on the same snap-in coil form, and these two coils are inductively coupled on channels 1 through 6, and are capacitively coupled on channels 7 through 13, to provide the proper amount of oscillator-injection voltage.

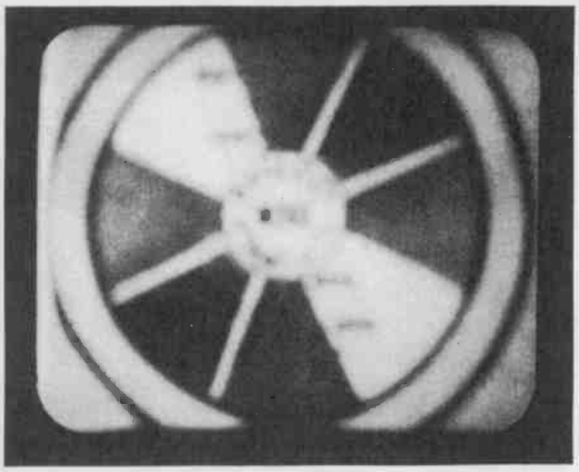


FIGURE 6. FOCUS CONTROL REQUIRES ADJUSTMENT.

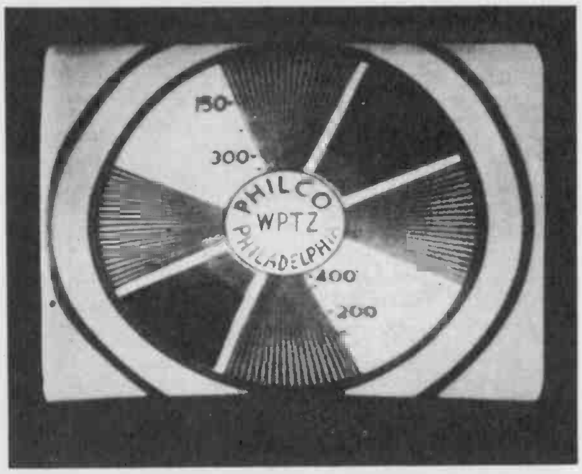


FIGURE 9. HEIGHT CONTROL REQUIRES ADJUSTMENT.

A Colpitts-type oscillator, employing one section of a 6J6 dual triode, is shunted by a reactance tube (osc. control), which employs the other section of the 6J6. The reactance tube is controlled by a d-c voltage obtained from the output of the discriminator. When a positive voltage is applied to the grid of the reactance tube, the oscillator frequency is decreased; conversely, when a negative voltage is applied, the oscillator frequency is increased. Since the output of the discriminator, at the point from which the control voltage is taken, varies in polarity from a negative maximum through zero to a positive maximum in accordance with the frequency of the signal, any change in the oscillator frequency changes the frequency of the audio i.f. and produces a correction voltage. In this manner, the oscillator is maintained constantly at the correct frequency, and a maximum of stability is obtained, regardless of the aging of tubes, changes in component values, and input-signal drift.

The output of the mixer is applied to the input-i-f impedance coupler Z300. The various frequencies existing in the Receiver for each channel when the oscillator coil for each channel has been correctly adjusted is given in the following chart:

CHANNEL NO.	BAND (mc.)	VIDEO-CARRIER FREQUENCY (mc.)	AUDIO-CARRIER FREQUENCY (mc.)	LOCAL-OSC. FREQUENCY (mc.)	VIDEO I.F. (mc.)	AUDIO I.F. (mc.)	ADJACENT-AUDIO I.F. (mc.)
1	44—50	45.25	49.75	71.85	26.6	22.1	None
2	54—60	55.25	59.75	81.85	26.6	22.1	32.1
3	60—66	61.25	65.75	87.85	26.6	22.1	28.1*
4	66—72	67.25	71.75	93.85	26.6	22.1	28.1*
5	76—82	77.25	81.75	103.85	26.6	22.1	32.1
6	82—88	83.25	87.75	109.85	26.6	22.1	28.1*
7	174—180	175.25	179.75	201.85	26.6	22.1	None
8	180—186	181.25	185.75	207.85	26.6	22.1	28.1*
9	186—192	187.25	191.75	213.85	26.6	22.1	28.1*
10	192—198	193.25	197.75	219.85	26.6	22.1	28.1*
11	198—204	199.25	203.75	225.85	26.6	22.1	28.1*
12	204—210	205.25	209.75	231.85	26.6	22.1	28.1*
13	210—216	211.25	215.75	237.85	26.6	22.1	28.1*

* Adjacent-channel audio-i-f signal falls within the Receiver band pass, and is rejected by the adjacent-channel-sound trap.

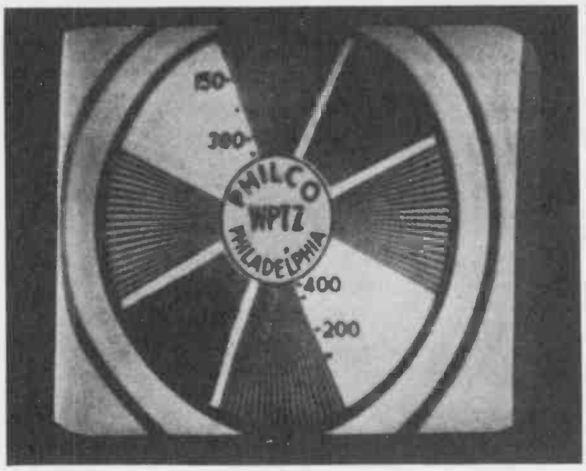


FIGURE 10. WIDTH CONTROL REQUIRES ADJUSTMENT.

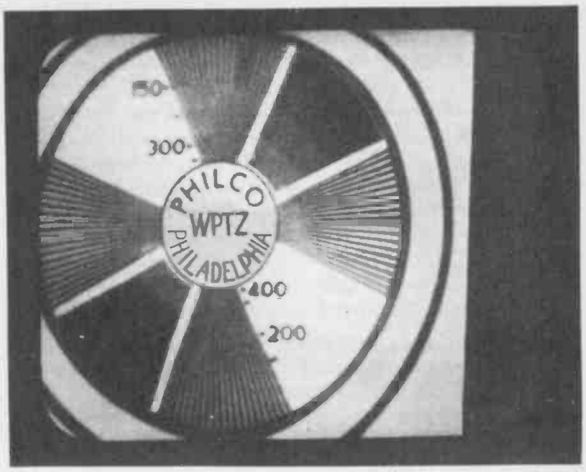


FIGURE 12. HORIZ. CENT. CONTROL REQUIRES ADJUSTMENT.

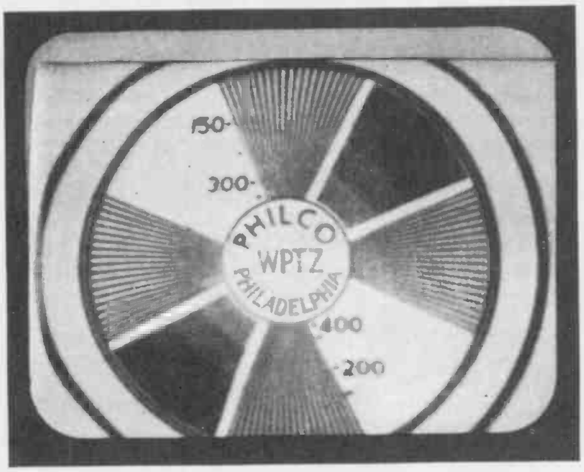


FIGURE 11. VERT. CENT. CONTROL REQUIRES ADJUSTMENT.

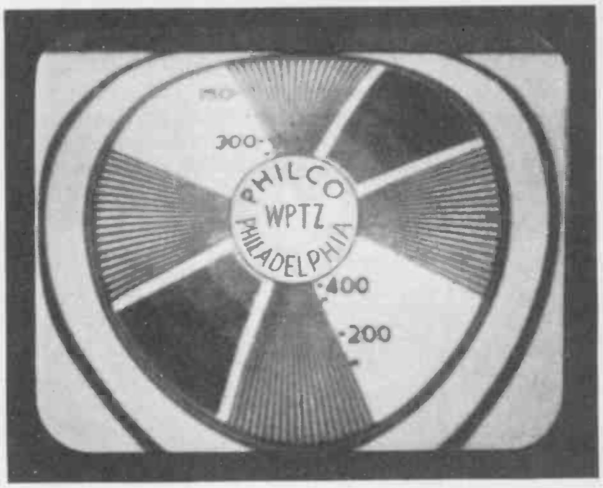


FIGURE 13. VERT. LIN. CONTROL REQUIRES ADJUSTMENT.

Video Section

The intermediate-frequency signals present in the plate circuit of the mixer are transferred by impedance coupler Z300 to the grid of the 6AG5 input i-f amplifier and amplified. The plate and grid windings of the first video-i-f impedance coupler Z301 are tuned to accept the video-i-f signal (26.6 mc.), while the sound trap L301B is adjusted to reject the audio-i-f signal (22.1 mc.); thus very little, if any, of the audio-i-f signal remains in the video section. Since the plate supply to the input i-f amplifier is connected through the first audio-i-f transformer Z200, the audio-i-f signal is transferred to the first audio-i-f stage.

The video-i-f signal is amplified by the 6AG5 first video-i-f amplifier, and passed through the second video-i-f impedance coupler Z302. This coupler is tuned to a frequency slightly different from that of Z301 to achieve the desired band pass. The adjacent-channel-sound trap L302B is tuned to the adjacent-channel audio-i-f signal (28.1 mc.), and offers a high impedance to the adjacent-channel audio-i-f signal, if present. (Because of channel allocation, the adjacent-channel sound appears on some channels as a 32-mc. i.f. Since this frequency is not within the band pass of the

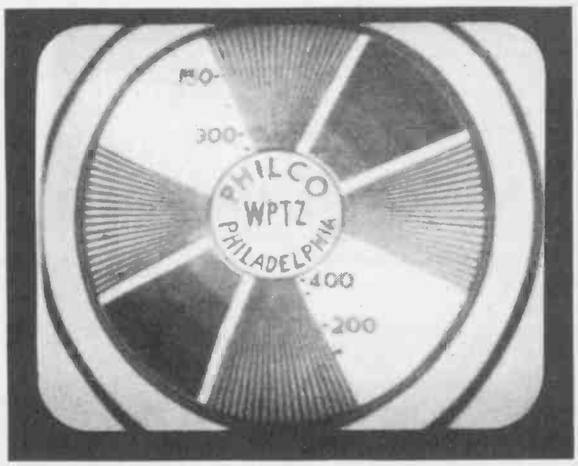


FIGURE 14. HORIZ. LIN. CONTROL REQUIRES ADJUSTMENT.

Receiver, no interference results.) The amplified video-i-f signal is transferred by the third video-i-f impedance coupler Z303, which is tuned to a frequency slightly different from that of Z302 or Z301, to the video detector. The video detector, consisting of one section of a 6AL5 dual-diode, rectifies the negative portion of the video-i-f signal. The resultant video signal is then amplified by the 6AG5 first video amplifier and the 7C5 video output tube, and is applied to the grid of the picture tube. The amplitude of this signal is controlled by the CONTRAST control R326, which varies the bias on the video output tube. High and low-frequency compensation is employed to provide a video response from approximately 30 cycles to 4 mc. D-c restoration by means of a 1N34 crystal establishes a d-c bias level according to the picture content of the signal on the grid of the picture tube, thus insuring that the picture brightness changes only with each change of scene — not with each frame.

Automatic Control of Picture and Sound is achieved by means of an a-g-c circuit which is controlled by a voltage obtained by rectifying the sync tips. Since the sync tips are always at the same modulation level but vary in amplitude with the strength of the signal, they are a suitable reference for a-g-c. One half-section of the video-detector diode is used to rectify the sync tips. Enough a-g-c voltage is available at all times to regulate the gain of the r-f amplifier, the input i-f amplifier, and the first video-i-f amplifier, so that any change in the strength of the incoming signal is compensated for by a change in the gain of these stages.

Audio Section

The audio section employs two audio-i-f stages (tuned to the accompanying-sound frequency of 22.1 mc.), a discriminator, and two stages of audio amplification. The audio section can supply an undistorted output of approximately 2,5 watts to the 6-inch electrodynamic loud-speaker.

The discriminator is an improved FM detector of the ratio type. The band width of this discriminator is approximately 500 kc., to permit high-quality FM reception. The output of the discriminator is connected to the a-f-c test jack for test purposes, and is also connected through a two-section r-c filter to the grid of the oscillator-control tube to supply a voltage for controlling the oscillator frequency, as described in the discussion of the RADIO-FREQUENCY SECTION.

Sweep Section

A portion of the video signal is taken from the screen of the first video amplifier and is applied to the grid of the 7B5 sync-separator tube, so that the synchroniz-

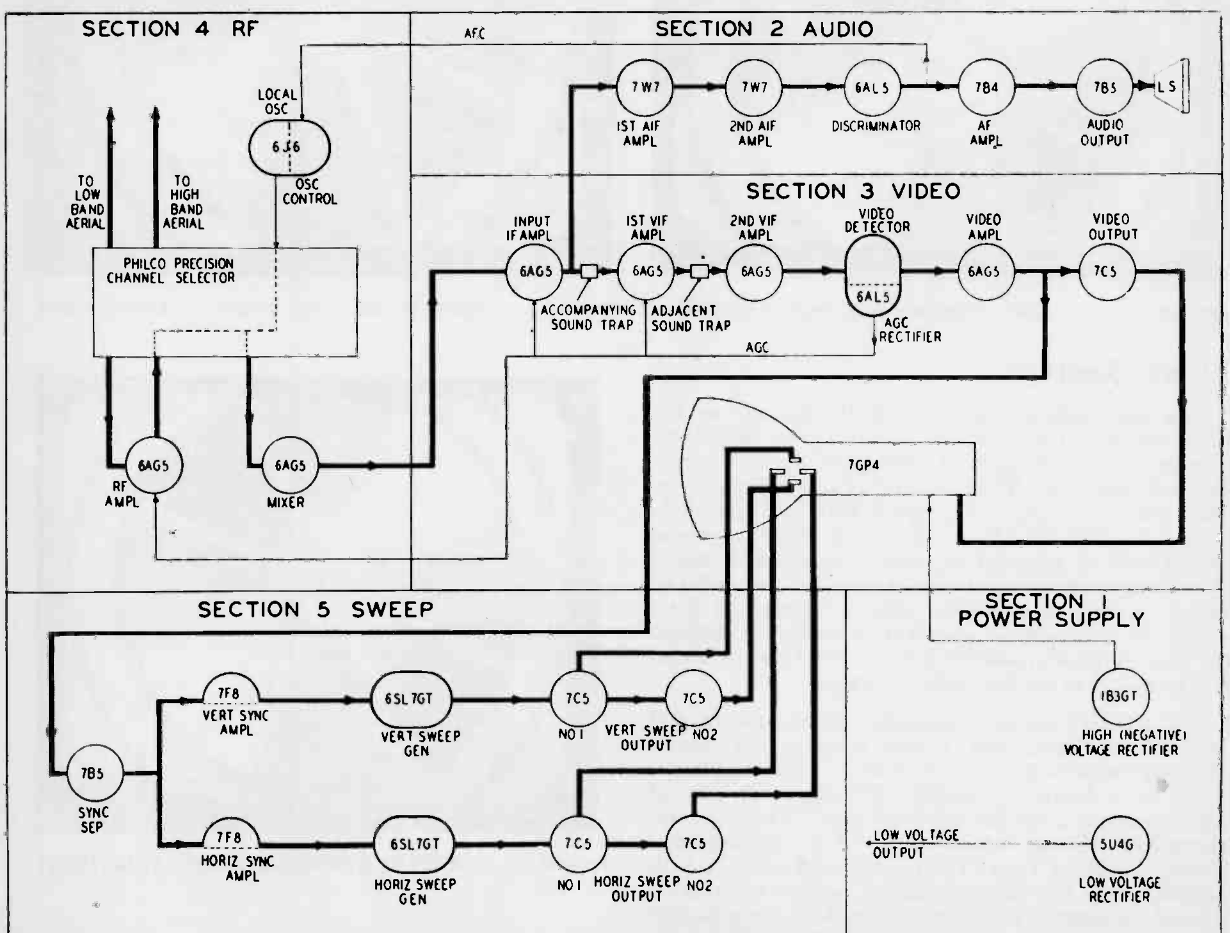


FIGURE 15. MODEL 48-700. BLOCK DIAGRAM.

ing and equalizing pulses, which must be used to control the recurrence rate of the horizontal and vertical-sweep generators, may be separated from the video signal. The sync-separator-tube potentials are such that the video portion of the composite video signal applied to its input circuit is insufficient to operate the tube, and only the "blacker-than-black" portion of the video signal is passed. This blacker-than-black portion contains the horizontal and vertical-synchronizing pulses and the equalizing pulses, each type of pulse differing greatly in duration and recurrence rate from the others. The output of the sync separator is applied to the 7F8 vertical-sync and horizontal-sync amplifiers through separate r-c coupling circuits, each circuit having a different time constant.

C502 and R506 form a long-time-constant circuit, which accepts both vertical and horizontal-synchronizing pulses and applies them to the vertical-sync-amplifier grid. These signals are amplified and applied to an integrating network consisting of C504 and C505, and then to the vertical-sweep-generator grid. The horizontal-sync pulses, being of short duration, have little effect on the voltage build-up in the integrating network, whereas the long, serrated, vertical-sync pulses have a maximum effect; thus they trigger the vertical-sweep generator (which is also a blocking oscillator) in synchronism with the vertical-sweep pulses, which occur at a rate of 60 c.p.s. The output of the vertical-sweep generator is applied to the grid of vertical-sweep output tube No. 1, which operates in push-pull with vertical-sweep output tube No. 2. A portion of the output voltage from vertical-sweep output tube No. 1 is used to drive vertical-sweep output tube No. 2. Two output voltages of the proper saw-tooth wave shape but of opposite polarity are coupled to the vertical-deflection plates of the picture tube. The HEIGHT control R514 determines the amplitude of the input voltage to the vertical-sweep output tubes, and is adjusted for the desired picture height. The VERT. LIN. control R523 determines the amount of voltage fed back to, and in phase with the input of the vertical-sweep output tubes, to control the linearity of the vertical sweep. Vertical centering is achieved by the VERT. CENT. control R525, which varies the d-c voltage applied to the vertical-deflection plates of the picture tube to deflect the beam up or down, as required for proper centering of the picture.

C513 and R527 form a differentiating network which changes the short-time horizontal-synchronizing pulses to sharp negative pips. These pips are amplified and inverted by the horizontal-sync amplifier and are applied to the grid of the 6SL7GT horizontal-sweep generator.

Since the horizontal sweep is much faster than the vertical sweep, certain circuit components are required in the horizontal-sweep-generator circuit which are not needed in the vertical-sweep-generator circuit. The plate circuit of the horizontal-sweep-generator tube contains a tuned circuit consisting of L500 and C518, which is resonant at a frequency of approximately 15,000 c.p.s. The positive sync pulse at the first grid (pin 4) triggers the blocking oscillator. During the positive swing of the grid, the plate current of the first section of the tube increases rapidly. When the grid voltage falls sharply to its maximum negative peak (see figure 26), due to the feedback developed in the transformer, the plate current is abruptly cut off. The sudden stopping of the plate-current flow shock excites the tuned circuit, causing it to oscillate and produce a voltage at its resonant frequency. This sine-wave voltage is combined, at the second cathode (pin 3) of the horizontal-sweep-generator, with the negative pulse from the first plate (pin 5). See figure 29. The frequency of the resonant circuit, in conjunction with the generator-circuit time constant, determined by the setting of the HORIZ. HOLD control R534, sets the frequency of the horizontal-sweep generator. The stabilization produced by the tuned circuit reduces the effect of noise on the horizontal sweep. The output of the horizontal-sweep-generator is applied to the grid of horizontal-sweep output tube No. 1, which operates in push-pull with horizontal-sweep output tube No. 2. A portion of the output voltage from horizontal-sweep output tube No. 1 is used to drive horizontal-sweep output tube No. 2. Two output voltages of the proper saw-tooth shape but of opposite polarity are coupled from the horizontal-sweep output stage to the horizontal-deflection plates of the picture tube. The WIDTH control R539 adjusts the bias applied to horizontal-sweep output tube No. 1, thus increasing or decreasing the amplitude of the sawtooth voltage applied to the horizontal-deflection plates. The HORIZ. LIN. control R545 determines the amount of voltage fed back to, and in phase with the input of the horizontal-sweep output tubes, to control the linearity of the horizontal sweep.

Horizontal centering is controlled by HORIZ. CENT. control R546, which varies the d-c voltage applied to the horizontal-deflection plates of the picture tube to deflect the beam to the left or right, as required for proper centering of the picture. Focusing is achieved by FOCUS control R104 which varies the d-c voltage applied to the first anode of the picture tube.

Power-Supply Section

The power-supply section contains two power supplies; one is a low-voltage high-current supply for the Receiver circuits, and the other is a negative high-voltage low-current supply for the picture tube.

The negative high-voltage supply uses a 1B3GT tube in a half-wave rectifier circuit, the output of which is filtered by a low-pass filter. A bank of series resistors make up the bleeder network, which supplies voltages for the FOCUS and BACKGROUND controls and the picture-tube bias.

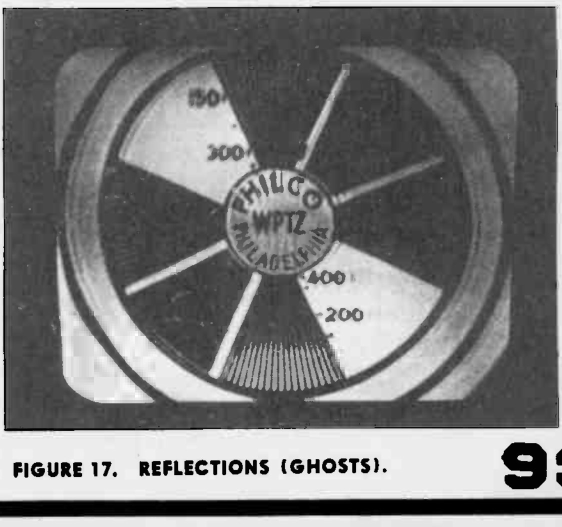


FIGURE 17. REFLECTIONS (GHOSTS).

THE PHILCO TROUBLE-SHOOTING PROCEDURE FOR TELEVISION RECEIVERS

The Philco trouble-shooting procedure for television receivers is logical, thorough, and easy to follow. The basis of the Philco procedure is:

First, localization of the trouble to a functional section, or block of circuits.

Second, isolation of the faulty circuit, or stage, within that section.

Third, location of the defective part within that circuit.

The receiver circuit is divided into five functional sections, or blocks of circuits, as follows:

Section 1—the power-supply circuits
Section 2—the audio circuits
Section 3—the video circuits
Section 4—the r-f circuits
Section 5—the sweep circuits

In the Philco trouble-shooting procedure, localization of the trouble to a functional section is accomplished, if possible, by the OPERATIONAL CHECK. Charts are given to help the serviceman make this check quickly and accurately. Practically all of the troubles which occur in a television receiver cause abnormal indications on the screen or from the speaker, or both. By simply looking and listening, the serviceman often can localize the trouble to a block of circuits immediately, without needless testing.

If the trouble cannot be localized by the OPERATIONAL CHECK, it can be localized by the TEST-POINT ANALYSIS. To aid in this analysis, the parts in the schematic diagram, base layouts, and replacement parts list are symbolized according to the section numbers, and a trouble-shooting chart is given for each section. Each sectional chart refers to one or more "major" test points (numbers within stars) and a subordinate group of "key" test points (letters within circles), which are indicated on the schematic diagram and base layout. A few tests at the "major" test points throughout the receiver, as directed in the trouble-shooting charts, will definitely localize the trouble to a particular section, and eliminate other sections from suspicion.

After the trouble has been localized to a section, either by the OPERATIONAL CHECK or by the TEST-POINT ANALYSIS, a few additional tests at the "key" test points, specified in the chart for that section, will isolate the faulty circuit. The defective part can then be located by testing tubes, by simple voltage and resistance measurements, by substitution of parts, or, in some circuits, by waveform checks. Trouble revealed by any test should be corrected before testing further.

IMPORTANT

To insure proper operation, all repairs should be made using exact replacement parts, and the new part should be located in the exact position from which the original part was removed. If it is necessary to temporarily move other parts or wiring to make the repair, be sure to dress the parts and wiring back to their original positions after the repair has been made.

OPERATIONAL CHECK

NOTE: Do not make an operational check if the complaint indicates that the Receiver cannot be turned on without risk of further damage — proceed with the TEST-POINT ANALYSIS.

If the complaint indicates that the Receiver can be turned on without risk of further damage, turn on the Receiver and set the Philco Precision Channel Selector to receive a television station which is on the air. Either the picture or the sound, or both, may be unsatisfactory. If both are unsatisfactory, apply a signal of the proper frequency from an AM signal generator to the aerial receptacle; this should produce audio output from the speaker and modulation bars on the screen. If both are satisfactory, check the aerial installation. If either the sound or modulation pattern, or both, are unsatisfactory, disconnect the signal generator and refer to the classified portions of the following charts.

SOUND PRESENT, BUT PICTURE MISSING

INDICATION	PROBABLE TROUBLE	REFERENCE
Only bright, horizontal line appears on picture tube.	Defective vertical-sweep circuits.	Refer to Section 5 trouble-shooting chart.
No picture, but sound is good, and raster appears. See figure 16.	Trouble in video circuits, except input i-f amplifier stage.	Refer to Section 3 trouble-shooting chart.
Sound good, but picture tube unlighted.	Defective high-voltage power supply or defective picture tube.	Refer to Section 1 and Section 3 trouble-shooting charts.
Only bright vertical line appears on picture tube.	Defective horizontal-sweep circuits.	Refer to Section 5 trouble-shooting chart.
Only bright spot appears on picture tube.	Defective horizontal and vertical-sweep circuits.	Refer to Section 5 trouble-shooting chart.

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PICTURE PRESENT, BUT SOUND MISSING

Picture good, but no sound.	Trouble in audio circuits.	Refer to Section 2 trouble-shooting chart.

BOTH PICTURE AND SOUND MISSING

No picture or sound, but raster appears.	Trouble in r-f circuits. Defective input i-f amplifier stage or a-g-c circuit.	Refer to Section 3 and Section 4 trouble-shooting charts.
No picture, sound, or raster.	Defective low-voltage power supply.	Refer to Section 1 trouble-shooting chart.

PICTURE NOT CLEAR

Sound and picture weak.	Weak r-f amplifier, oscillator, mixer, or input-i-f amplifier tube. Defective aerial. Defective a-g-c circuit.	Refer to Section 3 and Section 4 trouble-shooting charts. Check aerial.
Picture too dark (CONTRAST and BACKGROUND controls properly adjusted).	Defective a-g-c circuit.	Refer to Section 3 trouble-shooting chart.
Flashes in raster with aerial disconnected.	High-voltage power supply arcing (corona discharge).	Refer to Section 1 and Section 3 trouble-shooting charts. Check lead dress of high-voltage circuit.
Multiple images (ghosts) appear. See figure 17.	Defective aerial installation, or incorrect orientation of aerial. Standing waves on transmission line.	Check aerial and transmission line.
Insufficient contrast in picture (CONTRAST control properly adjusted). See figure 5.	Insufficient gain in video circuits, or defective picture tube.	Refer to Section 3 trouble-shooting chart.
Sound in picture (horizontal bars following modulation). See figure 19.	Microphonic tubes, L301B (accompanying-sound trap) incorrectly adjusted, or oscillator-core adjustment incorrectly set.	Refer to alignment chart.
Picture lacks sharpness of detail.	Defective FOCUS control. Defective picture tube. Trouble in r-f or video circuits.	Refer to Section 1, Section 3, and Section 4 trouble-shooting charts and to alignment charts.
Picture lacks detail (FOCUS control properly adjusted).	Misalignment of Receiver, or defective aerial system.	Refer to alignment chart. Check aerial system.
Picture background unstable.	Trouble in d-c restorer.	Refer to "D-C RESTORATION CHECK"
Beat pattern (fine, weaving, meshed lines).	Interference from short-wave transmitter. Misalignment of Receiver. Improperly adjusted oscillator coil L400A.	Check aerial orientation and installation. Refer to alignment chart.

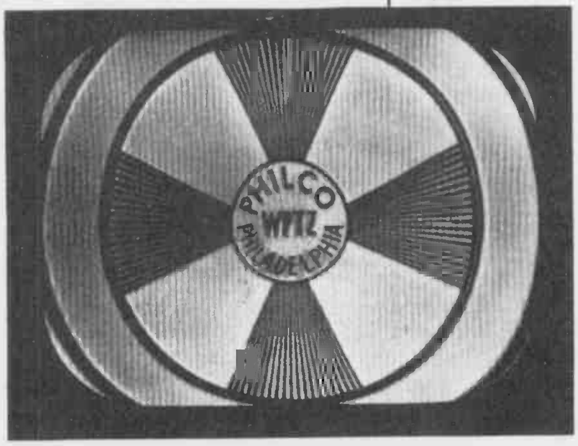

FIGURE 18. BEAT PATTERN.

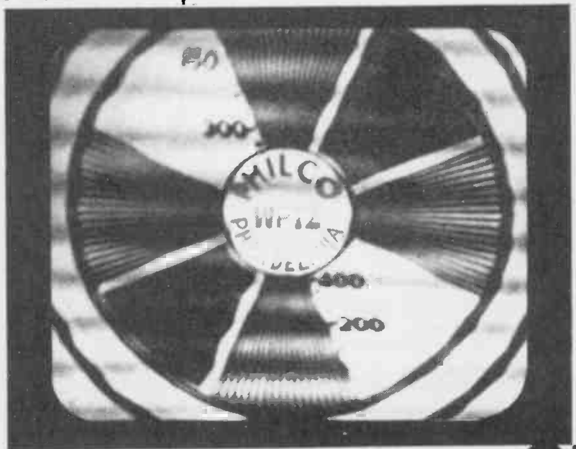

FIGURE 19. SOUND IN PICTURE.

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PICTURE DOES NOT REMAIN STATIONARY

INDICATION	PROBABLE TROUBLE	REFERENCE
Picture will not sync vertically and horizontally. See figures 7 and 8.	Defective sync-separator tube or associated circuit, or weak signal with high noise level.	Refer to Section 5 trouble-shooting chart.
Picture will not sync vertically. See figure 7.	Defective vertical-sync-amplifier or vertical-sweep-generator tube, or associated circuits.	Refer to Section 5 trouble-shooting chart.
Picture will not sync horizontally. See figure 8.	Defective horizontal-sync-amplifier or horizontal-sweep-generator tube, or associated circuits.	Refer to Section 5 trouble-shooting chart.

IMPROPER PICTURE SIZE

WIDTH control will not reduce width of raster.	Defective WIDTH control or associated circuit, or low anode voltage.	Refer to Section 1 and Section 5 trouble-shooting charts.
Raster too small, either vertically or horizontally (HEIGHT and WIDTH controls properly adjusted). See figures 9 and 10.	Low output from low-voltage power supply. Weak or defective vertical or horizontal-sweep-output tube, or insufficient drive for output tubes. Defective WIDTH or HEIGHT control circuits.	Refer to Section 1 and Section 5 trouble-shooting charts.

RECEIVER DOES NOT OPERATE ON ALL CHANNELS

Trouble on one channel only (stations received on other channels).	Improper adjustment of oscillator for defective channel, or open oscillator or r-f coil.	For oscillator adjustment, refer to "Installation Instructions for Philco Television Receiver Model 48-700," PR-1468. Refer to Section 4 trouble-shooting chart.

TEST-POINT ANALYSIS

Preliminary Check

Remove the Receiver chassis from the cabinet and carefully inspect it for evidence of burnt or overheated parts, tubes broken or loose in sockets, broken or loose connections, defective insulation, or other indication of trouble. If any indications of trouble are found, locate the cause of the trouble before replacing the damaged part.

After the inspection has been made, and any necessary repairs have been completed, connect the Receiver for operation on the bench, using the speaker and picture tube from the set being repaired.

Test Equipment Required for Test-Point Analysis

To perform the trouble-shooting tests, the following test equipment and parts are required:

VTVM or 20,000-ohms-per-volt voltmeter

OSCILLOSCOPE with broad-band amplifiers

SIGNAL GENERATORS

Audio signal generator

AM signal generator (frequency range of 20 mc. to 28 mc. for i-f tests; frequency range for r-f tests to cover local-station carrier frequencies)

FM signal generator (center-frequency range of 20 mc. to 30 mc., and sweep range of at least 250 kc. A television FM signal generator with a sweep range of 8 mc. may be used.)

MISCELLANEOUS

.1-mf. condenser (paper, 600-volt rating)
50-mmf. condenser (mica, 2000-volt rating)
.002-mf. condenser (mica, 2000-volt rating)
1000-ohm resistor

Line cord, with standard male connector, Part No. L2183, a special female connector, Part No. 27-6217, and shell flange, Part No. 56-4346 (to fit a-c interlock).

CAUTION

High voltage dangerous to human life is used in this Receiver. Unless the high voltage is required for a picture-tube presentation or for a voltage check, the 1B3GT high-voltage rectifier should be removed while trouble-shooting, to avoid possible physical contact and serious injury.

PHILCO MODEL 48-700

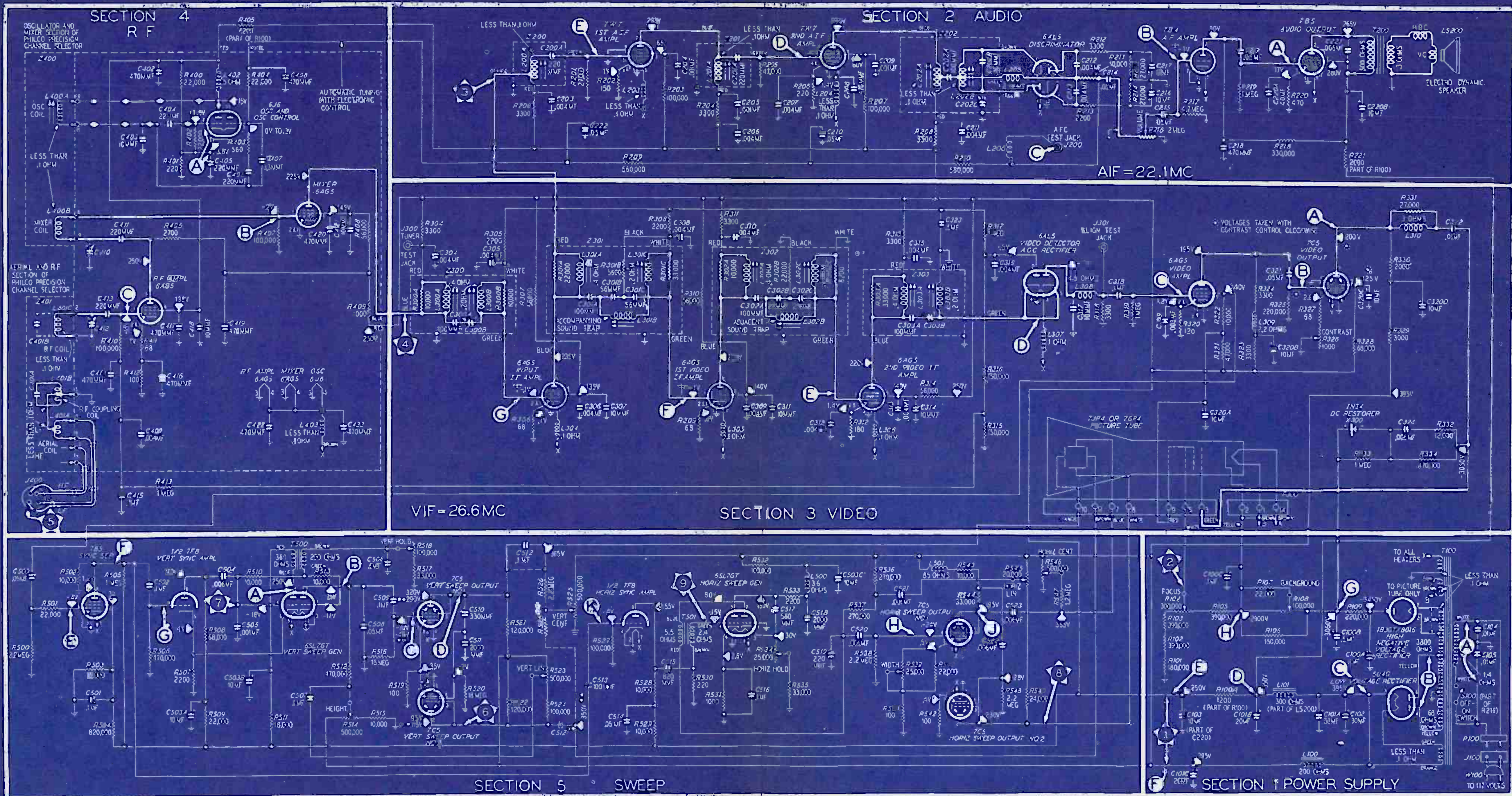

FIGURE 33. MODEL 48-700, SECTIONALIZED SCHEMATIC DIAGRAM, SHOWING TEST POINTS.

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TROUBLE SHOOTING SECTION 1 — POWER-SUPPLY CIRCUITS

NOTE: For step 1, connect a VTVM or a 20,000-ohms-per-volt voltmeter across test point. For steps 2 and 3, connect an a-c voltmeter across test point. For steps 4, 5, 6, and 7, connect a VTVM or a 20,000-ohms-per-volt voltmeter between test point and ground. For steps 8, 9, 10, and 11, turn BACKGROUND and FOCUS controls fully counterclockwise, and connect a 20,000-ohms-per-volt voltmeter (5000-volt range) between test point and ground.

Voltage readings given were measured at a line voltage of 117 volts, a.c.

If the "NORMAL INDICATION" is obtained in steps 1 and 8, proceed with the tests for Section 2 (audio circuits); if not, isolate and correct the trouble in this section.

LOW-VOLTAGE POWER SUPPLY

STEP	TEST POINT	NORMAL INDICATION	ABNORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	1	140 volts, d.c.		If normal indication is obtained, proceed with step 8. If abnormal indication is obtained, proceed with step 2.
2	A	117 volts, a.c. (110 to 120 volts)	High or low voltage No voltage	Incorrect power source. Defective: P100, J100, W100.
3	B Remove 5U4G tube.	745 volts, a.c.	Low voltage No voltage	Defective: T100. Defective: T100, S100.
4	C Replace 5U4G tube.	395 volts, d.c.	High voltage Low or no voltage	Open: L100, L101, R100A. Shorted or leaky: C101A, C101B, C101C, C102, C103, C206*. Defective: 5U4G, T100.
5	D	350 volts, d.c.	High voltage No voltage	Open: L100, R100A. Open: L101.
6	E	250 volts, d.c.	No voltage	Open: R100A.
7	F	395 volts, d.c.	No voltage	Open: L100.

* This part, located in another section, may cause abnormal indication in this section.

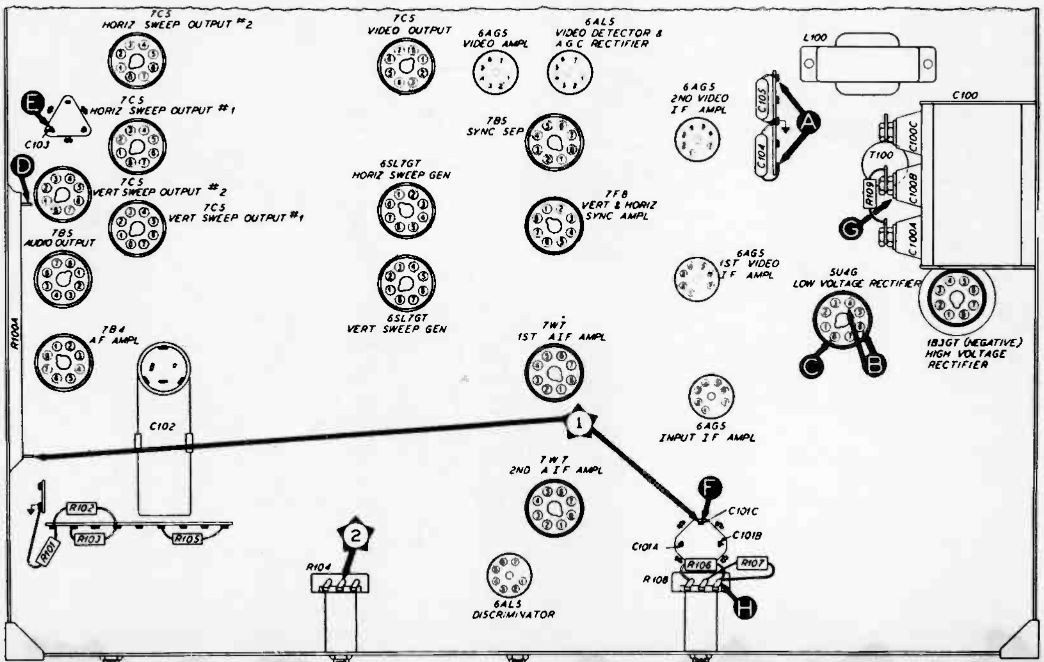


FIGURE 20. BOTTOM VIEW OF CHASSIS, SHOWING SECTION 1 TEST POINTS.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

HIGH-VOLTAGE POWER SUPPLY

BE SAFE! TURN OFF RECEIVER BEFORE MAKING CONNECTIONS

8	2	Negative 2100 volts, d.c.		If abnormal indication is obtained, proceed with step 9.
9	G	Negative 3050 volts, d.c.	High voltage Low voltage No voltage	Open: R105, R104, R103, R102, R101. Leaky: C100A, C100B, C100C. Open: C100A. Defective: 1B3GT, T100. Open: R109. Shorted: C100A, C100B.
10	H	Negative 2900 volts, d.c.	Low voltage	Open: R108, R106.
11	2	Negative 2100 volts, d.c.	No voltage	Open: R104.

TROUBLE SHOOTING SECTION 2 — AUDIO CIRCUITS

Set VOLUME control to maximum.

NOTE 1: Use an FM signal generator, set to 22.1 mc. An AM signal generator with 400-cycle modulation may be used if an FM signal generator is not available. If an AM signal generator is used, it should be adjusted slightly below 22.1 mc. For steps 1, 5, 6, and 7, connect the signal generator between test point and ground; use a .1-mf. condenser in series with the signal lead. Use moderate to weak output.

NOTE 2: For steps 2, 3, and 4, connect an audio signal generator, set at 400 cycles, between test point and ground; use a .1-mf. condenser in series with the signal lead. Use moderate to weak output.

If the "NORMAL INDICATION" is obtained in step 1, proceed with the tests for Section 3 (video circuits); if not, isolate and correct the trouble in this section.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1 See note 1.	3	Loud, clear audio signal.	Trouble in this section; proceed with step 2.

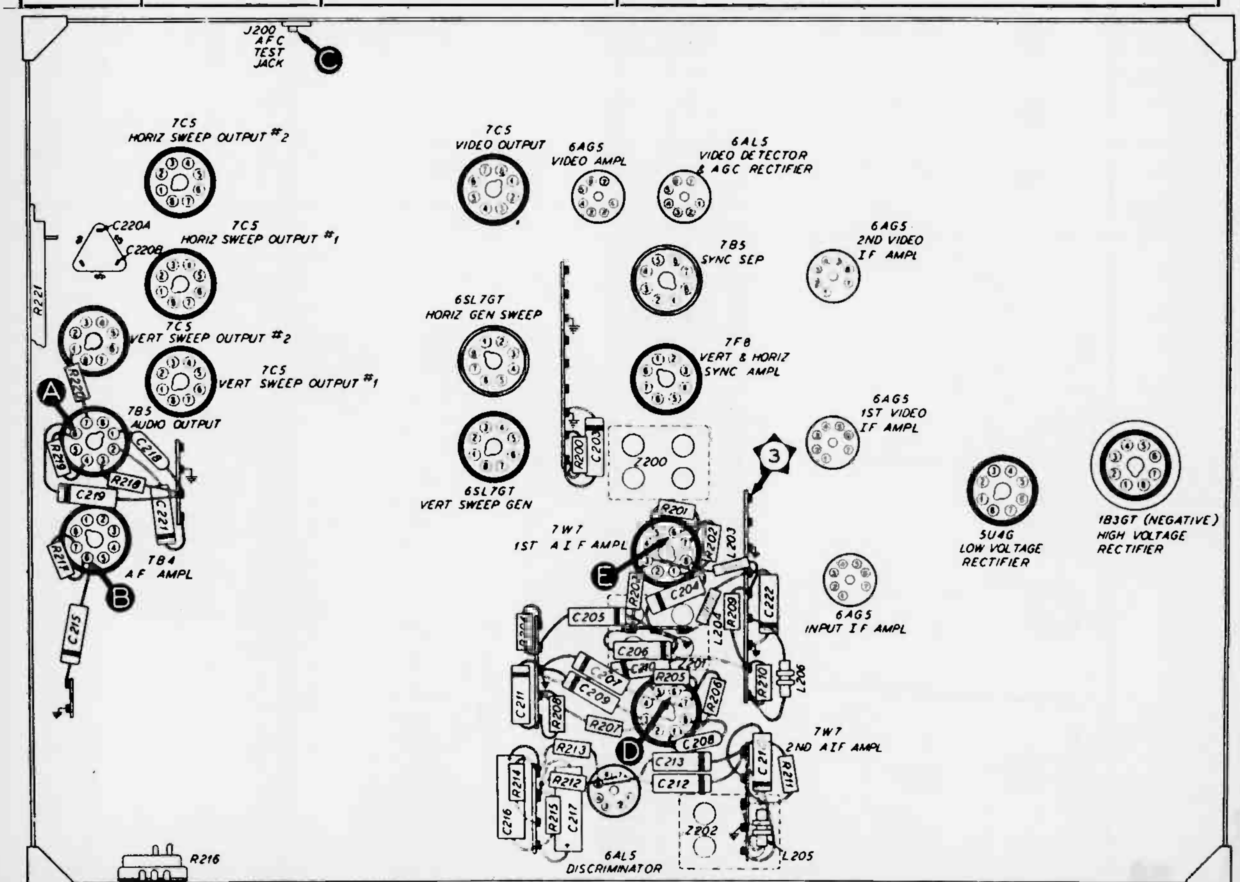


FIGURE 21. BOTTOM VIEW OF CHASSIS, SHOWING SECTION 2 TEST POINTS.

TROUBLE SHOOTING SECTION 2 — AUDIO CIRCUITS (Cont.)

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
2 See note 2.	A	Loud, clear audio signal.	Defective: LS200, T200, C221, 7B5. Open: C220A, R220, R221. Shorted or leaky: C220B.
3 See note 2.	B	Loud, clear audio signal, louder than in step 2.	Open: C219, R219, R218, R217. Defective: 7B4. Shorted or leaky: C218.
4 See note 2.	C	Clear audio signal, weaker than in step 3.	Shorted: C212, C213, C216, C217. Open: C214, C215. Defective: R216.
5 See note 1.	D	Loud, clear audio signal, louder than in step 4.	Defective: 6AL5 (discriminator), 7W7 (2nd a.i.f.), Z202. Open: L205, R208, R207, R205, R206, R211, R212, C209, C207. Shorted: C211, C209.
6 See note 1.	E	Loud, clear audio signal, louder than in step 5.	Defective: 7W7 (1st a.i.f), Z201. Open: R201, R202, R204, R203, C204, C205, L203. Shorted: C205, C204.
7 See note 1.	3	Loud, clear audio signal.	Defective: Z200. Open: R200. Shorted: C203. Misalignment: See alignment chart, page 27. Trouble in Section 3.

TROUBLE SHOOTING SECTION 3 — VIDEO CIRCUITS

Set CONTRAST control fully clockwise. Set BACKGROUND control so that raster is faintly visible on picture tube. If raster cannot be obtained, proceed to Section 5, and test for horizontal and vertical-sweep action; after correcting the trouble, return to this section.

NOTE 1: For steps 1, 5, 6, 7, 8, and 9, connect an AM signal generator, set at 26.6 mc. and modulated at 400 cycles, between test point and ground; use a .1-mf. condenser in series with the signal lead.

NOTE 2: For steps 2, 3, and 4, connect an audio signal generator, set at 400 cycles, between test point and ground; use a .1-mf. condenser in series with the signal lead.

If the "NORMAL INDICATION" is obtained in step 1, proceed with the tests for Section 4 (r-f circuits); if not, isolate and correct the trouble in this section.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1 See note 1.	4	Strong, alternate white and black bars on picture tube, with weak signal-generator output.	Trouble in this section; proceed with step 2.
2 See note 2.	A	Alternate white and black bars, with strong signal-generator output.	Defective: 7GP4 (picture tube). Open: C322, L310, L314. Shorted: C322.
3 See note 2.	B	Same as step 2, except stronger bars, with less signal-generator output than in step 2.	Defective: 7C5. Open: R329, R330, R325, R326, R327, R328. Shorted: C320C, C320D.
4 See note 2.	C	Same as step 2, except stronger bars, with less signal-generator output than in step 3.	Defective: 6AG5 (video amplifier). Open: R319, R324, L307, R320, R321, R322, C321. Shorted: C320A, C320B.
5 See note 1.	D	Same as step 2, with strong signal-generator output.	Defective: 6AL5 (video detector). Open: L308, C318, R318, L307.
6 See note 1.	E	Same as step 2, with less signal-generator output than in step 5.	Defective: 6AG5 (2nd video i.f.), Z303. Open: R313, R314, L306, R312. Shorted: C315, C313, C314.
7 See note 1.	F	Same as step 2, with less signal-generator output than in step 6.	Defective: 6AG5 (1st video i.f.), Z302. Open: R310, R311, L305, R309. Shorted: C309, C311, C310.

TROUBLE SHOOTING SECTION 3 — VIDEO CIRCUITS (Cont.)

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
8 See note 1.	G	Same as step 2, with less signal-generator output than in step 7.	Defective: 6AG5 (input i.f.), Z301. Open: R200*, R307, R306, L304. Shorted: C306, C307, C203*.
9 See note 1.	4	Same as step 1.	Defective: Z300.

* This part, located in another section, may cause abnormal indication in this section.

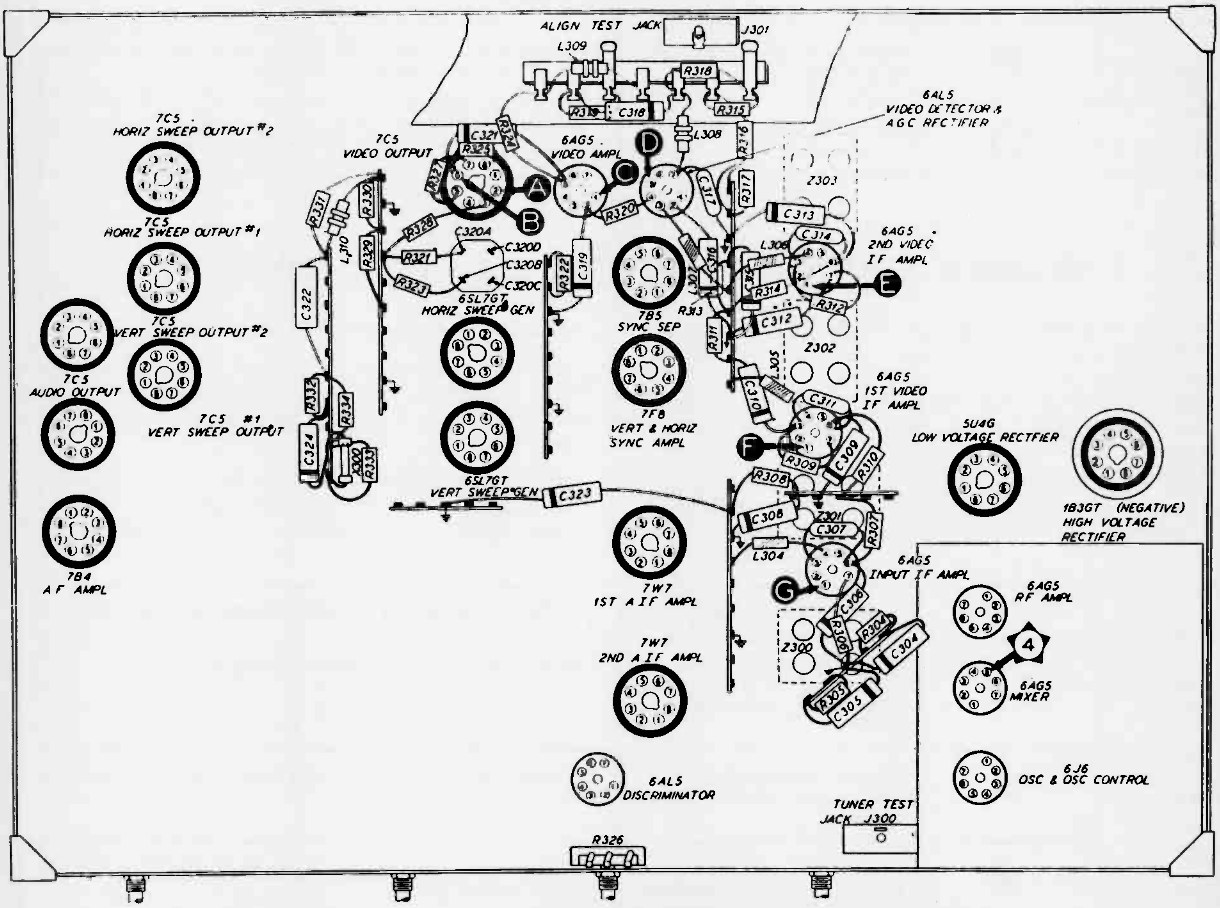


FIGURE 22. BOTTOM VIEW OF CHASSIS, SHOWING SECTION 3 TEST POINTS.

TROUBLE SHOOTING SECTION 4 — R-F CIRCUITS

Set channel selector to desired channel (make certain that proper coils are inserted in channel selector), and turn VOLUME control fully clockwise.

For all steps, except step 2, connect an AM signal generator, set to audio-carrier frequency of desired channel (see page 9 for frequency chart), between test point and ground; use a .1-mf. condenser in series with the signal lead. For steps 1 and 5, loose coupling should be used.

NOTE: For step 2, connect a voltmeter (VTVM, or 20,000-ohms-per-volt voltmeter), with a 1000-ohm isolating resistor in series with the prod end of the negative lead, across test point A (pins 6 and 7 of oscillator tube).

If the "NORMAL INDICATION" is obtained in step 1, proceed with the tests for Section 5 (sweep circuits); if not, isolate and correct the trouble in this section.

TROUBLE SHOOTING SECTION 4 — R-F CIRCUITS (Cont.)

STEP	TEST POINT	NORMAL INDICATION	ABNORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	5	Loud, clear audio signal.	Weak or no signal.	Trouble in this section; proceed with step 2.
2 See note above.	A	2.5 volts negative.	Low or no voltage.	Defective: 6J6 (oscillator), Z400. Open: L402, R405, R401, C404. Shorted: C404, C403, C402.
3	B	Loud, clear audio signal.	Weak or no signal.	Oscillator off frequency. Defective: 6AG5 (input i.f.), 6AG5 (mixer), Z300*. Open: R304*, R408, R409. Shorted: C304*, C420, C421, C411, C419.
4	C	Loud, clear audio signal.	Weak or no signal.	Defective: 6AG5 (r-f amplifier), Z400. Open: R406, C413, R411, R412. Shorted: C417, C418.
5	5	Loud, clear audio signal.	Weak or no signal.	Defective: Z401.

* This part, located in another section, may cause abnormal indication in this section.

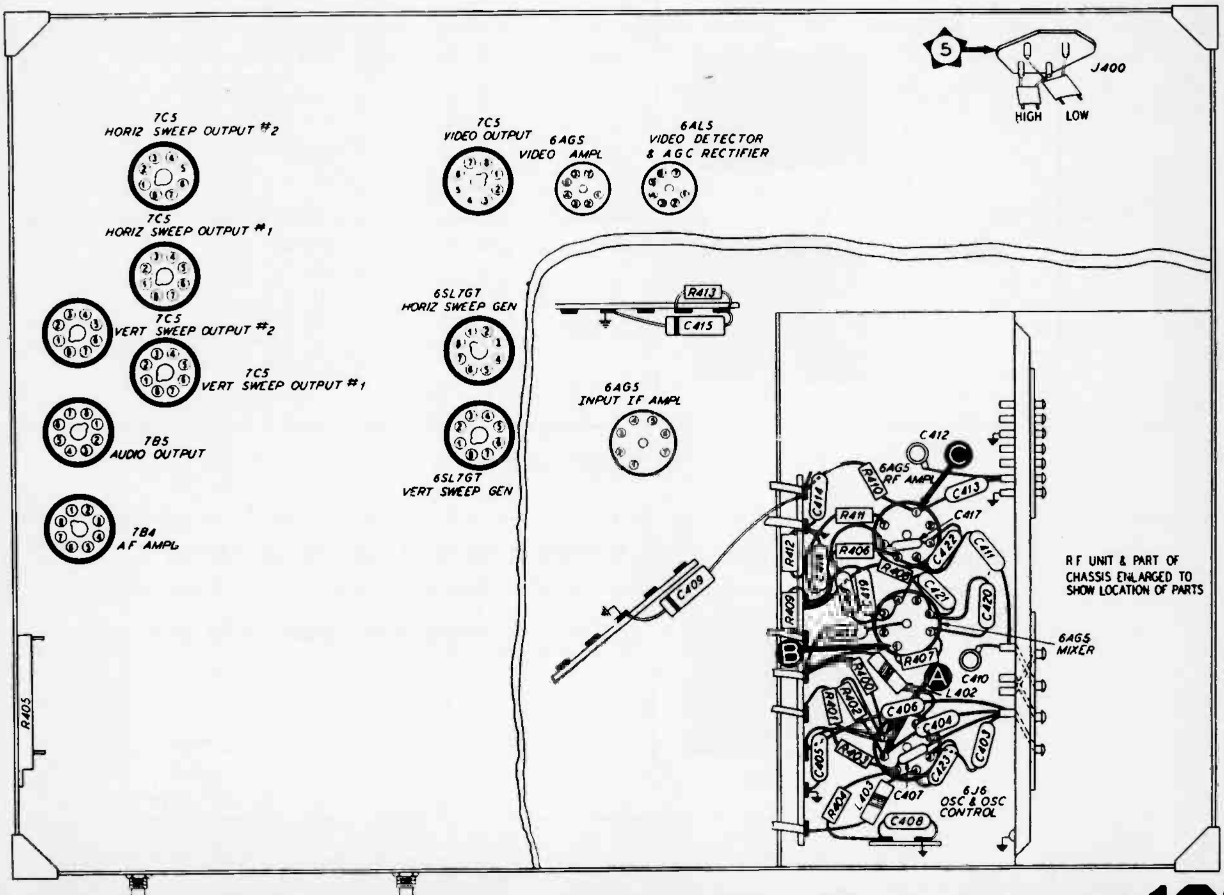


FIGURE 23. BOTTOM VIEW OF CHASSIS, SHOWING SECTION 4 TEST POINTS.

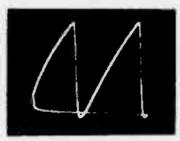
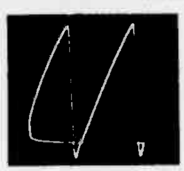
MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

TROUBLE SHOOTING SECTION 5 — SWEEP CIRCUITS

For all steps, connect the vertical-plate leads of an oscilloscope between the test point and the Receiver chassis. For the waveforms taken at the vertical-sweep and vertical-sync circuits, the oscilloscope must be synchronized at approximately 30 c.p.s. (half the vertical-sweep rate), and for the waveforms taken at the horizontal-sweep and horizontal-sync circuits, the oscilloscope must be synchronized at approximately 7875 c.p.s. (half the horizontal-sweep rate). These tests must be made with a standard RMA television signal applied to the Receiver input. The test-chart signal from a television station may be used. The voltage values indicated under each waveform in the "NORMAL INDICATION" column are peak-to-peak values.

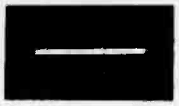
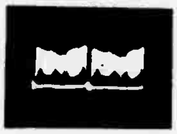
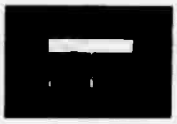
If the "NORMAL INDICATION" is not obtained in steps, 1, 7, 12, and 16, follow the steps, or sections, specified for testing the circuits in which abnormal operation is indicated.

VERTICAL-SWEEP CIRCUITS

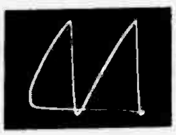
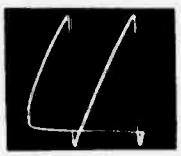
STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
1	6	 230 volts	Trouble in vertical-sweep circuits; proceed with step 2.	
2	A	 220 volts	Defective: 6SL7GT (vertical-sweep generator), T500. Open: R507, R510, R511, R517, R518, C505, C503B, C506. Shorted: C505, C503B, C506, C504.	
3	B	 35 volts	Open: R512, R513, R514, R515, C508. Shorted: C508.	
4	C	 38 volts	Open: C508, C509, R516. Shorted: C508, C509.	

VERTICAL-SYNC CIRCUITS

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
5	D	 280 volts	Defective: 6C5 (vertical-sweep output). Open: R519, R521. Shorted: C512, C510.	
6	6	Same as step 1.	Defective: 6C5 (vertical-sweep output). Open: C510, C511, R522, R520. Shorted: C511, C510.	See figure 25.

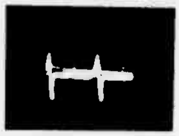
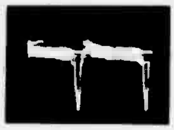
7 Remove vertical-sweep generator tube.	7	 22 volts	Trouble in vertical-sync circuits; proceed with step 8	
8	E	 20 volts	Defective: 6AG5* (video amplifier) or other trouble in Section 3. Open: C500, R500, R501. Shorted: C500.	
9	F	 4 volts	Defective: 7B5 (sync separator). Open: R502, R503, R504, R505. Shorted: C501.	
10	G	 3 volts	Open: C502, R506. Shorted: C502.	
11	7	Same as step 7.	Defective: 7F8 (vertical-sync amplifier). Open: C504, R507, R508, R509. Shorted: C503A, C504.	After step 11, replace vertical-sweep-generator tube.

HORIZONTAL-SWEEP CIRCUITS

12	8	 250 volts	Trouble in horizontal-sweep circuits; proceed with step 13.	
13	H	 60 volts	Defective: 6SL7GT (horizontal-sweep generator), T501. Open: R530, R531, R532, R533, R534, R535, R536, R537, R538, C516, C519, C520, L500. Shorted: C516, C517, C518, C503C, C519, C520, C521.	See figures 26, 27, 28, and 29.
14	J	 200 volts	Defective: 7C5 (horizontal-sweep output). Open: R539, R540, R541, R543, R544, L501. Shorted: C522, C523.	
15	8	Same as step 12.	Defective: 7C5 (horizontal-sweep output). Open: R542, R548, R545, R549, C522. Shorted: C522.	See figure 30.

TROUBLE SHOOTING SECTION 5 — SWEEP CIRCUITS (Cont.)

HORIZONTAL-SYNC CIRCUITS

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
16 Remove horizontal-sweep-generator tube.	9	 5 volts	Trouble in horizontal-sweep circuits; proceed with step 17.	
17	K	 3 volts	Open: C513. R527. Shorted: C513.	See steps 8 and 9.
18	9	Same as step 16.	Defective: 7F8 (horizontal-sync amplifier). Open: R528. R529. R530. C515. Shorted: C514. C515.	After step 18, replace horizontal-sweep-generator tube.

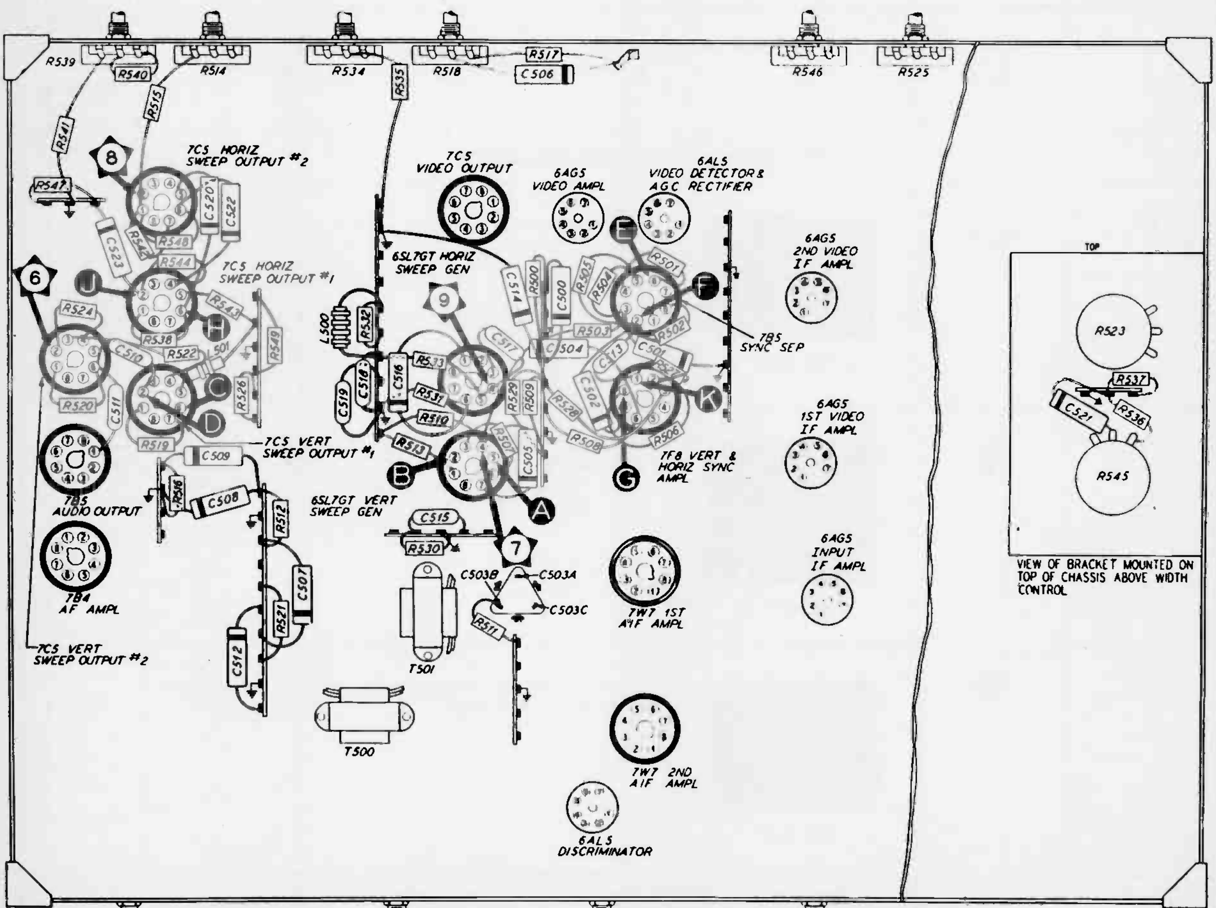


FIGURE 24. BOTTOM VIEW OF CHASSIS, SHOWING SECTION 5 TEST POINTS.

SUPPLEMENTARY WAVEFORMS

The following waveforms supplement the trouble-shooting procedure for Section 5. The oscilloscope was synchronized at half the vertical-sweep rate for vertical waveforms, and at half the horizontal-sweep rate for horizontal waveforms. The station was transmitting a standard test chart. Note that the picture-waveform content will appear different if other than the test chart is being transmitted; however, the blanking and synchronizing pulses will be unchanged.

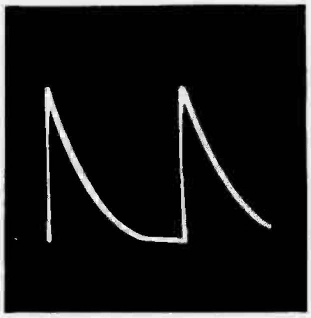


Figure 25. Waveform at Grid (Pin 6) of Vertical-Sweep Output No. 2.

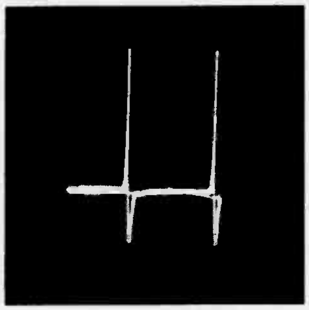


Figure 26. Waveform at Grid (Pin 4) of Horizontal-Sweep Generator.

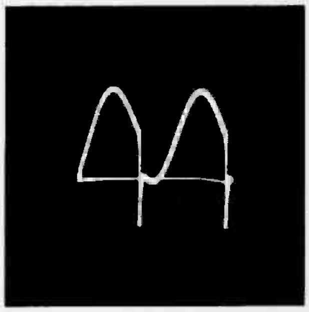


Figure 27. Waveform at Plate (Pin 5) of Horizontal-Sweep Generator.

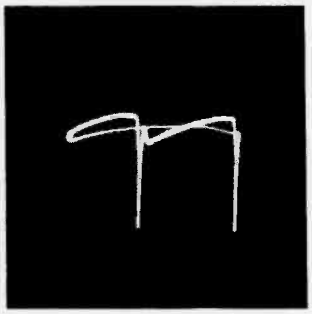


Figure 28. Waveform (Taken Through a 50-mmf. Condenser) at Plate (Pin 2) of Horizontal-Sweep Generator.

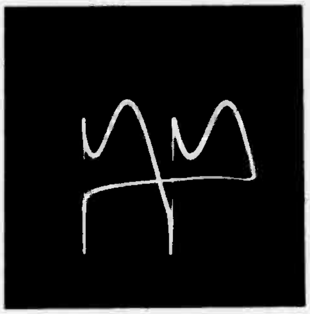


Figure 29. Waveform at Cathode (Pin 3) of Horizontal-Sweep Generator.

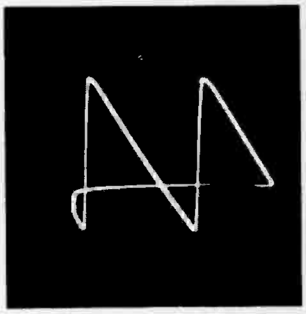


Figure 30. Waveform at Grid (Pin 6) of Horizontal-Sweep Output No. 2.

ALIGNMENT

The intermediate frequencies of the Receiver are 22.1 megacycles for the audio channel and 26.6 megacycles for the video channel. The alignment of circuits operating at these high frequencies requires accurately calibrated equipment and extreme care in making the adjustments.

The top of the work bench should be metallic, or a separate metal plate should be placed on the bench; the Receiver chassis and signal-generator case must make good metal-to-metal contact with the bench top or plate, which should be securely grounded.

All leads from the signal generator must be shielded. The unshielded length of signal lead must be kept very short and the shield must be clipped to the Receiver chassis at a point close to the signal-lead connection. The signal-generator output lead should be terminated with a shunt resistance equal to its characteristic impedance.

The signal-generator output must be kept low enough to prevent overloading the Receiver circuits. Limiting action produced by overloading circuits causes incorrect response curves.

Test Equipment Required

The following equipment is necessary to properly align and adjust the Receiver:

FM SIGNAL GENERATOR

Deviation, ±4 mc.; center-frequency ranges, 20 mc. to 30 mc.; sweep-sync output with either built-in or separate phase corrector.

AM SIGNAL GENERATOR

Carrier-frequency ranges, 20 mc. to 30 mc. (accurately calibrated); accurate output indicator (either calibrated attenuator or separate output meter); known modulation percentage (variable up to 100% is preferred).

VOLTMETER

VTVM or 20,000-ohms-per-volt voltmeter, with ranges of 0—1, 0—10, and 0—600 volts, a.c. and d.c.

OSCILLOSCOPE

Calibrated; vertical sensitivity of 1 volt (peak-to-peak) per inch, or better.

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

All adjustments should be made with low-loss, non-metallic alignment tools.

Never disconnect the picture tube or loud-speaker while the Receiver is turned on.

NOTE: Before starting the alignment, allow the Receiver and signal generators to warm up for at least 20 minutes.

Special test equipment for television-receiver alignment will be available in the near future. Such equipment may combine several of the test instruments listed below. The information given for each instrument is generalized, so that the serviceman can determine whether his present equipment is adequate.

ALIGNMENT CHART

VIDEO I-F

STEP	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUST
1	Connect oscilloscope vertical input to align test jack. Connect horizontal input to sweep output of FM generator. See note 1	Connect FM and AM generators to grid (pin 1) of 2nd video-i-f amplifier. See note 2.	Set FM generator to 25 mc., deviation ±4 mc. Set AM generator (unmodulated) to 27.1 mc., to produce marker "pip" on response curve.	Set C303B fully counterclockwise. Adjust L303A and L303B for single peak at 27.1 mc. (indicated by position of marker "pip").
2	Same as step 1.	Same as step 1.	FM generator, same as step 1. AM generator, (unmodulated) to 23.1 mc., to produce marker "pip" on response curve.	Adjust C303B clockwise until low-frequency peak of response curve is at 23.1 mc.; curve should resemble curve 1 in figure 36. It may be necessary to readjust L303A or L303B slightly, to equalize amplitude of peaks.
3	Same as step 1.	Disconnect FM generator. Connect AM generator to grid (pin 1) of 1st video-i-f amplifier.	28.1 mc. (modulated).	Adjust L302B for minimum signal.
4	Same as step 1.	Connect FM and AM generators to grid (pin 1) of 1st video-i-f amplifier. See note 2.	FM generator, same as step 6. Set AM generator (unmodulated) to 23.75 mc. and 26.6 mc., as required, to produce marker "pips" on response curve.	Adjust L302A for low-frequency peak, and L302C for high-frequency peak, to obtain response curve similar to curve 2 in figure 36.
5	Same as step 1.	Disconnect FM generator. Connect AM generator to grid (pin 1) of input-i-f amplifier.	22.1 mc. (modulated).	Adjust L301B for minimum signal.
6	Same as step 1.	Connect FM and AM generator to grid (pin 1) of input-i-f amplifier. See note 2.	Set FM generator to 25 mc., deviation ±4 mc. Set AM generator (unmodulated) to 22.75 mc., 24.25 mc., 25.75 mc., and 27.0 mc., as required, to produce marker "pips" on response curve.	Adjust L301A and L301C for response curve similar to curve 3 in figure 35.
7	Same as step 1.	Connect FM and AM generator to grid (pin 1) of mixer. See notes 2 and 3.	FM generator, same as step 6. Set AM generator (unmodulated) to 22.6 mc., 23.75 mc., 24.6 mc., and 26.6 mc., as required, to produce marker "pips" on response curve.	Adjust L300A, C300B, and L300B for over-all response curve similar to curve 4 in figure 35. (C300B controls band width). If curve is not satisfactory, see note 4.
		AUDIO I-F		
8	Connect oscilloscope vertical input to a-f-c test jack. See note 1. Connect horizontal input to sweep output of FM generator.	Connect FM and AM generators to grid (pin 6) of 2nd audio-i-f amplifier. See note 2.	Set FM generator to 22.1 mc., deviation ±3 mc. Set AM generator (unmodulated) to produce marker "pips" on discriminator curve at each of the three following points, in turn: 1. crossover point 2. negative peak 3. positive peak	No adjustments for this step. Observe the frequency setting of the AM generator required to produce "pips" at each of the 3 points. The following frequencies should be indicated: 1. crossover point—22.1 mc. 2. negative peak—21.8 mc. 3. positive peak—22.4 mc. Discriminator curve is shown in figure 37.
9	Same as step 8.	Same as step 8.	FM generator, same as step 8. Set AM generator (unmodulated) to produce marker "pip" at crossover point on discriminator curve.	Adjust L202B until crossover point occurs at frequency setting of 22.1 mc. See note 5.

ALIGNMENT CHART — Continued

AUDIO I-F

STEP	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUST
10	Same as step 8.	Same as step 8.	FM generator, same as step 8. Set AM generator (unmodulated) first to 21.8 mc., then to 22.4 mc. as adjustments are made, to produce marker "pips" on discriminator curve.	Adjust L202A and C202C until marker "pips" occur at negative and positive peaks of discriminator curve (thus making the two peaks 600 kc. apart). See note 5.
11	Same as step 8.	Connect FM generator to grid (pin 6) of 1st audio-i-f amplifier.	22.1 mc., deviation ±3 mc. Adjust output for same amplitude obtained in step 10.	Adjust L201A for maximum amplitude, while keeping amplitude of peaks equal.
12	Same as step 8.	Connect FM generator to grid (pin 1) of input-i-f amplifier.	Same as step 11.	Adjust L200A for maximum amplitude.
13	Same as step 8.	Connect FM and AM generators to grid (pin 1) of mixer. (See notes 2 and 3.)	Set FM generator to 25 mc., deviation ±4 mc. Set AM generator (unmodulated) to 22.4 mc., 22.1 mc., and 21.8 mc., as required, to produce marker "pips" on discriminator output curve.	If necessary, adjust L200A and L201A slightly to equalize amplitude of negative and positive peaks of discriminator output curve.
	FINAL I-F CHECK NOTE: The procedure given in the following step is performed to make certain that the accompanying-sound trap and the discriminator are tuned to the same frequency.			
14	Connect oscilloscope vertical input to align test jack. Connect VTVM or 20,000-ohms-per-volt meter to a-f-c test jack.	FM generator not used. Connect AM generator to grid (pin 1) of input i-f amplifier.	22.1 mc. Set generator (unmodulated) for minimum signal on oscilloscope.	D-c output of discriminator should be zero; if not, readjust L202B. See note 6.

NOTE 1: Connect the "hot" lead of the oscilloscope vertical input through a 10,000-ohm isolating resistor, to prevent radiation from the lead.

NOTE 2: Connect the signal lead of the AM generator through a small isolating condenser, approximately 10 mmf.

NOTE 3: Grounding of the signal lead shield is critical at this point. Try adding additional grounding, while observing the output curve, until no change in curve results from added grounds.

NOTE 4: If necessary, readjust L301A, L302C, L301C, and L302A *slightly*, to obtain best possible reproduction of curve 1. IMPORTANT: DO NOT DISTURB L303A, L303B, C303B, L302B, or L301B.

NOTE 5: When making this adjustment, it is possible to apparently obtain the proper curve, and yet have the discriminator output (a-f-c) voltage so phased as to shift the oscillator frequency away from the correct frequency, thus preventing the oscillator from locking in. To avoid this difficulty, check the phasing by observing the polarity of the discriminator output voltage; negative output voltage is produced when the audio-i.f. is lower than the center frequency. If this condition does not exist, turn L202A further in (clockwise) until the required polarity is obtained.

NOTE 6: If this adjustment requires more than 1/2 turn of L202B, the discriminator output curve should be rechecked (see step 8). If necessary, readjust C202C *slightly*, to obtain equal peaks on the response curve.

ALL VOLTAGES TAKEN WITH NO SIGNAL INPUT

NOTE - SECTION 1
HIGH VOLTAGE MEASUREMENTS TAKEN WITH ALL SECTION 1 CONTROLS IN COUNTERCLOCKWISE DIRECTION

NOTE - SECTION 5
VOLTAGES TAKEN WITH ALL SECTION 5 CONTROLS CLOCKWISE

NOTE - ALL DC VOLTAGES MEASURED FROM POINTS SPECIFIED TO GROUND WITH 20,000 OHMS-PER-VOLT METER, WITH AN INPUT OF 117 VOLTS, 60 CYCLES, AC

† VOLTAGES TAKEN WITH 100,000 OHM RESISTOR IN SERIES WITH METER LEAD

** IN LATER PRODUCTION THE LOCATION OF C512 AND R526 IS CHANGED AND THIS PORTION OF THE VERTICAL SWEEP OUTPUT CIRCUIT IS REWIRED AS SHOWN BY THE DOTTED LINES. VOLTAGE READINGS OF THE LATER PRODUCTION ARE ALSO INDICATED BY **

— RF, IF, AND AUDIO SIGNAL PATH
◆ OSCILLATOR SIGNAL PATH
INDICATES SOCKET OR PLUG CONNECTION

ALL RESISTOR VALUES IN OHMS UNLESS MARKED OTHERWISE

CONDENSER SYMBOLS

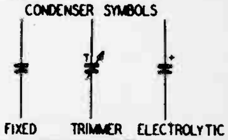


FIGURE 32. LEGEND FOR SCHEMATIC DIAGRAM.

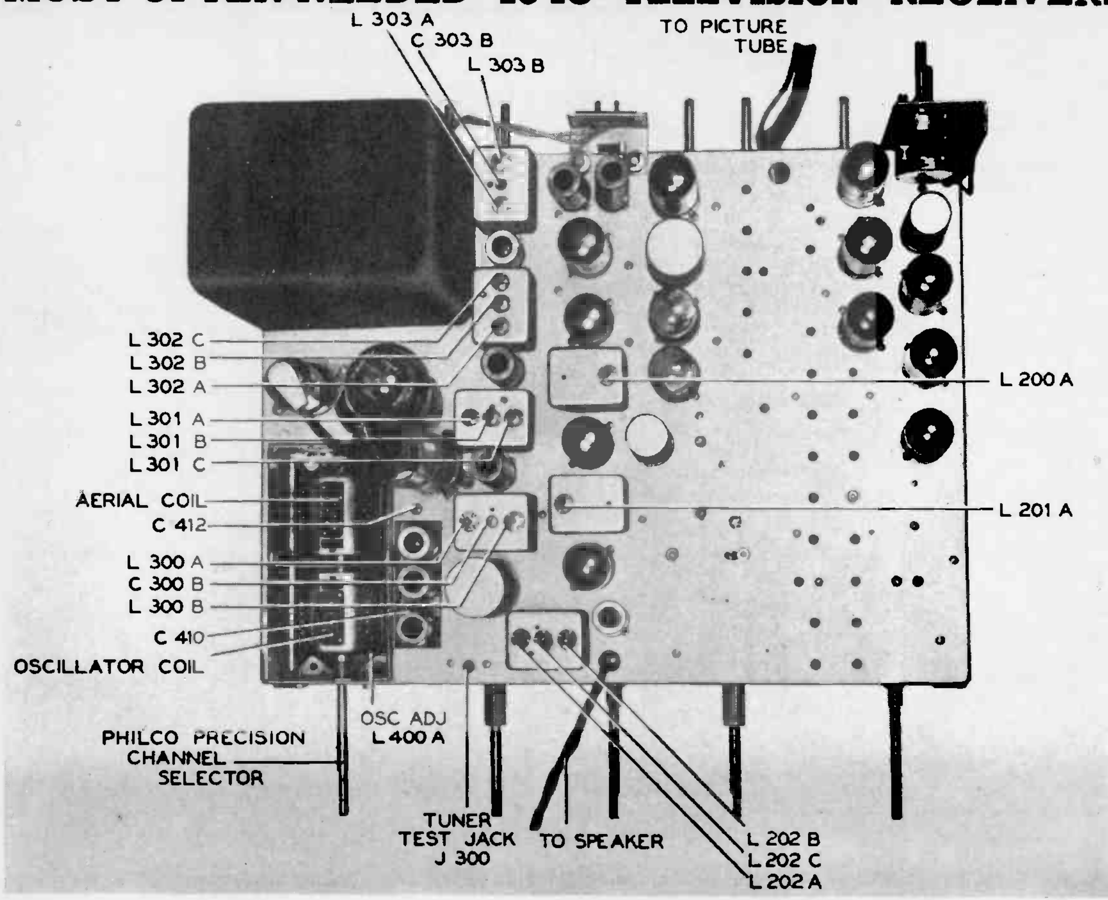


FIGURE 34. LOCATION OF ADJUSTMENTS FOR ALIGNMENT OF RECEIVER.

Video-Amplifier-Gain Check

The video-amplifier stages should have a gain of 35 to 40. To check the gain, connect the AM signal generator to the aerial receptacle J400, and set the frequency to any picture-carrier channel for which coils are provided. Adjust the signal generator for 100% modulation, if possible. Connect the calibrated oscilloscope to the align test jack J301 (video-detector output), and note the peak-to-peak voltage. Set the CONTRAST control fully clockwise. Connect the calibrated oscilloscope through a .01-mf. condenser to the plate (pir 2) of the video output tube, and note the peak-to-peak voltage. The gain of the video stages will be the output voltage (plate of the video output tube) divided by the detector voltage. This should be about 35 to 40.

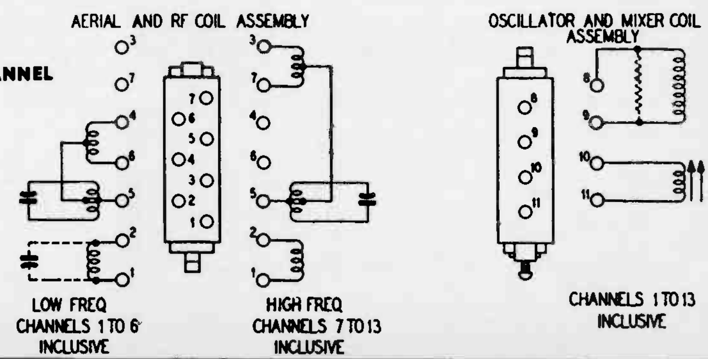
If the video-amplifier gain is low, try new video-amplifier and video-output tubes; if the gain is still low, check for trouble in Section 3.

D-C Restoration Check

A general check of d-c restoration may be made as follows: With the Receiver turned on and a picture appearing on the picture tube, disconnect the aerial. If the d-c restorer is operating properly, the raster will disappear when the aerial is disconnected; if not, the raster will remain visible.

To make a more accurate check of the d-c restorer, proceed as follows: Turn off the Receiver, disconnect the picture tube, remove the high-voltage rectifier, and discharge the high-voltage circuit. Turn the CONTRAST control fully clockwise. With a normal video-signal input (approximately 2 volts peak-to-peak at the video-detector output), measure the voltage developed across the d-c restorer (1N34 crystal). This voltage, measured with a 20,000-ohm-per-volt meter, should be 15 to 25 volts.

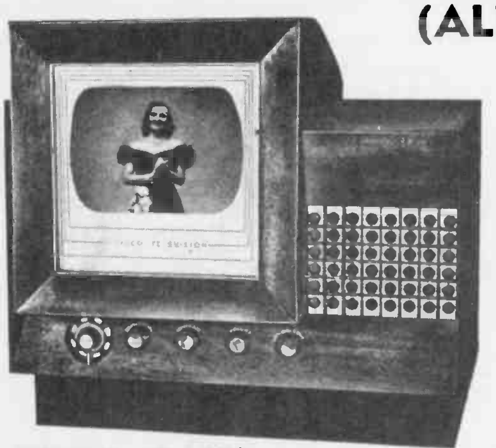
FIGURE 31. LOW AND HIGH-FREQUENCY-CHANNEL COIL CONNECTIONS.



MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

PHILCO TELEVISION RECEIVERS

MODELS 48-1000, 48-1000-5, 48-1050 AND 48-1050-5 (ALL CODE 122)



MODELS 48-1000

AND 48-1000-5

Models 48-1000 and 48-1000-5 are table models. Models 48-1050 and 48-1050-5 are console models. These twenty-seven tube, ten-inch, direct-view Television Receivers are designed to provide reception of television broadcasts on Channels 1 through 13. Except for the cabinets, and those components which differ for 50-cycle operation (in Models 48-1000-5 and 48-1050-5) these Receivers are essentially identical.

Model 48-1001 is similar to Model 48-1000, Code 122, Run 9, except for the cabinet.

CIRCUIT DESCRIPTION

The schematic diagram, figure 32, is divided into five major sections. The block diagram, figure 18, shows this division and the interrelation of the sections. For circuit analysis, the sections will be considered in the following order: the Radio-Frequency Section, the Video Section, the Audio Section, the Sweep Section, and the Power-Supply Section.

The Radio-Frequency Section

Television reception, in the very-high-frequency range from 44 to 216 megacycles, requires special design techniques. The Philco Precision Channel Selector is designed to provide the short leads and the low switch-contact resistance and capacitance which are necessary to obtain high sensitivity at these frequencies. To insure maximum sensitivity and selectivity, and at the same time to maintain the necessary six-megacycle band-pass, separate aerial, r-f-amplifier, oscillator, and mixer coils are used for each channel. These coils are built on "snap-in" assemblies; two assemblies, of two coils each, comprise a set of coils for any one channel. One coil assembly contains the aerial and r-f-amplifier windings, while the other assembly contains the oscillator and mixer windings. The proper sets of coils, for the channels in use in the area where the Receiver is to be operated, are installed in the Philco Precision Chan-

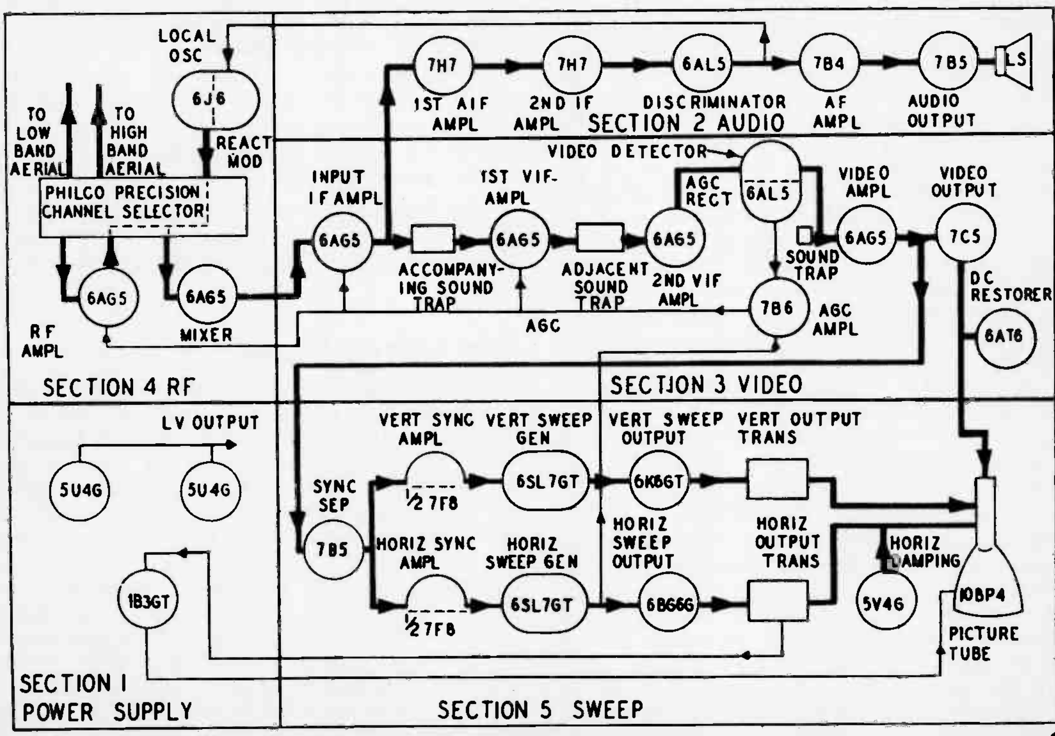


FIGURE 18. BLOCK DIAGRAM

nel Selector. This system of channel selection has the further advantage of providing for the use of separate high-band and low-band aerials in those areas where the characteristics of the usable signals are such as to require this type of installation. Special installations, using as many as four aerials, are also possible. Information on such installations are included in the instructions furnished with each Philco Television Aerial Kit.

Turning the Philco Precision Channel Selector knob to the desired channel connects the correct aerial, aerial coil, r-f amplifier coil, oscillator coil, and mixer coil into the circuits. The signal from the aerial is amplified and applied to the grid of the mixer, along with the signal from the local oscillator. The output of the mixer contains both the audio and the video intermediate-frequency signals.

The local oscillator, a modified Colpitts, is designed to obtain maximum frequency stability. In addition, automatic frequency control is provided; a reactance modulator electronically controls the oscillator frequency, compensating automatically, and instantly, for any drift of the oscillator frequency or incoming-signal frequency. This compensation is controlled by a d-c signal derived from the audio discriminator, where deviation of the audio i-f center frequency develops a positive or negative voltage. This voltage, applied to the grid of the modulator, swings the oscillator frequency either higher or lower, to re-establish the correct intermediate frequency. The output of the discriminator is zero volts when the center frequency is correct.

The Video Section

The audio i-f, video i-f, and adjacent-audio i-f signals are all present in the output of the mixer. These intermediate-frequency signals are transferred through impedance-coupler Z300 to the input i-f amplifier. All signals between 28.1 and 22.1 megacycles are amplified and passed on to impedance-coupler Z301. The audio i-f signal is transferred to the audio i-f amplifier through the plate circuit of the input i-f amplifier. The accompanying-sound trap No. 1 (adjusted by L301B) presents a high impedance to the audio i-f signal, so that little or no audio i-f signal is passed on to the first video i-f amplifier. The video i-f (and adjacent-audio i-f) signals are amplified in the first video i-f amplifier. The adjacent-audio i-f signal is rejected by the adjacent-sound trap (adjusted by L302B) in impedance-coupler Z302, leaving only the video i-f signal, which is further amplified by the second video i-f amplifier. This signal is applied, through impedance-coupler Z303, to the 6AL5 video detector and a-g-c rectifier; in the video detector section, the negative portion of the modulation is rectified, and becomes the video signal. The biasing arrangement on the a-g-c rectifier section permits only the sync tips of the positive modulation to be rectified, thereby yielding a voltage which is proportional to the strength of the incoming signal, and unaffected by the video variations. This voltage is applied to the grid of the triode section of the 7B6 a-g-c amplifier, governing the amplifying action of the tube. A small amount of the sweep voltage from the horizontal-sweep generator is also applied to the grid of the 7B6, and the amplified signal appears in the plate circuit. This signal is applied, through condenser C322, to the diode plates of the 7B6, providing a d-c voltage, of negative polarity, which is proportional to the amplitude of the received signal. This a-g-c voltage is used to control the gain of the r-f amplifier, the input i-f amplifier, and the first video i-f amplifier, thus serving to maintain constant video and audio output levels.

A second accompanying-sound trap (sound trap No. 2) is incorporated in the output circuit of the video detector, to remove any small percentage of audio i-f signal which may have passed the first trap.

The video signal is amplified in the video amplifier and applied to the 7C5 video output tube, where it receives its final amplification.

The 4.5-mc. trap, in the plate circuit of the video amplifier, removes the signal induced by the beating of the video and audio i-f signals, which have a frequency difference of exactly 4.5 mc.

D-c restoration is accomplished by the 6AT6 tube, which conducts during the synchronizing pulses, producing a positive d-c voltage at the grid of the picture tube; this voltage is proportional to the composite signal amplitude. The picture-tube brightness, therefore, will vary only from scene to scene, and not from frame to frame, in the received picture.

The complex signal path in the video output circuit contains frequency-compensating networks, to insure an essentially flat response from 30 c.p.s. to 4.0 megacycles, approximately. Excellent definition in the picture is thereby insured.

The Audio Section

The Audio Section contains two stages of audio-i-f amplification, broadly tuned to pass a 22.1 ± 250-kc. signal. This pass band provides for excellent frequency-modulated sound. The discriminator is an improved ratio-type detector, the output of which is applied through the volume control to the audio amplifier. The amplified signal drives the 7B5 audio output tube, which works into a permanent-magnet speaker.

The bass-compensating network is connected to the tap on the volume control. The tone control permits attenuation of the treble tones.

The discriminator also develops the control signal for the local-oscillator frequency-control circuit, as described in the discussion of the Radio-Frequency Section.

The Sweep Section

A video signal, taken from the screen grid of the video amplifier, is fed to the control grid of the 7B5 sync separator. This tube is grid-leak biased so that only the sync-signal portion of the signal is amplified. In addition, the circuit components are so chosen that the sync signals are limited, or clipped, producing uniform output signals over a wide range of variation in the input signal. See figure 19. This actions helps to make the control of the sweep voltages more positive. The output of the sync separator is applied to the vertical-sync amplifier through a long-time-constant circuit, which responds only to the "wide" vertical-sync signals. The horizontal-sync pulses are passed to the horizontal-sync amplifier by a short-time-constant circuit. The outputs of the sync amplifiers control their respective blocking oscillators, which, in turn, initiate the

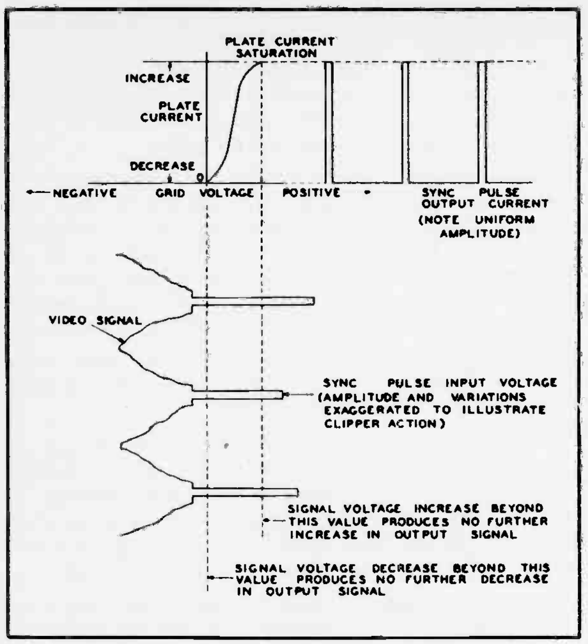


FIGURE 19. SYNC-SEPARATOR ACTION

horizontal and vertical sweep voltages. These voltages are amplified, and are transferred, by transformer coupling, to the picture-tube deflection coils.

The horizontal sweep, being much faster than the vertical sweep, requires circuit refinements not needed for the vertical sweep. The plate circuit of the horizontal-sweep oscillator tube contains a shock excited, or "ringing", tank consisting of L503 and C516. The positive sync pulse at the first grid (pin 1) triggers the blocking oscillator. During the positive swing of the grid, the plate current of the first section of the tube increases rapidly. When the grid voltage falls sharply to its maximum negative peak (see figure 33),

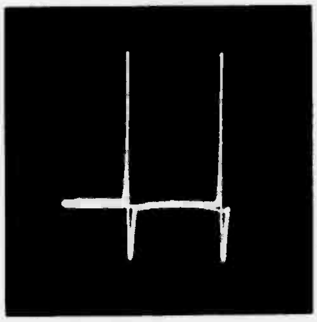


FIGURE 33. WAVEFORM AT GRID (PIN 1) OF 6SL7GT HORIZONTAL-SWEEP OSCILLATOR

due to the feedback developed in the transformer, the plate current is abruptly cut off. The sudden stopping of plate-current flow produces an oscillating voltage at the resonant frequency of the tank (approximately 15,000 c.p.s.). This sine-wave voltage is combined, at the second cathode (pin 6) of the sweep oscillator, with the negative pulse from the first plate (pin 2). See figure 36. The frequency of this resonant circuit, in conjunction with the oscillator-circuit time constant, as determined by the HORIZ. HOLD CONTROL,

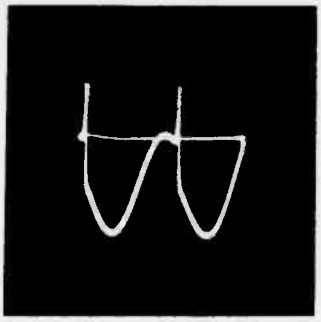


FIGURE 34. WAVEFORM AT PLATE (PIN 2) OF 6SL7GT HORIZONTAL-SWEEP OSCILLATOR

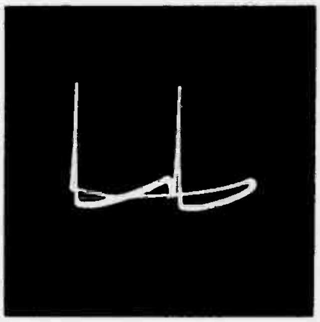


FIGURE 35. WAVEFORM (TAKEN THROUGH 50-MMF. CONDENSER) AT PLATE (PIN 5) OF 6SL7GT HORIZONTAL-SWEEP OSCILLATOR

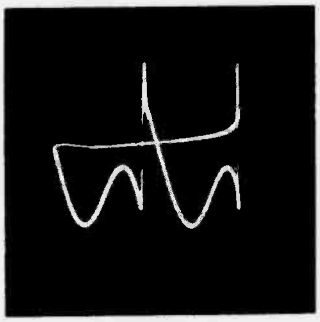


FIGURE 36. WAVEFORM AT CATHODE (PIN 6) OF 6SL7GT HORIZONTAL-SWEEP OSCILLATOR

sets the frequency of the oscillator. The stabilization thus produced by the resonant circuit reduces the effect of noise on the horizontal sweep.

The horizontal-sweep current is produced and controlled in the following manner:

1. The sawtooth sweep voltage from the horizontal-oscillator tube is applied to the horizontal-output-tube grid, causing a steady increase in current through the primary of T503. A constant voltage is thereby induced in the secondary of T503 and, consequently, this voltage appears across the deflection yoke.

2. The constant voltage across the yoke initiates a current flow in the yoke. This current, which, because of the R, L, and C constants of the circuit, increases in an essentially linear manner, causes the beam to move from the center toward the right-hand edge of the screen.

3. When the signal is removed from the grid of the output tube, the primary current of T503 is abruptly cut off, thereby inducing a large reverse voltage in the secondary of T503.

4. This reverse voltage quickly causes the current in the deflection coil to drop rapidly through zero to a maximum in the opposite direction, driving the picture-tube beam quickly across the screen, from right to left.

5. At the instant the reverse current reaches maximum, (when the beam is at the left-hand edge of the screen) the sweep signal is again applied to the grid of the horizontal-output tube.

6. The induced voltage in the secondary of T503 now opposes the flow of reverse current in the deflection yoke, causing the current to fall to zero; because of the constants of the circuit, plus the action of the 5V4G horizontal-damping tube, the reverse current decreases in a linear fashion. As this current decreases, the sweep spot progresses from the left-hand side of the tube toward the center. This starting portion of the sweep is developed by the action of the damping tube while the horizontal output tube is virtually cut off.

7. Since the secondary voltage across T503 remains constant for the duration of the sweep, the action described in step 2 is continued, producing an approximately linear change of deflection current in the original direction, and causing the sweep to continue smoothly to the right. This latter portion of the sweep is developed by the action of the horizontal output tube.

8. Again the sweep signal cuts off the horizontal-output tube, and the current in the deflection yoke dies to zero and then reverses, causing the beam to return to the left before the next sweep begins.

9. During the return sweeps, the high counter-voltages induced in the yoke are damped by the 5V4G horizontal-damping tube, thus preventing unrestricted oscillations in the yoke. This damping action also charges C520 and C522, and their charge acts as an additive voltage, so that the plate voltage of the horizontal-output tube is equal to the B+ voltage (345 volts) plus the voltage across C520. This extra voltage aids in obtaining a better sweep action without requiring a higher B+ supply voltage.

10. When the horizontal-output tube is abruptly cut off at the end of each sweep, the induced voltage in the primary of T503 causes a very high voltage (approximately 7000 volts) to appear at the plate of the high-voltage rectifier, 1B3GT. This voltage is used to supply the d-c anode voltage for the picture tube.

The low-voltage d-c supply employs two 5U4G rectifier tubes, which are connected in parallel to provide the high-current, 345 volts, 245 volts, and −12 volts for the receiver circuits. The high-voltage circuit operates on the induced voltage in the autotransformer winding of the horizontal-sweep-output transformer.

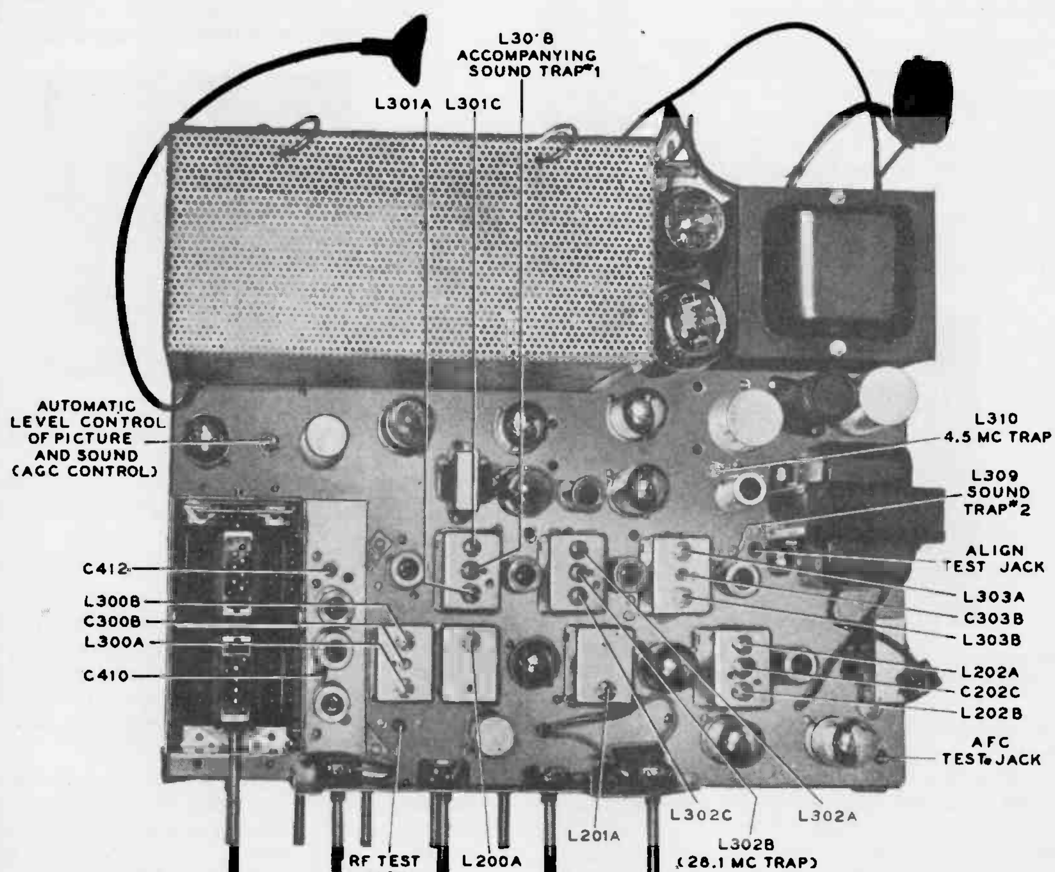


FIGURE 37. TOP VIEW OF CHASSIS, SHOWING TRIMMER AND TUNING-CORE LOCATIONS

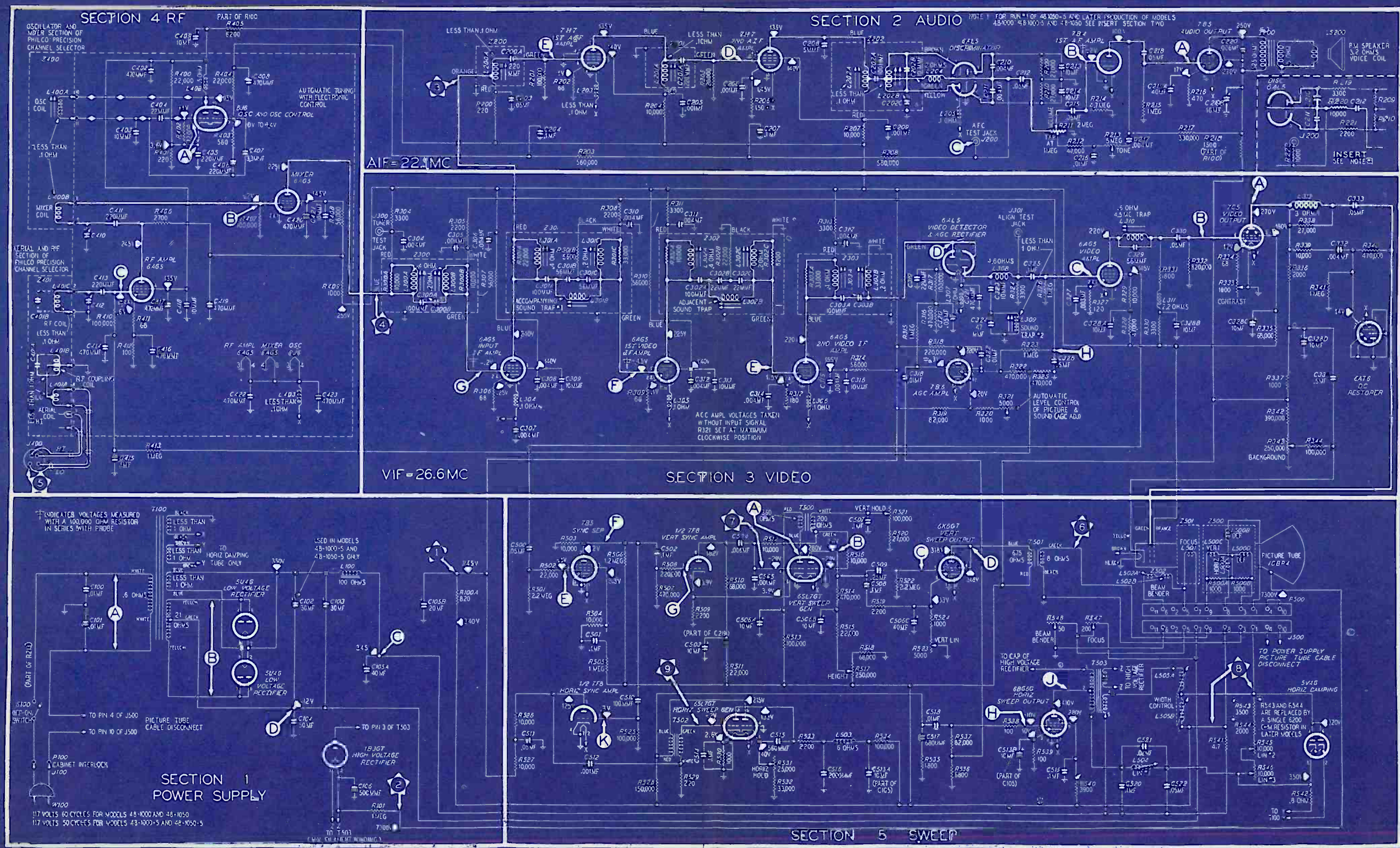


FIGURE 32. SECTIONALIZED SCHEMATIC DIAGRAM, SHOWING TEST POINTS

RCA VICTOR
TELEVISION RECEIVER MODEL 8TS30

Chassis No. KCS 20J-1 (60 cycles) and KCS 20K-2 (50 cycles)

ION TRAP MAGNET ADJUSTMENT—The ion trap rear magnet poles should be approximately over the ion trap flags as shown in Figure 2. Starting from this position adjust the magnet by moving it forwards or backwards at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R184 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

PICTURE SIZE .... 6⅝" x 8½"—2" radius at corner

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.

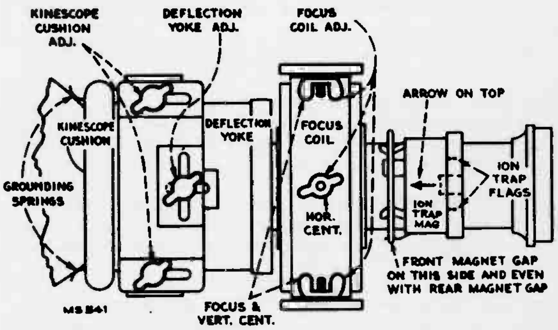


Figure 2—Yoke and Focus Coil Adjustments

OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time.

1. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.
2. Set the STATION SELECTOR to the desired channel.
3. Turn the PICTURE control fully counter-clockwise.
4. Turn the BRIGHTNESS control clockwise, until a glow appears on the screen then counter-clockwise until the glow just disappears.
5. Turn the PICTURE control clockwise until a glow or pattern appears on the screen.
6. Adjust the FINE TUNING control for best sound fidelity and SOUND VOLUME for suitable volume.
7. Adjust the VERTICAL hold control until the pattern stops vertical movement.
8. Adjust the HORIZONTAL hold control until a picture is obtained and centered.
9. Adjust the PICTURE control for suitable picture contrast.
10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.
11. In switching from one station to another, it may be necessary to repeat steps number 6 and 9.
12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 6 is generally sufficient.
13. If the positions of the controls have been changed, it may be necessary to repeat steps number 1 through 9.

NOTE: If any difficulty is experienced with steps number 7 or 8, turn the PICTURE control ¼ turn counterclockwise and repeat those adjustments.

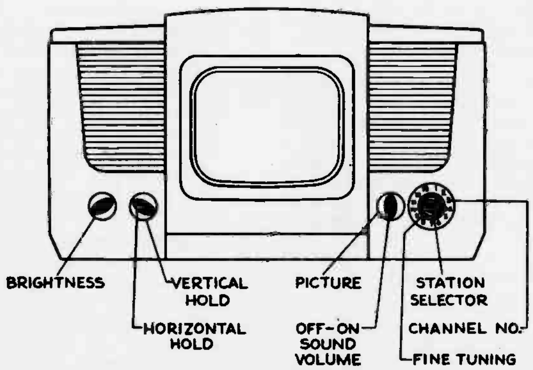


Figure 1—Receiver Operating Controls

INSTALLATION INSTRUCTIONS

FOCUS COIL ADJUSTMENTS—Turn the centering controls R181 and R211 to mid position. See Figure 6 for location of these rear apron controls.

If a corner of the raster is shadowed, it indicates that the electron beam is striking the neck of the tube. Loosen the focus coil adjustment wing nuts and rotate the coil about its vertical and horizontal axis until the entire raster is visible, approximately centered and with no shadowed corners. Tighten the focus coil adjustment wing nuts with the coil in this position.

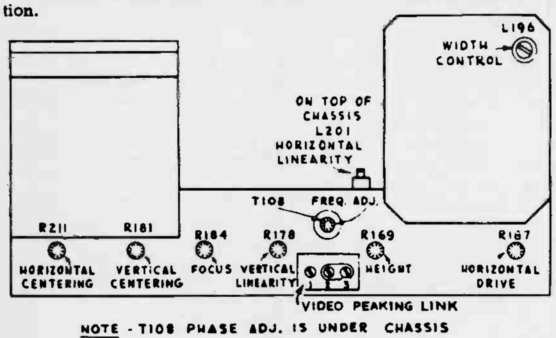


Figure 6—Rear Chassis Adjustments

DEFLECTION YOKE ADJUSTMENT—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 2 through 9 and the note of the receiver operating instructions.

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT—Turn the horizontal hold control to the extreme counter-clockwise position. 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. Skip "Alignment of Horizontal Oscillator and proceed with 'FOCUS' adjustment."

ALIGNMENT OF HORIZONTAL OSCILLATOR—If in the above check the receiver failed to hold sync with the hold control at either extreme or failed to pull into sync after momentary removals 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, then make the adjustments under "Complete Realignment."

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 to pul in. Momentarily remove the signal. Turn the T108 frequency adjustment on the chassis rear apron until the oscillator pulls into sync. Check hold and pull-in for the other extreme position of the hold control.

Complete Realignment—Tune in a Television Station and adjust the fine tuning control for best sound quality.

Turn the T108 frequency adjustment on rear apron until the picture is synchronized. Adjust the picture control so that the picture is somewhat below average contrast level.

Turn the T108 phase adjustment screw (under chassis) until the blanking bar, which may appear in the picture, moves to the right and off the raster. The range of this adjustment is such that it is possible to hit an unstable condition (ripples in the raster). The screw must be turned clockwise from the unstable position. The length of stud beyond the bushing in its correct position is usually about ½ inch.

Turn horizontal hold to the extreme counter-clockwise position. Turn T108 frequency adjustment clockwise until the picture falls out of sync. Then turn it slowly counter-clockwise to the point where the picture falls in sync again.

Readjust T108 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. If it does, readjust the phase control.

Momentarily remove the signal. When the signal is restored, the picture should fall in sync. If it doesn't, turn T108 frequency adjustment counter-clockwise until the picture falls in sync.

Turn horizontal hold to the extreme counter-clockwise position. Remove the signal momentarily. When signal is restored, the picture should fall in sync.

NOTE: If the picture does not pull in sync after momentary removals of the signal in both extreme positions of horizontal hold, the pull-in range may be inadequate, though not necessarily. A pull-in through ¾ 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 hold about 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 variations in the cut-off characteristic of the horizontal oscillator control tubes, V124.

FOCUS—Adjust the focus control R184 for maximum definition of the vertical wedge of the test pattern.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS—Adjust the height control (R169 on chassis rear apron) until the picture fills the mask vertically (6⅜ inches). Adjust vertical linearity (R178 on rear apron), until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering to align the picture with the mask.

WIDTH AND HORIZONTAL LINEARITY ADJUSTMENTS—Turn the horizontal drive (R187 on rear apron) clockwise as far as possible without causing crowding of the right of the picture. This position provides maximum high voltage to the kinescope second anode. Adjust the width control (L196 on rear chassis) until the picture just fills the mask horizontally (8½ inches). Adjust the horizontal linearity control L201 (see Figure 6) until the test pattern is symmetrical left to right. A slight readjustment of the horizontal drive control may be necessary when the linearity control is used. Adjust horizontal centering to align the picture with the mask.

If repeated adjustments of drive width and linearity fail to give proper linearity, it may be necessary to move the tap on R209, which is located in the high voltage compartment. Adjustments of drive, width and linearity must then be repeated. **Check to see that all cushion, yoke, focus coil and ion trap magnet thumb screws are tight.** Replace the cabinet back and top. Make sure that the back is on tight, otherwise it may rattle at high volume.

CHECK OF R-F 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 Figure 7. Adjustments for channels 6 and 13 are under the chassis.

VIDEO PEAKING LINK—A video peaking link is provided (see Figure 6) 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).

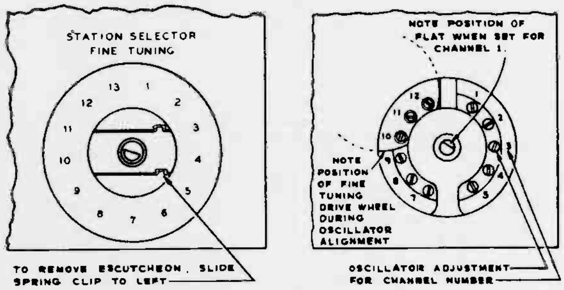


Figure 7—R-F Oscillator Adjustments

ALIGNMENT PROCEDURE

Service Precautions—If necessary to remove the chassis from cabinet, the kinescope must first be removed.

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.

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 line when changing the tube.

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 transformers
- 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 meter.

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.

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 16A. 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 16B.

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, permitting 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.

8TS30

CHASSIS TOP VIEW

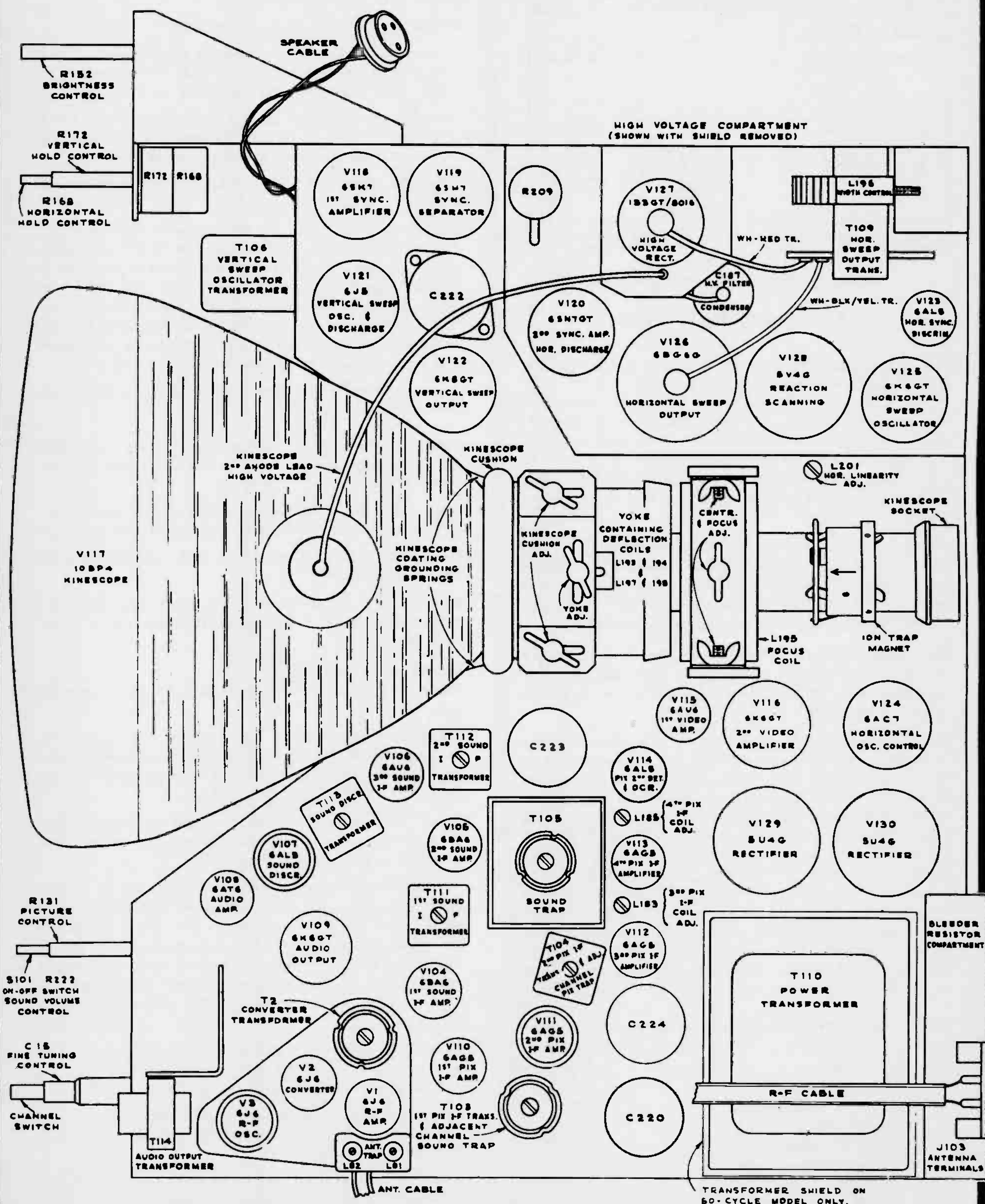


Figure 8—Chassis Top View

CHASSIS BOTTOM VIEW

8TS30

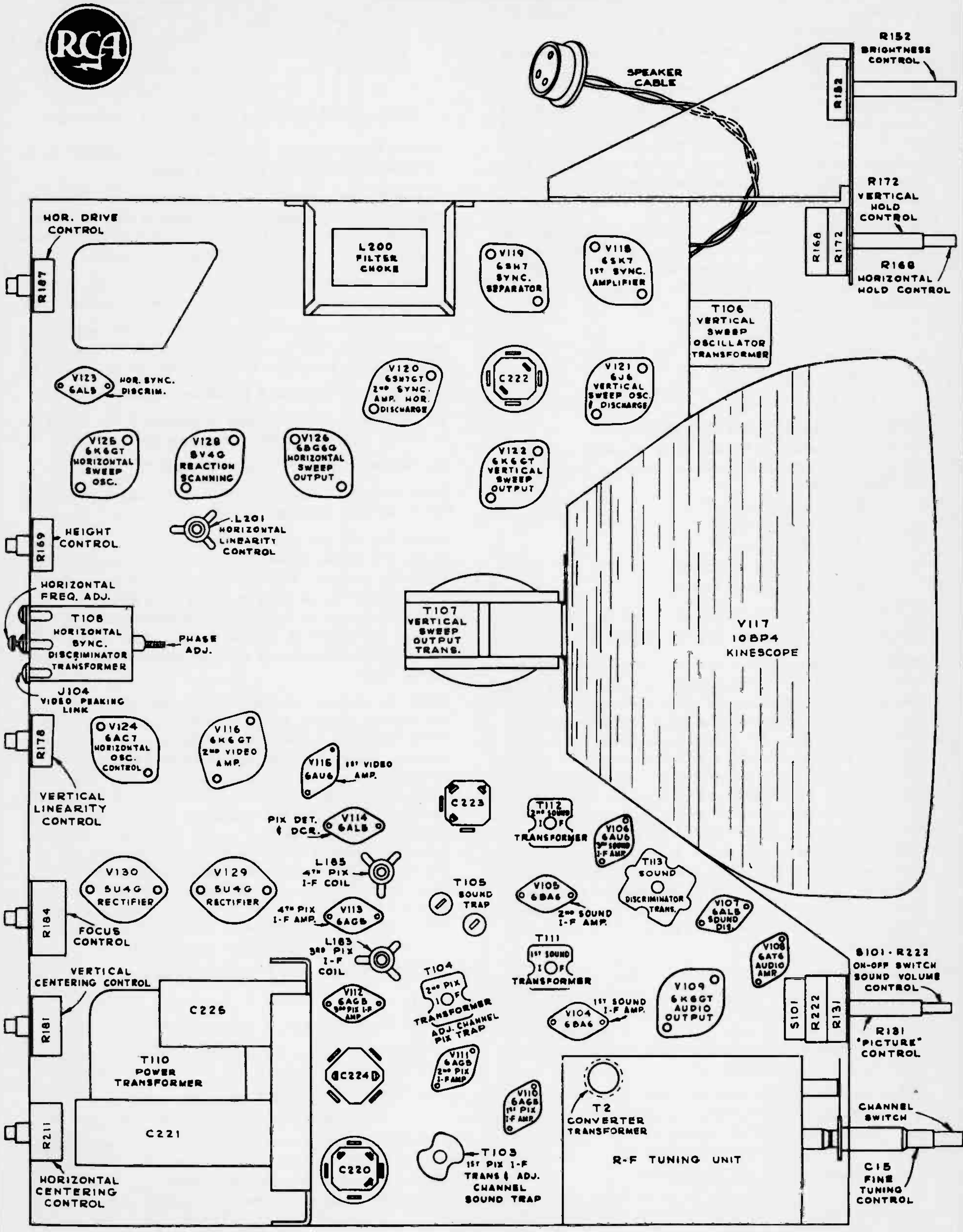


Figure 9—Chassis Bottom View

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 load 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 10.

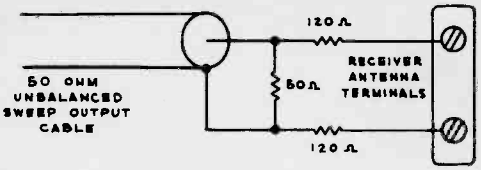


Figure 10—Unbalanced Sweep Cable Termination

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.

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 narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7 (see Figure 15 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 17) 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 17, 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 17 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 70% response. It 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 sweep oscillator to cover 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 permissible is limited by the peak-to-valley excursion which should not be greater than 30% on any channel.

R-F OSCILLATOR LINE ADJUSTMENT—
The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency 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.

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 is used, couple the meter probe loosely to the receiver oscillator.

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

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 inductance, 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 recheck 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.

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 18.

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 10. 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 counterclockwse and readjust L82. Repeat for the lowest minimum.

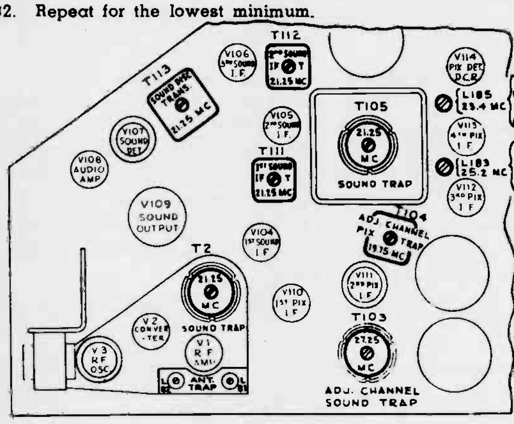
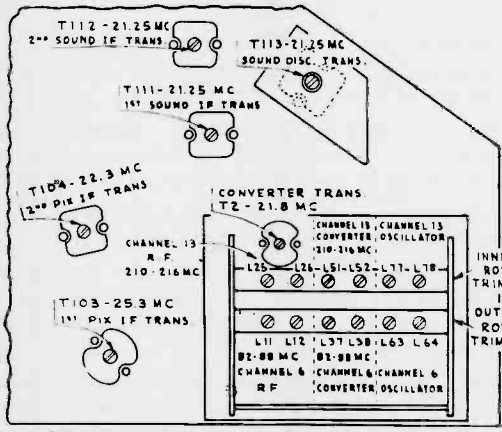


Figure 12—Top Chassis Adjustments



R F UNIT SHOWN WITH SHIELD REMOVED

Figure 13—Bottom Chassis Adjustments

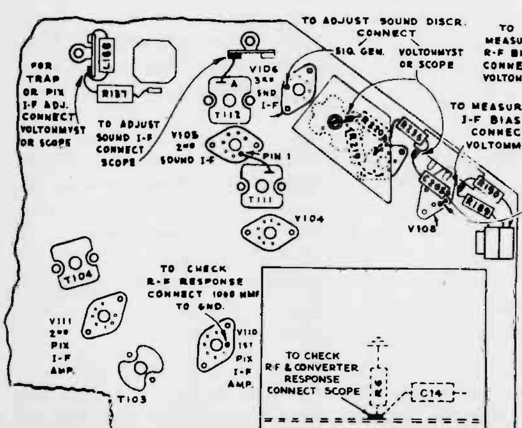


 Figure 14—Test Connection Points

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.

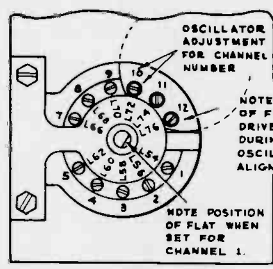
Method 1 for channel 5-7 interference. With the same setup as above, switch the receiver to channel 5 and tune the receiver oscillator to 103 mc. Feed in the picture 7 sound carrier (179.75 mc.) from the signal generator and adjust the trap as above.

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.



OSCILLATOR ADJUSTMENTS FOR CHANNELS 6 AND 13 ARE ON SIDE OF R.F. UNIT

Figure 15—R-F Oscillator Adjustments

RESPONSE CURVES— 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 depnd 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.

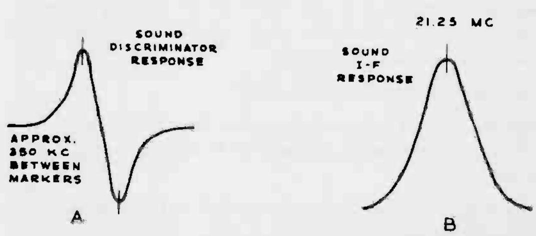


Figure 16—Sound Discriminator and I-F Response

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 BEGINNING ON PAGE 8 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	REFER TO
				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	Fig. 14 Fig. 13 Fig. 12
2	"	"	"		"	Junct of R236 & C205	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 14 Fig. 13
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		Fig. 14 Fig. 16 A
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.	Fig. 14 Fig. 12 Fig. 13 Fig. 16 B
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.	Fig. 12 Fig. 13 Fig. 14 Fig. 16 B
				PICTURE I-F AND TRAP ADJUSTMENT					
6	Not used		Not used		Not used	Junction of R189 & R190		Picture control for –3 volts on meter	Fig. 14
7	Junction C14 and R6	21.25	"		"	Junction of L188 & R137	Meter on 3 volt scale. Receiver on channel 13	T105 (top) for min.	Fig. 12
8	"	21.25	"		"	"	"	T2 (top) for min.	Fig. 14 Fig. 12
9	"	27.25	"		"	"	"	T103 (top) for min.	"
10	"	19.75	"		"	"	"	T104 (top) for min. on meter	Fig. 12
11	"	21.8	"		"	"	"	T2 (bottom) for max.	Fig. 13
12	"	25.3	"		"	"	"	T103 (bottom) for max.	"
13	"	22.3	"		"	"	"	T104 (bottom) for max.	"
14	"	25.2	"		"	"	"	L183 (top chassis) for max.	Fig. 12
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 6 V108		Picture control for –1.5 volts on meter	Fig. 14 Fig. 13
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, L26, L51 & L52 for approx. flat top response between markers. Markers above 70%	Fig. 14 Fig. 13 Fig. 17 (7)
19	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	Check to see that response is as above	Fig. 17 (8)
20	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 17 (9)
21	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 17 (10)
22	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 17 (11)
23	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 17 (12)
24	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 17 (13)
25	If the response on any channel (steps 19 through 24) is below 70% at either marker, switch to that channel and adjust L25, L26, L51, & L52 to pull response up on that channel. Then recheck steps 18 through 24.								

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ALIGNMENT TABLE

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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	REFER TO
	R-F AND CONVERTER LINE ALIGNMENT (Cont'd)								
26	Antenna terminals (loosely)	83.25 87.75	Antenna terminals (see text for precaution)	Sweeping channel 6	Junction C14 and R6 through 10,000 ohm series resistor	Not used	Receiver on channel 6	L11, L12, L37 & L38 for response as above	Fig. 17 (6)
27	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 17 (5)
28	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 17 (4)
29	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 17 (3)
30	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	
31	"	45.25 49.75	"	channel 1	"	"	Receiver on channel 1	"	Fig. 17 (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	REFER TO
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. feq. meter	Fig. 14 Fig. 13
34	"	209.75	"	231	"	"	Rec. on chan. 12	L76 as above	Fig. 15
35	"	203.75	"	225	"	"	Rec. on chan. 11	L74 as above	"
36	"	197.75	"	219	"	"	Rec. on chan. 10	L72 as above	"
37	"	191.75	"	213	"	"	Rec. on chan. 9	L70 as above	"
38	"	185.75	"	207	"	"	Rec. on chan. 8	L68 as above	"
39	"	179.75	"	201	"	"	Rec. on chan. 7	L66 as above	"
40	"	87.75	"	109	"	"	Rec. on chan. 6	L33 & L64 as above	Fig. 13
41	"	81.75	"	103	"	"	Rec. on chan. 5	L62 as above	Fig. 15
42	"	71.75	"	93	"	"	Rec. on chan. 4	L60 as above	"
43	"	65.75	"	87	"	"	Rec. on chan. 3	L58 as above	"
44	"	59.75	"	81.	"	"	Rec. on chan. 2	L56 as above	"
45	"	49.75	"	71	"	"	Rec. on chan. 1	L54 as above	"
46	Repeat steps 33 through 45 as a check.								
	RETOUCHING PICTURE I-F TRANSFORMERS								
47			Not used		Not used	Junction of R189 & R190	Receiver & sweep on a channel between 1 and 6 known to have good r-f response	Picture control for −3 volts on meter	Fig. 14
48	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		Fig. 14 Fig. 13 Fig. 18
49	If T104 (bottom) was adjusted in step 48, repeat step 10 and step 48.								
	ANTENNA TRAP ADJUSTMENT								
	Select 1 of the 6 steps below for suitable method for type of interference encountered.								
50-1	Antenna terminals through termination	193.25	Loosely coupled to r-f osc.	109	Not used	Junction of L188 & R137	Rec. on chan. 6	L81 & L82 for min. on meter	Fig. 14 Fig. 12
50-2	"	109	"	87	"	"	Rec. on chan. 3	"	"
50-3	"	179.75	"	103	"	"	Rec. on chan. 5	"	"
50-4	"	103	"	81	"	"	Rec. on chan. 2	"	"
50-5	"	FM Sta. Freq.	"	81	"	"	"	"	"
50-6	Not used		Not used		Not used	Not used	Rec. on interfered channel	L81 & L82 for min. interference	"
	SENSITIVITY CHECK								
51	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.								

Figure 17—R-F Response

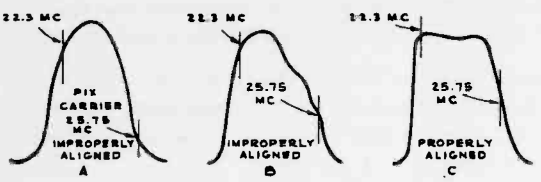

Figure 18—Overall Response

SERVICE SUGGESTIONS

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet—Coils reversed either front to back or top to bottom, ion trap magnet coil open.

(2) V126 or V127 inoperative—check voltage and waveform on grids and plates.

(3) No high voltage—If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of horizontal output transformer, the trouble can be isolated to the 8016 circuit. Either the T109 high voltage winding is open (points 2 to 3), the 8016 tube is defective, its filament circuit is open, C187 is shorted or R233 or R235 open.

(4) V125 and V120-B circuits inoperative—check for sine wave on V125 grid, pulse on V120-B grid, and sawtooth on V126 grid. Refer to schematic and wave form chart.

(5) Reaction scanning tube (V128) inoperative.

(6) Defective kinescope.

(7) R152 open, (terminal 3 to ground).

(8) No receiver plate voltage—filter capacitor or filter choke shorted—negative bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V121 or V122 inoperative. Check voltage and wave forms on grids and plates.

(2) T107 open.

(3) Vertical deflection coils open.

NO HORIZONTAL DEFLECTION:

(1) V125, V120B, V126 or V128 inoperative—check voltage and wave forms on grids and plate.

(2) T109 open.

(3) Horizontal deflection coil open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V122.

(2) Vertical output transformer defective.

(3) V121 inoperative—check voltage and wave forms on grid and plate.

(4) R174, C158, C221-C or C222-B defective.

(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V128 or V126.

(2) T109 or L201 defective.

(3) C186 or C188 or R209 defective.

(4) C179, R187 or R210 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) R180, R201 or C181 defective.

(2) Defective yoke.

PICTURE OUT OF PHASE HORIZONTALLY:

(1) T108 winding D to F incorrectly tuned or connected in reverse.

(2) R200 or R202 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER & SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, 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 AT KINESCOPE GRID BUT NO SYNC:

(1) Picture control advanced too far.

(2) V114-B, V118, V119, or V120-A inoperative. Check voltage and waveforms at their grids and plates.

(3) C142 defective.

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SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V121 and associated circuit—C154, T106, etc.

(2) Integrating network inoperative—Check C149, C151, C152, C153, R162, R163, R164 and R165.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T108 misadjusted—readjust as instructed on page 5.

(2) V123 or V124 inoperative—check socket voltages and waveforms.

(3) T108 defective.

(4) C166, C167, C170 or C171 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C168, C169, R168 and R196.

SOUND & RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V110, V111, V112, V113, V114, V115 and N116—check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V114, V115 or V116 defective.

(2) Peaking coils defective—check for specified resistance.

(3) C138, C140, C141 or C142 defective.

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

(5) R-F and I-F circuits misaligned.

PICTURE SMEAR:

(1) Video amplifier overloaded by excessive input—reduce picture control settina.

(2) Insufficient bias on V115 and V116 resulting in grid current on video signal. Check bias and possible grid current.

(3) Defective coupling condenser or grid load resistor—check C138, C140, C141, C223B, R138, R142, R143, R148, etc.

(4) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) Picture control operated at excessive level.

(2) If regular sections at the left picture are displaced change V126.

(3) Vertical instability may be due to loose connections or noise.

(4) Horizontal instability may be due to unstable transmitted sync.

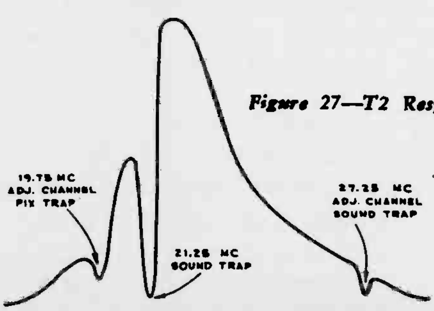

Figure 27—T2 Response

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.

(2) R-F oscillator off frequency.

(3) R-F unit inoperative—Check V1, V2, V3 and their socket voltages.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.

(2) Replace V126.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C181 defective.

(2) V128 defective.

(3) Change tap on R209.

PICTURE I-F RESPONSE—At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method.

Select a channel with a flat r-f response as outlined in the R-F and Converter Line adjustment section of the alignment procedure.

Shunt all i-f transformers and coils with a 330 ohm carbon resistor except the one whose response is to be observed.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures 27 through 29 show the response of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

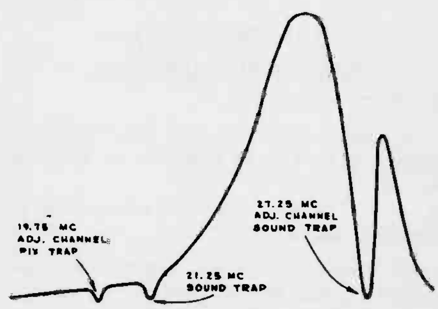

Figure 28—T103 Response

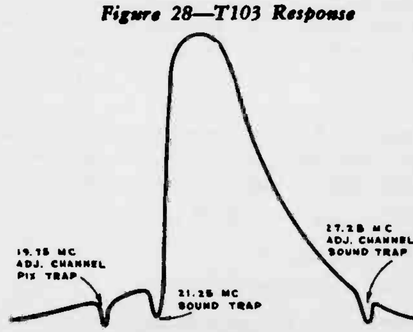

Figure 29—T104 Response

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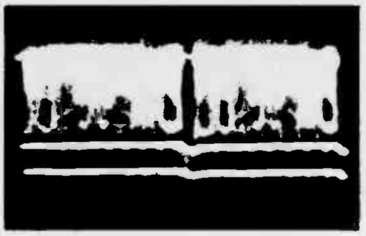
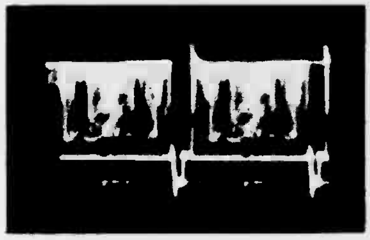
WAVEFORM PHOTOGRAPHS

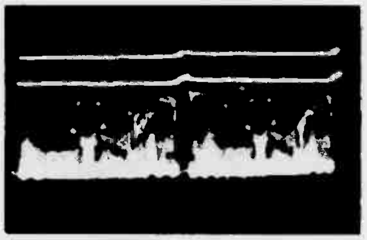


Video Signal Input to 1st Video Amplifier (Junction of L187, R136, L188 and C138)

Figure 32—Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (1.5 Volts PP)
←

Figure 33—Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (1.5 Volts PP)
→

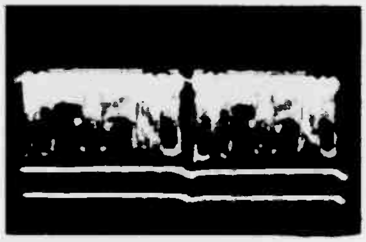




Output of 1st Video Amplifier (Junction of L189, R139, L190 and C140)

Figure 34—Vertical (10 Volts PP)
←

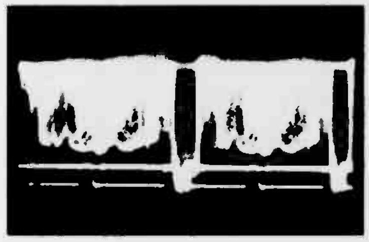
Figure 35—Horizontal (10 volts PP)
→

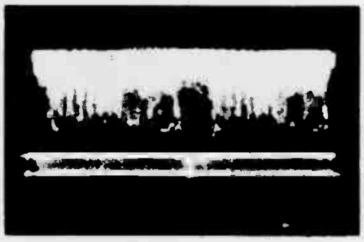


Input to Kinescope Grid (Junction of C141, R148 and Green Lead to Kinescope)

Figure 36—Vertical (38 Volts PP)
←

Figure 37—Horizontal (38 Volts PP)
→





Cathode of D-C Resistor (Pin 5 of V114-B) (6AL5)

Figure 38—Vertical (36 Volts PP)
←

Figure 39—Horizontal (36 Volts PP)
→

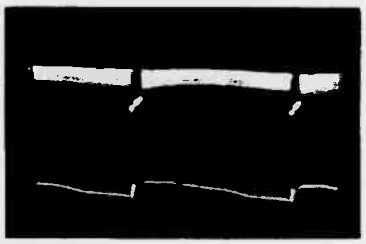
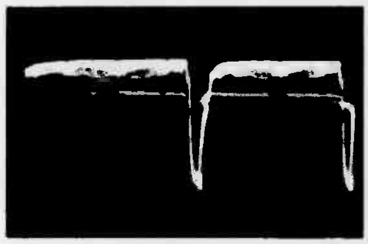
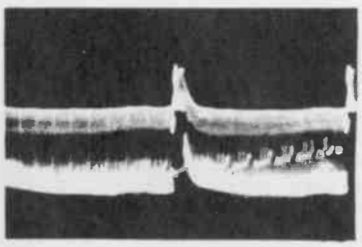


Plate of D-C Restorer (Pin 2 of V114-B) (6AL5)

Figure 40—Vertical (9 Volts PP)
←

Figure 41—Horizontal (9 Volts PP)
→

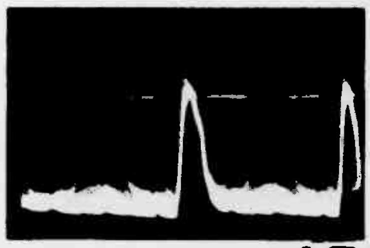




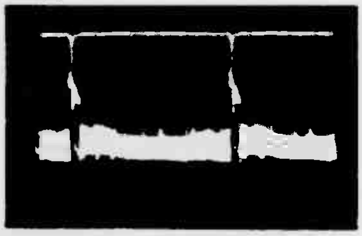
Output of 1st Sync. Amplifier (Pin 8 of V118) (6SK7)

Figure 42—Vertical (58 Volts PP)
←

Figure 43—Horizontal (40 Volts PP)
→



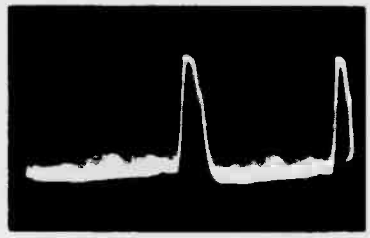
WAVEFORM PHOTOGRAPHS

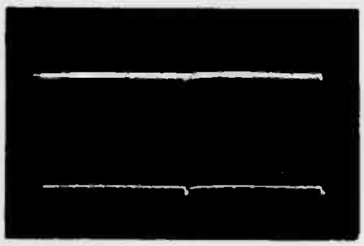


Input to Sync. Separator (Pin 4 of V119) (6SH7)

Figure 44—Vertical (35 Volts PP)
←

Figure 45—Horizontal (35 Volts PP)
→

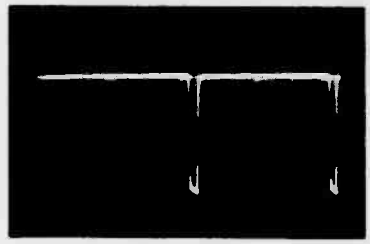


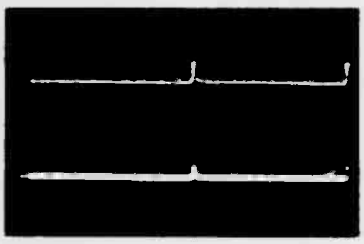


Output of Sync. Separator (Pin 8 of V119) (6SH7)

Figure 46—Vertical (75 Volts PP)
←

Figure 47—Horizontal (75 Volts PP)
→

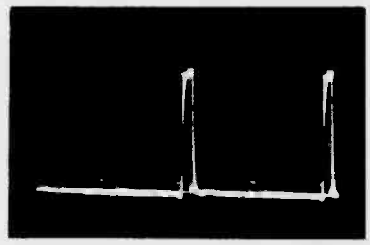


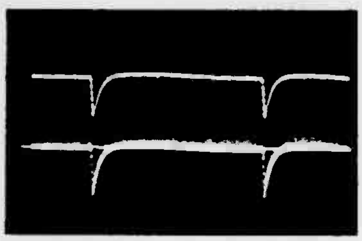


Output of 2nd Sync. Amplifier (Pin 2 of V120-A) (6SN7GT)

Figure 48—Vertical (35 Volts PP)
←

Figure 49—Horizontal (29 Volts PP)
→

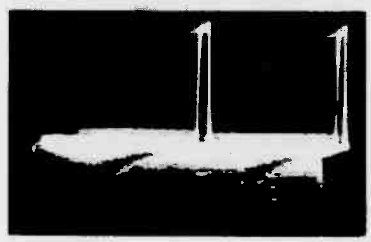




Input to Integrating Network (Junction of C149, R162 and R163)

Figure 50—Vertical (45 Volts PP)
←

Figure 51—Horizontal (30 Volts PP)
→



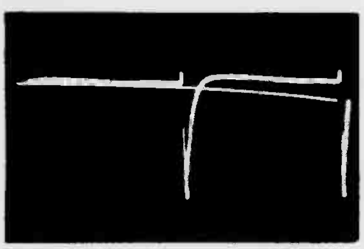
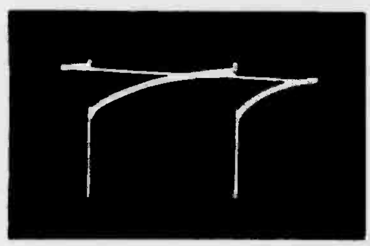


Figure 52—Output of Integrating Network (Junction of R165, C153 and Yellow Lead of T106). Vertical (32 Volts PP)
←

Figure 53—Grid of Vertical Osc. (350 Volts PP) (Pin 5 of V121) (6J5)
→



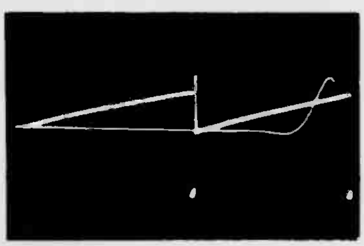


Figure 54—Plate of Vertical Osc. (140 Volts PP) (Pin 3 of V121) (6J5)
←

Figure 55—Input Coupling of Vertical Output (125 Volts PP) (Junction of C157, C158, R170 and Red Lead of T106)
→

8TS30

WAVEFORM PHOTOGRAPHS

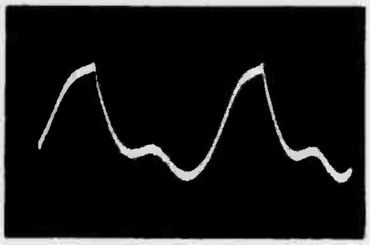
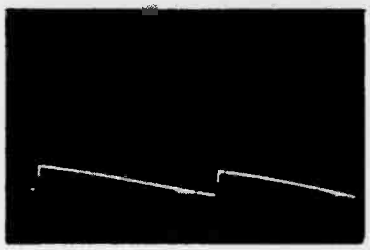


Figure 56—Cathode of Vertical Output (.75 Volt PP) (Pin 8 of V122) (6K6GT)
←

Figure 57—Plate of Vertical Output (700 Volts PP) (Pin 3 of V122) (6K6GT)
→



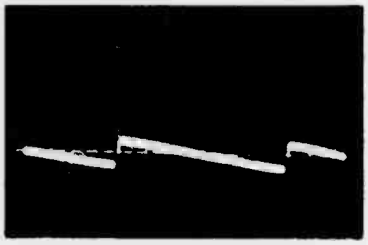
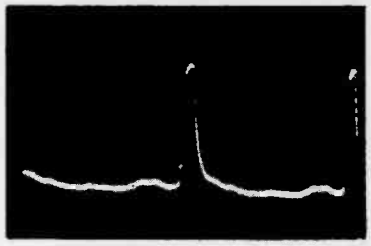
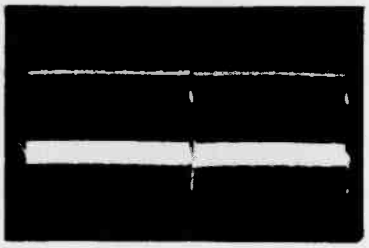


Figure 58—Input to Vertical Deflection Coils (60 Volts PP) (Junction of Green Lead of T107 and Green Lead of Yoke)
←

Figure 59—Vertical Boost of 1st Sync. Amplifier (16 Volts PP) (Junction of R154, R155 and C146)
→

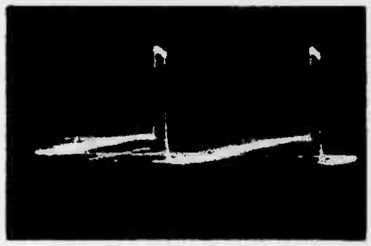


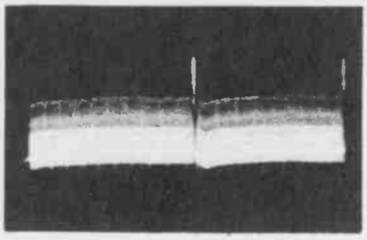


Terminal "E" of Sync Discriminator Transformer (T108)

Figure 60—Vertical (16 Volts PP)
←

Figure 61—Horizontal (13 Volts PP)
→

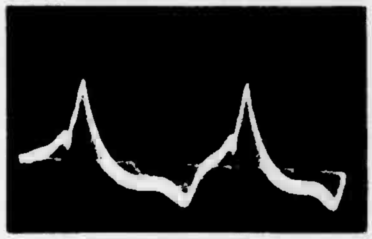


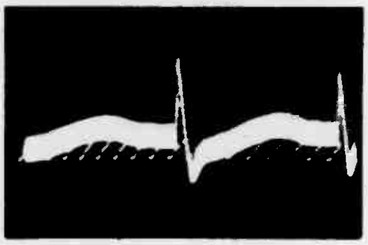


Junction of R191 and R192 (Cathode Resistors of Horizontal Sync. Discriminator)

Figure 62—Vertical (3 Volts PP)
←

Figure 63—Horizontal (1.7 Volts PP)
→

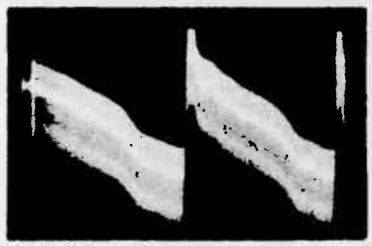




Cathode of Hor. Sync. Discriminator (Pin 1 of V123) (6AL5)

Figure 64—Vertical (.8 Volt PP)
←

Figure 65—Horizontal (.15 Volt PP)
→



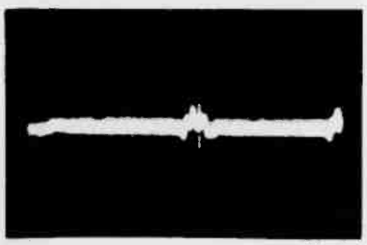
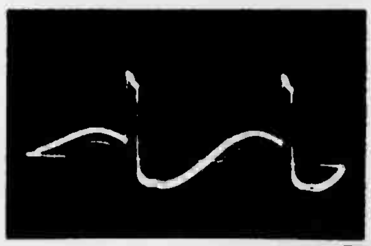


Figure 66—Cathode of Hor. Sync. Discr. (Pin 5 of V123) (6AL5) Horizontal (.19 Volt PP)
←

Figure 67—Plate of Hor. Sync. Discr. (Pin 7 of V123) (6AL5) Horizontal (23 Volts PP)
→



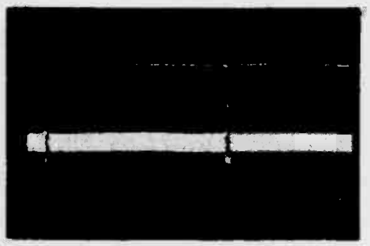


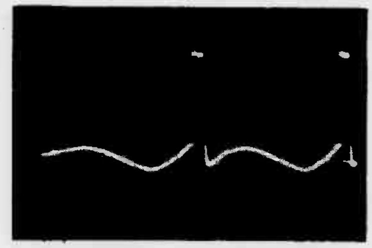
Plate of Hor. Sync. Discr. (Pin 2 of V123) (6AL5)

Figure 68—Vertical (21 Volts PP)

←

Figure 69—Horizontal (21 Volts PP)

→



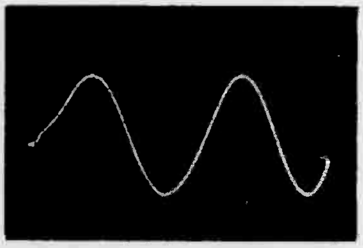
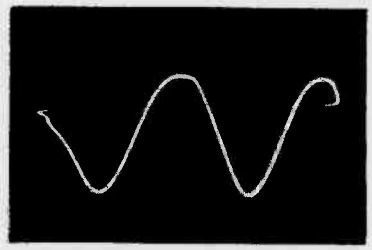


Figure 70—Horizontal (95 Volts PP) Terminal "A" of Sync. Discriminator Transformer (T108)

←

Figure 71—Cathode of Horizontal Oscillator Control (1.5 Volts PP) (Pin 5 of V124) (6AC7)

→



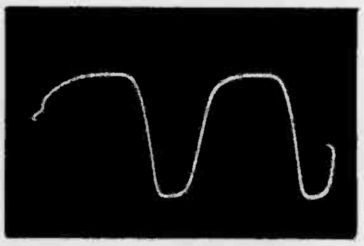
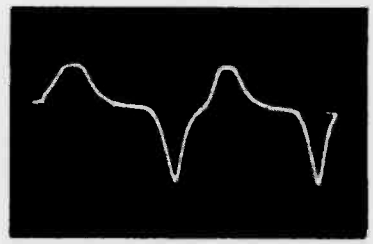


Figure 72—Plate of Horizontal Oscillator (225 Volts PP) (Pin 3 of V125) (6K6GT)

←

Figure 73—Input of Horiz. Discharge (100 Volts PP) (Junction of C176, C177 and R202)

→



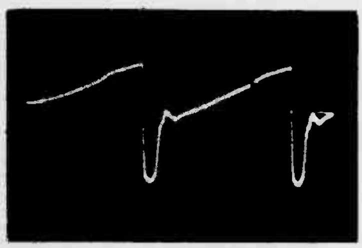
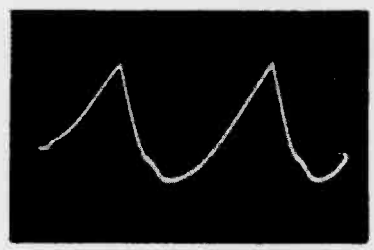


Figure 74—Plate of Hor. Discharge (78 Volts PP) (Pin 5 of V120-B) (6SN7GT)

←

Figure 75—Cathode of Hor. Output (11.5 Volts PP) (Pin 3 of V126) (6BG6-G)

→



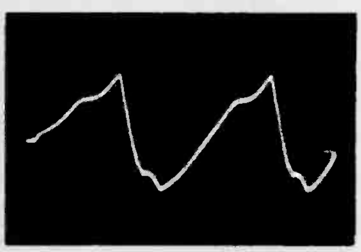
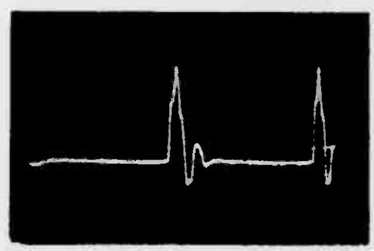


Figure 76—Screen of Hor. Output (9 Volts PP) (Pin 8 of V126) (6BG6-G)

←

Figure 77—Plate of Horizontal Output (Approx. 6000 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V126 to Ground)



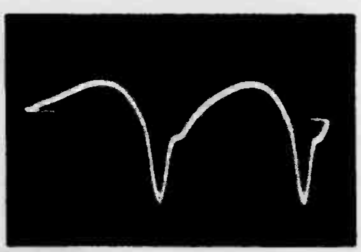
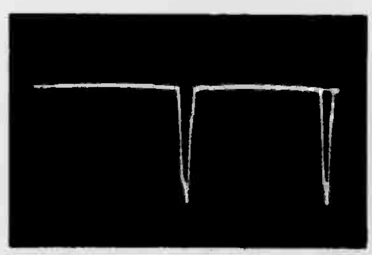


Figure 78—Cathode of Reaction Scanning (60 Volts PP) (Pin 8 of V128) (5V4G)

→

Figure 79—Input to Horizontal Deflection Coils (1325 Volts PP) (Pin 4 of V128) (5V4G)

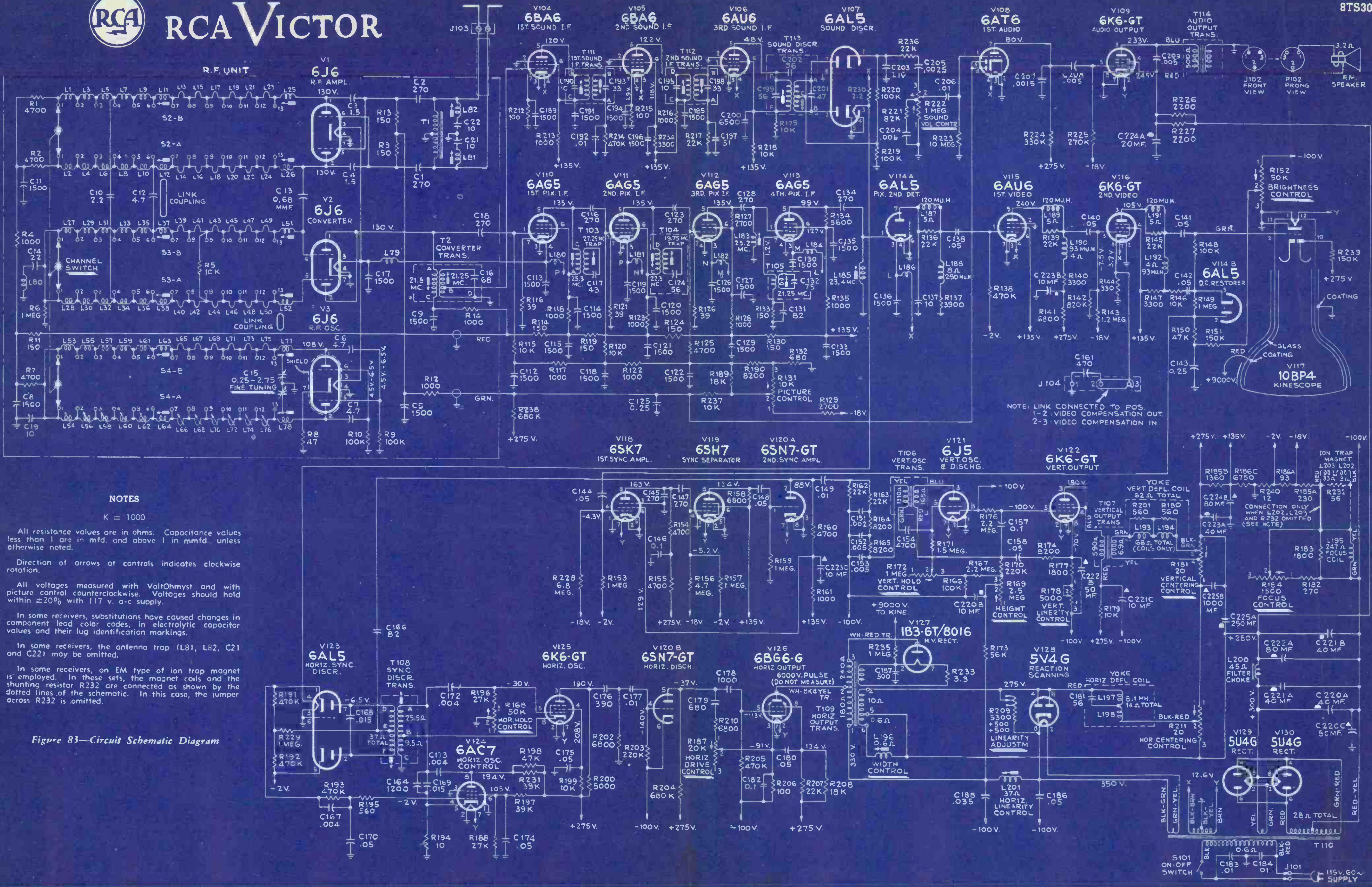
→



RCA VICTOR

CIRCUIT SCHEMATIC DIAGRAM

8TS30



NOTES

K = 1000

All resistance values are in ohms. Capacitance values less than 1 are in mfd. and above 1 in mmfd. unless otherwise noted.

Direction of arrows at controls indicates clockwise rotation.

All voltages measured with VoltOhmyst and with picture control counterclockwise. Voltages should hold within ±20% with 117 v. a-c supply.

In some receivers, substitutions have caused changes in component lead color codes, in electrolytic capacitor values and their lug identification markings.

In some receivers, the antenna trap (L81, L82, C21 and C22) may be omitted.

In some receivers, on EM type of ion trap magnet is employed. In these sets, the magnet coils and the shunting resistor R232 are connected as shown by the dotted lines of the schematic. In this case, the jumper across R232 is omitted.

Figure 83—Circuit Schematic Diagram

Sonora
Clear as a Bell

Television Radio Receiver
Model 700

The Model 700 is a 26 tube receiver (including 10 inch Kinescope) which covers the television band - channels 2 to 13 inclusive. This receiver features F.M. sound and improved Horizontal Synchronization.

SAFETY PRECAUTIONS: The kinescope should not be handled unless all people in the room are equipped with protective goggles. The person handling this tube must also wear gloves as an added precaution against dropping kinescope.

When the power is connected, care must be taken in servicing the High Voltage supply of the receiver; also the "B" voltages and transformer voltages are higher than normally encountered in a radio receiver.

VOLTAGE READINGS: The voltage readings to be obtained at various locations in the receiver have been indicated on the Schematic Diagram. These voltages will be very advantageous when "trouble shooting". Check voltages and tubes first before attempting to re-align receiver.

All Voltages were taken with a 117.5 V. line and with no signal input. The contrast control set at its maximum clockwise position; the brightness control for a barely visible raster and all other controls in normal operating position. The tuner set for Channel 2. All voltages are positive with respect to ground unless otherwise indicated.

DISASSEMBLY OF CABINET: After removing knobs and Cabinet Back, the top hood of the cabinet may be removed from the cabinet base by removing two screws at the rear of the mounting rails and sliding the hood forward to a free position. The hood may then be raised from the base.

CABINET ASSEMBLY: Lower cabinet hood until the control shafts in the front of the chassis align with cutouts in the face of cabinet. Move hood to the rear until the semi-circular cutout in the retaining brackets is even with the two side controls. Lower hood so that the retaining bracket passes the shafts of the side controls and the head of each of the four retaining screws protrudes through the "keyhole" slot in the brackets. Slide the hood to the rear until the rear of the hood is flush with the edge of the cabinet base. Replace knobs, two locking wood screws and cabinet back.

ALIGNMENT OF HORIZONTAL SYNCHRONIZATION

Tune in a station using the usual procedure. Adjust the Horizontal Position control (R-309) to the center position. Turn the Brightness Control (R-510) to maximum and reduce the Contrast Control until a weak picture or test pattern is observed with the raster appearing on one or both sides of the picture. If the horizontal synchronization is too far out of adjustment the picture will be distorted or moving. In that case adjust the horizontal synchronization control (L-302) until the picture is steady and in the center of the position of synchronization. If the picture is folded in at the edges, adjust L-301, which is on the opposite side of the can from the horizontal synchronization control. When final adjustment is achieved, there should be approximately twice as much of the raster showing on the left side of the picture as on the right.

The diagram for the Sonora Television Receiver 700 is printed across pages 132 and 133.

ALIGNMENT PROCEDURE

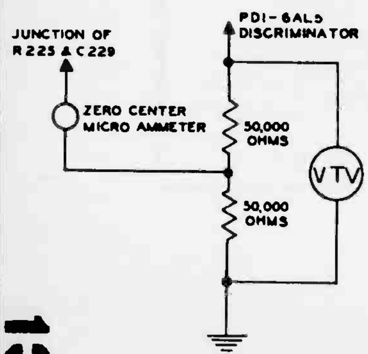
For ease in the I.F. alignment of this receiver, the Chassis should be placed with its back on block of wood so as to allow the line cord plug to rest in the socket. Alignment should be made without the kinescope, if possible.

Do not permit the High Voltage lead to become shorted to the Chassis.

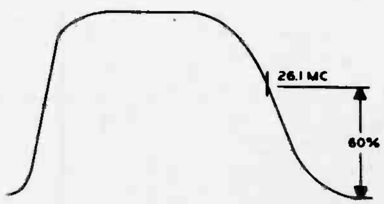
PICTURE AND SOUND I.F. ADJUSTMENTS

Step No.	Connect Signal Generator To	Signal Gen. Freq. MC	Connect Sweep Generator To	Sweep Generator Freq. MC	Connect Oscilloscope To	Remarks	Adjustments (Use Peak Obtained when Screw is Farthest out of Can)
1.	G_1 of 6AU6 Sound Driver	21.6 No Modulation	Not Used	-	Not Used	Connect Vacuum Tube Voltmeter and Zero Center Microammeter as shown in Note 1. (50,000 ohm resistors shown in note must match within 3%.)	L218 for balance or zero on Microammeter. L216 for maximum on Vacuum tube Voltmeter.
2.	G_1 of 6AU6 I.F. Amplifier	21.6 400 Cycle A.M. Modulation	Not Used	-	K of Kinescope	Oscilloscope or Vacuum Tube Voltmeter may be used as indicator. Sufficient input must be used to receive accurate minimums.	L214 to minimum. L207 to minimum.
3.	G_1 of 6AU6 I.F. Amplifier	21.6 No Modulation	Not Used	-	Not Used	Connect Vacuum Tube Voltmeter and zero center Microammeter as shown in Note 1.	L215 for maximum on Vacuum Tube Voltmeter.
4.	G_1 of 6AU6 I.F. Amplifier	21.6 400 Cycle A.M. Modulation	Not Used	-	Junction of R225 and C229		C227 to minimum. Recheck Steps 1 and 3.
5.	G_1 of 6AU6 I.F. Amplifier	27.6 400 Cycle A.M. Modulation	Not Used	-	K of Kinescope	Oscilloscope or Vacuum Tube Voltmeter may be used as indicator. Sufficient input must be used to receive accurate minimum.	L208 to minimum.

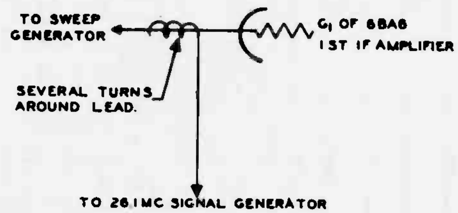
6.	Not Used	-	G_1 of 6AU6 I. F. Amplifier	24 Center Frequency. At least 6 MC Wide	K of Kinescope		L206 for maximum gain with flat response. L209 to complete flatness. If peaked, increase capacity of C216. Then readjust L209.
7.	Not Used	-	G_1 of 6BA6 2nd I. F. Amplifier	24 Center Frequency. At least 6 MC Wide	K of Kinescope		L205 to maximum flat response. L204 to level curve and maximum response.
8.	G_1 of 6BA6 1st I. F. Amplifier	26.1 No Modulation	G_1 of 6BA6 1st I. F. Amplifier	24 Center Frequency. At least 6 MC Wide	K of Kinescope	Attach Signal Generator and Sweep Generator to G_1 of 6BA6 per Note 3.	L203 to place 26.1 MC marker at 60% of slope. (See Note 2 for pattern). If pattern is not obtained, retouch adjustments L204, L205, L206, L209 and C216, with equipment as now connected, L202 for maximum flat response.
9.	G_1 of 6AK5 Converter	26.1 No Modulation	G_1 of 6AK5 Converter	24 Center Frequency At least 6 MC Wide	K of Kinescope	Attach Signal Generator and Sweep Generator to G_1 of 6AK5 as per Note 4.	L201 to maximum flat response. See Note 2 for pattern. L101 to maximum flat response with pattern per Note 2.



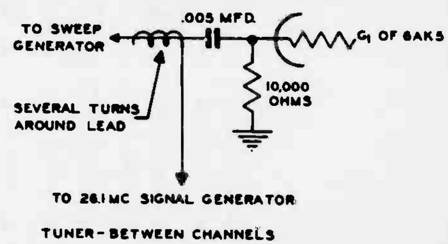
NOTE 1



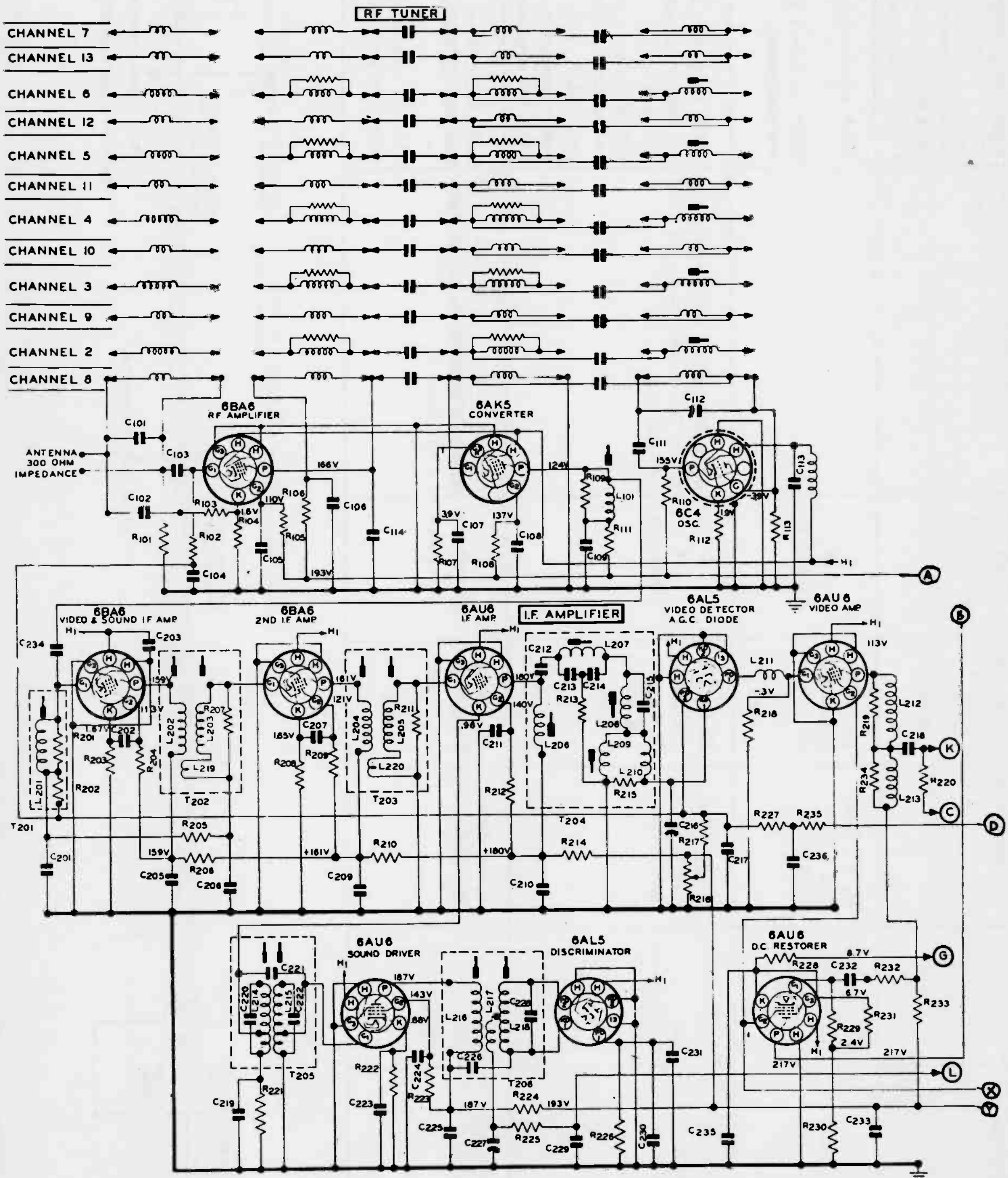
NOTE 2

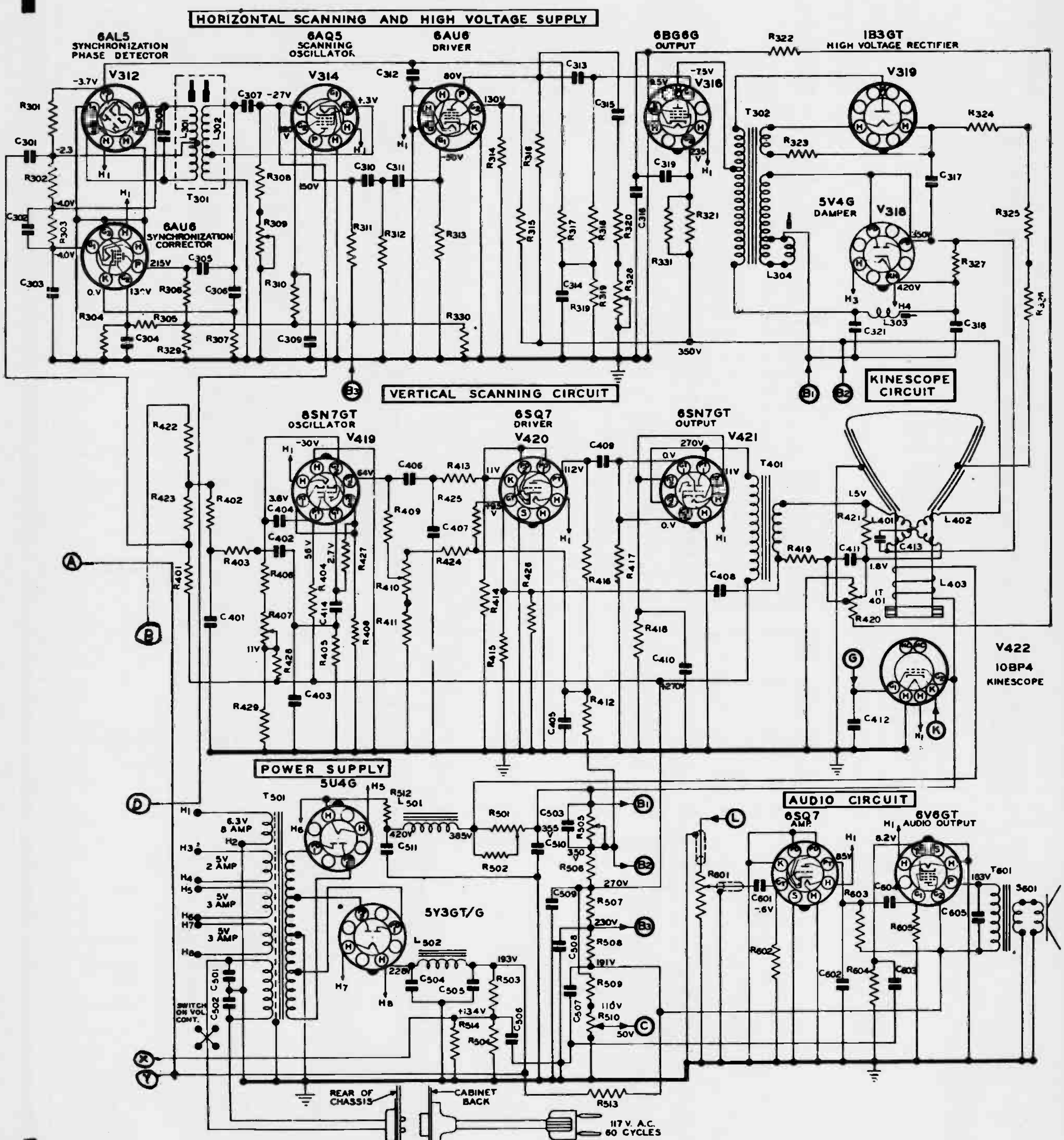


NOTE 3



NOTE 4


RF TUNER
CHANNEL 7
CHANNEL 13
CHANNEL 6
CHANNEL 12
CHANNEL 5
CHANNEL 11
CHANNEL 4
CHANNEL 10
CHANNEL 3
CHANNEL 9
CHANNEL 2
CHANNEL 8
ANTENNA 300 OHM IMPEDANCE
6BA6 RF AMPLIFIER
6AK5 CONVERTER
6C4 OSC.
6BA6 VIDEO & SOUND I.F. AMP
6BA6 2ND I.F. AMP
6AU6 I.F. AMP
I.F. AMPLIFIER
6AL5 VIDEO DETECTOR A.G.C. DIODE
6AU6 VIDEO AMP
6AU6 SOUND DRIVER
6AL5 DISCRIMINATOR
6AU6 D.C. RESTORER


HORIZONTAL SCANNING AND HIGH VOLTAGE SUPPLY
6AL5 SYNCHRONIZATION PHASE DETECTOR
V312
6AQ5 SCANNING OSCILLATOR
V314
6AU6 DRIVER
6BG6G OUTPUT
V316
1B3GT HIGH VOLTAGE RECTIFIER
V319
6AU6 SYNCHRONIZATION CORRECTOR
5V4G DAMPER
V318
T301
T302
L304
L303
VERTICAL SCANNING CIRCUIT
KINESCOPE CIRCUIT
6SN7GT OSCILLATOR
V419
6SQ7 DRIVER
V420
6SN7GT OUTPUT
V421
T401
V422
10BP4 KINESCOPE
POWER SUPPLY
5U4G
5Y3GT/G
T501
L501
L502
6.3V 8 AMP
5V 2 AMP
5V 3 AMP
5V 3 AMP
SWITCH ON VOL. CONT.
REAR OF CHASSIS
CABINET BACK
117 V. A.C. 60 CYCLES
AUDIO CIRCUIT
6SQ7 AMP.
6V6GT AUDIO OUTPUT
T601
S601

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

SCHEMATIC PARTS LIST

R. F. TUNER

Dia. No.	Description
R101	220 Ohm .5 W. 5%
R102	10,000 " .5 " 20%
R103	100 " .5 " 5%
R104	100 " .5 " 5%
R105	18,000 " .5 " 10%
R106	2,200 " .5 " 20%
R107	390 " .5 " 20%
R108	33,000 " .5 " 10%
R109	10,000 " .5 " 5%
R110	4,700 " .5 " 20%

Dia. No.	Description
R111	12,000 Ohm 1.0 W. 10%
R112	820 " .5 " 10%
R113	22,000 " .5 " 20%
C101	10 MMF Zero T.C. Ceramic
C102	680 " Ceramic
C103	680 " Ceramic
C104	680 " Ceramic
C105	680 " Ceramic

Dia. No.	Description
C106	680 MMF Ceramic
C107	680 " Ceramic
C108	680 " Ceramic
C109	680 " Ceramic
C110	(this number not used)
C111	680 MMF Ceramic
C112	Oscillator Vernier
C113	680 MMF Ceramic
C114	1.0 " Ceramic

I. F. AMPLIFIER

Dia. No.	Part No.	Description
R201	*	3300 Ohm .5 W. 5%
R202	*	10,000 " .5 " 20%
R203	N-1615	100 " .5 " 10%
R204	N-4895	10,000 " .5 " 10%
R205	N-1258	10,000 " .5 " 20%
R206	N-3663	150 " .5 " 10%
R207	*	2200 " .5 " 5%
R208	N-1615	100 " .5 " 10%
R209	N-4895	10,000 " .5 " 10%
R210	N-4280	560 " .5 " 10%
R211	*	2200 " .5 " 10%
R212	N-4895	10,000 " .5 " 10%
R213	*	91,000 " .5 " 5%
R214	N-4121	270 " .5 " 10%
R215	*	12,000 " .5 " 10%
R216	N-6977	100,000 " Contrast Control
R217	N-6053	12 Megohm .5 W. 10%
R218	N-6718	3300 Ohm .5 " 10%
R219	N-7002	36,000 " .5 " 5%
R220	N-1779	150,000 " .5 " 20%
R221	N-6485	68 " .5 " 10%
R222	N-6485	68 " .5 " 10%
R223	N-4895	10,000 " .5 " 10%
R224	N-4066	470 " .5 " 10%
R225	N-6717	33,000 " .5 " 10%
R226	N-5690	12,000 " .5 " 10%
R227	N-2976	1.0 Megohm .5 " 10%
R228	N-4064	33,000 Ohm .5 " 20%
R229	N-2976	1.0 Megohm .5 " 10%
R230	N-4895	10,000 Ohm .5 " 10%
R231	N-7001	18,000 Ohm .5 " 10%
R232	N-4823	56,000 " .5 " 10%
R233	N-7111	6800 " 2.0 " 10%
R234	N-7002	36,000 " .5 " 5%
R235	N-2976	1.0 Megohm .5 " 10%
C201	N-6887	1000 MMFD (Minimum)
C202	N-6887	1000 " "
C203	N-6272	5000 " "
C204		
C205	N-6887	1000 MMFD (Minimum)
C206	N-6887	1000 " "
C207	N-6887	1000 " "
C208		
C209	N-6887	1000 MMFD (Minumum)
C210	N-6887	1000 " "
C211	N-6887	1000 " "
C212	*	1500 " ± 20%
C213	*	51 " ± 5%

Dia. No.	Part No.	Description
C214	*	51 MMFD ± 5%
C215	*	18 " ± 5%
C216	N-6420	Trimmer
C217	N-6887	1000 MMFD (Minimum)
C218	N-7023	.25 MFD 400 V.
C219	N-6887	1000 MMFD (Minimum)
C220	*	51 "
C221	*	7.5 "
C222	*	51 "
C223	N-6887	1000 " (Minimum)
C224	N-6272	5000 " "
C225	N-6272	5000 " "
C226	*	3.3 "
C227	N-6997	10-150 " Trimmer
C228	*	47 "
C229	N-6891	2200 " 10%
C230	N-6887	1000 " (Minimum)
C231	N-6912	16 " 50 V.
C232	N-4894	.005 MFD 600 V.
C233	N-6887	1000 MMFD (Minimum)
C234	N-7021	1.875 "
C235	N-1344	.01 MFD 400 V. 10%
C236	N-1351	.1 " 200 V. −10 +20%
T201	N-6970	1st IF Transformer
T202	N-6963	2nd IF "
T203	N-6964	3rd IF "
T204	N-6965	4th IF "
T205	N-6966	Sound IF Transformer
T206	N-6967	Ratio Detector
L201	*	Contained in 1st IF Transformer
L202	*	" in 2nd IF "
L203	*	" in 2nd IF "
L204	*	" in 3rd IF "
L205	*	" in 3rd IF "
L206	*	" in 4th IF "
L207	*	" in 4th IF "
L208	*	" in 4th IF "
L209	*	" in 4th IF "
L210	*	" in 4th IF "
L211)	N-6969	Detector Peaking Coil
L212)	N-6968	Video Peaking Coil
L213)		
L214	*	Contained in Sound IF Transformer
L215	*	" " " " "
L216	*	" " Ratio Detector
L217	*	" " " "
L218	*	" " " "

*Resistors & Condensers shown with an Asterisk (*) are contained in cans.

HORIZONTAL SCANNING AND HIGH VOLTAGE SUPPLY

Dia. No.	Part No.	Description
R301	N-5694	470,000 Ohm .5 W. 10%
R302	N-5694	470,000 " .5 " 10%
R303	N-4027	470,000 " .5 " 20%
R304	N-7012	27,000 " 1.0 " 10%
R305	N-7011	18,000 " 1.0 " 10%
R306	N-7012	27,000 " 1.0 " 10%
R307	N-6998	10 " .5 " 20%
R308	N-4451	27,000 " .5 " 10%
R309	N-6901	5000 " Horizontal Position
R310	N-7154	4700 " 1.0 W. 10%
R311	N-7018	4700 " 2.0 " 10%
R312	N-4630	6800 " .5 " 10%
R313	N-2976	1.0 Megohm .5 " 10%
R314	N-4823	56,000 Ohm .5 " 10%
R315	N-7015	68,000 " 1.0 " 10%
R316	N-7117	750,000 " .5 " 5%
R317	N-2973	100,000 " .5 " 10%
R318	N-2976	1.0 Megohm .5 " 10%
R319	N-2976	1.0 " .5 " 10%
R320	N-7000	4700 Ohm .5 " 20%
R321	N-7019	11,000 " 2.0 " 5%
R322	N-6379	68 " 1.0 " 10%
R323	N-7024	3.3 " .5 " 10%
R324	N-7020	22,000 " 2.0 " 20%
R325	N-7020	22,000 " 2.0 " 20%
R326	N-7020	22,000 " 2.0 " 20%
R327	N-6929	10,000 " 10.0 " Koolohm
R328	N-7113	25,000 " Horizontal Linearity
R329	N-7127	39,000 " 2.0 W. 10%
R330	N-7125	82,000 " 1.0 " 10%
R331	N-1778	100,000 " .5 " 20%

Dia. No.	Part No.	Description
C301	N-6889	82 MMFD Mica 20%
C302	N-1344	.01 MFD 400 V.
C303	N-1345	.05 " 200 "
C304	N-1623	.1 " 400 "
C305	N-6892	3900 MMFD 500 V. 10% Mica
C306	N-4927	.015 MFD 400 V.
C307	N-6892	3900 MMFD 500 V. 10% Mica
C308	N-1376	.02 MFD 400 V. 20%
C309	N-1346	.05 " 400 V.
C310	N-6890	390 MMFD 500 V. 10% Mica
C311	N-1344	.01 MFD 400 V.
C312	N-1351	.1 " 200 V.
C313	N-1478	.01 " 600 V.
C314	N-1344	.01 " 400 V.
C315	N-7114	470 MMFD 500 V. 5%
C316	N-1479	.25 MFD 200 V.
C317	N-6917	500 MMFD 10,000 V.
C318	N-1623	.1 MFD 400 V.
C319	N-1973	.02 " 600 V. 20%
C320		
C321	N-7116	.035 MMFD 400 V. 10%
T301	N-6930	Horizontal Sync. Coil
T302	N-6923	Horizontal Output Transformer
L301	*)	Contained in
L302	*)	Horizontal Sync. Coil
L303	N-6962	Linearity Coil
L304	N-6928	Width Control Coil

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

VERTICAL SCANNING

Dia. No.	Part No.	Description
R401	N-5692	39,000 Ohm .5 W. 10%
R402	N-7003	180,000 " .5 " 10%
R403	N-7003	180,000 " .5 " 10%
R404	N-7014	56,000 " 1.0 " 10%
R405	N-4895	10,000 " .5 " 10%
R406	N-3450	1.5 Megohm .5 " 10%
R407	N-6903	1.0 " Vertical Hold Control
R408	N-3341	1000 Ohm .5 W. 10%
R409	N-4899	220,000 " .5 " 10%
R410	N-6906	.5 Megohm Height Control
R411	N-7005	330,000 Ohm .5 W. 10%
R412	N-7003	180,000 " .5 " 10%
R413	N-6012	22,000 " .5 " 10%
R414	N-5693	68,000 " .5 " 10%
R415	N-7006	680,000 " .5 " 5%
R416	N-4469	820,000 " .5 " 10%
R417	N-1262	1.0 Megohm .5 " 20%
R418	N-3341	1000 Ohm .5 " 10%
R419	N-6999	15 " .5 " 5%
R420	N-6902	40 " Vertical Center Control
R421	N-4280	560 " .5 W. 10%
R422	N-4468	150,000 " .5 " 10%
R423	N-7124	47,000 " .5 " 10%
R424	N-7005	330,000 " .5 " 10%
R425	N-7118	20 Megohm .5 " 5%

Dia. No.	Part No.	Description
R426	N-2976	1.0 Megohm .5 W. 10%
R427	N-7119	3.3 " .5 " 10%
R428	N-4469	820,000 Ohm .5 " 10%
R429	N-6717	33,000 " .5 " 10%
C401	N-4894	.005 MFD 600 V.
C402	N-1623	.1 " 400 "
C403	N-4894	.005 " 600 "
C404	N-6893	4700 MMFD Mica 10%
C405	N-6897	.5 MFD 400 V.
C406	N-7023	.25 " 400 "
C407	N-6896	.5 " 200 "
C408	N-1376	.02 " 400 "
C409	N-7022	.1 " 400 "
C410	N-6911	100 " 15 "
C411	N-6915	1.0 Ohm Impedance at 60 Cycles
C412	N-1367	6 MFD 150 V.
C413	N-6888	56 MMFD 500 V. 5% Mica
C414	N-1345	.05 MFD 200 V.
L401	N-6922	Vertical Yoke Coil
L402		Horizontal Yoke Coil
L403	N-6918	Focus Coil
IT401	N-6971	Ion Trap
T401	N-6920	Vertical Output Transformer

POWER SUPPLY

Dia. No.	Part No.	Description
R501	N-6978	1000 Ohm Focus Control
R502	N-7016	220 " 2.0 W. 20%
R503	N-7126	2700 " 2.0 " 10%
R504	N-2970	15,000 " 2.0 " 10%
R505	N-6905	40 " Horizontal Center Control
R506	N-6927	915 " 7.0 W.
R507		650 " 4.0 "
R508	N-7017	1200 " 2.0 " 10%
R509	N-7013	39,000 " 1.0 " 10%
R510	N-6907	25,000 " Brightness Control
R512	N-6311)	
in	N-6311)	250 " 20%
Parallel	N-6311)	
R513	N-4900	1200 " 1.0 W. 10%
R514	N-2970	15,000 " 2.0 " 10%

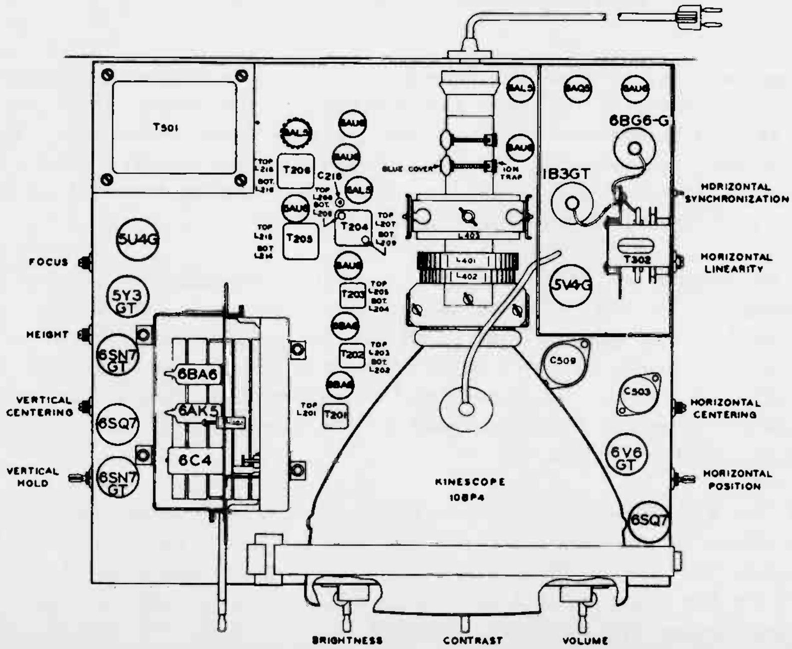
Dia. No.	Part No.	Description
C501	N-6979	.01 MFD 600 V.
C502	N-6979	.01 " 600 V.
C503	N-6916	.5 Ohm Impedance at 15,750 Cycles
C504	N-6914	50 MFD 300 V.
C505		50 " 300 V.
C506		20 " 250 "
C507	N-6908	40 " 350 "
C508		20 " 350 "
C509	N-6913	.25 " 400 "
C510	N-6909	40 " 450 "
C511		40 " 450 "
L501	N-6919	High "B" Supply Choke Filter
L502	N-6924	Low "B" " " "
T501	N-6925	Power Transformer

AUDIO CIRCUIT

Dia. No.	Part No.	Description
R601	N-6904	.5 Meg. Volume Control
R602	N-4028	6.8 Megohm .5 W. 20%
R603	N-7004	270,000 Ohm .5 " 10%
R604	N-7007	270 " 1.0 " 10%
R605	N-4027	470,000 " .5 " 20%
C601	N-1344	.01 MFD 400 V.
C602	N-6015	100 MMFD

Dia. No.	Part No.	Description
C603	Part of N-6908	100 MFD 15 V.
C604	N-1376	.02 MFD 400 V.
C605	N-4894	.005 " 600 V.
S601	N-6961	5" P.M. Speaker
T601	N-6932	Audio Output Transformer

TUBE LAYOUT & TRIMMER ADJUSTMENTS



Sonora Television Radio Receiver Model 700

R.F. TUNER ADJUSTMENT

This tuner is equipped with 12 independent tuner strips fastened on a drum. These strips can be removed for adjustment by removing the nuts at the end of each strip. The first coil from the front of the tuner is the oscillator section. If the fine tuning control does not have sufficient range to tune in the audio on a channel, it may be necessary to adjust the oscillator coil inductance to a value which will permit the sound channel to be tuned in. This can be accomplished by feeding an FM modulated signal into the antenna at the sound frequency as given on the Frequency Chart below.

Channel No.	Channel Freq.MC.	Picture Carrier M.C.	Sound Carrier M.C.	Receiver RF. Osc. M.C.
2	54-60	55.25	59.75	81.35
3	60-66	61.25	65.75	87.35
4	66-72	67.25	71.75	93.35
5	76-82	77.25	81.75	103.35
6	82-88	83.25	87.75	109.35
7	174-180	175.25	179.75	201.35
8	180-186	181.25	185.75	207.35
9	186-192	187.25	191.75	213.35
10	192-198	193.25	197.75	219.35
11	198-204	199.25	203.75	225.35
12	204-210	205.25	209.75	231.35
13	210-216	211.25	215.75	237.35

IF. FREQ. M.C.

Picture Carrier	26.1
Sound Carrier	21.6
Adjacent Channel Sound Trap	27.6

Remove the strip and vary oscillator inductance. If the fine tuning condenser is at a minimum capacity it will be necessary to decrease the oscillator inductance, or if the condenser is at maximum capacity, it will be necessary to increase the oscillator inductance. On Channels 2 to 6 inclusive, the inductance is varied by means of a brass slug in the oscillator coil. On Channels 7 to 13 inclusive it will be necessary to vary the inductance of the coil by spreading or compressing the turns to decrease or increase inductance.

For adjustment of the Antenna and R.F. sections, it will be necessary to connect a sweep generator to the antenna, sweeping the correct frequency of the channel being adjusted. Before attempting to make the adjustment of any given channel, adjust the oscillator by means of the fine tuning control to the correct frequency as given on the Frequency Chart. This can be done by setting the signal generator on sound carrier frequency and adjusting fine tuning for maximum sound. The oscilloscope should be connected to the cathode of the kinescope as described on the Chart Step No. 2 of picture and sound I.F. adjustments.

The inductance of the R.F. section should be adjusted to give maximum gain without materially altering the wave shape as obtained on the scope for I.F. adjustment. The R.F. coils are the second and third coils from the front of the tuner. The antenna can also be adjusted in the same manner. This coil is the rear coil of the strip. These adjustments are made by spreading or compressing the coils as required.

STROMBERG-CARLSON SERVICE NOTES

TELEVISION RECEIVER TV-12

SERIES 10-11

CIRCUIT DESCRIPTION

(See Schematic Diagram)

R. F. Tuner

The incoming signals picked up by the antenna are conducted to the input of the television receiver by means of a 75 ohm, low-loss transmission line (coaxial cable). The transmission line is terminated by the cathode input circuit of the grounded-grid 6J6 RF Amplifier (V101). This input circuit is capacity coupled to the transmission line by means of capacitor C101. The untuned input circuit has been designed so that it presents the proper impedance match to the transmission line over the entire tuning range from 44 to 216 megacycles. The inductance L106 in parallel with the antenna input, provides a high-pass, radio-frequency filter to suppress broadcast-band or other low-frequency, cross-modulation, interference which may arise when the television receiver is located in an extremely intense field of an AM broadcast station or other radiator.

The plates of the 6J6 RF Amplifier (V101) are coupled to the grid of the 6AK5 Converter (V102) by means of a six megacycle wide coupling network. The variable series coil combinations consisting of L101-L102-A and L104-L102-B tune to the desired signal frequency in conjunction with the associated tube capacities and the coupling network consisting of C105, C106 and C107. Resistors R110 and R104 reduce the "Q" of the respective coils considerably in order for the coupling network to maintain the very wide pass band.

The RF Oscillator utilizes one section of the twin triode 6J6 (V103) in a modified Colpitts Oscillator circuit, and its frequency is on the high side of the signal. The feedback voltage of the oscillator is accomplished by means of the interelectrode capacity of the vacuum tube. The oscillator frequency is tuned by movement of the tap on the coil L102C which short circuits a portion of the coil. The oscillator circuit is factory aligned to track with the signal circuits (located in the plate of the RF Amplifier V101) by adjusting the inductance of L105 and capacitance of C111.

The oscillator output is coupled to the grid of the Converter (V102) by means of the small capacitator C112. The incoming signal is also fed into the grid of V102 and the resulting IF signal appearing on the plate is fed into the first video IF transformer.

Video IF Amplifier

The video IF amplifier chain consists of three stages (V201, V202 and V203) using the type 6AG5 sharp cutoff high gain pentode. Each video IF coupling network consists of two adjustable coils which are resonant with their respective tube capacities and coupling networks. The first video IF coupling network utilizes shunt inductive coupling. The second, third and fourth video IF coupling networks use the series type of inductive coupling. The two parallel resonant traps in the series arm of the pi network in the third coupling network provide a high degree of attenuation to the associated sound carrier and to the sound carrier of the adjacent channel.

The grids of the First and Second Video IF stages (V201 and V202) are returned to a variable negative bias provided by the Contrast Control, which thus varies the gain of the IF amplifier. The Third Video IF amplifier stage is operated at maximum gain. The input to the FM sound IF amplifier system is taken from the plate of the First Video IF amplifier (V201).

The output of the fourth video IF coupling network is fed into one diode section of the 6AL5 Video Detector (V204A) and the diode load which consists of the resistor R219 and peaking coils L213 and L214.

Video Amplifier

The grid of the Video Amplifier 6AC7 (V205) is directly connected to the diode load. A fixed bias of —3 volts (when no signal is present) is maintained on the grid of the Video Amplifier by returning the low potential end of the diode load resistor R219 to the —3 volt point of the bleeder resistor network consisting of R216, R220 and R233.

The plate of the video amplifier is coupled to the 12JP4 Picture Tube (V206) by means of the resonant trap, consisting of L216 and C217, and capacitor C218. This resonant trap provides the video amplifier section with an extremely sharp cutoff characteristic at 4.5 megacycles and thus attenuates the beat of the sound carrier and video carrier to prevent it from interfering with the picture.

DC Restorer and Sync Separator

The plate of the Video Amplifier is also coupled to the second section of the 6AL5 (V204B) diode and its associated circuit containing R256, R225 and C282. This circuit rectifies the composite video signal and reinserts its DC component on to the grid of the Picture Tube (V206). This diode also serves as a sync separator only negative sync pulses appearing across the output resistor R225.

Picture Tube Controls

The Brightness Control, R227, varies the positive DC bias on the cathode of the picture tube so as to vary the picture background brightness. The Bias Control, R229 (one of the non-operational controls located on the top of the chassis near the front) varies the positive voltage on the second grid of the picture tube.

Sync Clippers

The sync pulses developed across R225 and C282 are coupled into the two sync clipper stages consisting of V212A and V213. The clipper stages amplify and clip both top and bottom of the sync pulses. The sync pulses developed on the plate of the second stage remain substantially constant in amplitude over a wide range of input signal levels.

Vertical Deflection

The output of the second sync clipper is fed into the 6SN7 Vertical Buffer (V216A) with an integrating network used as the plate load. The integrating network adds the six vertical pulses into one pulse which is then fed into the primary of the vertical sawtooth generator transformer T201. The Vertical Sawtooth Generator, 6SN7, (V216B) then can be locked into synchronization with this pulse by adjusting the Vertical Hold Control R275. The Vertical Size Control, R277 varies the B supply voltage to the sawtooth generator and thus varies the vertical size.

The Vertical Deflection Amplifier (V217) amplifies the incoming signal so that it will have the power to deflect the picture tube to the correct height. The Vertical Linearity Control R281 varies the cathode bias of the Vertical Deflection Amplifier. This control interacts with the Vertical Size Control, so that when changing either the vertical size or the linearity, both controls will have to be adjusted.

The signal coming from the Vertical Deflection Amplifier is fed into the vertical deflection coils by means of the vertical output transformer T202. The Vertical Positioning Control R284, in conjunction with the Vertical Positioning Switch S203 adjusts the amount and polarity of DC current so the picture can be centered in the vertical direction on the screen of the picture tube.

Horizontal Sync and Deflection

The output of the sync clippers is also fed into the 6AL5 Horizontal Sync Discriminator (V214) through resistors R264, R263, and capacitor C247. The time constant of this combination is such that if either a wide vertical pulse or a narrow horizontal pulse is applied from the sync clipper plate, only sharps pips will result.

The resulting pulse is fed into the horizontal sync transformer Z204. At the same time the sine wave 6K6 Horizontal Oscillator (V215) impresses a sine wave on the secondary of the sync transformer, making one end of the transformer primary to have a sine wave 180° out of phase with the sine wave at the other end. The combination pulse and sine wave causes current to flow in each diode, the resultant being 0 at pin 7 of V214 if the currents are equal. If the frequency of the oscillator tries to change, the pulse will ride at a different point on the sine wave, causing a change of current in each diode resulting in a change of potential at pin 7 of V214. This voltage is then applied to the grid of the 6AC7 Reactance Tube (V220) through the network C265, R289, C266 which filters the voltage. The change of voltage on the grid causes a change of plate current in V220 which changes the inductive reactance of the tube (which is connected across the tuned circuit of the oscillator) in such a way as to bring the tuned circuit resonance back to where it was. This automatically keeps the oscillator at the horizontal sync or line frequency rate.

The phase control on the sync transformer Z204 adjusts the phase of the pulse with respect to the sine wave. This is adjusted so that the picture tube will have its horizontal sweep start at the correct moment in order to place all the picture information on the screen and none in the blanking interval. The hold control on the transformer adjusts the frequency of the oscillator.

The output from the plate of the Horizontal Oscillator is fed into the differentiating network consisting of capacitor C251 and resistor R268. The tips of the differentiated pulses shown in Figure 30 cause the Horizontal Sawtooth Generator (V212B) to discharge the sweep generating capacitor C271, in the plate circuit. The discharge network, consisting of R315, C271 and the Horizontal Drive Control R297, is returned to the most negative point in the power supply through the cathode bias resistor R300. The Horizontal Drive Control adjusts the shape of the wave being applied to the grid of the Horizontal Deflection Amplifier (V221) and therefore affects the horizontal linearity and size. This wave applied to the grid of V221 causes the tube to be conducting except for the time the negative pip of the wave is present. Current is made to flow in the horizontal yoke when the tube is conducting. When the tube is cut off, the current in the yoke collapses in a very short time, resulting in a very high negative voltage pulse across the yoke. This high voltage pulse becomes opposite in polarity and therefore positive on the priming of the output transformer and reaches an amplitude of about 4000 volts.

Horizontal Damping and High Voltage Power Supply

The 5V4 Horizontal Damping Tube (V223) and the damping resistor R304 critically damp the overshoot of the horizontal deflection yoke, which takes place as a result of energy storage in the yoke.

The horizontal linearity network consisting of L219, C275 and C276 is used to set the time at which the damper V223 will start conducting. By so doing, the waveform of the current in the deflection coil is governed to give good linearity. The Horizontal Positioning Control R305 controls the DC current through the horizontal deflection coils and thus the position of the picture in the horizontal direction.

The high voltage is obtained as follows: A pulse of 4000 volts is at the plate of V221. By adding more turns to the primary of T204 the voltage of this pulse can be increased. Then, this high voltage pulse is rectified by the H. V. Rectifier (V222) and then filtered by C277 and applied to the picture tube anode. The heater for the high voltage rectifier is also obtained from the energy in transformer T204.

Sound IF Channel

The sound is taken off at the plate of the 1st video IF and fed into the First Sound IF (V207) through C222, a small coupling capacitor. T201 is tuned to 21.9 mc which is the sound carrier frequency. After the sound signal is amplified in V207 it is limited in the 2nd Sound IF (V208) and detected in T203 and V209. R244 and C234 make up the de-emphasis network.

Power Supply

The low voltage power supply of the television receiver is obtained from a pair of 5U4G rectifiers (V218, V219) connected for full wave, high current rectification, with conventional filtering.

The low voltage power is applied to the receiver by the closing of the time delay relay K201. This relay is energized by the diode current of the 6AL5 (V224). The relay circuit has been designed so that the relay is energized approximately ten seconds after the power is applied to the television receiver. In this way all tubes have heated up and the capacitors are thereby protected from the initial high surge voltage.

Focus Coil and Control

The focus coil, L218, is in series with the section of the power supply which delivers 300 volts to most of the circuits, the current drain of these circuits thus providing the focus current. The focus current is adjusted to bring the picture tube to precise focus by means of the Focus Control R288, which is a variable resistor shunted, together with R286B, across the focus coil.

OPERATION

To Operate the Receiver*

1. Before turning the set on, turn brightness control and volume control off and turn the contrast fully on .
2. Turn the set on by rotating the master control switch to TV-FM position and wait three minutes for warm-up.
3. Set selector switch on the television panel to the first TV position.
4. Using the tuning control, tune in the desired station by setting the channel number on the cross-hair and adjust for maximum closing of the tuning eye. If the tuning eye has a square face on it, adjust the receiver to the point where the movable green strip is even with the stationary one, after it has made an excursion in either an up or down direction.

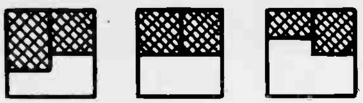


Figure 1.

MISTUNED TUNED MISTUNED

5. Turn contrast control all the way down and brightness control up until the picture tube just begins to show light.
6. Adjust contrast control until the picture is correctly shaded.
7. Adjust the focus control for a sharp picture and if necessary, readjust brightness and contrast for best reception.
8. Adjust sound volume to desired level and if needed, readjust the tuning control for undistorted sound.
9. Turn selector switch to extreme clockwise position to extinguish the dial light and tuning indicator.
10. To turn the television receiver off, turn the master control switch to the "Off" position.

When all the controls are adjusted properly, the picture obtained should be normal as shown below:

Fig 2. NORMAL PICTURE

Photographs Courtesy RCA

If the front panel controls are misadjusted, the picture will look like one or a combination of these:

Fig. 3. FOCUS Misadjusted

Fig. 4. CONTRAST Misadjusted

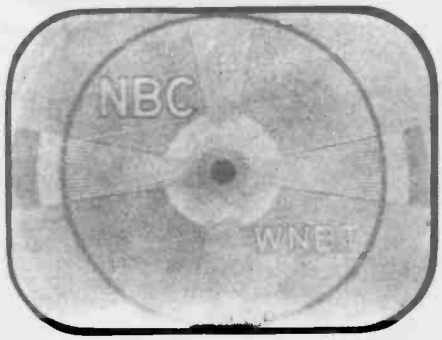


Fig. 5. BRIGHTNESS Misadjusted

Fig. 6. FINE TUNING Misadjusted

* On the TV-12LM the procedure is the same except that the set is turned on by rotating the volume control clockwise until a click is heard. The volume control on these sets is located between the selector switch and brightness controls. Disregard references to master control switch.

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Non-Operating Controls

Along the back flange of the receiver chassis base are a group of controls. These controls should be set correctly at the time of installation. The function of each control is labelled and they are vertical positioning, horizontal positioning, vertical linearity, vertical size, vertical hold, and horizontal drive controls.

Also on the back flange is the vertical positioning switch. If the picture cannot be centered vertically with the vertical positioning control, throwing the switch will make it possible to do so.

Located on a bracket on the outside of the high voltage cage is a slug tuned coil. This coil is a horizontal width control. There is one more horizontal control located in the under side of the chassis below the high voltage enclosure. This is a slug tuned coil and it adjusts the horizontal linearity.

The effect of misadjustment of these controls is shown here:

Fig. 7. VERTICAL POSITIONING Misadjusted

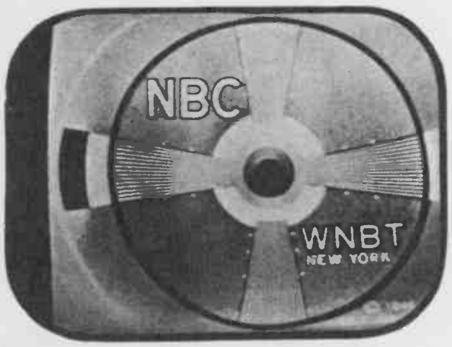

Fig. 8. HORIZONTAL POSITIONING Misadjusted

Fig 9. VERTICAL LINEARITY Misadjusted

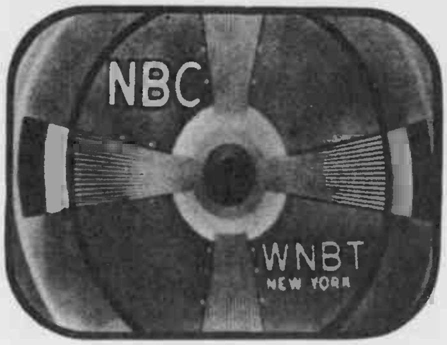

Fig. 10. VERTICAL SIZE Misadjusted

Fig. 11. VERTICAL HOLD Misadjusted

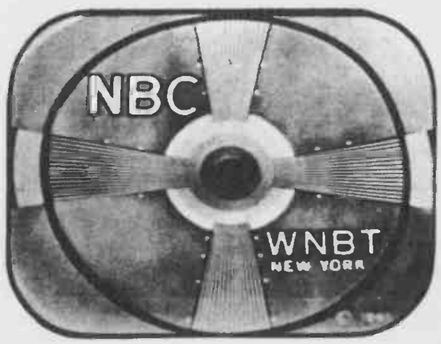

Fig. 12. HORIZONTAL DRIVE or HORIZONTAL LINEARITY Misadjusted

Near the rear of the chassis is the Automatic Frequency Control Transformer for the horizontal sweep. The hexigonal thumb nut at the top of this AFC transformer adjusts the frequency of the horizontal oscillator. If this is out of adjustment, the picture will appear as in

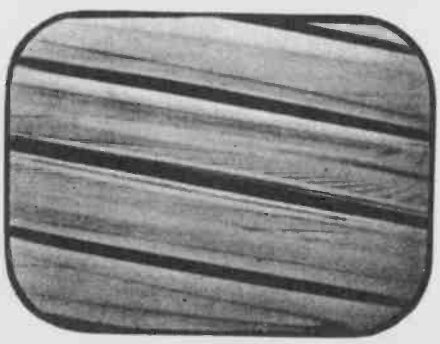

Fig. 13. HORIZONTAL HOLD Misadjusted

Fig. 13. On the bottom end of this transformer is a screwdriver adjustment which controls the phase of the horizontal sweep. When this control is misadjusted, the picture will not be centered as in Fig. 8, and will be folding back on itself. Adjust this so that neither edge of the picture will have a fold in it.

FM OPERATION

For FM reception, turn master control switch to TV-FM position and set selector switch on television panel to FM.

Use volume and tone control in radio set in normal manner.

To select desired station, rotate tuning control until the FM window on the rear (slow speed dial) is visible. The frequency to which the set is tuned is indicated by the numbers (88 to 108) on the front (high speed) dial that coincides with the hair line. Adjust for maximum closing of the tuning indicator. Final setting should be made for clearest sounding reception.

ALIGNMENT

ALIGNMENT OF THE R. F. TUNER

The equipment necessary to align the R. F. tuner is this:

1. Sweep generator having at least a 10 mc bandwidth and a frequency range of 40 to 225 mc.
2. Signal generator covering the same frequency range.
3. Oscilloscope with good 60 cycle response and a good Y axis amplifier.
4. A good vacuum tube D-C voltmeter.
5. A dummy shield with cutouts where the coils can be reached to be bent in aligning. With this shield in place and with all the leads connected and the picture tube removed, the unit can be aligned. If the screws holding the tuner to the chassis are left off, the tuner can be turned to a slight angle to allow better access to the coils.

Oscillator Alignment

Before starting, make sure that the I. F. system is in proper alignment. Inject a modulated signal generator into the antenna terminals of the receiver and connect the D-C voltmeter to the cathode (pin 5) of the sound discriminator, V209. Set the dial exactly on channel 4. Set the signal generator exactly on 71.75 mc. Rotate C111 until a zero balance is obtained in the D-C voltmeter.

With the signal generator set at 215.75 mc, and the dial changed to channel 13, adjust L-105 by pulling or squeezing until a null is obtained in the D-C voltmeter again.

Now check each channel against the signal generator to see if it is on frequency and readjust if necessary.

Channel #	Sound Frequency	Channel #	Sound Frequency
1	49.75	7	179.75
2	59.75	8	185.75
3	65.75	9	191.75
4	71.75	10	197.75
5	81.75	11	203.75
6	87.75	12	209.75
		13	215.75

Band Pass Alignment

With the connections the same as above, set the signal generator on 65.75 mc and tune the receiver for a null in the D-C voltmeter. Then connect a sweep generator to the antenna input and the Y axis of an oscilloscope to the screen of the 6AK5 converter (pin 6). By adjusting C107, C105, and C106 an inverted W can be obtained with the peaks about 4.5 mc apart. The signal generator can be used to superimpose a signal on the sweep and in this way check the frequency of the peaks, which should be at 61.25 mc and 65.75 mc. Adjust the capacitors so the valley does not exceed 30%.

With the signal generator set at 215.75 mc, tune the receiver to channel 13 for a null in the D-C voltmeter in the discriminator. Then with the sweep generator reconnected adjust L101 and L104 for a pass band to include 215.75 mc and 211.25 mc. The band-width should not exceed 6 mc.

I. F. ALIGNMENT

The equipment necessary to align the I. F. system is this:

1. Sweep generator having a 10 mc. bandwidth and a frequency range of 20 to 30 mc.
2. Signal generator covering the same frequency range, to be used as a marker. Note—This will not be needed if the sweep generator has a built in marker generator (such as the Hickok 610).
3. Oscilloscope with good 60 cycle response and a good Y axis amplifier.
4. A D-C vacuum tube voltmeter.

When it becomes necessary to align the I. F. of this receiver, it is best to follow the I. F. Alignment chart. If the traps and sound I. F. are aligned with the signal generator set up and left on 21.9 mc., as done on the chart, the traps will be sure to be on the same frequency as the sound detector.

The grid of the converter tube can be reached only from the top side of the chassis. Wrap a small wire around the tube pin which is the grid (pin 1). Then place some spaghetti over the lead to insulate it from the chassis and bring it out the hole in the tube socket shoulder. With the tube in place, the generator

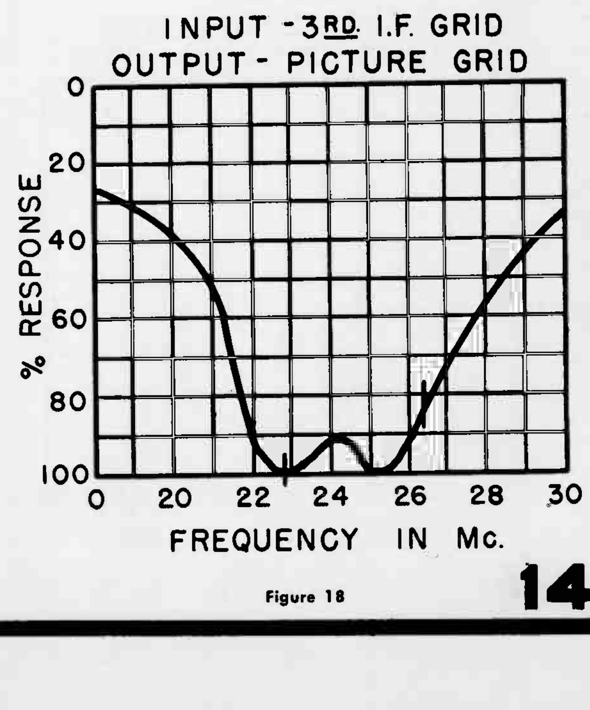

Figure 18

I. F. ALIGNMENT CHART

A. Traps and Sound

	Adjust	Type of Signal Input	Input Connection	Type of Signal Output	Output Connection	What To Adjust For
1.	L216	Sig. Gen., 30% Mod. at 4.5 mc.	Grid of video amp. V205 (pin 4)	D.C. Voltmeter*	Picture Tube Grid V206 (pin 2)	Minimum Reading (Keep brightness control reduced in steps 1&2)
2.	L222 Z201 primary (top)	Sig. Gen., 30% Mod. at 21.9 mc.	Grid of conv. V102 (pin 1)	" *	"	Minimum Reading
3.	Z201 Secondary (Bottom) Z202	"	"	"	Junction of R238, C228, R235 in limiter grid	Maximum Reading
4.	Z203	"	"	"	Sound Detector V209 (pin 5)	Detune secondary (top) Peak primary (bottom) Align secondary to zero

B. Video

	Adjust	Type of Signal Input	Input Connection	Type of Signal Output	Output Connection	What To Adjust For
1.	L210 L212	Sweep Gen. plus Sig. Gen.	Grid of 3rd Video IF. V203 (pin 1)	Oscilloscope	Picture Tube Grid V206 (pin 2)	Figure 18
2.	L207 L209 L208	"	Grid of 2nd Video IF. V202 (pin 1)	"	"	Figure 19
3.	L204 L206	"	Grid of 1st Video IF. V201 (pin 1)	"	"	Figure 20
4.	L201 L203	"	Grid of Conv. V102 (pin 1)	"	"	Figure 21

* These coils can also be adjusted for a minimum of horizontal bars on the screen of the picture tube in place of the D.C. voltmeter.

can be connected to the lead and the alignment can be carried out. If desired, a permanent connection can be made to the tube pin with solder and then this special tube can be plugged in each time a set is aligned.

If it becomes necessary to look at each stage separately, which may happen when trouble shooting, a detector circuit will have to be used. In Figure 22, a circuit is shown using a 1N34 crystal. Also shown is a phase control circuit which is to be used in conjunction with some sweep generators. If a "Hickok 610" or a "Mega-Sweep" is used, a phase control will not be necessary.

After aligning the I. F., readjust any of the coils to get the proper overall curve as shown in Figure 21.

The location of the coils to be tuned is shown in Figure 36 and Figure 37.

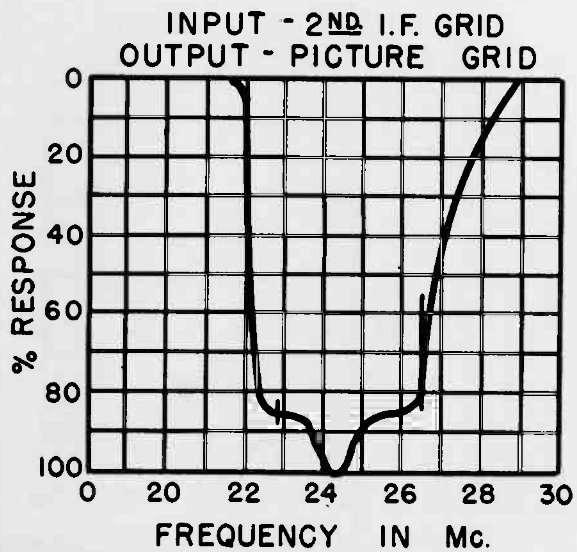

Figure 19

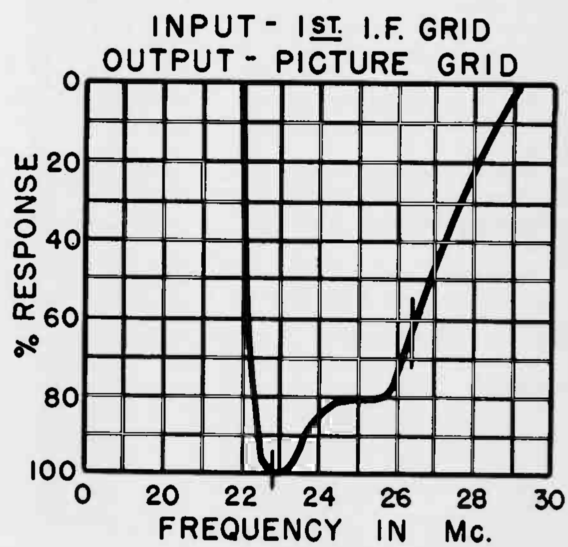

Figure 20

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ALIGNMENT AND TUBE LOCATION CHART

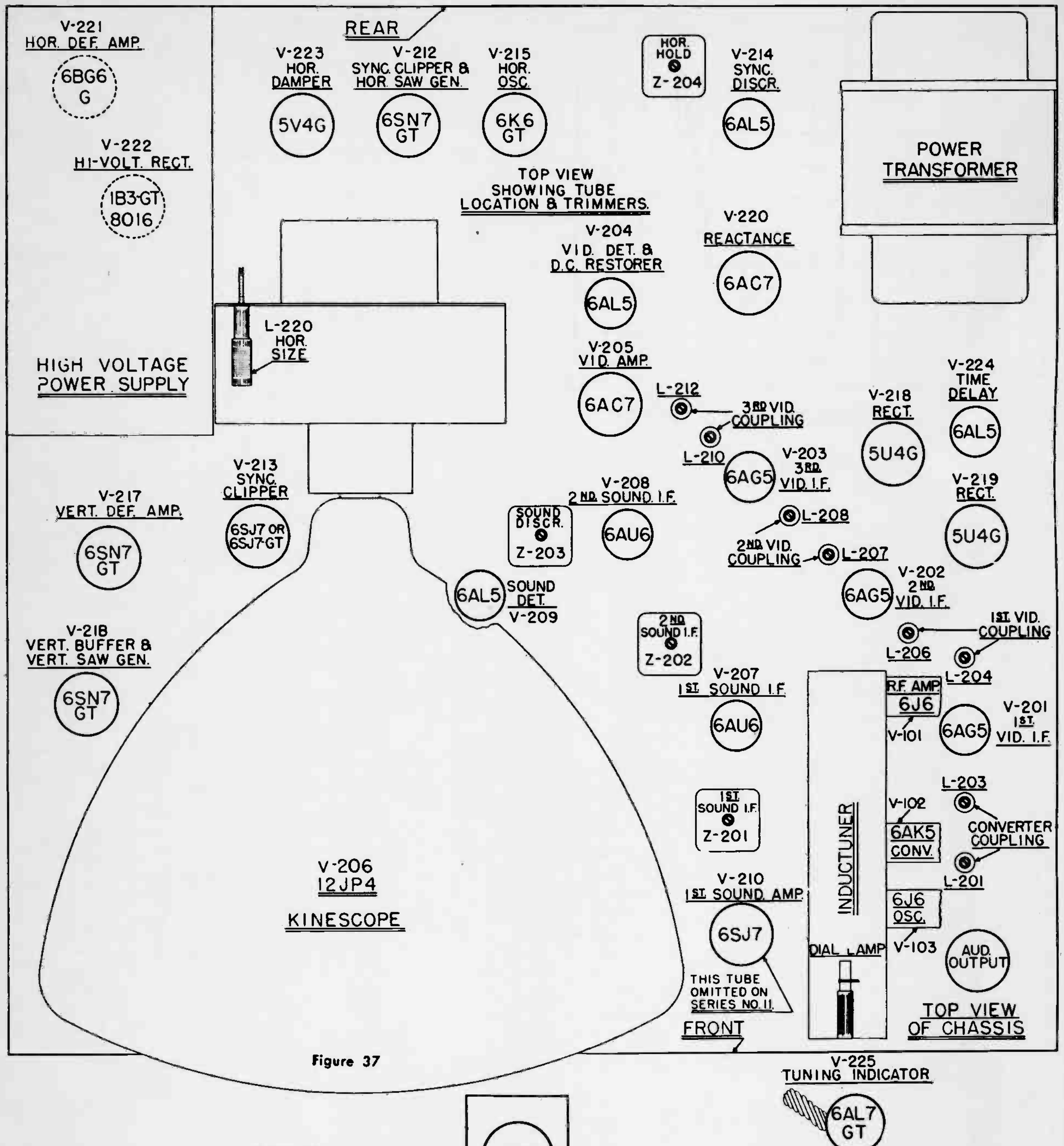


Figure 37

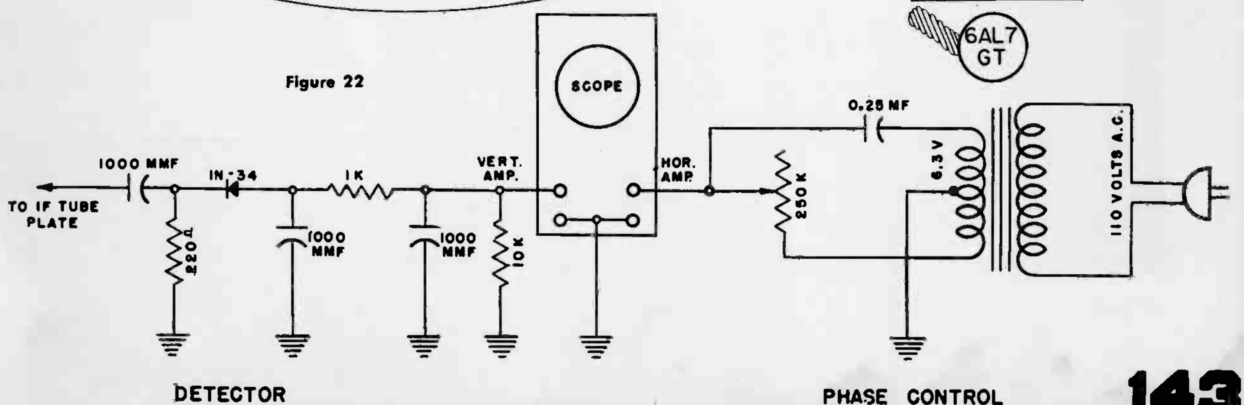


Figure 22

MOST-OFTEN-NEEDED 1948 TELEVISION RECEIVERS

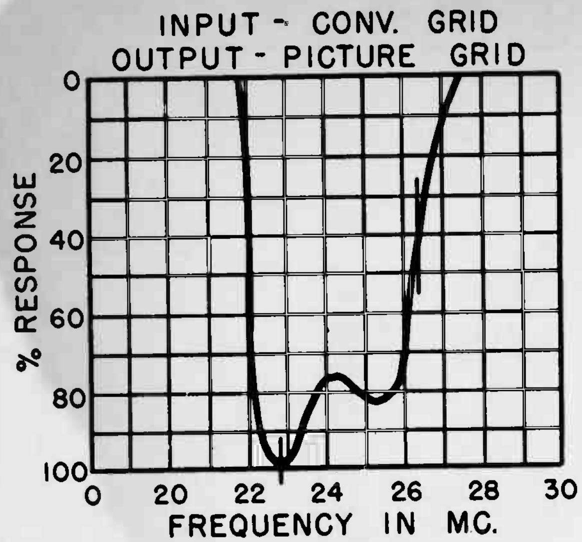


Figure 21

ALIGNMENT AND VOLTAGE CHART

MEASUREMENTS ARE MADE AT 117 V LINE USING 20,000 OHM VOLTMETER. ALL VOLTAGES ARE D.C. AND ARE POSITIVE WITH RESPECT TO CHASSIS GROUND EXCEPT WHERE NOTED.

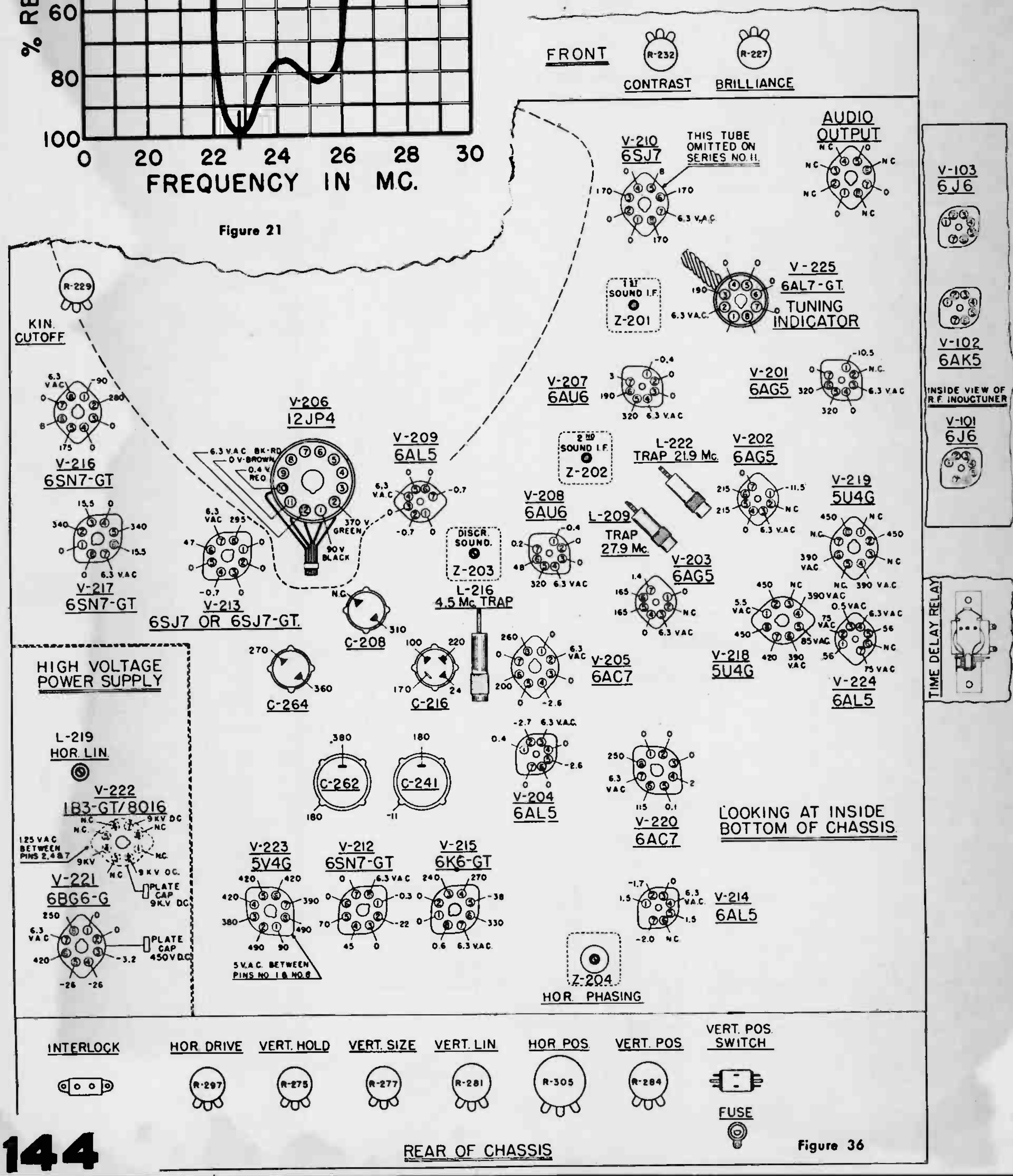
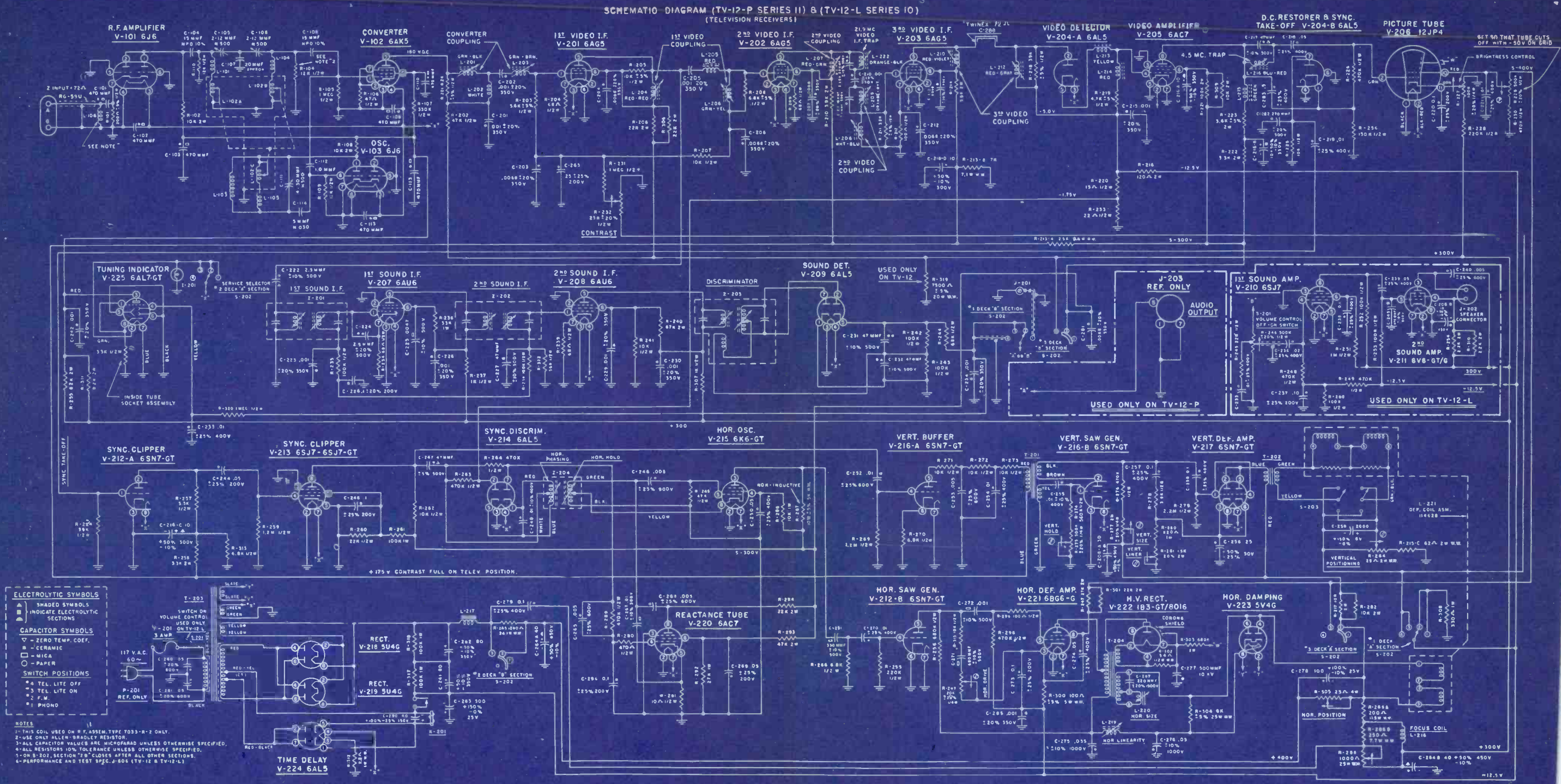


Figure 36



STROMBERG-CARLSON

Note:
1. Terminal 5 of horizontal output transformer T204 returns to +400 volts.
2. R-258 is 33K instead of 3,3K.
3. R-309 is 100K instead of 10K.
4. On recent models the relay contacts of K-201 break the B+ lead instead of the B—. This is between the junction of R-316 and L-217, and the cathodes (pin 8) of V-218 and V-219.

CAUTION

This receiver uses dangerous voltages and should be handled with care. Be especially careful of the red lead going to the anode of the picture tube.

THEORY

PRACTICE EXPERIENCE

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