I. SPECIFICATIONS

The model 21A21 Television Receiver is a 21-tube, AC-operated, direct-viewing, 7-inch table model. The receiver is complete in one unit and is operated by the use of six 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 3000 volts to the second anode of the picture tube.

Sensitivity at the Antenna
Video — 150 microvolts (400 with full contrast)
Audio — 50 microvolts for 50-milliwatt output.

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

Audio Power Output Rating
Undistorted — 2 watts.
Maximum — 4.5 watts.

Antenna Impedance Requirements
Balanced 300-ohm.

Speaker
Type — P.M. Dynamic, Alnico 5.
Size — 6-inch.
Voice Coil Impedance (400 cycles) - 3.2 ohms.

Picture Size
$5\frac{1}{2} \times 4\frac{1}{4}$ inches.

Dimensions (outside)
Cabinet — $21 \times 16 \times 14\frac{1}{2}$ inches.
Chassis — $19\frac{1}{4} \times 15\frac{1}{2} \times 12\frac{1}{2}$ inches.

Weight
Chassis with tubes in cabinet — 53 lbs.
Shipping weight — 68 lbs.

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 touched, with the possible exception of the VERT. HOLD and HORZ. HOLD controls. Variations in power-line voltage and other external conditions may require periodic adjustment of these two controls, which are provided with knobs. The function of each of the controls is described below.

On Front of Set

Volume-Off — Turns set on or off and 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 (left side of dial) or high television band (right side of dial).

Focus—Focuses picture on face of picture tube.

Brilliance—Adjusts brilliance of picture.

On Rear of Set

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

Vert. Hold—Stops picture from moving up or down. Such movement occurs when the receiver and the station transmitter are not perfectly synchronized.

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

Horz. Hold—Stops picture from moving left or right. (See description under "Vert. Hold" above.)

Vert. Cent.—Moves entire picture vertically.

Horz. Cent.—Moves entire picture horizontally.

MODEL 21A21

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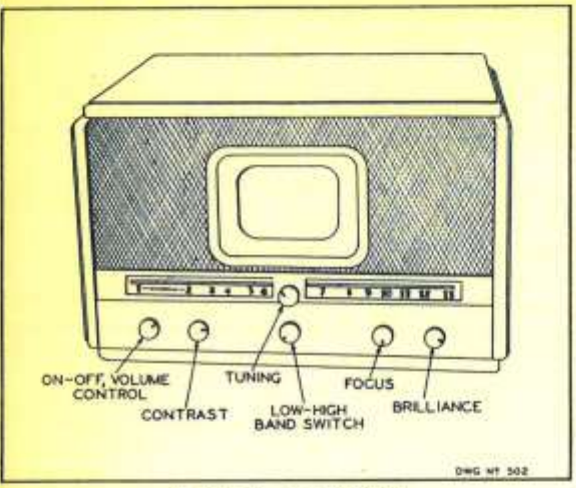


Figure 1. Front View

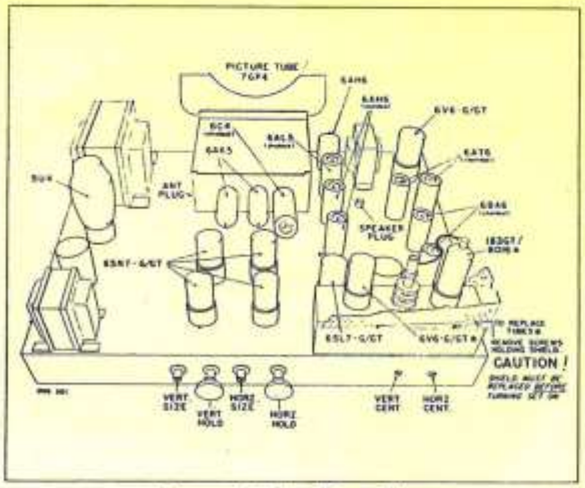


Figure 2. Top Rear View

Tuning Procedure

1. Turn the volume 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 (by either the left or right edge of the red indicator, depending on whether the low or high band is being tuned). The band-switch 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.
8. Adjust the focus control 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 below illustrates the reason for this effect.

Distance "A" Determines Picture Quality and Definition

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 posssible 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. If required later by a change in the location of the receiver, the line may be spliced as shown in the lower right-hand corner of figure 3. This figure also indicates the position of the antenna plug-in on the Model 21A21 receiver, and in addition offers a suggestion as to locating the lead-in at the antenna.

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

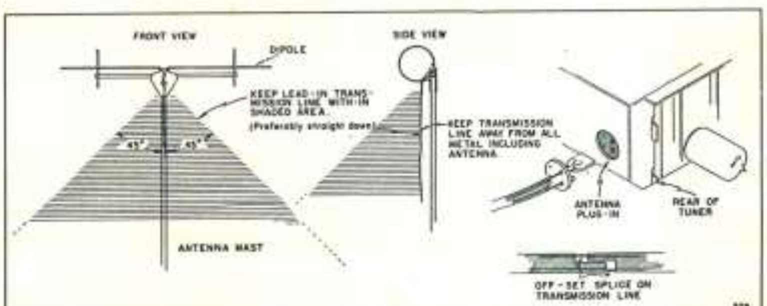
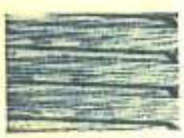
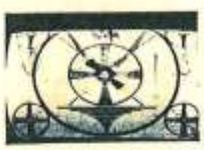


Figure 3. Antenna Installation

IV. TROUBLE-SHOOTING CHART

Symptom	*Procedure*	*Reference*
No picture **Sound normal** **Raster normal**	a. Check for defective tubes 5, 6, 7. b. Check resistances and voltages at tubes 5, 6, 7. c. Check coupling capacitor C66. d. Check tube 7. 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. Figs. 18, 19 c. Fig. 12 d. Figs. 12, 17 e. Fig. 8
No raster **Sound normal**	a. Check output of high-voltage supply (3000 volts is normal). b. Check voltage between grid and cathode of picture tube. Should be only a few 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. Figs. 18, 19
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, p. 7 b. Fig. 17 c. Par. 3 and Figs. 5, 7 d. Fig. 7 e. Figs. 18, 19
No sound **Picture normal**	a. Check for defective tubes 8, 9, 10, 11, 12. b. Connect audio generator across resistor R24, with gain control fully clockwise, and check for sound from speaker. c. Check resistances and voltages at sockets of tubes 8, 9, 10, 11, 12. d. Check alignment of audio i-f stage.	a. Fig. 17 b. Fig. 9 c. Figs. 18, 19
No sync. 	a. Check for defective tube 13. b. Check wave shapes at tubes 6, 13, 14. c. Check resistances and voltages at sockets of tubes 6, 13, 14.	a. Fig. 17 b. Figs. 8, 13, 15 c. Figs. 18, 19
No vertical sync. **Picture normal** 	a. Check wave shape at pin 1 of tube 16. b. Check frequency of vertical multivibrator. c. Check resistors R79 and R80 and capacitors C93 and C94.	a. Fig. 14 b. Par. 11 c. Fig. 14
No horizontal sync. 	a. Check wave shape at pin 1 of tube 14. b. Check frequency of horizontal multivibrator. c. Check resistor R65 and capacitor C79.	a. Fig. 15 b. Par. 12 c. Fig. 15

Symptom	Procedure	Reference
No vertical sweep 	a. Check for defective tubes 16 and 17. b. Check wave shapes at tubes 16 and 17. If OK, check coupling capacitors C97, C98, C99, C101. c. Check socket voltages and resistances of picture tube and tubes 16 and 17.	a. Fig. 17 b. Fig. 14 c. Figs. 18, 19
No horizontal sweep 	a. Check for defective tubes 14 and 15. b. Check wave shapes at tubes 14 and 15. If OK, check coupling capacitors C82, C83, C85, C86. c. Check socket voltages and resistances of picture tube and tubes 14 and 15.	a. Fig. 17 b. Fig. 15 c. Figs. 18, 19
Bunching at side of picture 	a. Check socket voltages and resistances of multivibrator and output tubes 14 and 15. b. Check coupling capacitors C82, C83, C85, C86 for value and leakage.	a. Figs. 18, 19 b. Fig. 15
Bunching at top or bottom of picture 	a. Check socket voltages and resistances of multivibrator and output tubes 16 and 17. b. Check coupling capacitors C97, C98, C99, C101 for value and leakage.	a. Figs. 18, 19 b. Fig. 14
Audio in picture 	a. Check value of capacitor C44-B. b. Check alignment.	a. Fig. 17
Picture cannot be centered vertically 	a. Check for leak in capacitors C98 and C101. b. Check resistance and voltage range of vertical centering control. c. Check resistors R97 and R100. d. De-magnetize the picture-tube shield.	a. Fig. 14 b. Figs. 10, 18, 19 c. Fig. 14 d. Par. 15
Picture cannot be centered horizontally 	a. Check for leak in capacitors C83 and C86. b. Check resistance and voltage range of horizontal centering control. c. Check resistors R97 and R100. d. De-magnetize the picture-tube shield.	a. Figs. 15 b. Figs. 10, 18, 19 c. Fig. 15 d. Par. 15

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Symptom	***Procedure***	***Reference***
Insufficient vertical sweep size 	a. Check to see that high voltage is not too high. b. Check for defective tubes 16 and 17. c. Check capacitors C97, C98, C99, C101. d. Check socket resistances and voltages of tubes 16 and 17. e. Check value of capacitors C95 and C96.	a. Par. 8 b. Fig. 17 c .Fig. 14 d. Figs. 18, 19 e. Fig. 14
Insufficient horizontal sweep size 	a. Check to see that high voltage is not too high. b. Check for defective tubes 14 and 15. c. Check capacitors C82, C83, C85, C86. d. Check socket resistances and voltages of tubes 14 and 15. e. Check value of capacitors C80 and C81.	a. Par. 8 b. Fig. 17 c. Fig. 15 d. Figs. 18, 19 e. Fig. 15
Inability to focus picture	a. Check resistances of high-voltage divider. b. Check B+ voltage.	a. Figs. 10, 19 b. Fig. 19
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 L4 and T13. e. Check range of focus control.	b. Fig. 17 d. Fig. 12 e. Figs. 10, 18, 19
120-cycle hum in picture	a. Check filter capacitors in low-voltage supply. b. Check capacitor C44-C. 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.	

OTHER CONDITIONS

Audio output tube oscillates	a. See that speaker is securely connected. b. Check lead dress to output transformer. Keep plate leads as far away from grid coupling capacitor as possible.	a. Fig. 17
Oscillation in audio or video i-f system	a. Check alignment. b. Check for defective by-pass capacitors.	b. 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 C83, C86, C98, C101 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 C91 or C92. c. Check circuit of high-voltage supply and leads on high-voltage oscillator coil.	a. Fig. 17 b. Fig. 10 c. Fig. 10

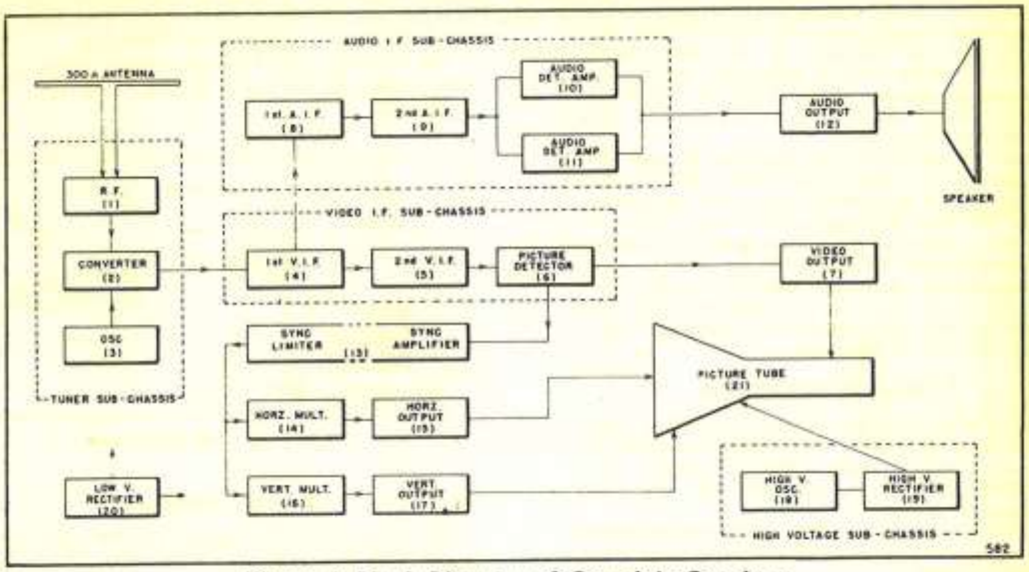

Figure 4. Block Diagram of Complete Receiver

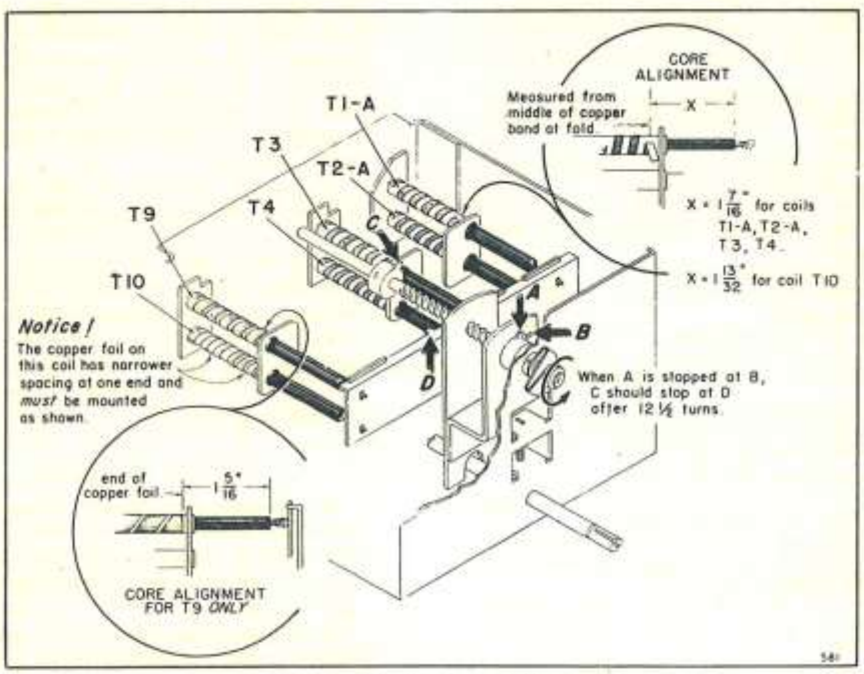

Figure 5. Tuner Core Adjustment

V. DESCRIPTION OF CIRCUITS

All electrical components of the Model 21A21 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 20.)

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 description 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.
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 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.

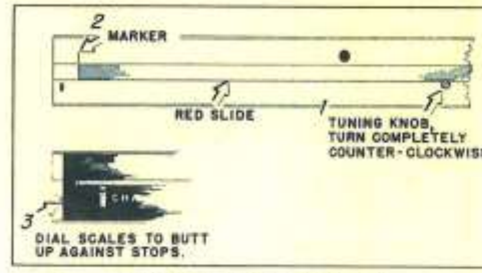

Figure 6. Dial Alignment

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 C12) and the oscillator voltage appearing on the grid causing rectification and charging the grid resistor-and-capacitor combination of R9 and C50.

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 C50.

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.

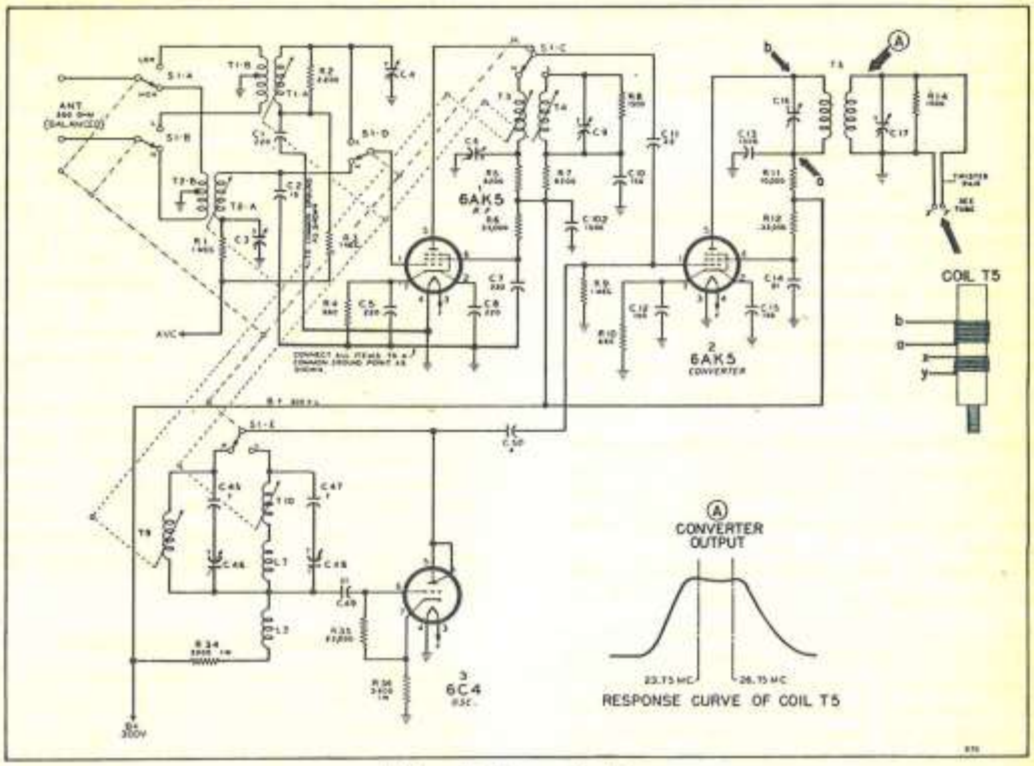

Figure 7. Tuner Section

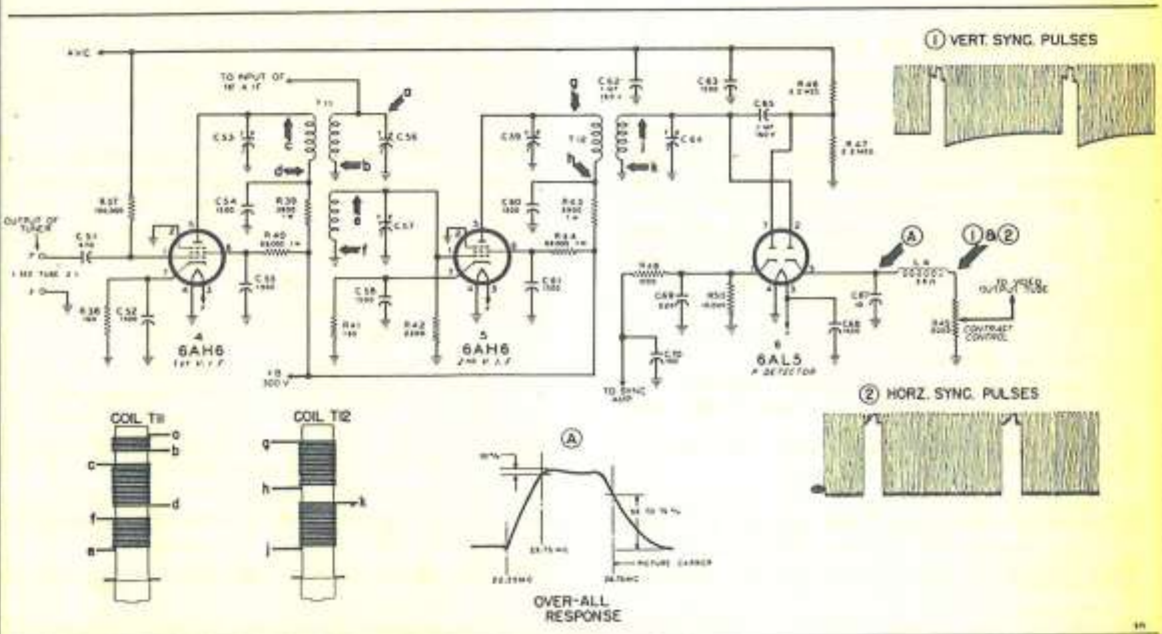

Figure 8. Video I-F Section

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 L7 to adjust band coverage. Increasing the inductance of L7 by pressing the winding closer together will reduce the effective range of coil T10. Likewise, spreading the winding of coil L7 will increase the effective range of coil T10.

Resistors R34 and R36 isolate the oscillator, permitting it to operate as a Colpitts over the full television bands. Choke coil L3 is needed to further isolate 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 C46 and C48 are connected in series with the fixed capacitors C45 and C47 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 C49.

6. VIDEO I-F SUB-CHASSIS

The video sub-chassis assembly combines the first and second video i-f amplifiers and the picture detector stages, employing double-tuned circuits over-coupled to have a 3½-megacycle band width with a 25.25-megacycle center frequency. Resistor R42 and contrast control R47 damp the secondaries of i-f coils T11 and T12 to provide a flat-topped response curve. A third winding is provided on i-f coil T11 to absorb the 22¼-megacycle sound i-f, and to provide rejection of this frequency 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 the first video i-f tube AVC-controlled. Trimmers C53, C56, C59, and C64 provide adjustment of the i-f coils.

The second stage feeds one half of a 6AL5 tube (see figure 8) as a conventional AM detector which feeds the video amplifier. The other half of the 6AL5 has a dual purpose. Its input time constant is such that it holds its bias just above picture black level and delivers separated super-sync to the sync amplifier. Because of this action the tube can also provide AVC voltage which is used on the r-f tube and first tube of both i-f strips.

Peaking coil L4 and capacitor C67 act together to form a compensating network with contrast control R45 providing a flat video frequency response up to 3½ megacycles (see figure 11.) Capacitor C66 blocks the direct-current of the diode circuit from biasing the grid of the video output tube. Coupling capacitor C65 couples the secondary of i-f coil T12 to the second diode plate, and combined with the AVC load resistor R47, establishes a bias on this diode to allow only the sync pulses to appear in the cathode load resistor R50.

The voltage developed across resistor R47 combined with the decoupling network of resistor R46 and capacitors C62 and C63 provides the AVC voltage for the i-f and r-f amplifiers. The pi-filter comprising resistor R48 and capacitors C69 and C70 separates the video i-f frequency and hash from the sync pulses. An electrostatic shield between coils T11 and T12, grounded at three points, helps prevent inter-action between the sound and the video. Capactitor C68 by-passes the filament of the picture detector tube.

7. AUDIO I-F SUB-CHASSIS

The audio i-f sub-chassis assembly combines the first and second audio i-f amplifiers and the audio detector amplifier, using single-tuned i-f coils peaked at 22¼ megacycles with an FM ratio detector. The first and second audio i-f amplifiers make use of type 6BA6 tubes (8 and 9 in figure 9), with the first audio i-f tube AVC-controlled. The secondary winding of coil T11 is connected to coupling capacitor C18 at the grid of the first audio i-f tube through a twisted pair. Capacitor C18, combined with capacitor C19, forms a voltage-dividing network, lowering the effect of regeneration created by the length of the twisted pair.

The i-f tuned circuit (capacitor C21 and coil T6) is adjusted to resonance at 22¼ megacycles by means of a slug adjustment. The capacitance tuning coil T7-A is divided into two branches formed by the network of capacitors C30 and C27 in parallel with capacitors C31 and C33. This principle stabilizes the balance of the detector. In order to slug-tune coil T7-B and maintain balance, separate chokes L1 and L2 are used.

The audio detector-amplifier tubes (10 and 11 in figure 9) are duo-diode-triode type 6AT6's, serving both as an FM ratio detector and as two stages of audio amplification. The diode currents of the ratio detector portion of the 6AT6 tubes develop the FM audio voltage across resistor R24 with capacitor C32 by-passing the audio i-f frequency. Cathode current of the triode section of the 6AT6 tube (10) also passes through resistor R24, placing a d-c voltage drop in series with

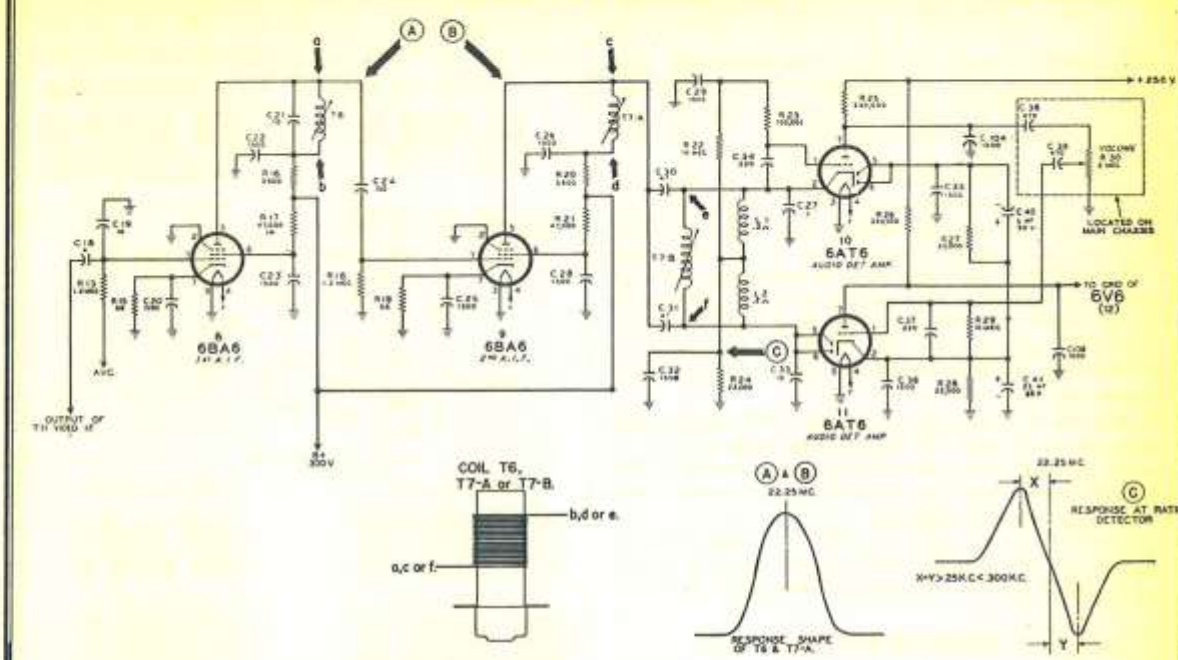

Figure 9. Audio I-F Section

the diode circuit, making it necessary to use a compensative network (resistor R28 and capacitor C41) in the cathode circuit of tube 11.

Resistor R27 and capacitor C40 make up the noise-rejection circuit of the ratio detector. Capacitors C35 and C36 place the detector diodes at ground i-f potential. The network of resistors R22 and R23 and capacitor C29 couples the audio signal to the grid of the first audio amplifier (tube 10), operating this tube as a grounded-grid amplifier. Capacitors C34 and C37 maintain the grids of the audio amplifiers at the same, i-f potential as the cathodes.

The triode sections of tubes 10 and 11 are self-biased by the use of high resistance in the grid circuit. Capacitors C38 and C39 not only provide coupling but also prevent direct current from creating noise in volume control R30.

The entire sub-chassis assembly is rubber-mounted on the main chassis to reduce speaker-to-tube microphonics.

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.

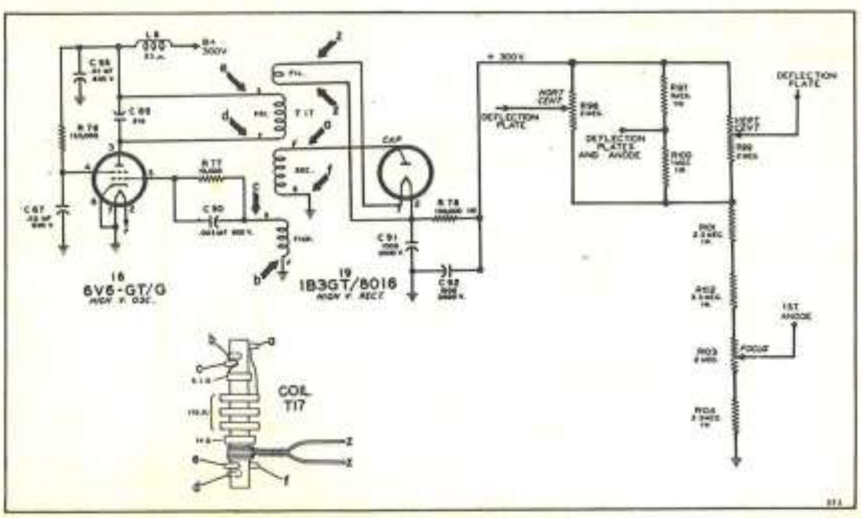

Figure 10. High-Voltage Supply

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 T17 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 R76 and capacitors C91 and C92 filter the r-f from the d-c output. This supply is capable of supplying 3,000 volts dc across an 8.5-megohm load.

9. VIDEO OUTPUT STAGE

The video output stage (figure 12) uses a single type 6AH6 tube (7) which is biased by the rectified video signal appearing on the grid, and is dc-coupled to the picture tube grid. This arrangement, with the heavy bleeder on the screen, optimizes d-c restoration. Peaking coil T13 and resistors R51 and R55 maintain a frequency response flat to within 3 db out to 3½ megacycles with a voltage gain of approximately 26 (see figure 11).

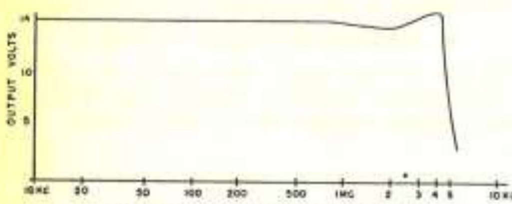

Figure 11. Video Response

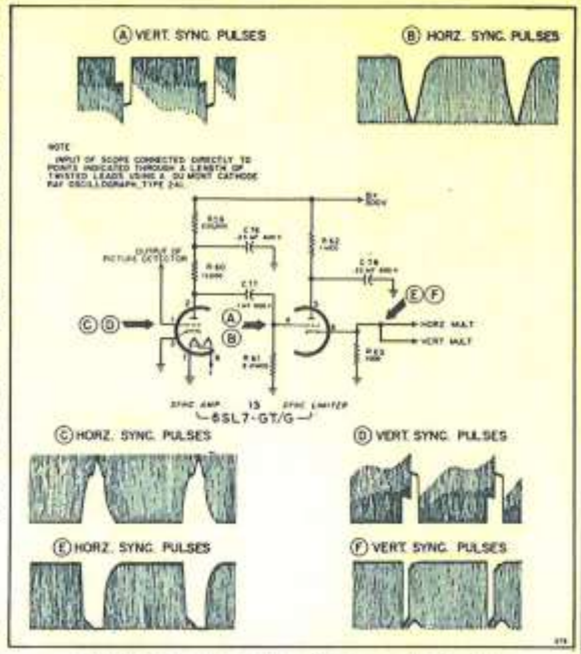

Figure 13. Sync Amplifier and Limiter

10. SYNC AMPLIFIER AND LIMITER

The sync amplifier and sync limiter (see figure 13) share a type 6SL7 tube (13). The first section amplifies the sync signal obtained from the sync separator diode of the picture detector. The second section acts as a limiting cathode follower which clips off the noise peaks and supplies constant sync voltage to the multivibrators.

The grid of the sync amplifier is dc-coupled to the diode circuit of the picture detector. Resistor R59 drops the voltage applied to the sync amplifier with R60 as the plate load resistor. Resistor R62 and capacitor C78 supply low d-c voltage on the plate of the cathode follower.

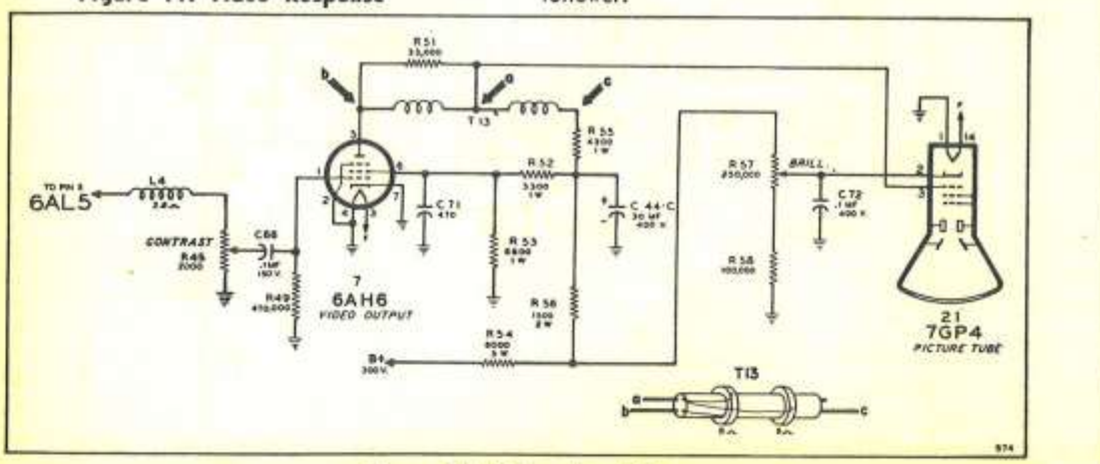

Figure 12. Video Amplifier

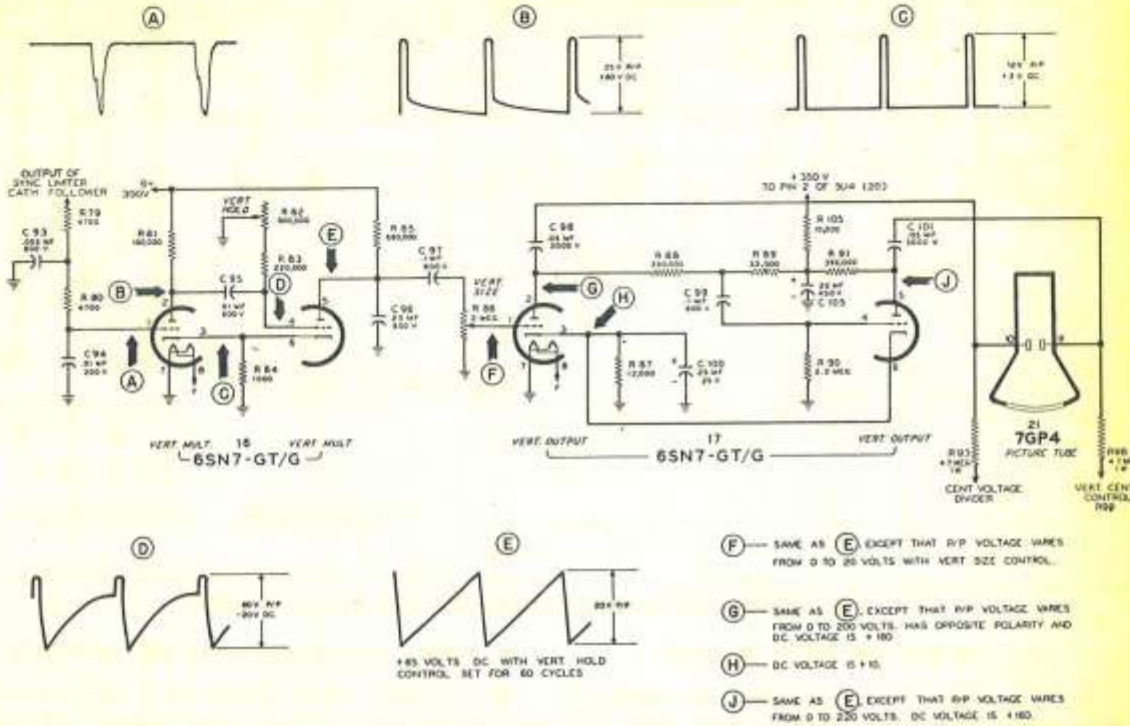

Figure 14. Vertical Sawtooth Generator and Sweep Amplifier

11. VERTICAL SAWTOOTH GENERATOR AND SWEEP AMPLIFIER

The vertical sawtooth generator (see figure 14) uses a type 6SN7 tube (16) as a conventional cathode-coupled multivibrator with an integrating circuit (R79, C93 and R80, C94) feeding sync pulses to the first grid (pin 1). The vertical multivibrator can be easily adjusted with the vertical hold control (R82) to sync at 60 cycles.

The second plate of the multivibrator acts as a discharge tube across capacitor C96 to give a sawtooth output. The value of the sawtooth-forming capacitor C96, along with the series charging resistor R85, is such as to permit use of the linear portion of the charging curve. Vertical size control R86 acts as a gain control to change the size of the picture vertically.

The vertical output uses a type 6SN7 tube (17) as a push-pull deflection plate driver. The phase-inversion network (R89, C99, and R90) is so designed that the second grid voltage is self-compensated to give equal output from both sections. The plate supply of the vertical output is taken from a point before the filter choke L5 to allow use of the decoupling network of resistor R105 and capacitor C105, needed to keep sawtooth modulation output out of the B+ 300-volt line.

12. HORIZONTAL SAWTOOTH GENERATOR AND SWEEP AMPLIFIER

The horizontal sawtooth generator (see figure 15) uses a type 6SN7 tube (14) as a conventional cathode-coupled multivibrator with a differentiating circuit, capacitor C79 and resistor R65, feeding sync pulses to the first grid (pin 1).The horizontal multivibrator can be easily adjusted with horizontal hold control R66 to sync at 15.75 kilocycles. The second plate of the multivibrator acts as a discharge tube across capacitor C81 to give a sawtooth output. A small change in the value of this capacitor C81 greatly affects the size of the sawtooth output. The value of sawtooth forming capacitor C81, with charging resistors R70 and R69, is such as to permit use of the linear portion of the charging curve. Changing the value of horizontal size control R70 changes the size of the picture horizontally.

The horizontal output uses a type 6SN7 tube (15) as a push-pull deflection plate driver. The phase-inversion network (R73, R75, and C84), together with resistor R74 and capacitor C85, 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 T15 and T16, providing a balanced a-c load.

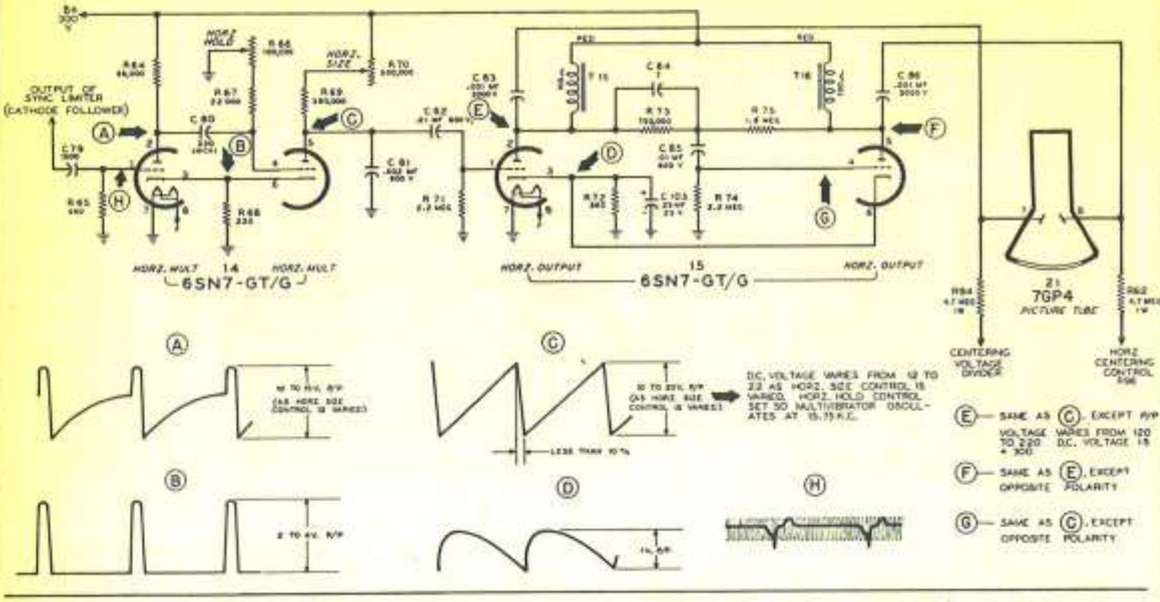

Figure 15. Horizontal Sawtooth Generator and Sweep Amplifier

13. AUDIO OUTPUT STAGE

The audio output stage (see figure 16) employs a conventional single-ended 6V6GT output tube (12) driving a 6-inch PM speaker with a 3.2-ohm voice coil. The over-all distortion is less than 5% at 2 watts and starts to break up at slightly over 3 watts. Resistor R33 and capacitor C44-B prevent audio current changes from modulating the 300-volt d-c supply to the rest of the receiver.

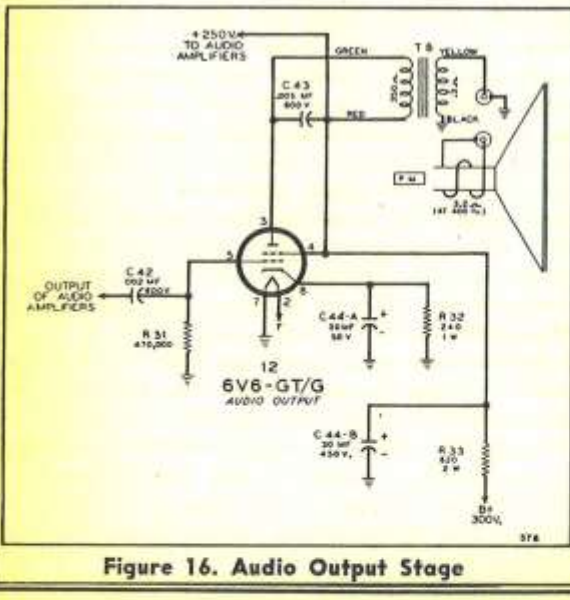

Figure 16. Audio Output Stage

14. LOW- VOLTAGE POWER SUPPLY

The low-voltage power supply uses a 5U4 full-wave rectifier tube and an 8-henry choke to supply 300 volts dc to B+ at 200 milliamperes dc. The filament winding on the power transformer is grounded on one side with the other side wired to all the tubes. The resistance of the filter choke is 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 7GA4 picture tube is operated with the heater grounded and with the second anode at a +3000-volt potential. This tube is enclosed in a shield.

> **Caution:** 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.

The picture tube is held in position by a rubber-lined curved bracket pressing on the base of the tube. Should the picture be orientated incorrectly, loosen the two screws holding this bracket, rotate the tube to correct orientation, and tighten. 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 the Model 21A21 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 50 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).

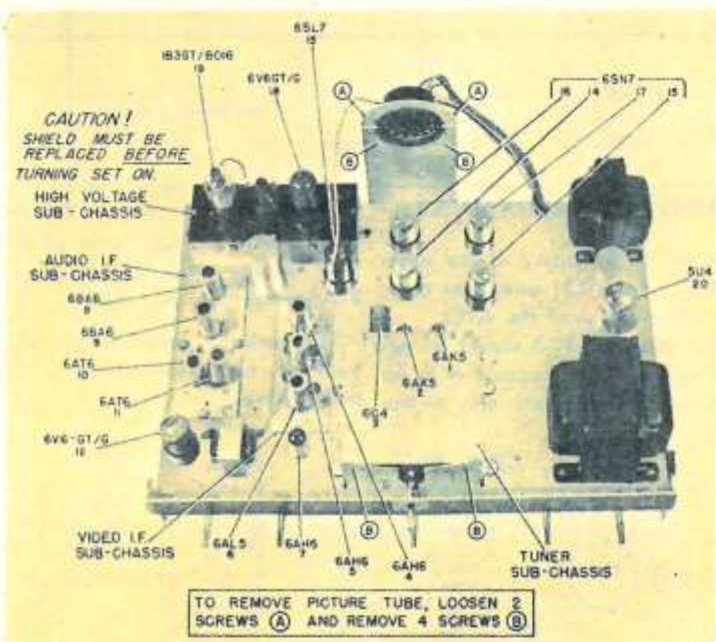

Figure 17. Top View of Chassis

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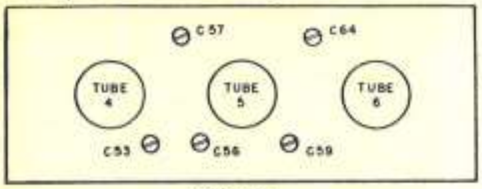
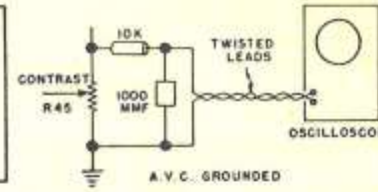
VIDEO I-F AMPLIFIER ALIGNMENT

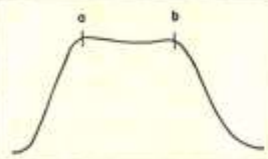
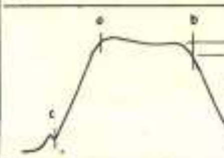
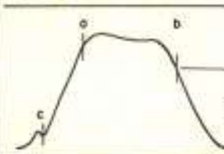
Connect the oscilloscope to the output of the video detector using test leads as shown in the illustration below. Ground the AVC. The overall response curve might be improved slightly by careful adjustment of each stage while observing the curve. Because the AVC is grounded, it is recommended that the 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 C56, is best done by turning off the sweep generator and using the tone-modulated 22.25-megacycle marker generator to adjust capacitor C56 for minimum AM at the output of the video detector.



TOP VIEW



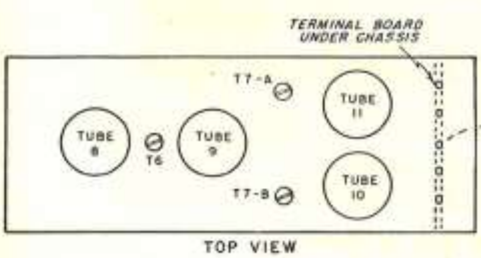
Step No.	Marker Generator Freq. (mc)	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve
1	(a) 23.75 (b) 26.75	20-30 mc 10-mc sweep	Tube 5 Pin 1	C59 C64	Shunt primary of T11 with 1000 mmf. Turn C56 in	
2	(a) 23.75 (b) 26.75 (c) 22.25	20-30 mc 10-mc sweep	Tube 4 Pin 1	C53, C57, C56 } T11	Remove shunt of step 1. Disconnect lead at point Y. Adjust C56 last	 10 TO 15 %
3	(a) 23.75 (b) 26.75 (c) 22.25	20-30 mc 10-mc sweep	Tube 2 Pin 1	C16, C17 } T5 in tuner	Reconnect point Y.	 55 TO 75 %

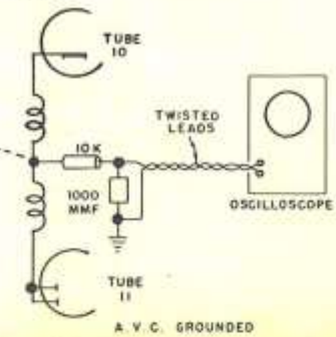
AUDIO I-F AMPLIFIER ALIGNMENT

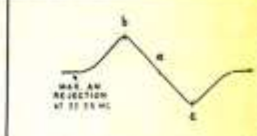
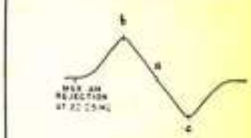
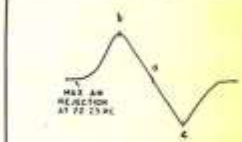
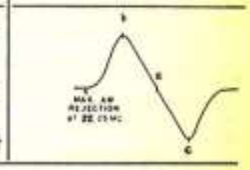
Connect the oscilloscope to the output of the audio detector (junction of coils L1 and L2) using test leads as shown in illustration below. Ground the AVC.

The ratio detector secondary coil T7-B should be adjusted to give minimum AM at 22.25 megacycles as indicated by the presence of tone on each side of the detector response curve. The shape of the response curve should be such as to provide the maximum vertical voltage slope 25 kilocycles to each side of the 22.25 megacycle AM null.

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





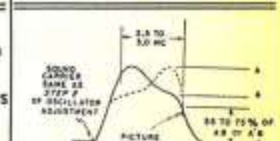
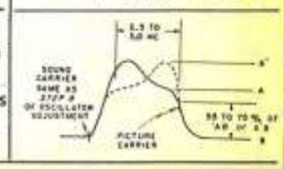
Step No.	Marker Generator Freq. (mc)	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve
1	(a) {22.25 Tone Mod. (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 9 Pin 1	T7-A T7-B	b to c greater than 50 kc and less than 600 kc	
2	(a) {22.25 Tone Mod. (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 8 Pin 1	T6	b to c greater than 50 kc and less than 600 kc	
3	(a) {22.25 Tone Mod. (b) 22.0 (c) 22.5	20-30 mc 10-mc sweep	Tube 4 Pin 1	C56	b to c greater than 50 kc and less than 600 kc T11 aligned per Video I-F Alignment	
4	(a) {22.25 Tone Mod. (b) 22.5 (c) 22.5	20-30 mc 10-mc sweep	Tube 2 Pin 1	C56	b to c greater than 50 kc and less than 600 kc T5 and T11 aligned per Video I-F Alignment	

R-F AMPLIFIER ALIGNMENT

Connect the oscilloscope to the output of the video detector using the test leads as illustrated in the "Oscillator Adjustments" table. Ground the 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 and 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 the band.

(Refer to illustration in Oscillation Adjustment Table

Step No.	Generator Frequency	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve
1	Modulated 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	Modulated 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	

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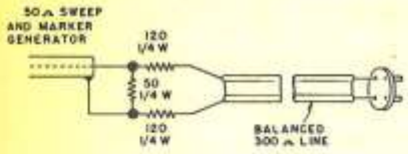
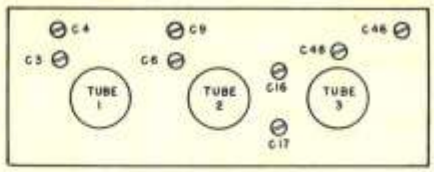
OSCILLATOR ADJUSTMENTS

Connect the oscilloscope to the output of the audio detector (junction of coils L1 and L2) using leads as illustrated below.

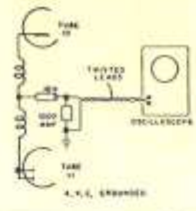
The primary purpose of this alignment is to provide proper oscillator tracking over each band. When the dial indicator is set at a given channel, the oscillator operating frequency, mixing with the sound carrier, should provide a 22.25-megacycle intermediate frequency as indicated by the AM rejection of the ratio detector. On the low band, the oscillator coverage coil L7 provides means of increasing or reducing oscillator tracking coverage. Compressing the windings of this coil reduces the oscillator tracking range.

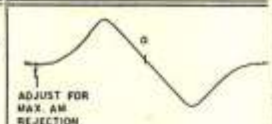
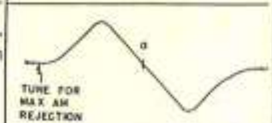
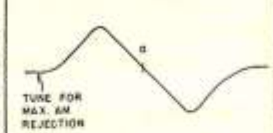
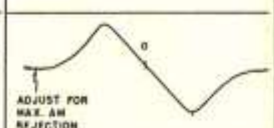
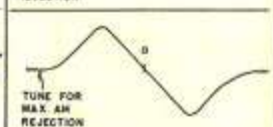
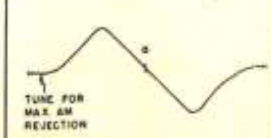
The dial indicator should come within one channel mark width of either side of the channel to which it is tuned. For these measurements the dial indicator must conform with instructions furnished in figure 6.





REAR VIEW OF TUNER



Step No.	Marker Generator Freq. (mc)	Sweep Generator Frequency	Signal Input Point	Adjust	Remarks	Response Curve
1	(a) 87.75 AM Tone Modulated	40-90 mc 10-mc sweep	Antenna input	C48	Set dial indicator at center of mark at channel 6	 ADJUST FOR MAX. AM REJECTION
2	(a) 49.75 AM Tone Modulated	40-90 mc 10-mc sweep	Antenna input	Adjust compression of L7	Tune dial to AM null. Indicator to be within mark width at channel 1	 TUNE FOR MAX. AM REJECTION
3 4 5 6	AM Tone Modulated (a) 59.75 (a) 65.75 (a) 71.75 (a) 81.75	40-90 mc 10-mc sweep	Antenna input	Adjust C48 and L7 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)	 TUNE FOR MAX. AM REJECTION
7	(a) 203.75 AM Tone Modulated	170-220 mc 10-mc sweep	Antenna input	C46	Set dial indicator at center of mark at channel 11	 ADJUST FOR MAX. AM REJECTION
8	(a) 179.75 AM Tone Modulated	170-220 mc 10-mc sweep	Antenna input	C46	Turn dial to AM null. Indicator to be within mark at channel 7	 TUNE FOR MAX. AM REJECTION
9 10 11 12 13	AM Tone Modulated (a) 185.75 (a) 191.75 (a) 197.75 (a) 209.75 (a) 215.75	170-220 mc 10-mc sweep	Antenna input	Set C46 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)	 TUNE FOR MAX. AM REJECTION

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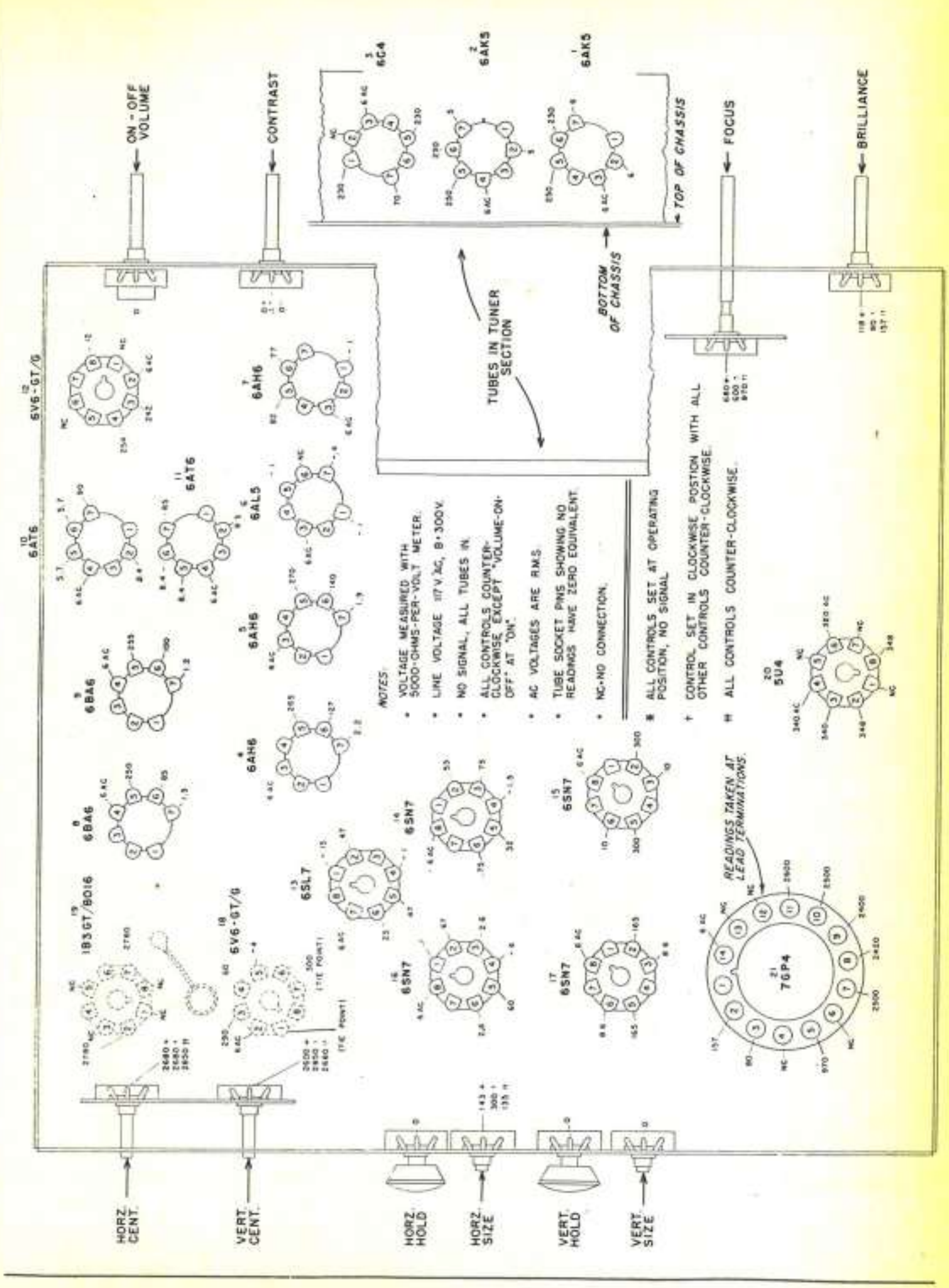

Figure 18. Voltages at Tube Sockets and Controls

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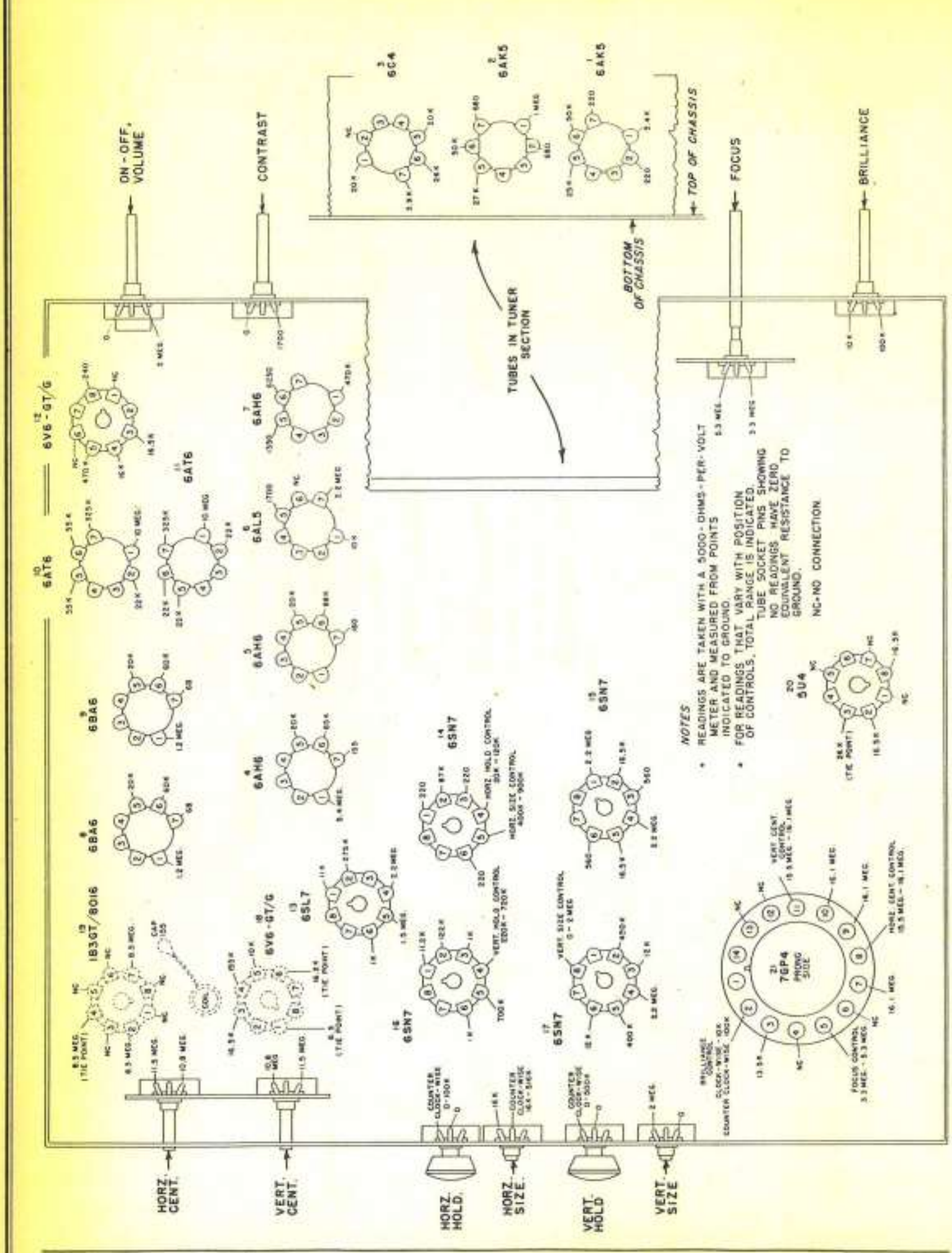

Figure 19. Resistances at Tube Sockets and Controls

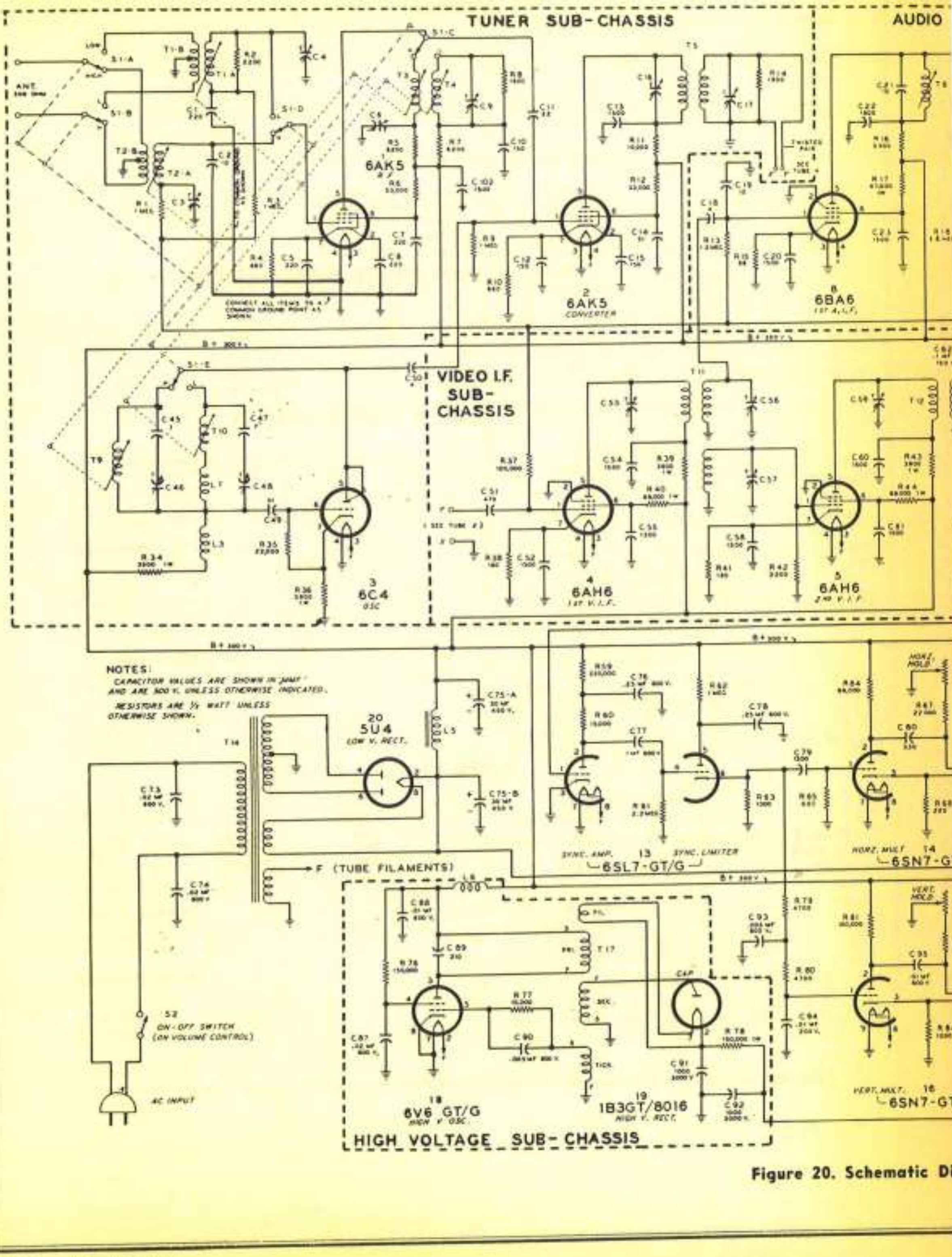

Figure 20. Schematic Dia

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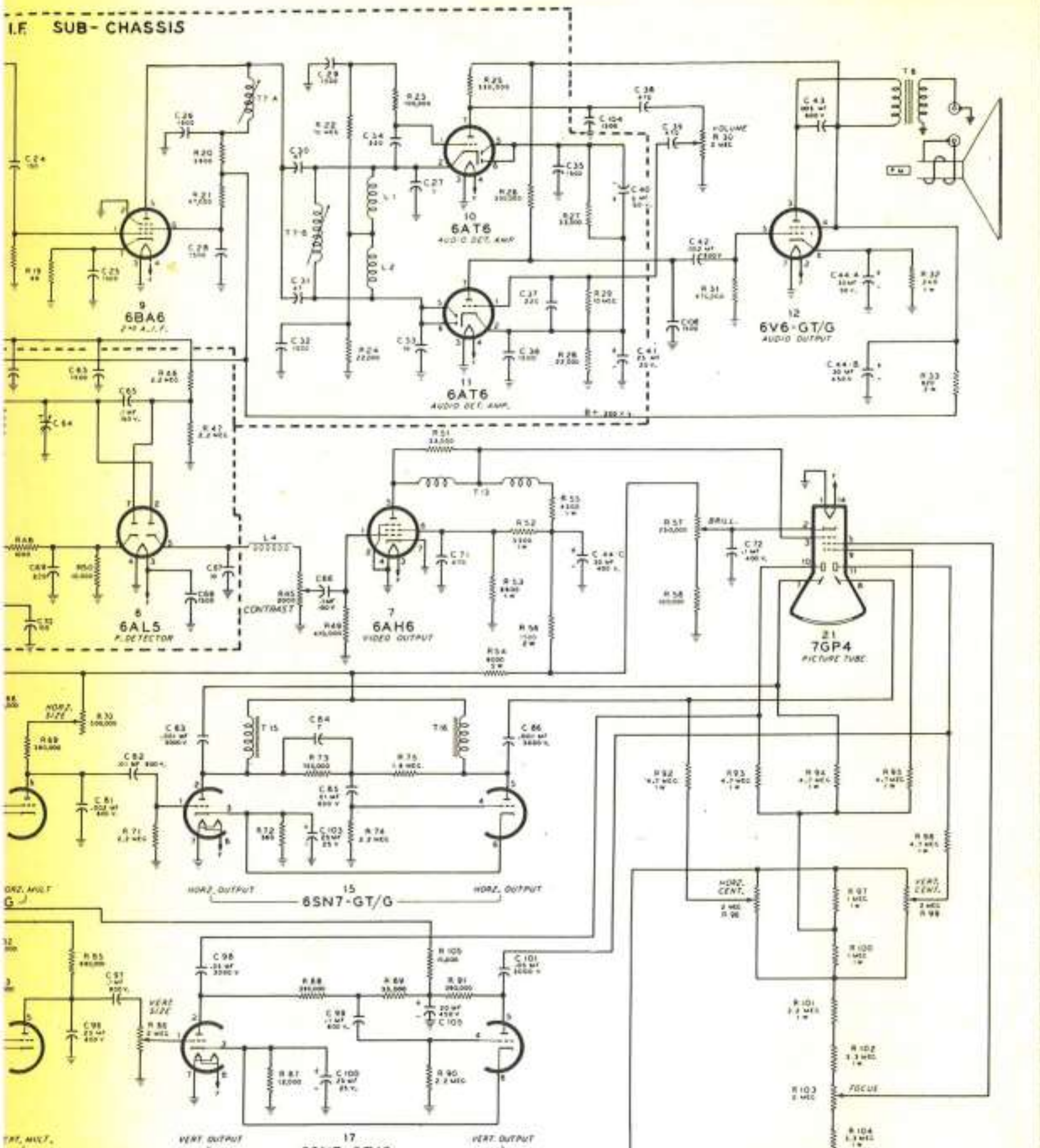

ram of Complete Receiver

REPLACEABLE PARTS LIST

MAIN CHASSIS

Capacitors

Ref. Symbol	Part No.	Description
C38-39-71	C-8G-11732	470 mmf, 500 volts, 20%
C42-81	C-8D-10778	.002 mf, 600 volts.
C43-93	C-8D-10935	.005 mf, 600 volts, +40% —15%
C44-A,-B,-C	B-8C-11630	Electrolytic, 30 mf x 50 volts, 30 mf x 450 volts, 30 mf x 400 volts
C66	A-8D-11730	.1 mf, 150 volts, +30% —10%
C72	C-8D-10760	.1 mf, 400 volts, +20% —10%
C73-74	C-8J-11321	.02 mf, 600 volts
C75-A,-B	B-8C-11629	Electrolytic, 30 mf x 450 volts, 30 mf x 450 volts
C76-78-96	C-8D-11737	.25 mf, 600 volts, +20% —10%
C77-97-99	C-8D-10983	.1 mf, 500 volts, +20% —10%
C79-104-106	C-8G-11731	1500 mmf, 500 volts, 20%
C80	C-8F3-119	330 mmf, 500 volts, 10%, mica
C82-85-95	C-8D-11128	.01 mf, 600 volts, 20%
C83-86	B-8D-11728	.001 mf, 3000 volts
C84	C-8G-11790	7 mmf, +½ mmf
C94	C-8D-11738	.01 mf, 200 volts, 20%
C98-101	B-8D-11727	.05 mf, 3000 volts
C100-103	B-8C-11750	.25 mf, 25 volts
C105	A-8C-13242	20 mf, 450 volts, +50% —10%

Resistors

Ref. Symbol	Part No.	Description
R30-52	A-10A-11625	Volume control (2 megohms) and on-off switch
R31-49	C-9B1-94	470,00 ohms, ½ watt, 10%
R32	C-9B2-144	240 ohms, 1 watt, 5%
R33	C-9B4-61	820 ohms, 2 watts, 10%
R45	C-10B-11621	Contrast control (2000 ohms)
R51	C-9B1-80	33,000 ohms, ½ watt, 10%
R52	C-9B2-68	3300 ohms, 1 watt, 10%
R53	C-9B2-72	6800 ohms, 1 watt, 10%
R54	B-9D-11643	6000 ohms, 5 watts
R55	C-9B2-174	4300 ohms, 1 watt, 5%
R56	C-9B4-64	1500 ohms, 2 watts, 10%
R57	C-10B-11620	Brilliance control (250,000 ohms)
R58-81	C-9B1-86	100,000 ohms, ½ watt, 10%
R59-83	C-9B1-27	220,000 ohms, ½ watt, 20%
R60	C-9B1-20	15,000 ohms, ½ watt, 20%
R61-71-74-90	C-9B1-102	2.2 megohms, ½ watt, 10%
R62	C-9B1-31	1 megohm, ½ watt, 20%
R63-84	C-9B1-62	1000 ohms, ½ watt, 10%
R64	C-9B1-84	68,000 ohms, ½ watt, 10%
R65	C-9B1-60	680 ohms, ½ watt, 10%
R66	C-10B-11624	Horizontal Hold control (100,000 ohms)
R67	C-9B1-21	22,000 ohms, ½ watt, 20%
R68	C-9B1-54	220 ohms, ½ watt, 10%
R69-88-91	C-9B1-93	390,000 ohms, ½ watt, 10%
R70	C-10B-11622	Horizontal size control (500,000 ohms)
R72	C-9B1-59	560 ohms, ½ watt, 10%
R73	C-9B1-228	750,000 ohms, ½ watt, 5%
R75	C-9B1-236	1.6 megohms, ½ watt, 5%
R79-80	C-9B1-17	4700 ohms, ½ watt, 20%
R82	C-10B-12727	Vertical Hold control (500,000 ohms)
R85	C-9B1-96	680,000 ohms, ½ watt, 10%
R86	C-10B-11623	Vertical Size control (2 megohms)
R87	C-9B1-75	12,000 ohms, ½ watt, 10%
R89	C-9B1-195	33,000 ohms, ½ watt, 5%
R92-93-94-95-98	C-9B2-35	4.7 megohms, 1 watt, 20%
R96	C-10B-11619	Horizontal Centering control (2 megohms)
R97-100	C-9B2-31	1 megohm, 1 watt, 20%
R99	C-10B-11619	Vertical Centering control (2 megohms)
R101	C-9B2-33	2.2 megohms, 1 watt, 20%
R102-104	C-9B2-34	3.3 megohms 1 watt, 20%
R103	C-10B-11618	Focus control (2 megohms)
R105	C-9B1-74	10,000 ohms, ½ watt, 10%

Transformers and Coils

Ref. Symbol	Part No.	Description
L4	B-13G-11980	Video series peaking coil
L5	C-16B-11641	Filter choke
T8	B-12C-11253-1	Output transformer
T13	B-16A-11815	Video peaking coil
T14	C-12A-11640	Power transformer
T15-16	B-16B-11644	Horizontal plate choke

Miscellaneous

Ref. Symbol	Part No.	Description
	B-14M-11479	A-c line cord and plug
	A-15B-10440	Tube socket, octal
	A-15C-10717	Tube socket, 7-prong miniature
	A-55A-7386-1	Speaker socket
	A-3J-11654	Pinion gear on tuning shaft
	A-3A-11653	Tuning shaft
	B-2C-11655	Dial indicator tape
	B-6D-11705	Dial scale (high band)
	B-6D-11705-1	Dial scale (low band)
	A-200-11587	Dial drive flexible coupling assembly
	C-5C-12246-40	Escutcheon
	B-6A-12126	Protective glass for picture tube
	C-23D-11649	Mask for picture tube
	B-5B-12278-41	Knob
	C-18A-11648	Speaker, 6-inch, P.M.
	A-25A-13019	Rubber grommet, for mounting speaker on cabinet
	B-40A-10380	Eyelets for speaker mounting

TUNER ASSEMBLY*

Capacitors

Ref. Symbol	Part No.	Description
C1-5-7-8-	C-8G-11733	220 mmf, 500 volts, 20%
C2	C-8G-11789	10 mmf, 500 volts, 10%
C3-4-6-9-46-48	B-8G-11895	Trimmer
C10-12-15	C-8G-11788	150 mmf, 500 volts, 20%
C11	C-8G-11892	22 mmf, 500 volts, 10%
C13-102	C-8G-11731	1500 mmf, 500 volts, 20%
C14-49	C-8G-11891	51 mmf, 500 volts, 5%
C16-17	A-8G-11609	Trimmer, 1-6 mmf
C45-47	C-8G-11790	7 mmf, ±½ mmf
C50	C-8G-11893	4 mmf, ±¼ mmf

Resistors

Ref. Symbol	Part No.	Description
R1-3-9	C-9B1-31	1 megohm, ½ watt, 20%
R2	C-9B1-66	2200 ohms, ½ watt, 10%
R4-10	C-9B1-60	680 ohms, ½ watt, 10%
R5-7	C-9B1-73	8200 ohms, ½ watt, 10%
R6-12	C-9B1-80	33,000 ohms, ½ watt, 10%
R8-14	C-9B1-64	1500 ohms, ½ watt, 10%
R11	C-9B1-74	10,000 ohms, ½ watt, 10%
R34-36	C-9B2-69	3900 ohms, 1 watt, 10%
R35	C-9B1-78	22,000 ohms, ½ watt, 10%

Coils

Ref. Symbol	Part No.	Description
L3	A-16A-11919	R-f choke coil
L7	A-13G-12043	R-f tracking coil
T1-A	B-13E-12046	Antenna coil (low band)
T1-B	A-13G-11939	Antenna coupling coil (low band)
T2-A	B-13E-12048	Antenna coil (high band)
T2-B	A-13G-11938	Antenna coupling coil (high band)
T3	B-13E-12048	R-f coil (high band)
T4	B-13E-12046	R-f coil (low band)
T5	A-13A-11610	Converter i-f coil
T9	A-13D-12045	Oscillator coil (high band)
T10	B-13D-12155	Oscillator coil (low band)

BELMONT RADIO CORP.

TUNER ASSEMBLY (contd)

Miscellaneous

A-15C-10717	Tube socket, 7-prong miniature
A-2H-10974	Tube shield
A-2H-10718	Tube shield base
A-19B-11974	Antenna socket
A-51A-11852	Iron core for all low band coils: antenna (T1-A), r-f (T4), and oscillator (T10)
C-200-11700	Core drive assembly
B-3F-11569	Lead screw for core drive
B-3A-11570	Bandswitch shaft with cam
A-49A-11597	Detent coil spring
A-2L-11598	Detent activator bar
A-3B-11591	Detent bushing
A-25A-11645	Grommet for mounting
A-51A-11853	Iron core for high-band oscillator coil T9
A-51A-12031	Iron core for antenna high-band coil T2-A and r-f high-band coil T3
A-2J-14373	Core adjustment strip, threaded (6 required)
A-49A-11590	Spiral spring for slug tension

HIGH-VOLTAGE POWER SUPPLY ASSEMBLY*

C87	C-8D-10772	Capacitor, .02 mf, 600 volts, 20%
C88	C-8D-11128	Capacitor, .01 mf, 600 volts, 20%
C89	C-8F-13477	Capacitor, 210 mmf, 5%
C90	C-8D-10935	Capacitor, .005 mf, 600 volts, +40% —15%
C91-92	B-8D-11728	Capacitor, 1000 mmf, 3000 volts
R76	C-9B1-88	Resistor, 150,000 ohms, 1/2 watt, 10%
R77	C-9B1-74	Resistor, 10,000 ohms, 1/2 watt, 10%
R78	C-9B2-25	Resistor, 100,000 ohms, 1 watt, 20%
L6	B-16A-11710	Filter choke
T17	B-13D-12574	High-voltage oscillator coil
	A-15B-10440	Tube socket, octal

AUDIO I-F STRIP ASSEMBLY*

Capacitors

C18	C-8G-11893	4 mmf, ±1/4 mmf
C19-21-33	C-8G-11789	10 mmf, 10%
C20-22-23-25-26-28-29-32-35-36	C-8G-11731	1500 mmf, 20%
C24	C-8G-11788	150 mmf, 20%
C27	C-8G-11790	7 mmf, 10%
C30-31	C-8G-11791	47 mmf, 5%
C34-37	C-8G-11733	220 mmf, 20%
C40	B-8C-11751	Electrolytic, 5 mf, 50 volts
C41	B-8C-11750	Electrolytic, 25 mf, 25 volts

Resistors

R13-18	C-9B1-99	1.2 megohms, 1/2 watt, 10%
R15-19	C-9B1-48	68 ohms, 1/2 watt, 10%
R16-20	C-9B1-69	3900 ohms, 1/2 watt, 10%
R17-21	C-9B2-82	47,000 ohms, 1 watt, 10%
R22-29	C-9B1-37	10 megohms, 1/2 watt, 20%
R23	C-9B1-25	100,000 ohms, 1/2 watt, 20%
R24-28	C-9B1-191	22,000 ohms, 1/2 watt, 5%
R25-26	C-9B1-28	330,00 ohms, 1/2 watt, 20%
R27	C-9B1-22	33,000 ohms, 1/2 watt, 20%

Coils and Transformers

L1-2	B-16A-11711	R-f choke coil
T6	B-13A-11707	1st audio i-f transformer
T7-A	B-13B-11708	2nd audio i-f transformer (primary)
T7-B	B-13B-11709	2nd audio i-f transformer (secondary)

Miscellaneous

A-15C-10717	Tube socket, 7-prong miniature
A-2H-10974	Tube shield
A-2H-10718	Tube shield base
A-51A-11701	Iron core for transformer (all)
A-25A-11212	Grommet for mounting

VIDEO I-F STRIP ASSEMBLY*

Capacitors

C51	C-8G-11732	470 mmf, 500 volts, 20%
C52-54-55-58-60-61-63-68	C-8G-11731	1500 mmf, 500 volts, 20%
C53-56-57-59-64	B-8G-11609	Trimmer, 1-6 mmf
C62-65	A-8D-11730	.1 mf, 150 volts, +30% —10%
C67	C-8G-11789	10 mmf, 500 volts, 10%
C69	C-8G-11733	220 mmf, 500 volts, 20%
C70	C-8G-11734	100 mmf, 500 volts, 20%

Resistors

R37	C-9B1-25	100,000 ohms, 1/2 watt, 20%
R38-41	C-9B1-140	160 ohms, 1/2 watt, 5%
R39-43	C-9B2-69	3900 ohms, 1 watt, 10%
R40-44	C-9B2-84	68,000 ohms, 1 watt, 10%
R42	C-9B1-66	2200 ohms, 1/2 watt, 10%
R46-47	C-9B1-102	2.2 megohms, 1/2 watt, 10%
R48	C-9B1-62	1000 ohms, 1/2 watt, 10%
R50	C-9B1-74	10,000 ohms, 1/2 watt, 10%

Transformers

T11	B-13A-11664	1st video i-f transformer
T12	B-13A-11665	2nd video i-f transformer

Miscellaneous

A-15C-10717	Tube socket, 7-prong miniature
A-2H-10974	Tube shield
A-2H-10718	Tube shield base

*Do not order complete assemblies. Send defective assemblies to the factory for repair.