CARE OF THE TELEVISION MIRROR

The mirror used in Sparton television receivers is of special design, made especially for television. Extreme care must be exercised in cleaning and protection provided against damage. This mirror and end plastic safety shield can be permanently ruined by using the wrong solution and process to remove any finger marks. Do not allow anything to scratch or otherwise mar the silvered surface of the mirror while servicing the receiver.

CAUTION Ordinary WINDEX such as used for windows and mirrors is the only solvent recommended for cleaning the mirror and plastic safety shield. Other solvents may have an etching or scratching effect on these surfaces.

Mirrors for television, unlike other mirrors are silvered on the top side instead of the back and do not have the glass for protection. The mirror and plastic safety shield may be wiped (very lightly) with a soft cloth or cotton pad to remove dust or finger marks. Marks which do not come off with a dry cloth may be removed with a soft cloth or cotton pad moistened with WINDEX. Always wipe vertically (up and down) when Windex is used. Wipe dry with another soft cloth or cotton pad.

MODEL 4900TV CREDENZA WITH RADIO-PHONOGRAPH COMBINATION

This large cabinet incorporated three distinct types of instruments. The center compartment houses a twenty-eight tube television receiver, the right-hand compartment a nine-tube A.M.-F.M. radio receiver, and the left-hand compartment an automatic record changer. The unit in the lower center compartment with the speaker is the high and low voltage power supply for the television receiver only, however the 110 volt line for the radio is taken from this unit.

BRIEF DESCRIPTION

Models 4939TV, 4940TV & 4941TV CONSOLETTE

The Sparton Consolette model is a twenty-eight tube small console, indirect viewing type television receiver. It is a two piece unit consisting of receiver and power supply and is operated by the use of five controls on the top panel, and covers all twelve television channels. The picture tube used is the type 10BP4 ten-inch.

The A.C. line off-on switch is operated by the lift lid cabinet cover. When the lid is raised the receiver is automatically turned on. When the lid is lowered the receiver is automatically turned off. No other power switching is necessary to turn the receiver on or off.

Complete service information will be found on the following pages of this bulletin.

The 117 volt for the phono unit is taken from the radio chassis. The power supply for the radio is self contained.

The lift lid controlled switch on the cabinet partition has two functions on this model.

When the lid for the television compartment (center) is raised it automatically switches on the A.C. line power and speaker voice coil to the television unit and the television receiver only can be operated. When the cabinet lid is lowered the A.C. line and speaker voice coil is switched from the television to the radio position. The off-on-tone control on the radio control panel turns the radio on and off.

The phono switch is located on the phono base plate.

A cabinet wiring diagram showing all units in their respective positions with wires and cables is shown in Fig. 2 page of this bulletin.

Complete service data for this model including radio is contained in this bulletin.

RECEIVER CONTROL POSITION AND FUNCTION

NOTE: Do not hesitate to turn the control knobs freely while making adjustments, but do not force them beyond their stops.

The four Sparton television models described in this bulletin are operated by the use of five controls as shown in Fig. 1 on this page.

There are seven non-operating controls as described in the electrical and mechanical specifications on page 5. They are located under the right-hand ventilating screen. (See Fig. 1) This screen can be snapped out if necessary to clean or to adjust any of the seven non-operating controls.

As the A.C. line power is automatically turned on when the cabinet lid is raised, no other power switching is necessary to turn the receiver on and off.

The function of the five operating controls located on the top panel are as follows:

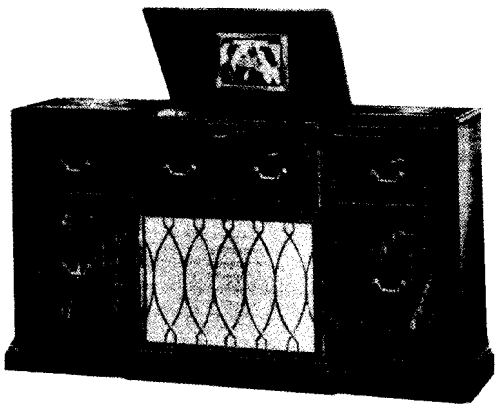
1. The control labeled VOLUME is to increase or decrease sound volume.
2. The control labeled TONE is to vary the tone quality of the sound reception.
3. The control labeled FINE TUNING tunes the receiver for best sound and best picture simultaneously. This control must be adjusted for optimum sound.

When the best sound is obtained in the speaker the picture on the screen will also be properly adjusted for best contrast.

4. The control labeled STATION SELECTOR changes and indicates the station channel numbers. This control is geared to the R. F. tuner and when turned the coils in the R. F. tuner are moved into switch position. The dial cord driven indicator disc is set to properly indicate the correct channel numbers as the switch is turned from one position to another. This control can not be rotated through 360°.
5. The control labeled PICTURE automatically combines the two functions of contrast and brightness with a single operation.

When this control is turned clockwise it increases the picture contrast by automatically increasing the brilliance of the white portions of the picture. Similarly, counter-clockwise rotation of this control decreases the picture contrast by decreasing the brilliance of the white area of the picture.

At any desired adjustment of this "SINGLE" picture control (e.g., at any desired overall brilliance). The Sparton receiver automatically gives the optimum reproduction of the transmitted picture without the further readjustment of another control found on most television receivers today.

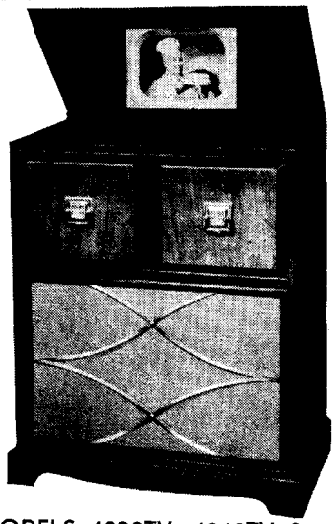


MODEL 4900TV

WITH RADIO-PHONOGRAPH COMBINATION

CHASSIS TYPE—24TV9C

POWER SUPPLY—3TV9C

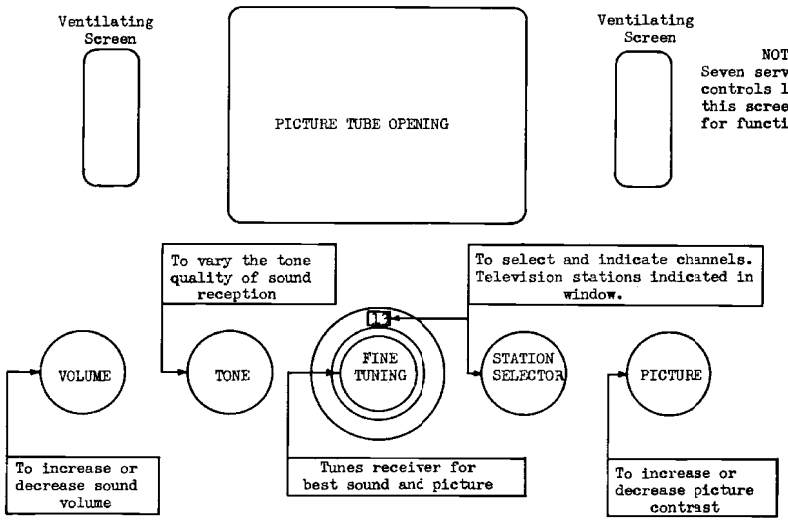


MODELS 4939TV, 4940TV & 4941TV

CHASSIS TYPE—24TV9

POWER SUPPLY—3TV9

FIG. 1



MODELS 4900TV, Ch. 24TV9C;
4939TV, 4940TV, 4941TV, Ch. 24TV9

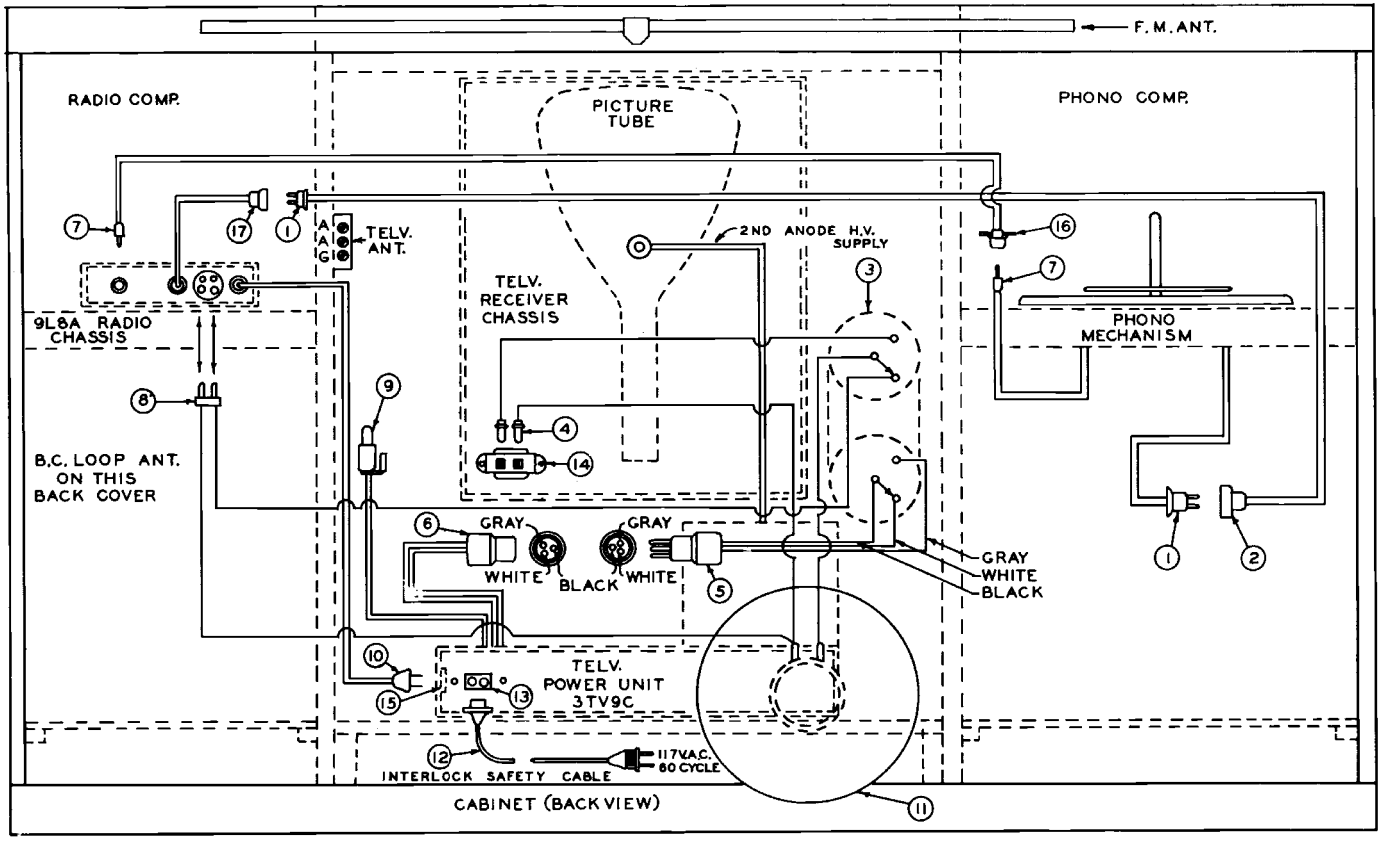


FIG. 2 CABINET WIRING DIAGRAM MODEL 4900TV

RECEIVER

Type 24TV9C (*) &
Type 24TV9

Picture Tube (Credenza) 12-inch Type 12LP4
Picture Tube (Consolette) 10-inch Type 10BP4

R. F. FREQUENCY RANGE

Channel Number	Channel Freq.Mc.	Picture Carrier Freq.Mc.	Sound Carrier Freq.Mc.	Receiver R.F.-Osc. Freq.Mc.
2	54-60	55.25	59.75	81.5
3	60-66	61.25	65.75	87.5
4	66-72	67.25	71.75	93.5
5	76-82	77.25	81.75	103.5
6	82-88	83.25	87.75	109.5
7	174-180	175.25	179.75	201.5
8	180-186	131.25	185.75	207.5
9	186-192	187.25	191.75	213.5
10	192-198	193.25	197.75	219.5
11	198-204	199.25	203.75	225.5
12	204-210	205.25	209.75	231.5
13	210-216	211.25	215.75	237.5

ELECTRICAL AND MECHANICAL SPECIFICATIONS

NOTE: Model 4900TV with radio and phono in combination is known as the Credenza Model. Models 4939TV, 4940TV and 4941TV Television only are known as Consoletts.

POWER SUPPLY RATING

117 Volts.....60 Cycles.....250 Watts

AUDIO POWER OUTPUT RATING

Maximum Undistorted.....2.5 Watts

LOUD SPEAKER

Type 10-inch round permanent magnet.
Voice Coil Impedance.....3.2 OHMS at 400 Cycles.

PICTURE I. F. FREQUENCIES

Picture Carrier Frequency.....26.25 Mc.
Adjacent Channel Sound Trap.....27.75 Mc.
Accompanying Sound Traps.....21.75 Mc.
R. F. Oscillator Trap.....94.0 Mc.

SOUND I. F. FREQUENCIES

Sound Carrier Frequency.....21.75 Mc.
Sound Discriminator Band Width (between peaks) 500 Kc.
Video Response.....to 4 Mc.
Focus..... Magnetic
Sweep Deflection..... Magnetic
Scanning..... Interlaced 525 Lines
Horizontal Scanning Frequency..... 15,750 Cps.
Vertical Scanning Frequency.....60 Cps.
Frame Frequency(Picture Repetition Rate)...30 Cps.
Receiver Antenna Input Impedance.300 OHMS Balanced

* Receiver uses type 12LP4 Picture Tube and Speaker switching.
* Power Supply has A.C. Outlets for radio and phono.

POWER SUPPLY

Type 3TV9C (*) &
Type 3TV9

TUBE COMPLEMENT

TUBE	TYPE	FUNCTION
V1	6BH6	R. F. Amplifier
V2	6AG5	Converter
V3	6C4	R. F. Oscillator
V4	6BH6	1st Pix. I. F. Amplifier
V5	6BH6	2nd Pix. I. F. Amplifier
V6	6BH6	3rd Pix. I. F. Amplifier
V7	6BH6	4th Pix. I. F. Amplifier
V8	6AL5	Pix. 2nd Det. & A.G.C. Rectifier
V9	6AU6	Video Amplifier
V10	6AL5	Sync.Separator & D.C. Restorer
V11	6AU6	Auxiliary Video Amplifier
V12	10BP4 12LP4	Picture Tube (Consolette Models) Picture Tube (Credenza Model)
V13	6AU6	1st Sound I. F. Amplifier
V14	6AU6	2nd Sound I. F. Amplifier
V15	6AL5	Ratio Detector
V16	6AT6	Audio Amplifier
V17	6V6GT	Audio Power Amplifier
V18	6J6	A.B.L. & Sync. Amplifier
V19	6SN7GT	Field Freq. Osc. & Sync.Amplifier
V20	6AL5	A.F.C. Rectifier
V21	12AU7	Line Frequency Oscillator
V22	6L6	Horizontal Output
V23	5V4G	Damper Tube
V24	6AK6	2nd Video Amplifier
V25	6V6GT	Vertical Output
V26	6SN7GT	H.V. Power Supply Oscillator
V27	1B3GT	High Voltage Rectifier
V28	5U4G	Low Voltage Rectifier

OPERATING CONTROLS LOCATED ON TOP PANEL

Volume Control	See Fig. 1
Tone Control	See Fig. 1
Fine Tuning Control	See Fig. 1
Station Selector Control	See Fig. 1
Picture Control	See Fig. 1

NON-OPERATING CONTROLS

(Not including R.F. and I.F. adjustments)

There are seven of these controls which are located under the right-hand top panel ventilating screen. (See Fig. 1 note) Adjustments are made from top side after screen is removed and they control the following operations.

Focus.....	(Under Top Panel) Knob Adj.
Vertical Linearity.....	" " " " "
Brightness.....	" " " " "
Vertical Size.....	" " " " "
Horizontal Size.....	" " " " "
Vertical Hold.....	" " " " "
Horizontal Hold.....	" " " " "
Ion Trap (See Fig.17)	
Deflection Coil (See Fig.17)	Screw Driver or Wrench

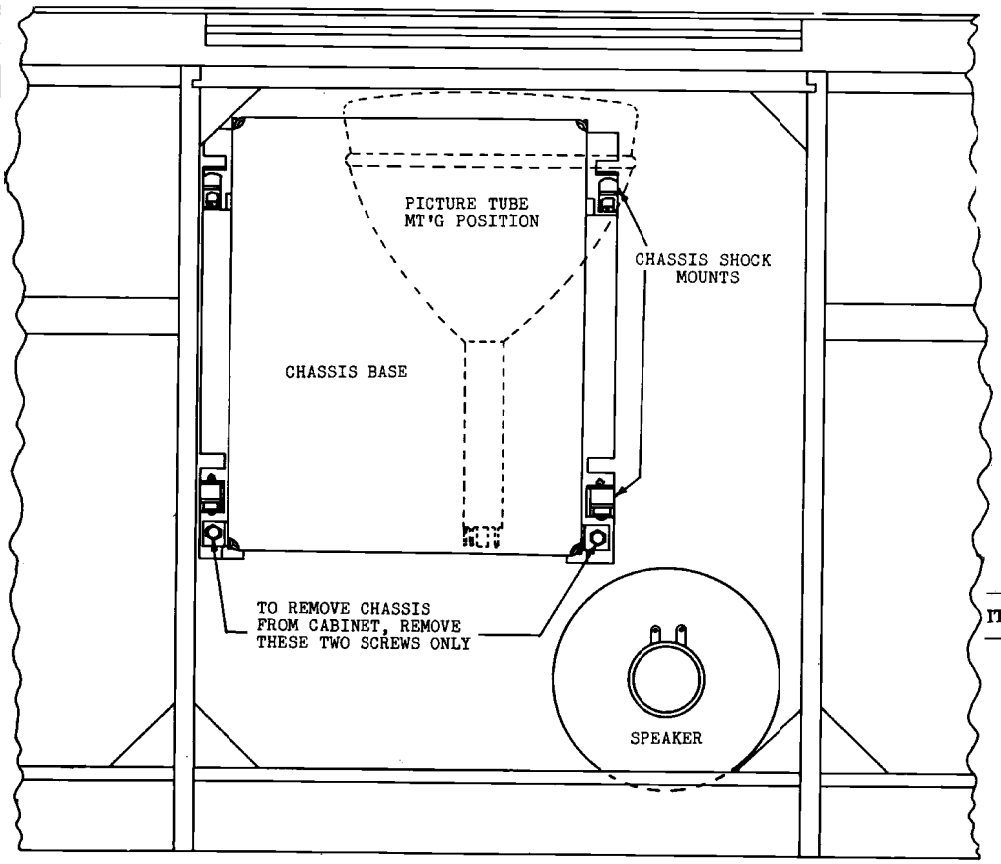
TO REMOVE CHASSIS FROM CABINET

Figure 3 below of a cabinet back view, shows the receiver chassis in its correct mounting position.

The receiver chassis in these Sparton Models are vertically shock mounted to special brackets. When receiver chassis removal is necessary, only the chassis should be removed leaving the rubber shock mounts and brackets in the cabinet.

Removal of the two hex-head screws as indicated by the arrows and note in Figure 3 will accomplish this. See the step by step procedure as outlined on page 10 of this bulletin.

FIGURE 3



WARNING: DANGER TO SERVICEMAN

Every practical safety device possible has been incorporated into these Sparton television receivers for the protection of the serviceman.

Nevertheless, servicing of any television receiver, especially when the receiver is on the service bench and possibly with the safety shield removed, offers many shock hazards to the experienced serviceman and work on the receiver should not be attempted by any one who is not familiar with the necessary precautions while working with high voltage circuit and picture tubes.

The serviceman should observe at all times the safety regulations while servicing television receivers.

PRECAUTION WHEN WORKING WITH HIGH VOLTAGE

CAUTION 1. Respect high voltage circuits and keep away from them. (See Schematic).

CAUTION 2. Do not depend upon interlock switches for protection, always disconnect the power cord if any possible danger exist. Interlock switches are not foolproof.

CAUTION 3. Do not attempt to change tubes or make adjustments in the high voltage circuits when the set is turned on.

CAUTION 4. Always use a long handle, well insulated screwdriver to short circuit the large capacitor terminals to ground before working on them.

CAUTION 5. Do not attempt to operate the receiver with the high voltage compartment shield removed.

CAUTION 6. Do not attempt to reach within the cabinet while the interlock switch is closed to effect some minor adjustment.

PRECAUTION FOR HANDLING PICTURE TUBE

CAUTION 1. Always wear gloves and shatter proof goggles when removing or replacing the picture tube.

CAUTION 2. Never rotate picture tube with the power turned on.

CAUTION 3. Never remove a new picture tube from shipping carton until it is ready to be installed.

CAUTION 4. Never hold a picture tube close to the body. This tube encloses a high vacuum and is subject to considerable air pressure due to its large surface.

CAUTION 5. Do not allow the picture tube to be bumped or struck while installing. Do not apply great pressure or force it. If it sticks or fails to slip smoothly through the deflection yoke or focusing coil, investigate and remove the cause of the trouble.

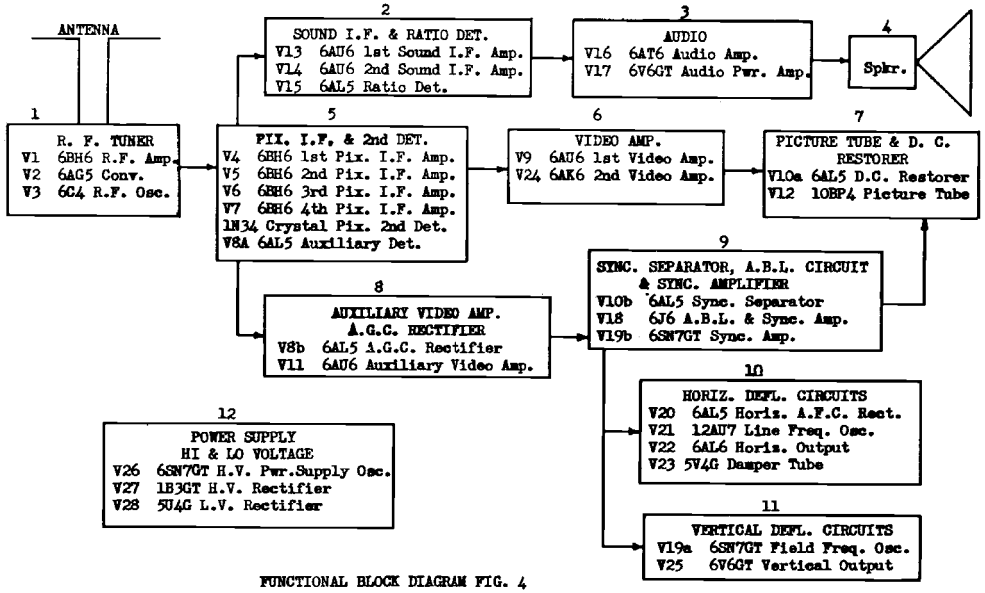
PARTS LIST

ITEM	PART NO	DESCRIPTION			
1	PA4901-	Phono A.C. Connector (Male)	10	PA4000	9L8 Power Cord A.C.
2	PA4930-1	Phono A.C. Connector	11	PC63000-21	Speaker
3	PB42007	Television Change Over Switch (On Cabinet)	12	PA4004	Power Cord A.C.
4	PA4926	Pin Plug-Speaker Lead	13	PA4921	Power Socket A.C.
5	PA4929-1	Male Unit Connector	14	AB44063-1	Output Transformer
6	PA4928-1	Female Unit Connector	15	PA4927-1	Radio Power Receptacle
7	PA4905	Phono Tip-Pickup	16	PA4904	Phono Tip Jack
8	PA4910	Speaker Plug	17	PA4902-2	Phono A.C. Connector (Female)
9	PA4855-2	Pilot Light			

CIRCUIT DESCRIPTION

GENERAL: The following circuit description for Sparton Television Models 4900TV, 4939TV, 4940TV and 4941TV provides all pertinent information necessary for proper servicing of these receivers. In the compilation of this data it is assumed that the service engineer is familiar with the basic electronic principles of modern television.

Fig. 4 (below) shows a fundamental block diagram breakdown of the receiver circuits. The description for these circuits follows in the same order as the blocks appear on the diagram.



FUNCTIONAL BLOCK DIAGRAM FIG. 4

R. F. TUNER (BLOCK #1)

SPECIAL SERVICE NOTE: Service replacement for the R. F. Tuning unit will be made only as a complete assembly including tubes. This unit will be shipped from the factory under part No. PD93150.

The R.F. Tuner is a separate sub-assembly of the receiver. It contains the R.F. amplifier, converter, local oscillator, fine tuning control, station selector switch, input transformers, R.F. amplifier coils, oscillator coils and the individual tuning adjustments for the transformers and coils. The unit provides operation on all twelve of the television channels. It serves to select the desired picture and sound carriers and associated side bands. It amplifies the selected R.F. signal and provides at the converter plate a picture I.F. carrier of 26.25 Mc. and a sound I.F. carrier of 21.75 Mc.

R.F. AMPLIFIER As shown on the schematic diagram (page 23), T1 to T9 together with incremental inductances L2, L3 and L4 are input transformers tuned to channels 2 to 13 respectively. The secondary of each of these transformers forms a parallel resonant circuit with the input capacity of V 1 the 6BH6 R.F. amplifier. The inductances of the secondaries of transformers T 1 through T 5, tuned to channels 2 to 6 respectively, are adjusted by means of individual slugs placed within these coils. Incremental inductances L 2, L 3 and L 4 are added in series with the slug tuned secondaries of transformers T 6, T 7 and T 8, tuned to channels 8, 10 and 12 respectively, to form the tuned circuits for channels 7, 9, and 11. Thus the secondary of T 6 tuned to channel 8 with an added series inductance L 2 forms the tuned circuit for channel 7 and so on with channels 9 - 10 and 11 - 12. The secondary of transformer T 9 is slug tuned for channel 13. On channels 7 through 13 small capacitors (C1, C2, C3, C4) are placed in series with the secondaries of transformers T 6 through T 9. In this way, the effective shunt capacity with which these coils resonate is decreased and the use of larger inductance values is permitted.

CONVERTER Each of the inductances L 5 through L 16 forms a tuned pi-network with the input capacity of the converter (V 2) and the output capacity of V 1. These resonant circuits are tuned to channels 2 to 13 respectively and couple R.F. energy to the grid of V 2. Since the oscillator output and the R.F. signal are both fed to the grid of V 2 the heterodyne products (I.F. frequencies) will appear at the converter plate.

CIRCUIT DESCRIPTION (Continued)

The inductance of coils L 5 through L 9, tuned to channels 2 through 6 respectively, is adjustable by means of individual slugs placed within these coils. Incremental inductances are added to the slug tuned coils for channels 8, 10 and 12 to form tuned circuits for channels 7, 9 and 11. L 16 is slug tuned to channel 13.

In the plate of the converter there are three tuned circuits. They are the following:

FIRST: L 34 with C 12 forms a parallel resonant circuit tuned to 27.75Mc. that acts as a series trap presenting a high impedance to the I.F. frequency of the adjacent channel sound carrier.

SECOND: L 35 with C 118 forms a parallel resonant circuit tuned to 94Mc. that acts as a series trap preventing the oscillator injection voltage from developing bias on the grid of V 4, the first video I.F. stage.

THIRD: L 36 in conjunction with the output capacity of V 2 and the input capacity of V 4 forms a parallel resonant circuit tuned to 22.4Mc. This is the first stage of the stagger tuned video I.F. system.

R.F.OSCILLATOR The local oscillator is a conventional Colpitts system. The inductances L 17 through L 28, together with the incremental inductances L 23, L 25 and L 27, form the oscillator tank circuits and are tuned to channels 2 to 13 respectively. Fine tuning is accomplished by means of C 121 which has a capacity range sufficient to produce a ± 300 KC variation in oscillator output frequency on channel 2 and a variation of approximately ± 2 Mc. on channel 13. The output of the oscillator is coupled to the grid of the converter by means of capacitor C 10. The oscillator operates at a frequency above that of the received signal.

SOUND I.F. AND RATIO DETECTOR (BLOCK # 2) The sound and picture I.F. signals are common to stages V 4 and V 5. At V 6 sound energy is taken off by means of L 67, the sound take off loop, which inductively coupled to L 41, the 21.75 Mc. cathode trap. This energy is fed to the first sound I.F. stage V 13. Two stages of sound I.F. amplification are employed in order to secure adequate gain. These two stages (V 13 and V 14) are operated with their plates grounded while their cathodes are returned to the -140 volt buss. Thus, these two tubes form part of the divider system that splits the B voltage. Inductors L 47 and L 49 are 1" pieces of straight, tinned copper wire. They are employed in the cathode circuits of V 13 and V 14 to provide a decreased input conductance at the grids of these stages at 21.75 Mc.

T 10 in conjunction with V 15 forms a conventional ratio dector system that operates on a center frequency of 21.75 Mc. and has a peak bandwidth of approximately 500 Kc.

AUDIO AMPLIFIER AND SPEAKER (BLOCKS # 3 AND # 4) Tubes V 16 and V 17 form a conventional two stage audio amplifier that feeds a 10" permanent magnet speaker. A compensated volume control R 71 is employed. Continuous tone control is provided by means of R 78 and its associated circuit. Maximum power output of the system is approximately 2.5 watts in the speaker voice coil.

PICTURE I.F. AMPLIFIER AND SEC. DET (BLOCK # 5) The primary requirements of the Picture I.F. system are wide overall response and adequate overall gain. To meet these requirements four stages of video I.F. amplification are employed.

As noted on the schematic diagram (page 23) these stages are V 4, V 5, V 6 and V 7. Single tuned I.F. coils are utilized in the plate circuit of the converter and each of the four successive stages. Starting with the coil L 36 in the converter plate each of the coils L 38, L 39, L 40 and L 30 in the following stages are tuned to a different frequency. Thus by virtue of stagger tuning the several stages, wide band picture I.F. response is obtained.

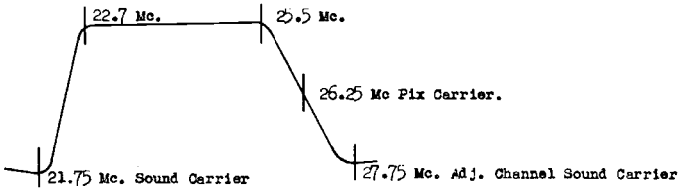


Figure (5) Pix. I.F. Response

In order to obtain a band pass as pictured in figure (5) the I.F. coils are peaked to the following fixed frequencies:

L36	plate of the conv.	(V2)	22.4 Mc.
L38	1st Pix. I.F.	(V4)	22.5 Mc.
L39	2nd Pix. I.F.	(V5)	25.9 Mc.
L40	3rd Pix. I.F.	(V6)	24.1 Mc.
L30	4th Pix. I.F.	(V7)	26.0 Mc.

In addition the traps L34 and L37 for the adjacent channel sound I.F. carrier, 27.75 Mc., and the traps L41 and L42 for the sound I.F. carrier, 21.75 Mc., are peaked for minimum output at the pix detector load.

CIRCUIT DESCRIPTION (Continued)

The overall response of the picture I.F. is observed with the aid of an I.F. sweep and an oscilliscope. Deviations in the observed response from that pictured in figure (5) are compensated for by slight variations in the tuning of the pix I.F. coils.

Under normal conditions replacement of any of the tubes in the picture I.F. strip will have little effect on the shape of the overall pass band. The information on physical location of the various transformers and traps will be found in the section on alignment.

TRAPS Referring to figure (6) it is evident that the I.F. frequency of the adj. channel sound carrier and the I.F. frequency of the received channel sound carrier are quite close to the frequencies passed by the picture I.F. system. If some means of attenuating these sound carriers is not provided in the picture I.F. they will pass through to the pix detector where they will be demodulated and passed on to the kinescope grid as video information. Once there, these signals would appear as interference in the observed picture.

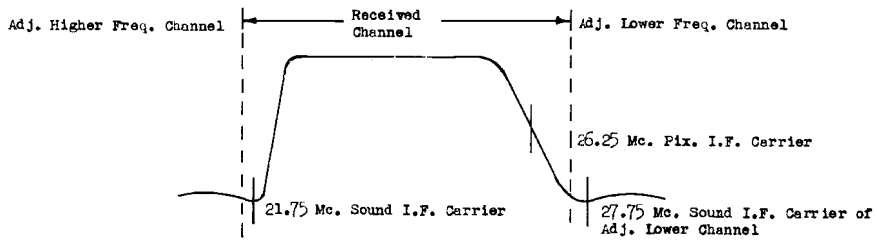


Figure (6)
Relation between Pix and Sound I.F. Carriers.

Note that with the R.F. oscillator operating above the channel being received the I.F. relation of the pix to sound carriers is the reverse of their R.F. relation.

In order to prevent this interference, trap circuits L34, L37, L41 and L42 are provided to attenuate the undesired sound carriers. L34 and L37 function as series traps in the plate circuits of V2 and V4 respectively, and are tuned to 27.75 Mc., the I.F. frequency of the adjacent channel sound carrier as noted in figure (6). The combined trapping action of these two stages is sufficient to keep the sound interference from this source at a negligible value. L41 and L42 are tuned traps inserted in the cathode circuits of V6 and V7 respectively. These traps are tuned to 21.75 Mc., the sound I. F. frequency. At this frequency, the voltage developed across these traps will function as a degenerative voltage opposing the 21.75 Mc. sound I.F. signal at the grids of the respective stages. The combined attenuation offered by stages V6 and V7 is sufficient to suppress the 21.75 Mc. sound carrier before it reaches the pix detector. Inductors L68 and L69 are used to stabilize stages V6 and V7.

PIX DETECTORS Two detectors are employed at the output of the pix I.F. system. One, a 1N34 crystal diode, is connected in the conventional manner to provide an output signal of negative polarity across its output load, while the other, V8A, is connected to give an output signal of positive polarity across its load.

VIDEO AMPLIFIER (BLOCK #6) The video amplifier is a conventional two stage system that is fed by the output of the 1N34 crystal detector. The frequency response of the amplifier extends to 4 Mc. while the overall voltage gain from the input grid to the output plate is approximately 60x. The gain of the amplifier is variable by means of R40, the picture control, in the cathode circuit of the first video stage V9.

The video signal at the kinescope grid must be of such polarity that the sync. and blanking pulses will drive the grid in the negative direction. For this reason with the two stage video amplifier it is necessary for the output of the pix second detector, the 1N34 crystal diode, to be of the same polarity as that of the video signal required at the kinescope grid. With this arrangement, sync. pulses drive the grid of the first video amplifier stage in the negative direction. This stage, V9, is so designed that with normal signal input at its grid the tube works over most of its operating range. However, any large noise pulses above sync. level will drive the grid beyond cut off. This results in a desirable peak noise limiting action by the video amplifier that effectively improves the overall signal to noise ratio of the receiver.

D.C. RESTORER AND KINESCOPE (BLOCK #7) Since the video amplifier is an A.C. coupled system the D.C. component of the video signal that represents the average background brightness of the televised scene is lost in the first video stage V9. If this resulting video signal were applied directly to the kinescope grid its average value would center about the kinescope bias as shown in figure (7).

CIRCUIT DESCRIPTION (Continued)

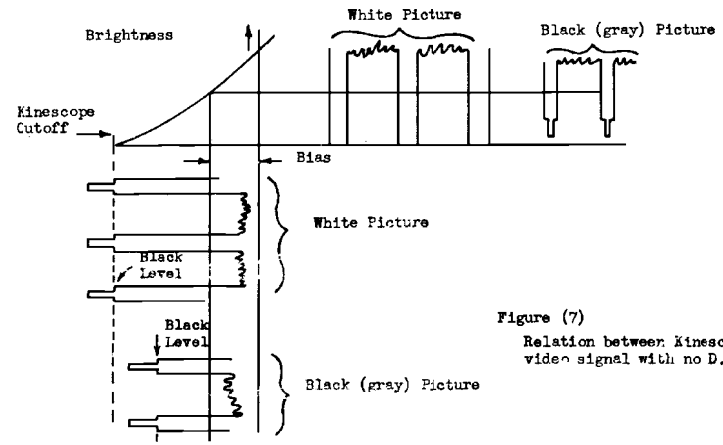


Figure (7)
Relation between Kinescope cutoff and video signal with no D.C. component.

In the case shown, the brightness control (which varies kinescope bias) was adjusted in such manner that the black level of the white picture signal occurred exactly at kinescope cut off. This is the correct kinescope operating point for the white picture signal and accurate reproduction will take place on the screen. Note that in figure (7) with the brightness control correctly set for the white picture signal, the black level for the black (grey) picture occurs below kinescope cut off. As a result, with the black (grey) picture signal on the kinescope grid, the sweep return traces will not be extinguished by the blanking pulses and will appear in the observed picture. Also, the ratio of black picture current to white picture current will be too small for correct contrast reproduction.

In order to correct this, most receivers utilize a conventional diode D.C. restorer, the basic circuit of which is shown in figure (8).

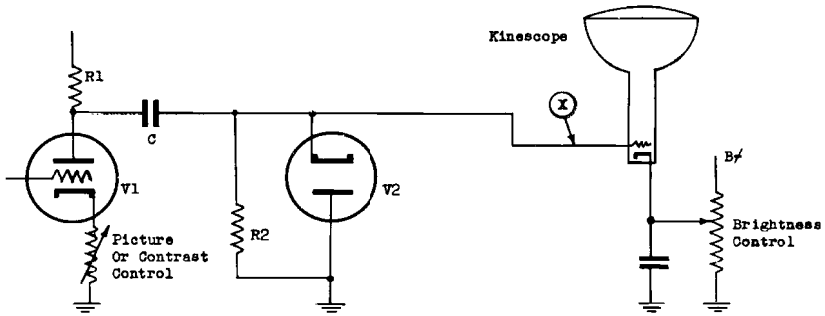


Figure (8). Basic Diode D.C. Restorer System

The diode V2 (figure 8) is so arranged that a variable positive voltage (in respect to ground) is developed at point X by the video signal. This positive voltage is essentially equal to the negative peak value of the sync. pulses of the video signal. It is established when C is charged through R1, Rp of V1, and V2 (conducting) during sync. pulses. It is maintained from line to line by the time constant R2C. As a result of the action of the D.C. restorer the video voltage waveform at point X is as shown in figure (9).

CIRCUIT DESCRIPTION (Continued)

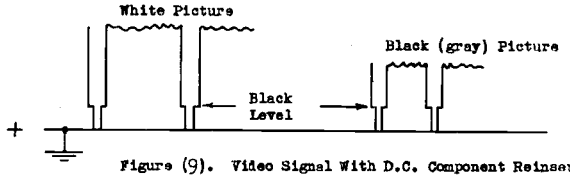


Figure (9). Video Signal With D.C. Component Reinserted

With this signal applied to the kinescope grid and the kinescope bias correctly adjusted the black and white picture signals will be oriented as shown in figure (10).

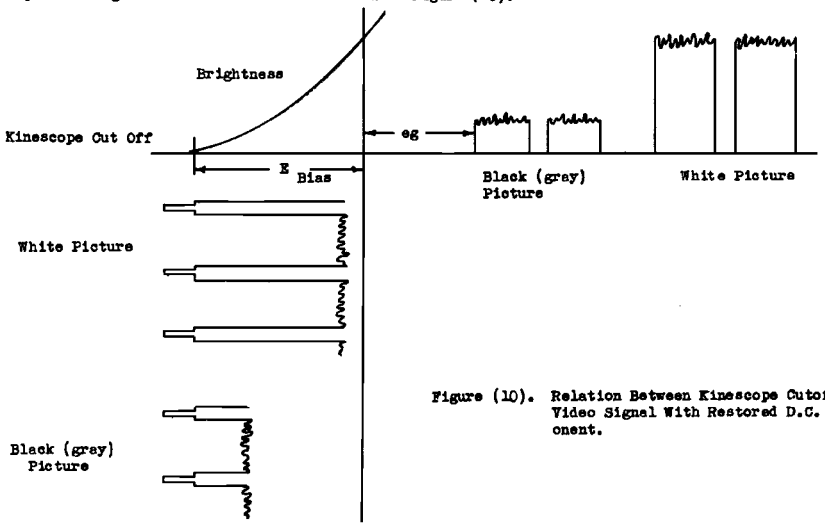


Figure (10). Relation Between Kinescope Cutoff and Video Signal With Restored D.C. Component.

Note that the black level for both the black and white picture signals occurs exactly at kinescope cut off. This results in correct reproduction of the transmitted scene on the receiver kinescope.

In actual operation the sync. pulse peaks of both the black and white picture signals are established at ground as a reference level (shown in figure 9). The kinescope bias is then adjusted until the sweep retrace lines visible in the picture are just extinguished. With this setting of the brightness control, kinescope zero beam current (cut off) will coincide with the black level of the video signal as shown in figure (10). In most receivers this operating condition will only be satisfactory for a single setting of the contrast (video gain) control. Any readjustment of this control will change the amplitude of the video signal appearing at the kinescope grid. As soon as this change in video signal amplitude occurs, the voltage difference between the sync. pulse peaks and the video signal black level (porches of the blanking pulse) will also change as shown in figure 11A, B and C.

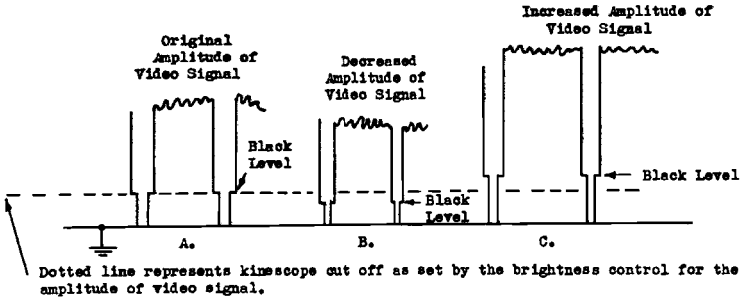


Figure (11). Relation Between Sync. Pulse Peaks and Black Level For Various Amplitudes Of Video Signal.

CIRCUIT DESCRIPTION (Continued)

Note that the D.C. restorer will set the sync. pulse peaks for the various amplitudes of video signal at the same reference level (ground) as it did before. (See figures 9 and 11). This results (as shown in figure 11B and C in a variation between the black level of the video signal and kinescope cut off for levels of video signal other than the level of the original signal for which brightness was correctly adjusted. As a result of this variation between black level and kinescope cut off, improper reproduction of the picture will take place on the kinescope screen unless the brightness control is correctly readjusted for each new level of video signal.

The object of the automatic black level circuit of this receiver is to eliminate the necessity of readjusting the brightness control whenever the video signal level at the kinescope grid is varied either by manipulation of the picture control or by change in the R.F. input to the receiver antenna terminals.

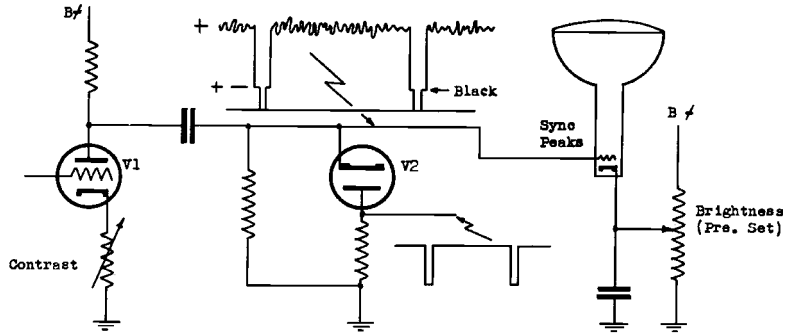


Figure (12). Basic "Automatic Black Level" System

The fundamental circuit for the automatic black level system is shown in figure 12. Its basic action is similiar to that of the diode D.C. restorer shown in figure (8). However, the circuit of the receiver is so arranged that negative sync. pulses of greater amplitude than the sync. pulses of the video signal (appearing at the cathode of V2, fig. 12) are applied to the plate of the diode as shown. These negative sync. pulses effectively cut off the D.C. restorer during the period the sync. pulses of the video signal appear at its cathode. The D.C. restorer then conducts only on the most negative portions of the remaining signal, that is, on the front and back porches of the blanking pulse which represent the true black level in any picture. Operating in this manner the D.C. restorer sets the black level of the video signal directly at a definite reference level at the kinescope grid instead of setting the sync. pulse peaks at the reference level and letting the black level fall where it may depending on video signal amplitude.

In the receiver V10A, (1/2 6AL5), performs the function of the D.C. restorer. The large negative sync. pulses applied to its plate are generated by stages V11, V8B, V10B, and V18. Since these stages perform other functions in the receiver, their action will be explained under their respective block diagram designations.

KINESCOPE The kinescope utilized in the receiver is a conventional 10" tube. This tube employs magnetic focus and deflection systems. An ion trap is used to prevent the ion beam from forming a dark spot on the kinescope screen. The flaring portion of the kinescope bulb has a metallic coating on both the inside and outside surfaces. The coating on the inside of the bulb forms the kinescope second anode and has the high voltage connected to it. The outside coating is grounded so that the capacity between the outside and inside coating acts as a filter for the high voltage power supply.

AUXILIARY VIDEO AMP. A.G.C. RECTIFIER (BLOCK #8) The video signal output of V8A is amplified by V11, the auxiliary video amplifier, and applied to the A.G.C. rectifier V8b. In order to preserve the D.C. component of the video signal direct coupling is employed between V8A, V11 and V8b. The A.G.C. voltage developed by V8b is applied to grids of the first two video I.F. stages and to the grid of the R.F. stage. Its action on these stages is such that it effectively varies the gain of the receiver to compensate for changes in R.F. input level to the antenna terminals.

Referring to the schematic diagram the output of the auxiliary pix detector, V8A, is directly fed to the grid of the auxiliary video amplifier V11. (Polarities and waveshapes of the various signals are shown on the schematic diagram page 23). V8b, the A.G.C. rectifier, is directly connected to the plate of V11. For this reason a positive voltage appears on its cathode. This positive (or delay) voltage renders the A.G.C. rectifier inoperative for low signal outputs of V11. Since no A.G.C. voltage can be developed for this condition the sensitivity of the receiver is preserved for low R.F. inputs at the antenna. As soon as the output of V11 exceeds the delay voltage, V8b conducts, and a negative voltage (in respect to ground) is developed across R51. This voltage charges C40, the A.G.C. condenser, through R52. Since the time constant of R52 and C40 is comparatively high the negative voltage appearing across C40 is fairly immune to fast changes in input signal level.

CIRCUIT DESCRIPTION (Continued)

SYNC. SEPARATOR, AUTOMATIC BLACK LEVEL, SYNC. AMPLIFIER (BLOCK #9) This section of the receiver performs three distinct functions. First, it separates the sync. pulses from the video signal; second, it amplifies these sync. pulses and third, it provides at its output the negative sync. pulses that are applied to the plate of the D.C. restorer for "automatic black level" circuit action. These negative sync. pulses are also applied to the second sync. amplifier which provides sync. of the proper polarity to the horizontal and vertical deflection systems.

SYNC. SEPARATOR The output of V11 is coupled to the cathode of the sync. separator (V10B) by means of capacitor C41. Since the output of V11 is of negative polarity V10B is so arranged that it conducts only on the most negative portions of the video signal applied to its cathode. By this action the sync. pulse peaks are clipped from the blanking pulses and appear across R54. These pulses are negative in polarity.

SYNC. AMPLIFIER The sync. pulses appearing across R54 are directly applied to the grid of V18 a twin triode amplifier. Since V18 operates at zero bias, grid clipping occurs when the sync. signal drives either of the grids beyond cutoff. Between the sync. separator and V18 both sides (top and bottom) of the sync. pulse are clipped. The net result of this action is such that the negative sync. pulses appearing at the output of the second section of V18 are free of noise and equal in amplitude for wide variations in input signal level to the sync. separator.

AUTOMATIC BLACK LEVEL The large negative sync. pulses appearing at the output of V18 are coupled to the plate of the D.C. restorer and to the grid of the second sync. amplifier, V19B, by means of C44 and a resistance divider network. These negative sync. pulses at the plate of the D.C. restorer effectively render it non-conductive while the sync. pulses of the video signal applied to the kinescope grid appear at its cathode. This results in D.C. restorer conduction on only the most negative portions of the remaining video signal. The result of this action is explained in the section on the D.C. restorer (page 14) and constitutes the "Automatic Black Level" system of the receiver.

SECOND SYNC. AMPLIFIER V19B, the second sync. amplifer, is in reality a phase splitter that provides sync. pulse outputs of positive and negative polarity at its plate and cathode circuits respectively. These sync. pulses are applied to the horizontal A.F.C. rectifier V20. The positive sync. pulses appearing at the plate of V19B are also applied to the integrating network that supplies sync. voltage to the vertical blocking oscillator V19A.

HORIZONTAL DEFLECTION CIRCUITS (BLOCK #10) The horizontal deflection and A.F.C. circuits depart considerably from the conventional systems employed by most present day receivers. However, the primary function of these circuits, as in other receivers, is to provide a stable, linear, deflection current in the horizontal yoke. Performance of this action results in framing the received picture in the horizontal direction.

HORIZONTAL OSCILLATOR AND A.F.C. SYSTEM The horizontal oscillator, V21, is a conventional cathode coupled multivibrator. In actual operation the frequency of the oscillator is set near line speed by means of the horizontal hold control R95. The oscillator is then locked in sync. by means of a D.C. control voltage which is applied to the grid (pin #7) of one of its triode sections. This control or A.F.C. voltage acts to speed up or slow down the oscillator until it operates at horizontal sweep frequency. The A.F.C. voltage is developed by the horizontal A.F.C. rectifier, V20, and is the resultant of the phase error between the incoming horizontal sync. pulses and the output of the horizontal oscillator which is coupled back to the rectifier by means of C76 and R100.

The peaked sawtooth voltage used to drive the horizontal output stage is developed by the charge-discharge action of capacitor C76 and the peaking resistor R100. The NE-2 neon bulb acts as a regulator for the voltages applied to the multivibrator and as a result provides for increased stability of oscillator operation.

HORIZONTAL OUTPUT Most present day receivers that employ magnetic deflection systems utilize transformer coupling between the horizontal output stage and the deflection yoke. In this receiver, however, no output transformer is used and the horizontal deflection yoke is directly connected to the plate of the output stage V22. Due to this fact, and in order to provide proper loading for the output stage, the inductance of the yoke is made quite high as compared to that of yokes used in conventional transformer coupled systems. Since horizontal retrace time is a function of the resonant frequency of the yoke and its associated circuit it is necessary to keep the shunt capacity across the yoke at a minimum value. However, due to the polarity of the deflection voltage, it is necessary to connect the filament of the damper tube directly to the plate of the output stage. This places the capacity of the damper tube filament transformer directly across the yoke. For this reason transformer T10 is especially designed for low capacity between the damper tube filament winding and the rest of the assembly. In order to avoid unnecessary difficulty whenever replacement of this unit is indicated, use factory supplied components only.

The majority of the output stage plate current is supplied through the damper while the remainder comes through R106 in series with the shunt feed choke, L52. Since the inductance of L52 is large (as compared to that of the yoke) it presents a high impedance in the B+ line to the deflection voltage developed by V22 and thus prevents the B supply from loading down the output stage.

Picture width is controlled by means of R106 which varies the plate voltage (and thereby the output) of the horizontal stage. Small improvements in trace linearity are affected by means of the variable linearity control system placed in the plate circuit of the damper. Figure 13 shows the voltage and current waveforms appearing in the horizontal system.

CIRCUIT DESCRIPTION (Continued)

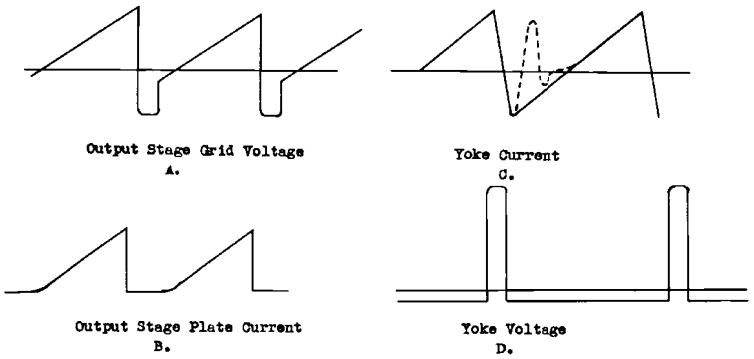


Figure (13). Voltage and Current Wave Forms in the Horizontal Output System

DAMPER When the plate current of the output stage is cut off by the negative portion of the voltage applied to its grid, the magnetic field in the deflection coil begins to collapse at a rate determined by the resonant frequency of the system. If permitted to go unchecked the circuit would oscillate as shown by the dotted curve in figure 13C. However, since this condition is undesirable, the damper stage V25, is placed across the horizontal yoke to prevent these oscillations. This stage is so arranged that a half cycle of oscillation (retrace) is permitted. At the end of the half cycle the damper conducts and causes the oscillatory currents in the yoke to decay in a linear manner and at a rate suitable for the visible trace. Very shortly after decay starts, the output stage begins to conduct and this additional current in conjunction with the decay current in the yoke produces an essentially linear trace motion of the electron beam

VERTICAL DEFLECTION SYSTEM (BLOCK # 11) This section of the receiver functions to supply vertical scanning for the kinescope. A conventional system similiar to that employed in most receivers is utilized. Stage V19 operates as a field frequency oscillator whose output signal is used to drive the vertical output stage V25. The combined action of stages V19A, V25 and their associated circuits provides a linear deflection current of proper polarity and frequency in the vertical deflection yoke.

VERTICAL INTEGRATING NETWORK The integrating network composed of R109, R110, R111, R126 and C85 A-B-C functions to separate the horizontal from the vertical sync. and to pass the vertical sync. on to the field frequency oscillator. In operation the network can be considered as a low pass filter that by-passes the horizontal sync. pulses and permits the low frequency vertical sync. to pass on through to the grid of V19A.

FIELD FREQUENCY OSCILLATOR The field frequency oscillator, V19A, is a conventional blocking oscillator system. In actual operation the free running frequency of the oscillator is adjusted by means of the vertical hold control R113. The oscillator is locked in sync. at field frequency by means of the vertical sync. pulses which are injected into its grid circuit by the integrator network. The cut off and conduction action of the oscillator charges and discharges capacitor C89 and the resulting sawtooth output is used to drive the output stage V25.

VERTICAL OUTPUT The peaked sawtooth output of the blocking oscillator system is used to drive the grid of the vertical output stage, a triode connected 6V6. An impedance matching transformer, T14, is used to couple the output stage to the vertical deflection yoke L54. Picture height is controlled by means of R115 which varies the B+ voltage supplied to the vertical system. Vertical trace linearity is adjustable by means of R119 in the cathode circuit of the output stage. In operation, adjustment of this control varies the bias and consequently the operating point of the stage.

Voltage waveforms at various points in the vertical system are shown on the schematic diagram. More detailed information on the operation of this type of circuit can be found in practically any modern text on television principles.

HIGH AND LOW VOLTAGE POWER SUPPLIES (BLOCK # 12) The receiver high and low voltage supplies are constructed on a seperate chassis. In operation the low voltage system supplies the plate and filament voltage requirements of the receiver while the high voltage system supplies the second anode voltage required by the kinescope.

LOW VOLTAGE POWER SUPPLY A single 5U4G rectifier supplies approximately 330 volts D.C. at 220 Ma. to the receiver chassis. Condensers C102A and B together with filter choke L55 form a pi-type filter system for the supply. Additional filter condensers C101 and C100 are placed in the receiver chassis.

CIRCUIT DESCRIPTION (Continued)

A unique system of D.C. voltage division and distribution is utilized. A simplified operational diagram of this sytem is shown in figure 14.

The divider system is so arranged that the receiver chassis is 140 volts positive in respect to the minus leg of the supply. Notice that the total current requirements of the receiver are supplied through the focus coil system. The over all design of the receiver circuits is such that the current requirements on the power supply are at a minimum for the number of tubes involved.

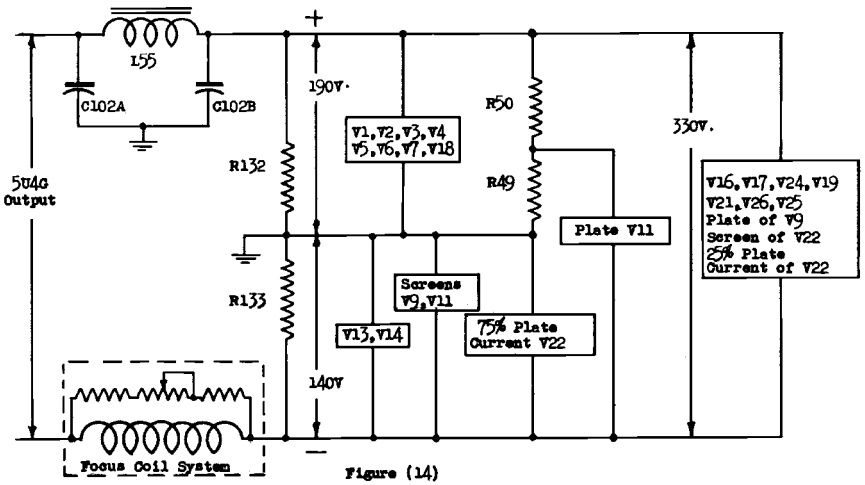


Figure (14)

Simplified diagram of low voltage divider and distribution system.

HIGH VOLTAGE SUPPLY As noted on the schematic diagram an R.F. high voltage supply system is utilized to provide the second anode potential for the kinescope. A twin triode (V26) with both sections connected in parallel functions as the R.F. oscillator. The voltage developed by the oscillator in its plate tank is stepped up in the secondary of the R.F. transformer, T15, and applied to V27 the high voltage rectifier. The operating frequency of the oscillator is approximately 190 K.C. The output voltage of the supply is adjustable by means of trimmer C95. Filtering of the high voltage is accomplished by means of C98, R125 and the capacity of the kinescope. Additional filters composed of R124, C94, R121 and C99 are used to prevent the R.F. voltage developed by the oscillator from getting into the receiver B+ lines. Normal output voltage of the supply is approximately 10KV.

SERVICE ADJUSTMENT OR NON-OPERATING CONTROLS

Controls for adjusting the focus, vertical linearity, brightness, vertical size, horizontal size, vertical hold and horizontal hold are assembled on a single bracket.

Control identification is stamped on the bracket above each control as shown in Figure 16. (front view)

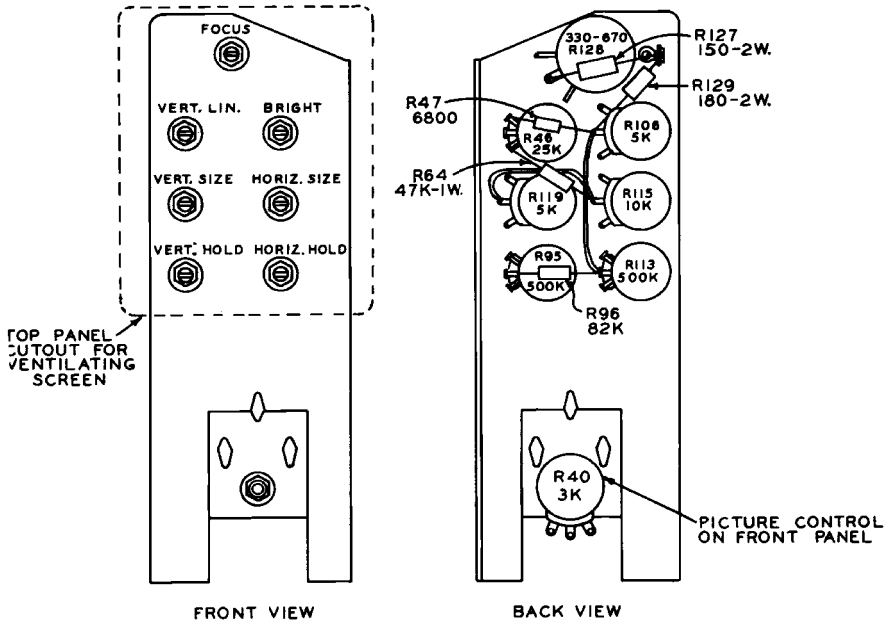
When the ventilating screen on the cabinet control panel is removed, (See Figure 1, page 4) these controls may be adjusted through the cabinet opening.

A knurled shaft permits these controls to be easily adjusted with the finger tips.

Figure 16 (back view) shows each control value and the "R" number for location on the schematic diagram Figure 15, page 23.

NOTE: The two screems should be cleaned free of lint and dust periodically, otherwise cabinet ventilation will be impeded.

Figure (16)



MODELS 4900TV, Ch. 24TV9C;
4939TV, 4940TV, 4941TV, Ch. 24TV9

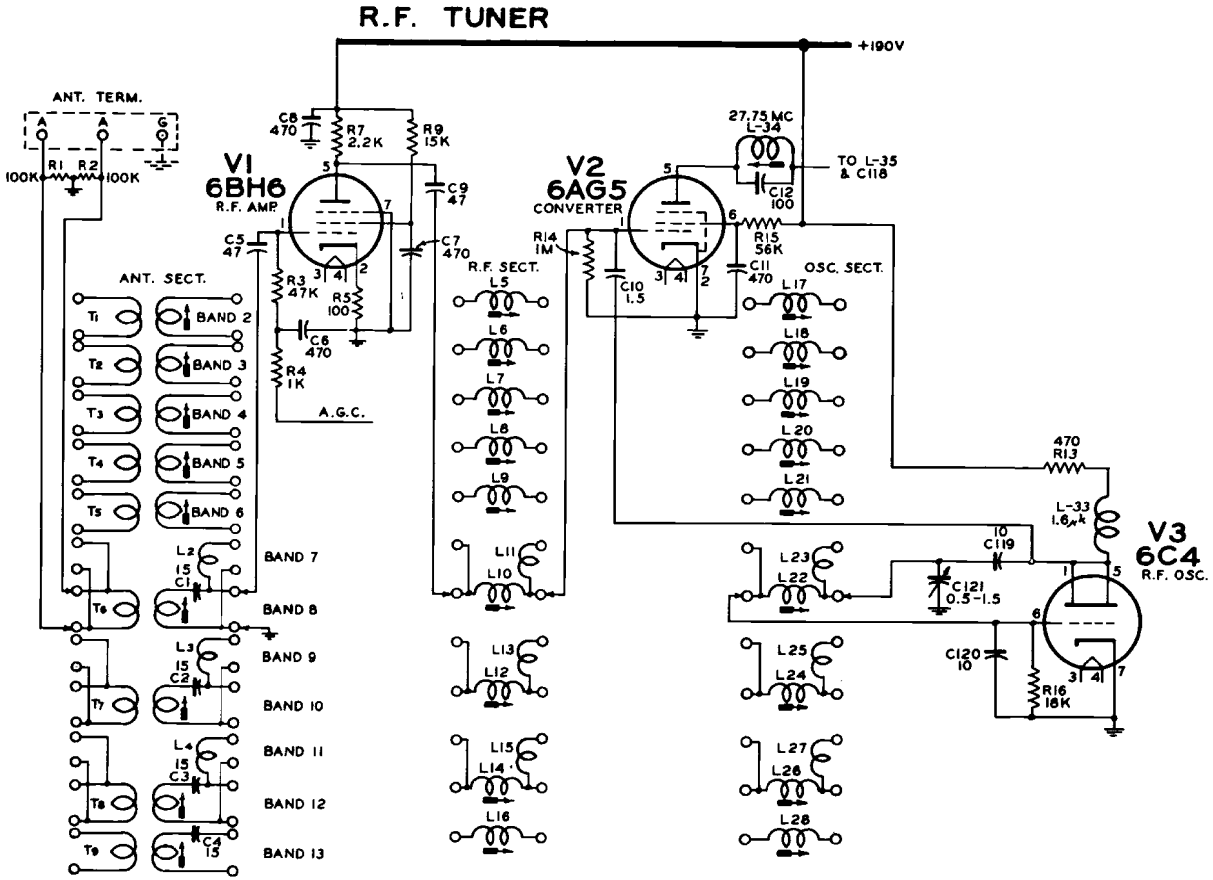


FIG. 17 SCHEMATIC DIAGRAM - R. F. TUNER

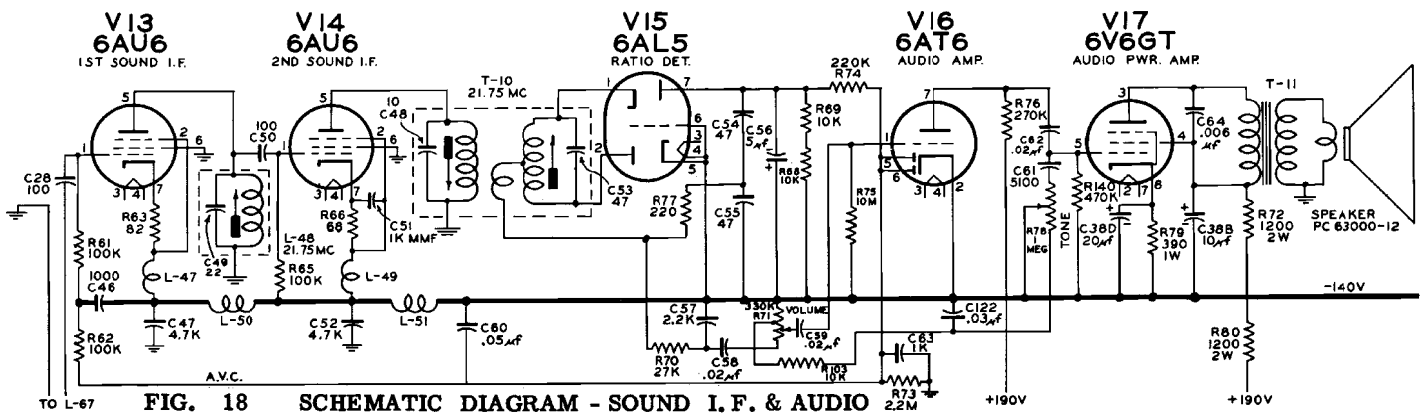


FIG. 18 SCHEMATIC DIAGRAM - SOUND I.F. & AUDIO

SOUND I.F. AND AUDIO CONDENSER

C28	100	Mmf	Ceramic	CC32A-101F
C38B	10	Mfd	350V Elect.	PA4307-5
C38D	20	Mfd	25V	
C46	1K	Mmf.	Ceramic	HK36H-102
C47	4.7K		Ceramic	PA4334-1
C48	10	Mmf	Ceramic	CC30A-100F
C49	22	Mmf	Ceramic	CC30A-220K
C50	100	Mmf	Ceramic	HK36G-101
C51	1000	Mmf	Ceramic	HK36H-102
C52	4.7K	Mmf	Ceramic	PA4334-1
C53	47	Mmf	Ceramic	CC30A-470F
C54	47	Mmf	Ceramic	CC30A-470F
C55	47	Mmf	Ceramic	CC30A-470F
C56	5	Mfd	50V tubular elect.	PA4308-2
C57	2.2	Mmf	Ceramic	PA4334-3
C58	.02	Mfd	400V tubular	PC40GL-203
C59	.02	Mfd	400V tubular	PC40GL-203
C60	.05	Mfd	200V tubular	PC40GK-503
C61	5100	Mmf	Mica	MC61G-512
C62	.02	Mfd	400V tubular	PC40GL-203
C63	1000	Mmf	Ceramic	HK36H-102
C64	.006	Mfd	600V tubular	PC40GM-602

RESISTORS SOUND I.F.

R61	100K	Ohm	1/2W	BR12S-104
R62	100K	Ohm	1/2W	BR12N-104
R63	82	Ohm	1/2W	BR12S-820
R65	100K	Ohms	1/2W	BR12S-104
R66	68	Ohms	1/2W	BR12S-680
R68	10K	Ohms	1/2W	BR12S-103
R69	10K	Ohms	1/2W	BR12S-103
R70	27K	Ohms	1/2W	BR12S-273
R71	330K	Ohms Volume Control		PA4418
R72	1200	Ohms	2 W	DR12S-122
R73	2.2	Megohm	1/2W	BR12N-225
R74	220K	Ohm	1/2W	BR12N-224
R75	10	Megohm	1/2W	BR12N-106
R76	270K	Ohm	1/2W	BR12S-274
R77	220	Ohm	1/2W	BR12S-221
R78	1	Megohm Tone Control		PA4414
R79	390	Ohm	1 W	CR12S-391
R80	1200	Ohm	2 W	DR12S-122
R103	10K	Ohm	1/2W	BR12S-103
R140	470K	Ohm	1/2W	BR12S-474

COILS AND TRANSFORMERS

L-47	Cathode Neutralizing Inductance	AA6646-1
L-48	Sound I.F. Coil Assembly	AA6663-2
L-49	Cathode Neutralizing Inductance	AA6646-1
L-50	R.F. Choke	AA6651-1
L-51	R.F. Choke	AA6651-1
T-10	Ratio Det. Coil Assem. (21.75Mc)	AA6684-2
T-11	Audio Output Transformer	AB44063-1

MODELS 4900TV, Ch. 24TV9C; 4939TV, 4940TV, 4941TV, Ch. 24TV9

C42C	20	Mfd		
C43	.01	Mfd	400V tubular	PC40GL-103
C44	.25	Mfd	400V tubular	PC40GL-254
C45	15	Mfd	450V Elect.	PA4309-2
C67	10	Mmf	Ceramic	CC30A-100F
C115	4.7	Mmf	Ceramic	PA4328-11
C116	4.7	Mmf	Ceramic	PA4328-11
C117	22	Mmf	Ceramic	CC30A-220K
C118	1.5	Mmf	Ceramic	PA4326-3

VIDEO I.F., VIDEO A.G.C., SYNC. SEPARATION & A.B.L. CIRCUITS

VIDEO I.F. RESISTORS

R18	1.5K	Ohms	1/2 W	BR12N-152
R19	15K	Ohms	1/2 W	BR12G-153
R20	1K	Ohms	1/2 W	BR12N-102
R21	100	Ohms	1/2 W	BR12S-101
R22	1.5K	Ohms	1/2 W	BR12N-152
R23	15K	Ohms	1/2 W	BR12S-153
R25	4.7K	Ohms	1/2 W	BR12G-472
R26	1K	Ohms	1/2 W	BR12N-102
R27	100	Ohms	1/2 W	BR12S-101
R28	1.5K	Ohms	1/2 W	BR12N-152
R29	15K	Ohms	1/2 W	BR12S-153
R30	15K	Ohms	1/2 W	BR12G-153
R31	15K	Ohms	1/2 W	BR12S-153
R32	1.5K	Ohms	1/2 W	BR12N-152
R33	100	Ohms	1/2 W	BR12S-101
R34	2.2K	Ohms	1/2 W	BR12G-222
R35	1.5K	Ohms	1/2 W	BR12N-152
R36	15K	Ohms	1/2 W	BR12S-153
R37	3.3K	Ohms	1/2 W	BR12G-332
R38	3.3K	Ohms	1/2 W	BR12S-332
R39	3.9K	Ohms	1/2 W	BR12S-392
R40	3K	Ohms	Contrast Control	PA4417
R41	1.8K	Ohms	1/2 W	BR12G-182
R42	15K	Ohms	1/2 W	BR12S-153
R43	4.7K	Ohms	1/2 W	BR12S-472
R44	4.7K	Ohms	1/2 W	BR12S-472
R45	1.5	Megohms	1/2 W	BR12N-155
R46	2.5K	Ohm	Brightness Control	PA4412
R47	6.8K	Ohm	1 W	CR12S-682
R48	470	Ohm	1/2 W	BR12S-471
R49	10K	Ohm	1/2 W	BR12G-103
R50	33K	Ohm	2 W	DR12G-333
R51	1	Megohm	1/2 W	BR12N-105
R52	2.2	Megohm	1/2 W	BR12N-225
R53	220K	Ohm	1/2 W	BR12N-224
R54	10K	Ohm	1/2 W	BR12N-103
R55	150	Ohm	1/2 W	BR12N-151
R56	15K	Ohm	1/2 W	BR12N-153
R57	47K	Ohm	1/2 W	BR12N-473
R58	22K	Ohm	1/2 W	BR12N-223
R59	1	Megohm	1/2 W	BR12N-105
R60	27K	Ohm	1/2 W	BR12S-273
R64	47K	Ohm	1 W	CR12S-473
R67	100	Ohm	1/2 W	BR12S-101
R89	2.7K	Ohm	1/2 W	BR12S-272
R134	68K	Ohm	1/2 W	BR12S-683
R135	470K	Ohm	1/2 W	BR12N-474
R136	820	Ohm	1/2 W	BR12S-821
R137	6.8K	Ohm	2 W	DR12G-682
R138	3.3K	Ohm	1 W	CR12S-332
R139	100K	Ohm	1 W	CR12S-104

VIDEO I.F. COILS

L-30	Pix. I.F. Coil	(26MC)	AB43523-2
L-31	Choke Coil	(25uh)	AA6650-1
L-32	Choke Coil	(95uh)	AA6650-3
L-35	R.F. Trap Coil	(94MC)	AA6654-1
L-36	Pix. I.F. Coil	(22.4MC)	AB43523-1
L-37	Pix. I.F. Coil	(27.75MC)	AB43524-1
L-38	Pix. I.F. Coil	(22.5MC)	AB43523-1
L-39	Pix. I.F. Coil	(259MC)	AB43523-2
L-40	Pix. I.F. Coil	(24.1MC)	AB43523-2
L-41	Pix. I.F. Trap Coil	(21.75MC)	AB43524-4
L-42	Pix. I.F. Trap Coil	(21.75MC)	AB43524-2
L-43	Choke Coil	(95uh)	AA6650-3
L-44	Choke Coil	(235uh)	AA6650-7
L-45	Choke Coil	(150uh)	AA6650-2
L-57	Choke Coil	(135uh)	AA6650-5
L-58	Choke Coil	(200uh)	AA6650-4
L-67	Pix. I.F. Trap Coil		AB43524-4
L-68	Choke Coil	(11uh)	AA6644-1
L-69	Choke Coil	(11uh)	AA6644-1
L-70	Choke Coil	(83uh)	AA6650-6
1N34	Diode Crystal		PA4206

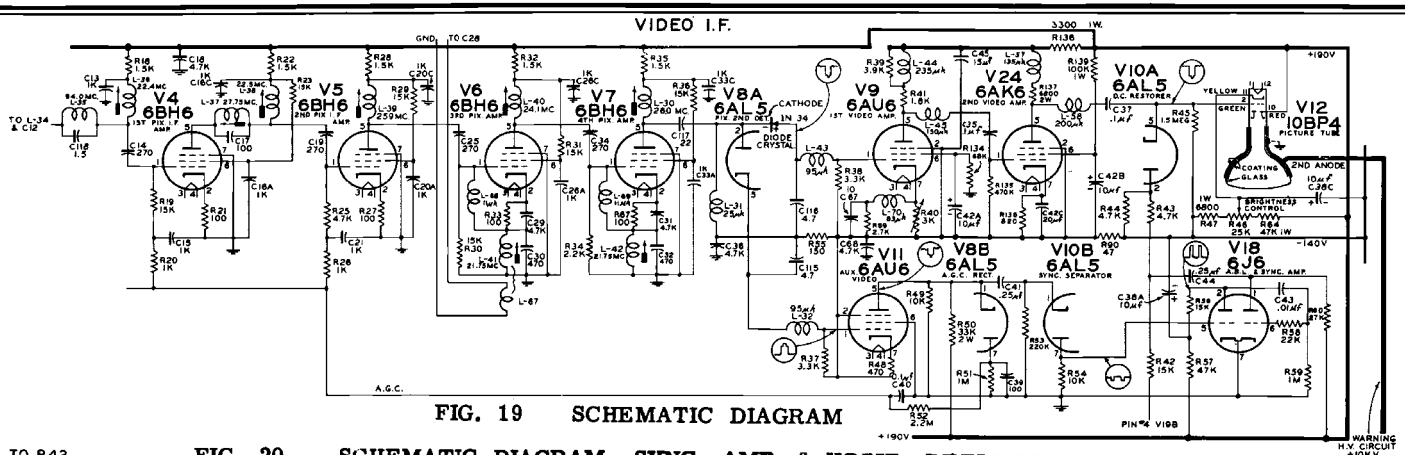
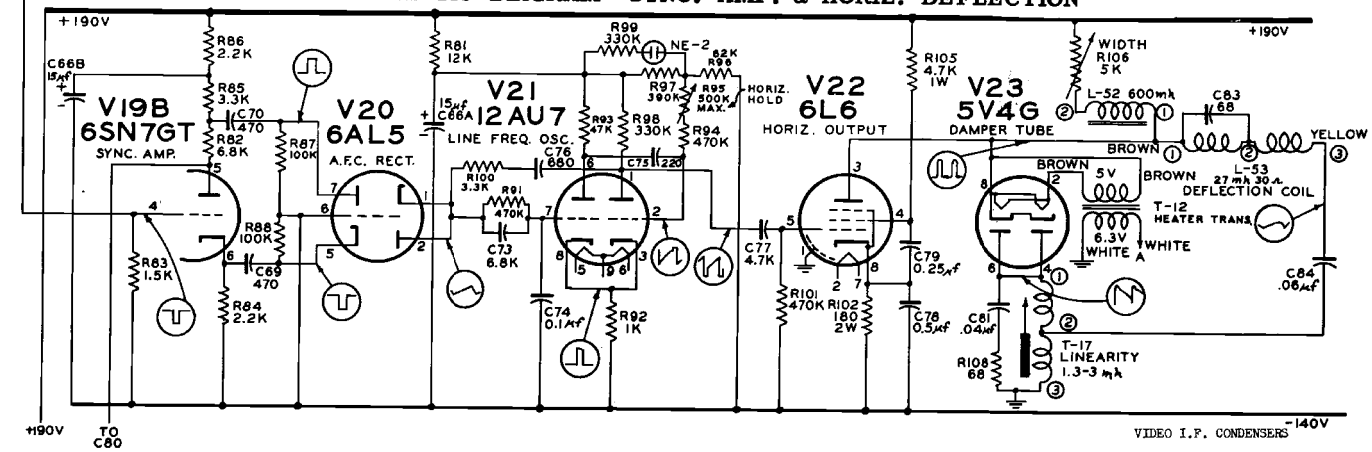


FIG. 19 SCHEMATIC DIAGRAM

FIG. 20 SCHEMATIC DIAGRAM - SYNC. AMP. & HORIZ. DEFLECTION



CONDENSERS

C66A	15	Mfd	350V	Elect.	PA4307-6
C66B	15	Mfd	350V		
C69	470	Mmf	Mica		MC60E-471
C70	470	Mmf	Mica		MC60E-471
C73	6.8K	Mmf	Mica		MC61F-682
C74	0.1	Mfd	200V tubular		PC40GK-104
C75	220	Mmf	Mica		MC60E-221
C76	680	Mmf	Mica		MC60F-681
C77	4.7K	Mmf	Ceramic		PA4334-1
C78	0.5	Mfd	200V tubular		PC40GK-504
C79	0.25	Mfd	400V tubular		PC40GL-254
C81	.04	Mfd	200V tubular		PC40GK-403
C83	68	Mmf	1200V Mica		PA4340-2
C84	.06	Mfd	400V tubular		PC40GL-603

COILS AND TRANSFORMERS

L-52	Feed Choke	(600mh)	AA6660-1
L-53	Deflection Yoke Coil	(27mh 30ohms)	PC70002
T-12	Heater Transformer		AB47002-1
T-17	Linearity Transformer		AA6659-1

RESISTORS

R81	12K	Ohms	1 W	CR12S-123
R82	6.8K	Ohms	1/2W	BR12G-682
R83	1.5K	Ohms	1/2W	BR12S-152
R84	2.2K	Ohms	1/2W	BR12G-222
R85	3.3K	Ohms	1/2W	BR12G-332
R86	2.2K	Ohms	1/2W	BR12N-222
R87	100K	Ohms	1/2W	BR12G-104
R88	100K	Ohms	1/2W	BR12G-104
R91	470K	Ohms	1/2W	BR12S-474
R92	1K	Ohms	1/2W	BR12S-102
R93	47K	Ohms	1/2W	BR12S-473
R94	470K	Ohms	1/2W	BR12S-474
R95	500K	Horizontal Hold		PA4416
R96	82K	Ohms	1/2W	BR12G-823
R97	390K	Ohms	1/2W	BR12G-394
R98	330K	Ohms	1/2W	BR12S-334
R99	330K	Ohms	1/2W	BR12G-334
R100	3.3K	Ohms	1/2W	BR12S-332
R101	470K	Ohms	1/2W	BR12S-474
R102	180	Ohm	2 W	DR12S-181
R105	4.7K	Ohm	1 W	CR12S-472
R106	5K	Ohm	Width Control	PA4411

VIDEO I.F. CONDENSERS

C13	1K	Mmf	Ceramic	HK36H-102
C14	270	Mmf	Ceramic	HK36M-271
C15	1K	Mmf	Ceramic	HK36H-102
C16A	1K	Mmf	Herlec Mult.	PA4339-2
C16C	1K	Mmf		
C17	100	Mmf	Ceramic	CC30A-101F
C18	4.7K	Mmf	Ceramic	PA4334-1
C19	270	Mmf	Ceramic	HK36M-271
C20A	1K	Mmf	Herlec Mult.	PA4339-2
C20C	1K	Mmf		
C21	1K	Mmf	Ceramic	HK36H-102
C25	270	Mmf	Ceramic	HK36M-271
C26A	1K	Mmf	Herlec Mult.	PA4339-2
C26C	1K	Mmf		
C29	4.7K	Mmf	Ceramic	PA4334-1
C30	470	Mmf	Mica	MC60E-471
C31	4.7K	Mmf	Ceramic	PA4334-1
C32	470	Mmf	Mica	MC60E-471
C33A	1K	Mmf	Herlec Mult.	PA4339-2
C33C	1K	Mmf		
C34	270	Mmf	Ceramic	HK36M-271
C35	.1	Mfd	400V tubular	PC40GL-104
C36	4.7K	Mmf	Ceramic	PA4334-1
C37	.1	Mfd	400V tubular	PC40GL-104
C38A	10	Mfd	350V Elect.	PA4307-5
C38C	10	Mfd	350V	
C39	100	Mmf	Ceramic	CC32A-101A
C40	0.1	Mfd	200V tubular	PC40GK-104
C41	.25	Mfd	200V tubular	PC40GK-254
C42A	10	Mfd		
C42B	10	Mfd	450V Elect.	PA4300-10

MODELS 4900TV, Ch. 24TV9C;
4939TV, 4940TV, 4941TV, Ch. 24TV9

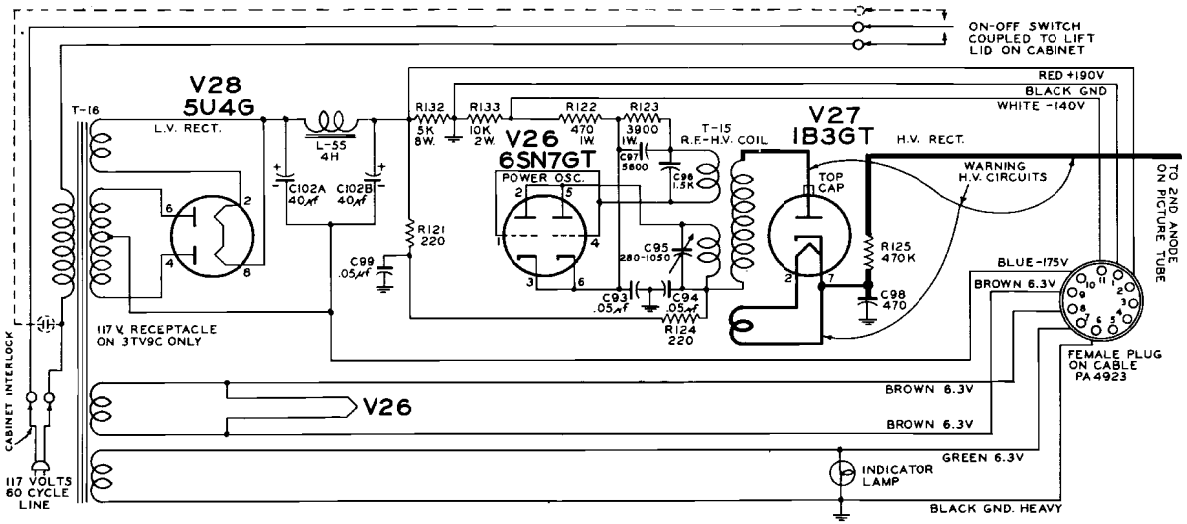
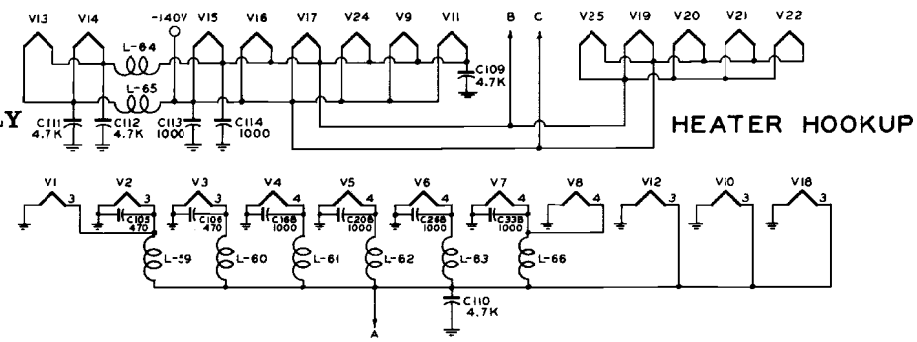


FIG. 22

SCHEMATIC DIAGRAM HIGH & LOW POWER SUPPLY



VERTICAL DEFLECTION

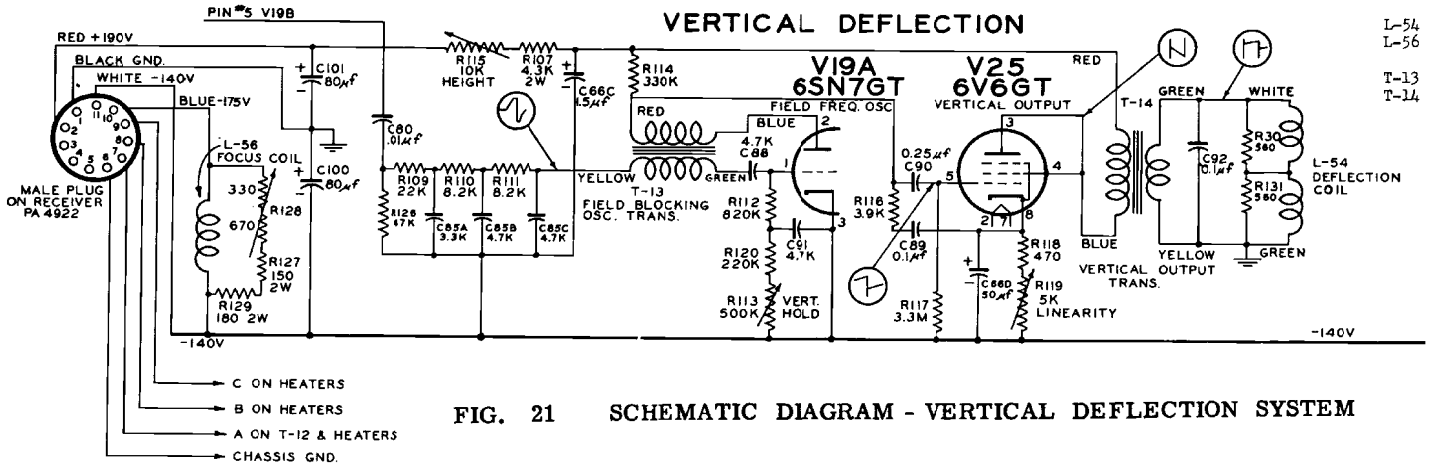


FIG. 21 SCHEMATIC DIAGRAM - VERTICAL DEFLECTION SYSTEM

CONDENSERS

C93	.05	Mfd	400V Tubular	PC40GL-503
C94	.05	Mfd	400V Tubular	PC40GL-503
C95	280-1050	Mmf	Trimmer	PA4380
C96	1.5K	Mmf	Mica	MC61E-152
C97	5.6K	Mmf	Mica	MC61F-562
C98	470	Mmf	Jeffers	PA4338
C99	.05	Mfd	400V Tubular	PC40GL-503
C102 A & B	40	Mfd	450V Electrolytic	PA4304-3

RESISTORS

R121	220	Ohm	1/2W	BR12N-221
R122	470	Ohm	1 W	CR12N-471
R123	3,900	Ohm	1 W	CR12N-392
R124	220	Ohm	1/2W	BR12N-221
R125	470K	Ohm	1/2W	BR12N-474
R132	5,000			
R133	10,000	Ohm	(Tapped)	PA4203

TRANSFORMER AND FILTER CHOKE

L-55	Filter Choke	AB47001-1
T-15	R.F. High Voltage Coil Assem.	AB43521-1
T-16	Power Transformer	AB44014-1

VERTICAL DEFLECTION

CONDENSERS

C66C	15	Mfd	350V	Electrolytic	PA4307-6
C66D	50	Mfd	50V		
C80	.01	Mfd	400V	Tubular	PC40GL-103
C85A	3.3K	Mmf			
C85B	4.7K	Mmf	Herlec Mult.		PA4339-1
C85C	4.7K	Mmf			
C88	4.7K	Mmf.	Mica		MC61F-472
C89	0.1	Mfd	400V Tubular		PC40GL-104
C90	0.25	Mfd	400V Tubular		PC40GL-254
C91	4.7K	Mmf	Ceramic		PA4334-1
C92	.1	Mfd	200V Tubular		PC40GK-104
C100	80	Mfd	300V Elect.		PA4309-1
C101	80	Mfd.	300V Elect.		PA4309-1

COILS AND TRANSFORMERS

L-54	Deflection Coil	PC700C2
L-56	Focus Coil	
T-13	Field Blocking Trans.	AB470C3-1
T-14	Field Output Trans.	AB44062-1

RESISTORS

R107	4.3K	Ohm	2 W	DR12G-432
R109	22K	Ohm	1/2 W	BR12S-223
R110	8.2K	Ohm	1/2 W	BR12S-822
R111	8.2K	Ohm	1/2 W	BR12S-822
R112	820K	Ohm	1/2 W	BR12S-824
R113	500K	Ohm	Vert. Hold Control	PA4415
R114	330K	Ohm	1/2 W	BR12N-334
R115	10K	Ohm	Height Control	PA4413
R116	3.9K	Ohm	1/2 W	BR12S-392
R117	3.3	Megohm	1/2 W	BR12N-335
R118	470	Ohm	1/2 W	BR12N-471
R119	5K	Ohm	Vert. Linearity Control	PA4411
R120	220K	Ohm	1/2 W	BR12N-224
R126	47K	Ohm	1/2 W	BR12S-473
R127	150	Ohm	2 W	DR12S-151
R128	330-670	(1000 Ohm)	Focus Control	PA4410
R129	180	Ohm	2 W	DR12S-181
R130	560	Ohm	1/2 W	BR12S-561
R131	560	Ohm	1/2 W	BR12S-561

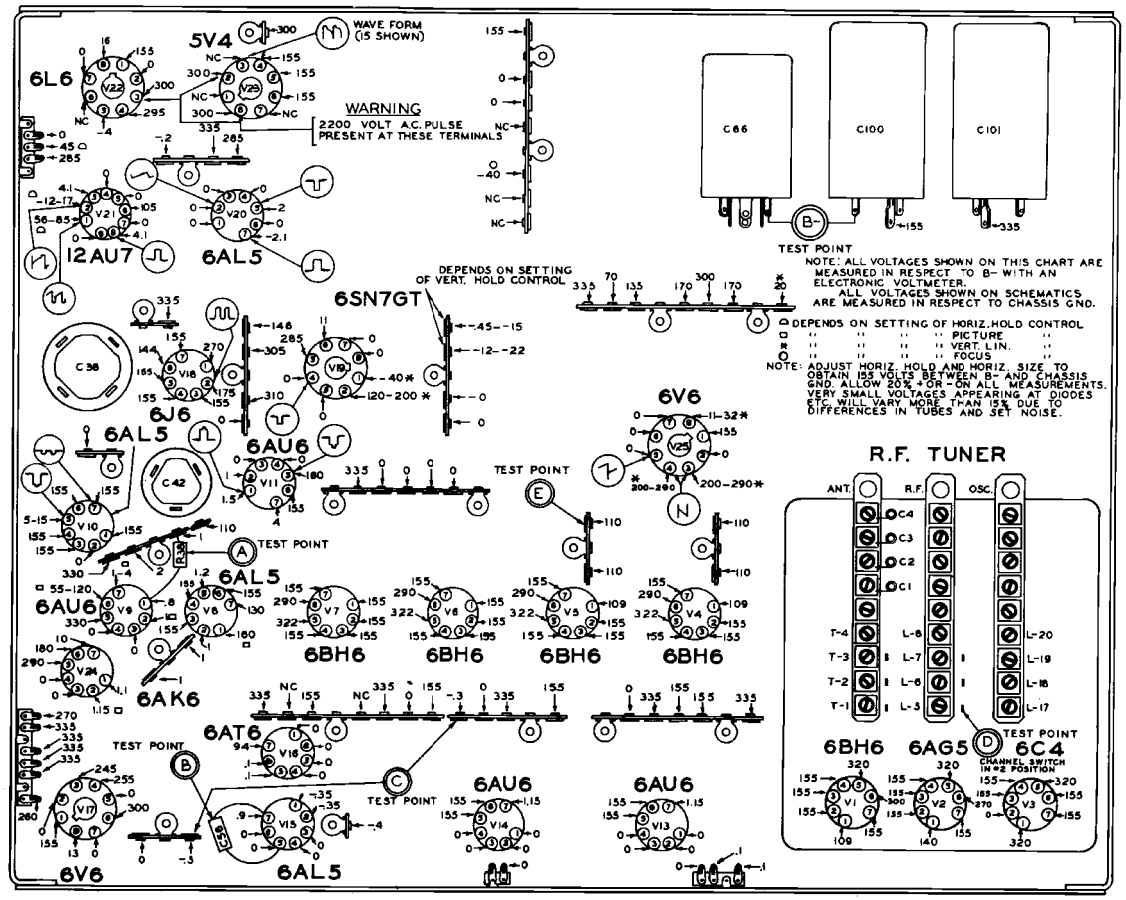
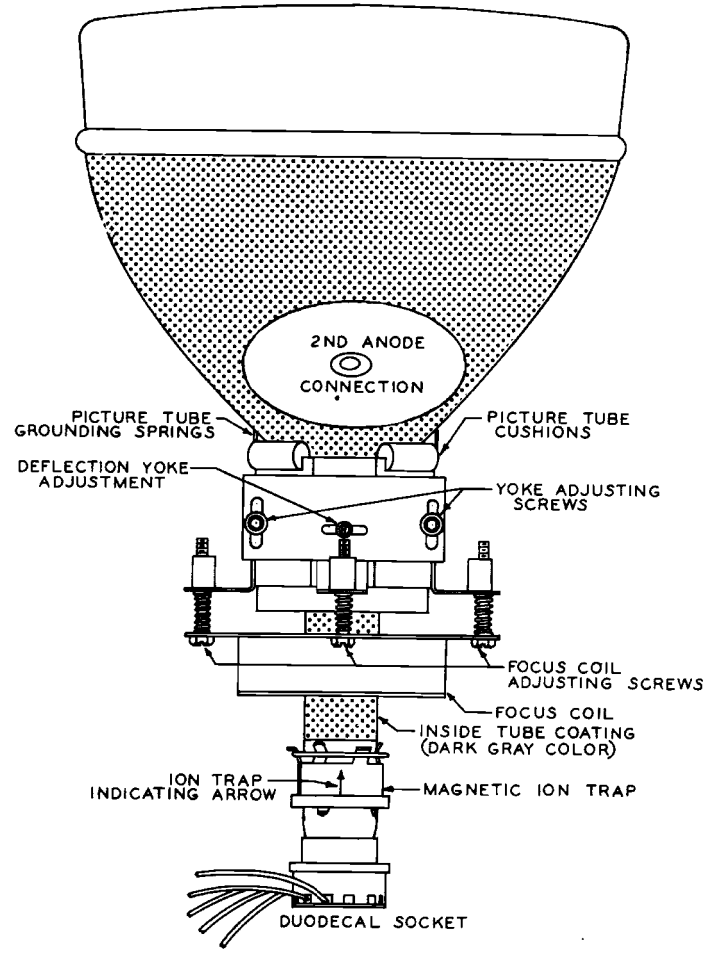


FIG. 23 VOLTAGE CHART AND ALIGNMENT TEST POINTS

FOCUS COIL AND ION TRAP

FIG. 24



ALIGNMENT EQUIPMENT AND TEST SETUP

TEST EQUIPMENT: In order to align and service Sparton television receivers properly the following test equipment should be available:

1. AN R.F. SWEEP GENERATOR of reliable quality that performs the following functions:
   A. Provides sweep outputs in the following frequency ranges:

19 to 30 Mc.	10 Mc. sweep width
40 to 90 Mc.	10 Mc. sweep width
170 to 225 Mc.	10 Mc. sweep width

   B. Provides an output signal that can be varied by means of an attenuator up to a maximum of at least .1 volt.

2. AN R.F. SIGNAL GENERATOR that will provide an adjustable output signal up to a maximum of at least .1 volt on the following fixed frequencies:

   A. I.F. Frequencies

21.75 Mc.	Sound I.F. and sound traps
22.4 Mc.	1st video I.F. coil
22.5 Mc.	2nd video I.F. coil
24.1 Mc.	4th video I.F. coil
25.9 Mc.	3rd video I.F. coil
26.0 Mc.	5th video I.F. coil
26.25 Mc.	Picture I.F. carrier
27.75 Mc.	Adjacent channel sound traps

   B. R.F. Frequencies

Channel No.	Picture Carrier	Sound Carrier
2	55.25 Mc.	59.75 Mc.
3	61.25 Mc.	65.75 Mc.
4	67.25 Mc.	71.75 Mc.
5	77.25 Mc.	81.75 Mc.
6	83.25 Mc.	87.75 Mc.
7	175.25 Mc.	179.75 Mc.
8	181.25 Mc.	185.75 Mc.
9	187.25 Mc.	191.75 Mc.
10	193.25 Mc.	197.75 Mc.
11	199.25 Mc.	203.75 Mc.
12	205.25 Mc.	209.75 Mc.
13	211.25 Mc.	215.75 Mc.

3. A CATHODE-RAY OSCILLOSCOPE of good quality that has a fairly wide band vertical amplifier and a low capacity input probe.

4. AN ELECTRONIC VOLTMETER on which the input probes are all insulated from the meter case.

5. A CRYSTAL CALIBRATOR that can be used for checks on the accuracy of the output frequencies of the R.F. signal generator.

GENERAL INSTRUCTIONS: Practically all servicing with the exception of some tube replacement will require removal of the receiver and power supply chassis from the cabinet. Detailed instructions for this removal appear on pages 10 and 11.

A convenient arrangement that makes both the top and bottom of the chassis accessible for alignment and servicing can be realized by orienting the receiver chassis in such manner that it rests on its side and on the "infrequent adjustment" control bracket. On receivers employing 12" kinescopes an additional support must be provided for the yoke mounting bracket or the chassis will turn over if placed as described above.

A.C. SWITCH: It is not recommended that the A.C. lid switch be removed from the cabinet during normal service procedure. Instead, a jumper should be placed across the switch line to complete the A.C. circuit to the power supply.

ALIGNMENT EQUIPMENT AND TEST SETUP

The lid operated A.C. switch is provided to insure against receiver operation with a closed cabinet cover. Use of the receiver under this condition results in overheating since cabinet ventilation is retarded.

ALIGNMENT REQUIREMENTS: Under normal conditions complete receiver realignment will seldom be necessary in the field. However, a detailed description of the overall alignment procedure is included to provide all necessary information if it should be required.

In general it is not recommended that the R.F. and converter circuits of the R.F. tuner be realigned by the service engineer unless absolutely necessary. In cases where tuner components have been damaged, or where complete realignment is indicated, the R.F. tuner assembly should be removed from the chassis and sent back to the factory in exchange for a new unit which will be shipped complete with tubes.

When the new R.F. unit is assembled to the chassis it will be necessary in all cases to realign the adjacent channel sound trap L34 which is located on the tuner assembly as shown in Figure 25, page 35. Normally this is the only adjustment that will be required with tuner change but a check on overall receiver alignment and sensitivity should be made for the sake of certainty and assured customer satisfaction.

EFFECTS OF TUBE REPLACEMENT ON THE ALIGNMENT OF R.F. TUNER CIRCUITS: The alignment of the R.F. and converter circuits of the R.F. tuner is critical and may be affected by a tube change. In cases where these tubes (6BH6 or 6AG5) are replaced it will be necessary for the service engineer to check for satisfactory receiver operation. If realignment is indicated it can usually be avoided by selection of replacement tubes until proper receiver operation is realized.

Replacement of the 6C4 local oscillator can usually be made with little or no effect on the alignment and operation of the oscillator circuits. However, when a replacement is made, a check should be performed to make certain that the vernier capacitor range is sufficient to tune in the sound carriers on all channels.

ORDER OF ALIGNMENT: When complete receiver realignment is indicated it should be performed in the following order:

1. Sound traps
2. Picture I.F.
3. Sound I.F.
4. Ratio Detector Transformer
5. Retouch Picture I.F.
6. Sound and Picture I.F. Sensitivity Check
7. R.F. Oscillator Circuits
8. R.F. and Converter Circuits (not recommended)
9. Overall Sensitivity Check

PRELIMINARY ADJUSTMENTS: Before alignment the receiver controls should be adjusted to the approximate operating positions specified in the table below. The controls should remain in these positions for all checks unless otherwise specified.

Picture Control - to center position
Brightness Control - to position where raster is visible on the kinescope
Focus Control - to position where focus is obtained
Vertical Hold - to center position
Vertical Linearity - to center position
Vertical size - adjusted to give normal raster height
Horizontal Hold - to center position
Horizontal size - adjusted to give normal raster width

TEST EQUIPMENT SET UP: A certain amount of experimentation must be employed to secure a stable test set up before alignment or service of the receiver is attempted. It is recommended that the top of the test bench be covered with a sheet of aluminum to insure good grounds between the various pieces of test equipment and the receiver chassis. In general all test signal input leads should be kept away from output leads as much as possible.

PICTURE I.F. INSTABILITY: If the picture I.F. strip is badly out of alignment it may

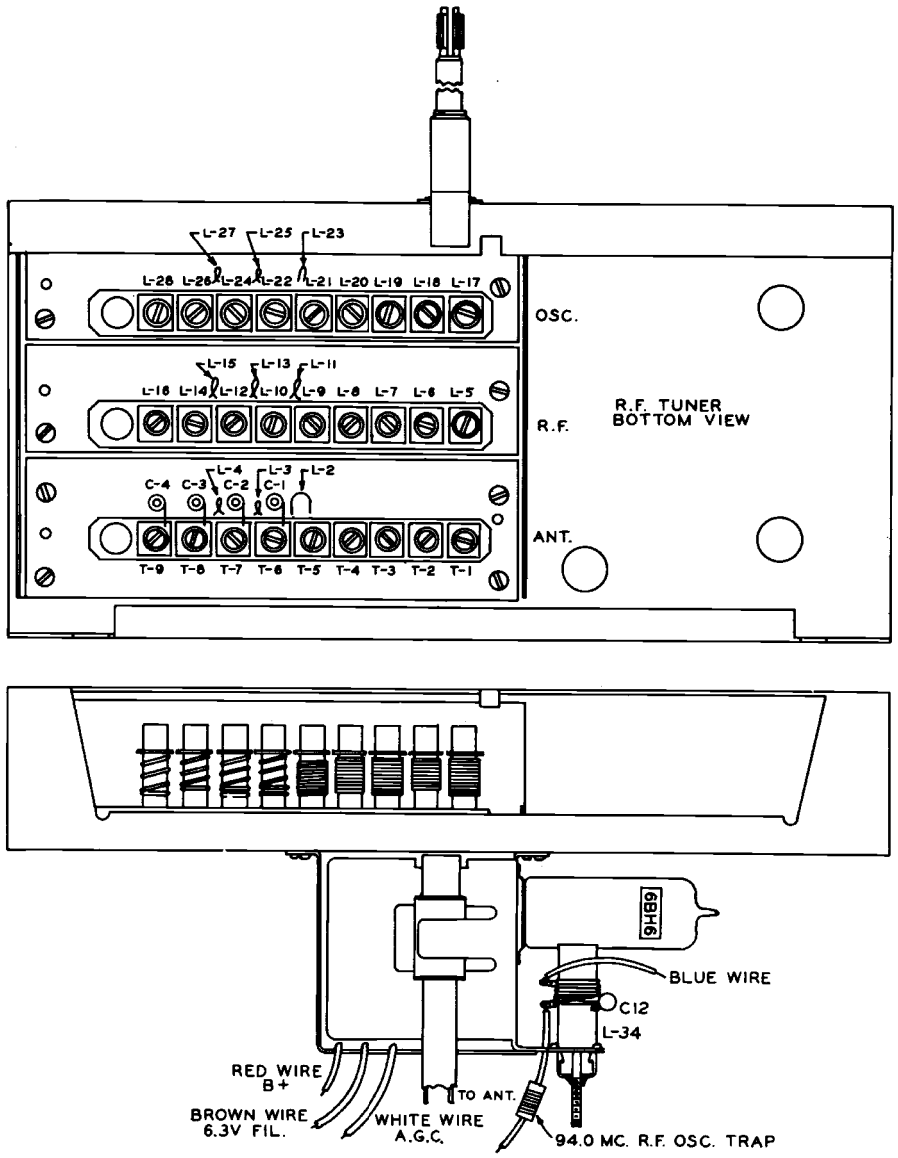
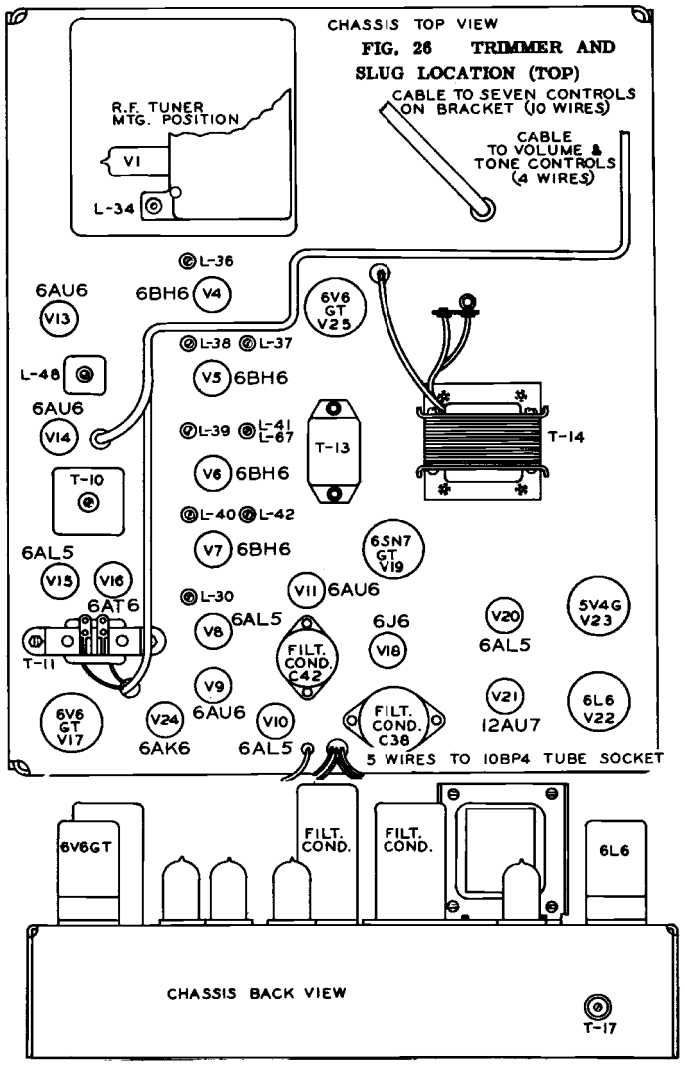


FIG. 25

R. F. TUNER SUB-CHASSIS ASSEMBLY

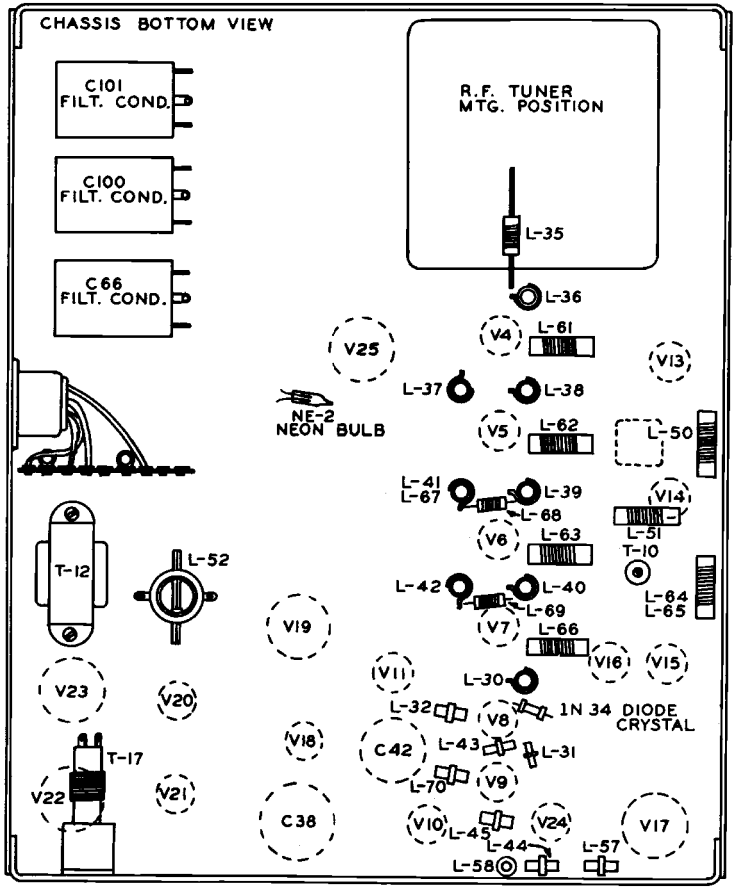
PART No. PD 93150



TRIMMER AND SLUG LOCATION

(BOTTOM)

FIG. 27



ALIGNMENT PROCEDURE

become unstable and fall into oscillation. When this condition occurs a comparatively large voltage is developed across the picture detector load resistor. This voltage is independent of I.F. signal input at the converter grid.

It is usually possible to stop I.F. oscillation due to misalignment by adjusting the iron cores in the various picture I.F. coils and traps according to the information given in the table below:

L34	Slug out	(Min. L)
L36	Slug in	(Max. L)
L37	Slug out	
L38	Slug in	
L39	Slug out	
L40	Slug out	
L41	Slug in	
L30	Slug out	
L32	Slug in	

The actual physical location of the various coils and traps is shown in Figure 26, page 36. As soon as the oscillation has been stopped, continue with the alignment as outlined in the following sections.

SOUND TRAP ALIGNMENT: 1. Remove V-1 (6BH6 R.F. Amplifier) and V-3 (6C4 local oscillator) from the R.F. tuner and connect the R.F. signal generator to the grid of V-2 (point D, Figure 23, page 31) by means of the I.F. input adapter shown in Figure 28.

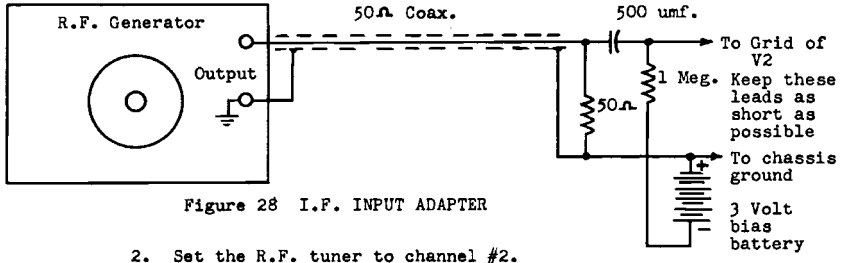


Figure 28 I.F. INPUT ADAPTER

2. Set the R.F. tuner to channel #2.

3. Connect a 3 volt bias battery between the A.G.C. buss (point E, Figure 23) and chassis ground so that the voltage on the A.G.C. buss is -3 volts in respect to the chassis.

4. Connect the Electronic Voltmeter across the picture detector load resistor R38 (point A, Figure 23) and set the voltmeter on the low D.C. volts scale.

CAUTION: In instances where the common input lead of the voltmeter is grounded to the meter case it will be necessary to keep the case insulated from the receiver chassis or the -140 volt buss will be shorted out. By the same token a shock hazard exists between the meter case and chassis ground. Because of these conditions a reasonable mount of care should be exercised by the service engineer when handling the equipment. In order to avoid these difficulties it is recommended that the voltmeter used be constructed in such manner that the input leads are well insulated from the meter case.

5. Set the R.F. signal generator to each of the frequencies shown in the table below and in each case tune the specified adjustment for minimum indication on the voltmeter. It is advisable to check the output of the generator with the crystal calibrator to make certain that it is exactly on frequency in each case.

27.75 Mc.	L34	(Top of chassis as shown in Fig. 26)
27.75 Mc.	L37	(Top of chassis as shown in Fig. 26)
21.75 Mc.	L41	(Top of chassis as shown in Fig. 26)
21.75 Mc.	L42	(Top of chassis as shown in Fig. 26)

PICTURE I.F. ALIGNMENT: 1. Connect the R.F. signal generator, voltmeter and bias battery to the receiver as described in steps 1, 2, 3 and 4 of the sound trap alignment instructions.

2. Set the signal generator to each of the following frequencies and peak the specified adjustments for maximum indication on the voltmeter.

22.4 Mc.	L36	(Top of chassis as shown in Fig. 26)
22.5 Mc.	L38	(Top of chassis as shown in Fig. 26)
25.9 Mc.	L39	(Top of chassis as shown in Fig. 26)
24.1 Mc.	L40	(Top of chassis as shown in Fig. 26)
26.0 Mc.	L30	(Top of chassis as shown in Fig. 26)

NOTE: On some receivers it is possible to tune through resonance on L39 and set the I.F. strip in oscillation. When this occurs the voltage across the picture detector load

ALIGNMENT PROCEDURE (Continued)

resistor will increase to the point where the effects of the oscillation may be mistaken for the actual resonance peak of L39. If trouble of this nature is encountered tune L39 to the point where I.F. oscillation ceases and go on to peak L40 and L30 at their respective frequencies and then return to peak L39.

SOUND I.F. ALIGNMENT: 1. Connect the R.F. signal generator and bias battery to the receiver as described in steps 1,2 and 3 of the sound trap alignment instructions.

2. Connect the electronic voltmeter across C56 (from point B, as shown in Figure 23, to pin 5 of V15). Set the voltmeter on the low D.C. volts scale.

3. Set the R.F. signal generator to 21.75 Mc. and peak the following coils for maximum indication on the voltmeter:

L48 (Top of chassis as shown in Fig. 26, page 36)
T10 (Primary, bottom of chassis, shown in Fig. 27, page 37)

RATIO DETECTOR TRANSFORMER ALIGNMENT: 1. Connect the R.F. signal generator and bias battery to the receiver as described in steps 1,2 and 3 of the sound trap alignment instructions.

2. Connect the electronic voltmeter from the junction of R68 and R69 to the junction of R70, C57 and C58. (Point C as shown in Figure 23).

3. Set the signal generator output to 21.75 Mc. Adjust the secondary of T10. (Adjustment available on top of the chassis as shown in Figure 26).

Notice that it is possible to produce a positive or a negative voltage indication on the meter by varying this adjustment. As the voltage swings from positive to negative adjust T10 for zero output as indicated by the voltmeter. This point is called zero ratio detector output and indicates correct alignment of T10.

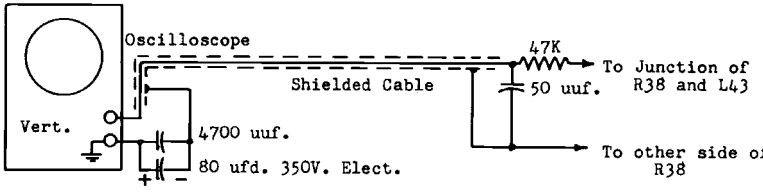
If the secondary of T10 is found to be way out of alignment it will be necessary to re-peak the primary as described in the preceding section on sound I.F. alignment.

PICTURE I.F. TOUCH UP: 1. Connect the R.F. sweep generator output to the grid of V2 (Point D., Figure 23) by means of the I.F. input adapter shown in Figure 28, page 38.

2. Remove V1 and V3 from the R.F. tuner. Set the R.F. selector to channel #2.

3. Connect the oscilloscope across the picture detector load resistor R38 (Point A, Figure 23) by means of the shielded cable and the filter system shown in Figure 29. The two capacitors also shown permit grounding of the oscilloscope case to the receiver chassis without shorting out of the -140 volt buss in the receiver.

Figure 29



FILTER SYSTEM FOR SCOPE CONNECTION

4. Set the R.F. sweep generator so that it sweeps from approximately 20 to 30 Mc.

5. Adjust the oscilloscope so that the swept I.F. response is visible on the cathode-ray tube screen.

6. Loosely couple the output of the R.F. signal generator to the grid of V-2 so that marker signals of proper frequency can be mixed in with the R.F. sweep signal.

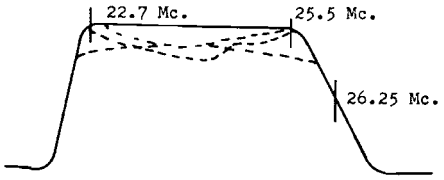
7. Observe the band width, relative position of the picture carrier, and flatness of the overall I.F. response curve. If necessary slightly vary the tuning of the picture I.F. coils L36, L38, L39, L40 and L30 until the picture I.F. response shown in Figure 30 is obtained. The solid curve in Figure 30 depicts the ideal I.F. response while the dotted curves show permissable variations.

The picture I.F. carrier should appear approximately half way down the I.F. response curve as shown in Figure 30. Variation in the pix carrier position should not exceed ± 10% from the half way point.

PICTURE I.F. SENSITIVITY CHECK: 1. Connect the R.F. signal generator to the receiver as specified in steps 1 and 2 of the sound trap alignment instructions. (When making sensitivity checks no bias battery is connected to the A.G.C. buss).

2. Connect the electronic voltmeter across the picture detector load resistor R38 and set the meter on the low D.C. volts scale.

ALIGNMENT PROCEDURE (Continued)



IDEAL I.F. RESPONSE WITH PERMISSABLE VARIATIONS

Figure 30

3. Set the generator ouput frequency at approximately 23 Mc. Adjust the generator output until the voltmeter reads approximately .7 volt. Record the R.F. signal input in microvolts. Repeat the procedure with the generator out put frequency set at 24.2 and 25.4 Mc. In all cases the I.F. input voltage should be 200 microvolts or less. The sensitivity at the I.F. picture carrier 26.25 Mc., should be approximately half of the I.F. sensitivity between 24.2 and 25.4 Mc. (Maximum of 400 microvolts).

If the generator output is not calibrated in microvolts, comparative sensitivity measurements can be made by using another receiver that is known to be in good operating condition as a standard. This applies to all sensitivity measurements and good results can be obtained if sufficient care is used.

SOUND I.F. SENSITIVITY: 1. Connect the R.F. signal generator to the receiver chassis as specified in steps 1 and 2 of the sound trap alignment instructions.

2. Connect the electronic voltmeter across C56 (from point B, as shown in Figure 23, to pin 5 of V15). Set the meter on the low D.C. volts scale.

3. Set the generator output frequency at 21.75 Mc. Adjust the output signal level until the voltmeter indicates 5 volts across C56. The generator output signal should then be 250 microvolts or less.

R.F. OSCILLATOR ALIGNMENT: The R.F. oscillator circuits may be aligned by feeding signals at the R.F. sound carrier frequencies into the receiver antenna terminals and adjusting the oscillator frequency on each channel for zero output from the ratio detector. The ratio detector should be aligned exactly before this method of R.F. oscillator adjustment is attempted.

Since incremental inductances are placed in series with the tuned circuits for channels 8,10 and 12 to form the tuned circuits for channels 7,9 and 11, the order in which these channels are aligned becomes important. In these cases it is necessary to align the higher channel of each connected pair before the alignment of the lower channel is attempted. For example, L22 forms the tuned circuit for channel 8 but with the additional series inductance L23 also forms the tuned circuit for channel 7. Note that the tuning of L22 not only affects oscillator operation on channel 8 but also on channel 7 since L22 is common to both circuits. L23, however, affects only channel 7 since it is switched out of circuit when the tuner operates on channel 8. For these reasons it is necessary to first tune L22 for correct oscillator frequency on channel 8, and then to adjust L23 for correct oscillator frequency on channel 7. In practice the inductance of the incremental coils is adjusted by actual mechanical distortion of the incremental coils themselves.

The physical location of all coils and adjustments is shown in Figure 25, page 35. The output of the R.F. generator should be checked by means of the crystal calibrator to make certain that it is exactly on frequency in all cases.

CAUTION: In manufacture the slugs in the R.F. tuner coils are firmly held in place by means of wax which is put into the forms after alignment. This wax must be removed before tuning of the coils is attempted and must be replaced after re-alignment is completed.

The following description gives a step by step procedure that simplifies oscillator circuit alignment.

1. Insert V1 and V3 in the R.F. tuner. Connect the signal generator to the receiver antenna terminals.

2. Set the oscillator vernier capacitor (fine tuning) at approximately the center of its effective capacity range. This can best be determined by finding the maximum and minimum capacity settings of the vernier and then interpolating between the two extremes for the center position.

3. Connect the electronic voltmeter from the junction of R68 and R69 to the junction of R70, C57 and C58. (Point C as shown in Figure 23).

4. Set the R.F. signal generator to each of the following sound R.F. carrier frequencies, the tuner to the corresponding R.F. channel, and peak the specified adjustment for zero output of the ratio detector as observed on the voltmeter. (Zero output of the ratio detector is explained in the section on ratio detector alignment).

ALIGNMENT PROCEDURE (Continued)

ADJUST R.F. GENERATOR FREQUENCY TO	SET TUNER TO CHANNEL	ADJUST INDUCTANCE OF COIL NO.
215.75 Mc.	13	L28 (Slug tured)
209.75 Mc.	12	L26 (Slug tured)
203.75 Mc.	11	L27 (Incremental)
197.75 Mc.	10	L24 (Slug tured)
191.75 Mc.	9	L25 (Increasing)
185.75 Mc.	8	L22 (Slug tured)
179.75 Mc.	7	L23 (Incremental)
87.75 Mc.	6	L21 (Slug tured)
81.75 Mc.	5	L20 (Slug tured)
71.75 Mc.	4	L19 (Slug tured)
65.75 Mc.	3	L18 (Slug tured)
59.75 Mc.	2	L17 (Slug tured)

R.F. AND CONVERTER CIRCUIT ALIGNMENT: The alignment of the R.F. and converter circuits of the tuner is a difficult and tedious task when it must be performed without benefit of special factory test equipment. For this reason it is not recommended that the complete re-alignment of these circuits be attempted by the service engineer.

The information provided in the paragraphs below is intended primarily for descriptive purposes and cases where only one or two of the coils may require readjustment. In general, where complete tuner re-alignment is indicated, it is recommended that the complete tuner assembly be removed and returned to the factory for a replacement unit.

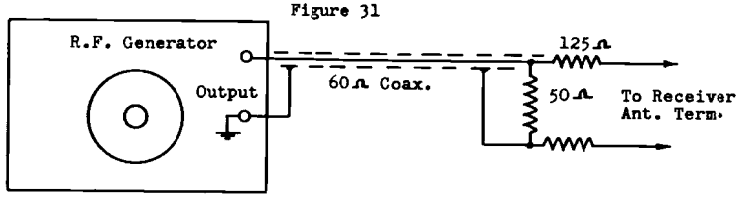
On channels 2 through 6 the R.F. and converter circuits of the tuner are stagger tuned to obtain wide band R.F. response. In alignment the R.F. transformers T1 through T5 are peaked to the R.F. sound carrier frequencies on their respective channels while the converter coils L5 through L9 are peaked at the corresponding R.F. picture carrier frequencies. Slight deviations in the tuning of these coils are made to obtain an essentially flat R.F. pass band characteristic.

On the high channels, 7 through 13, the R.F. and converter coils are synchronously tuned to the center of each band. At these frequencies the tuned circuits are broad enough to provide an essentially broad, flat, pass band without stagger tuning.

The alignment of these circuits can best be accomplished in the following manner:

1. Make certain all tubes are in place.
2. Connect the R.F. signal generator to the receiver antenna terminals. If the R.F. generator has an unbalanced output it must be converted to a balanced system as shown in Figure 31. The component values indicated are for generators whose output impedance is approximately 50 Ω . All specified resistors should be of the non inductive type.

Figure 31



UNBALANCED OUTPUT CONVERSION SYSTEM

3. Perform the operations indicated in the following table and in the order that they are shown. In all cases keep the R.F. signal input as low as possible so that the resonance peaks of the various coils are not masked by A.G.C. circuit action. (Shorting of the A.G.C. buss to chassis ground is recommended when aligning these circuits).

ALIGNMENT PROCEDURE (Continued)

SET R.F. TUNER TO CHANNEL NO.	SET R.F. GEN. OUTPUT FREQ. TO.	ADJUST OSC. VERNIER CAP. IN EACH CASE FOR	CONNECT VOLTMETER	ADJUST THESE COILS FOR MAXIMUM INDICATION ON VOLTMETER
2	59.75 Mc.	Zero Ratio Det. Output	Across C56	T1
3	65.75 Mc.	Zero Ratio Det. Output	Across C56	T2
4	71.75 Mc.	Zero Ratio Det. Output	Across C56	T3 ALL
5	81.75 Mc.	Zero Ratio Det. Output	Across C56	T4
6	87.75 Mc.	Zero Ratio Det. Output	Across C56	T5 SLUG
2	55.25 Mc.	Max. Volt. Across R38	Across R38	L5
3	61.25 Mc.	Max. Volt. Across R38	Across R38	L6 TUNE
4	67.25 Mc.	Max. Volt. Across R38	Across R38	L7
5	77.25 Mc.	Max. Volt. Across R38	Across R38	L8
6	83.25 Mc.	Max. Volt. Across R38	Across R38	L9
13	213 Mc.	Max. Volt. Across R38	Across R38	T9 & L16 Slug tuned
12	207 Mc.	Max. Volt. Across R38	Across R38	T8 & L14 Slug tuned
11	201 Mc.	Max. Volt. Across R38	Across R38	L4 & L15 Increment.
10	195 Mc.	Max. Volt. Across R38	Across R38	T7 & L12 Slug tuned
9	189 Mc.	Max. Volt. Across R38	Across R38	L3 & L13 Increment.
8	183 Mc.	Max. Volt. Across R38	Across R38	T6 & L10 Slug tuned
7	177 Mc.	Max. Volt. Across R38	Across R38	L2 & L11 Increment.

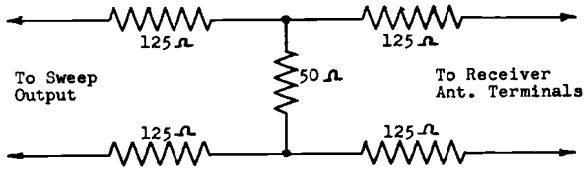
4. Replace the R.F. signal generator by the R.F. sweep generator. (If the sweep has an unbalanced output convert it to a balanced system as described in step #2).
5. Connect a cathode-ray oscilloscope across R38 as described in step #3 of the picture I.F. touch up instructions (page 39).
6. Perform the operations indicated in the following table. In each case adjust the specified coils for flat wide band overall response with maximum gain as indicated on the oscilloscope screen. The oscillator vernier capacitor must be correctly adjusted (as indicated by zero ratio detector output) for the sound R.F. carrier on each channel before any adjustment of the R.F. or converter circuits is made.

The shape of the overall response curve on all channels should be approximately the same as that of the video I.F. response curve shown in Figure 30. Marker pulses of proper frequency should be mixed in with the R.F. sweep input to check overall bandwidth and relative position of the picture carrier on each channel. Always keep the R.F. input signal low so that slight variations in the tuning of the various coils are easily discernable on the oscilloscope screen. The physical location of all the adjustments is shown in Figure 26 and 27, page 36 and 37.

SET TUNER TO CHANNEL NO.	SET SWEEP GENERATOR CENTER FREQ. AT.	SET SWEEP WIDTH AT APPROX.	SLIGHTLY ADJUST FOLLOWING WHERE NECESSARY
13	213 Mc.	10 Mc.	T9 and L16 (Slug tuned)
12	207 Mc.	10 Mc.	T8 and L14 (Slug tuned)
11	201 Mc.	10 Mc.	L4 and L15 (Incremental)
10	195 Mc.	10 Mc.	T7 and L12 (Slug tuned)
9	189 Mc.	10 Mc.	L3 and L13 (Incremental)
8	183 Mc.	10 Mc.	T6 and L10 (Slug tuned)
7	177 Mc.	10 Mc.	L2 and L11 (Incremental)
6	85 Mc.	10 Mc.	L9 and T5 (Slug tuned)
5	79 Mc.	10 Mc.	L8 and T4 (Slug tuned)
4	69 Mc.	10 Mc.	L7 and T3
3	63 Mc.	10 Mc.	L6 and T2 (Slug tuned)
2	57 Mc.	10 Mc.	L5 and T1 (Slug tuned)

NOTE: If the output of the sweep generator cannot be adjusted to a satisfactory low level, an attenuator pad, (as shown in Figure 32) should be used in series with the receiver antenna terminals and the output connections of the sweep. (Several sections can be cascaded for increased attenuation if necessary.

Figure 32



ATTENUATOR PAD

The same type of pad can be used in series with the receiver antenna terminals and the antenna lead in areas where the R.F. signal level is high enough to overload the receiver.

ALIGNMENT PROCEDURE (Continued)

OVERALL PICT. SENSITIVITY CHECK: After alignment of the various sections of the receiver has been completed the following overall sensitivity checks should be made. (In cases where the signal generator output is not calibrated in microvolts comparative sensitivity measurements can be made by using another receiver which is known to be in good operating condition as a standard).

1. Connect the R.F. signal generator to the receiver antenna terminals as described in step #2 of the R.F. and converter circuit alignment data.
2. Connect the D.C. voltmeter across R38 as previously described. Set the voltmeter on the low D.C. volts scale.
3. Perform the operations indicated in the following table. In each case the oscillator vernier should be tuned for zero detector output at the sound R.F. carrierfrequency of the channel being checked before any measurements are made.

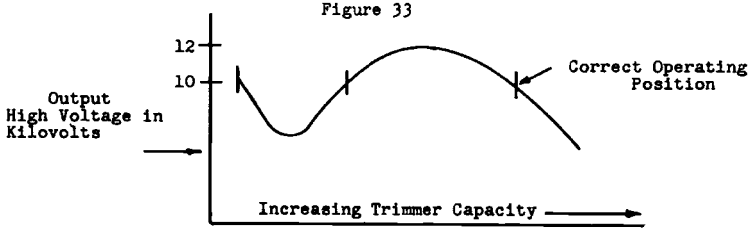
SET R.F. TUNER TO CHANNEL NO.	SET R.F. GENERATOR OUTPUT FREQUENCY TO	ADJUST R.F. INPUT LEVEL UNTIL VOLTMETER READS	GENERATOR OUTPUT SHOULD BE
2	57 Mc.	.7 V.D.C.	250 uV or less
3	63 Mc.	.7 V.D.C.	250 uV or less
4	69 Mc.	.7 V.D.C.	250 uV or less
5	79 Mc.	.7 V.D.C.	250 uV or less
6	85 Mc.	.7 V.D.C.	250 uV or less
7	177 Mc.	.7 V.D.C.	400 uV or less
8	183 Mc.	.7 V.D.C.	400 uV or less
9	189 Mc.	.7 V.D.C.	400 uV or less
10	195 Mc.	.7 V.D.C.	400 uV or less
11	201 Mc.	.7 V.D.C.	400 uV or less
12	207 Mc.	.7 V.D.C.	400 uV or less
13	213 Mc.	.7 V.D.C.	400 uV or less

OVERALL SOUND SENSITIVITY CHECK: After proper circuit operation and alignment has been realized, with volume and tone controls set at maximum, the vernier capacitor (fine tuning) properly adjusted on each channel, the overall sound sensitivity can be checked as indicated in the table below:

SET R.F. TUNER TO CHANNEL NO.	SET R.F. GENERATOR FREQUENCY OUTPUT TO	SET GENERATOR MODULATION TO	ADJUST GEN. OUTPUT TO GIVE	GENERATOR OUTPUT
2	59.75 Mc.	400~	.5 watts	400 uV or less
3	65.75 Mc.	± 7.5 Kc.		400 uV or less
4	71.75 Mc.		in speaker	400 uV or less
5	81.75 Mc.	deviation		400 uV or less
6	87.75 Mc.		voice coil	400 uV or less
7	179.75 Mc.			400 uV or less
8	185.75 Mc.		(Approx.	400 uV or less
9	191.75 Mc.		1.25 V.	400 uV or less
10	197.75 Mc.		A.C.	400 uV or less
11	203.75 Mc.		across	400 uV or less
12	209.75 Mc.		voice	400 uV or less
13	215.75 Mc.		coil)	400 uV or less

HIGH VOLTAGE R.F. OSCILLATOR ALIGNMENT: In practice the high voltage output of the R.F. supply can be varied by the adjustment of C95. This trimmer is adjusted for a no load high voltage of approximately 10 KV. Figure 33 shows the variation in high voltage output with trimmer capacity variation. Notice that the correct alignment position for this trimmer is on the high capacity side of the high voltage output peak. With the trimmer in this position maximum high voltage regulation and power supply efficiency is realized.

Figure 33



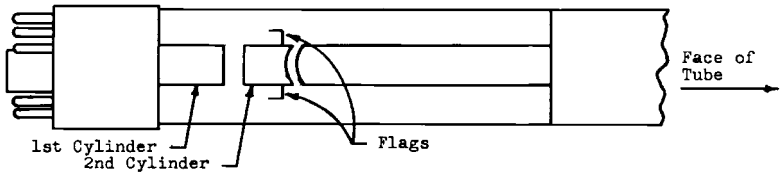
VARIATIONS IN HIGH VOLTAGE WITH CHANGE IN TRIMMER CAPACITY

WARNING: Never remove the horizontal scanning oscillator V21 or the damper tube V23 from their sockets while the receiver is in operation. Removal of either of these tubes results in eventual burn out of the horizontal size control (R106).

ION TRAPS AND THEIR ADJUSTMENTS: Regardless of mechanical design the function and adjustment of the ion trap is approximately the same procedure.

With the picture tube properly installed, with the second Anode Contact on top, it will be observed that the second cylinder from the base inside the glass neck, is provided with two small metal flags as shown in Figure 34.

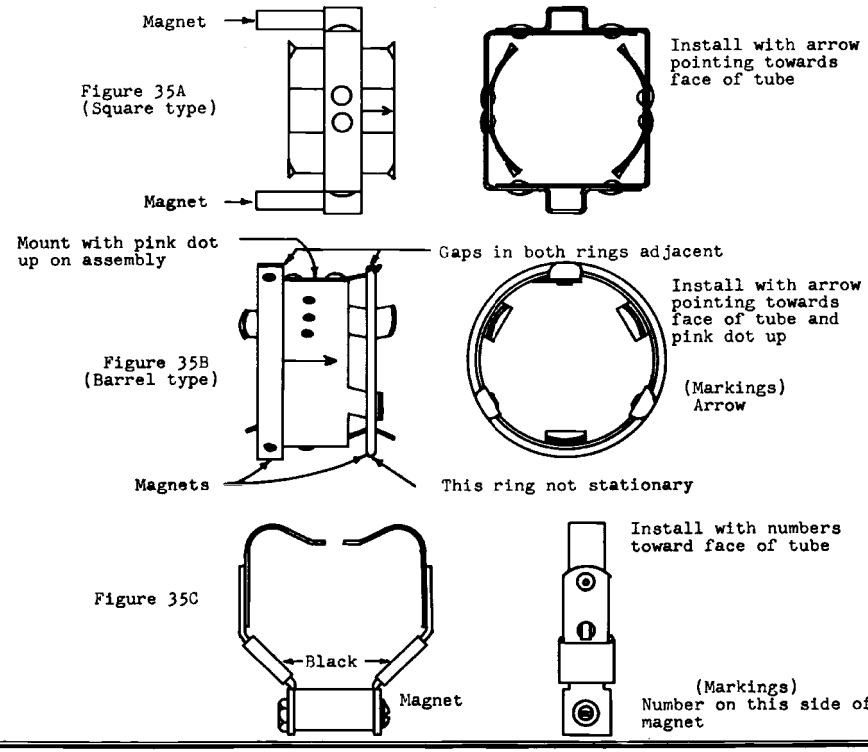
FIGURE 34

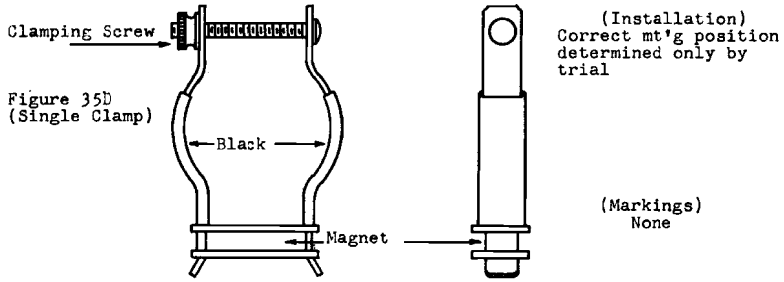


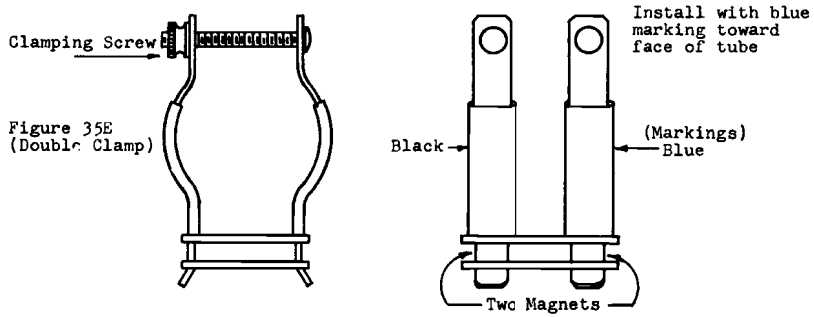
When the ion trap is placed on the picture tube neck, the magnet poles should be approximately over the small metal flags in the tube neck.

Maladjustment of this unit may cut off a corner of the picture and/or produce a milky, insufficiently bright image. This adjustment is considered critical as only slight movement (1/16 to 1/8 inch) of the trap will make considerable change in picture quality. The adjustment of the ion trap is accomplished by two movements, forward or backward and rotation of the trap on the tube neck until a picture of optimum quality is produced.

Figures 35A,B,C,D and E show views of five ion traps, each with a distinct mechanical design that may be used on Sparton television receivers. When possible, ion traps with identification marks such as arrows, numbers, lettering or colors are referred to, to indicate the proper mounting positions. Please refer to Figure 35 for markings and service notes.







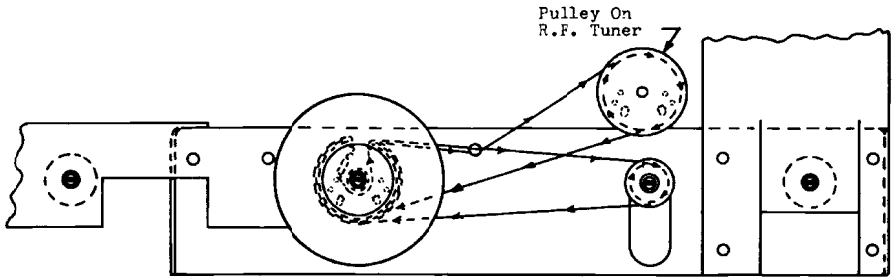
NOTE: Figure 35C,D and E are installed with magnet toward chassis base.

STRINGING FOR CHANNEL INDICATOR AND FINE TUNING CONTROLS

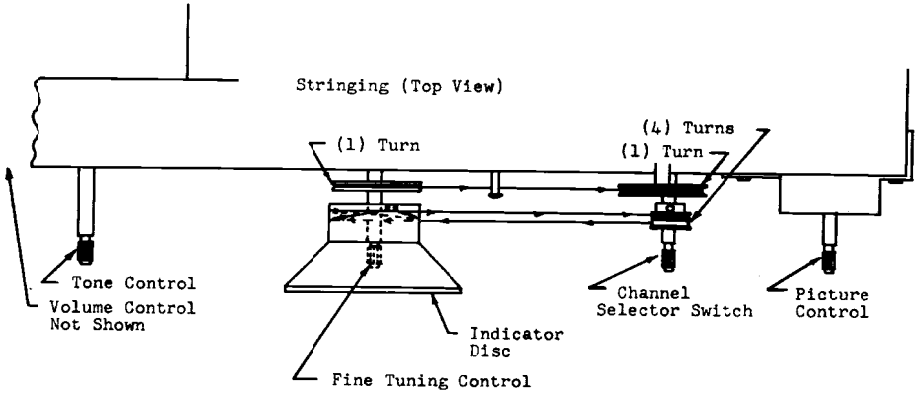
When the channel selector switch is turned to the extreme counter-clockwise (left hand) position the R.F. tuner is set to channel #2 and the number 2 on the indicating disc should appear in the escutcheon window. Likewise, when the channel selector switch is in the extreme clockwise position the R.F. tuner is set to channel #13 and the number 13 on the indicator disc should appear in the escutcheon window.

As the frequency for channel #1 has been discontinued by the F.C.C. the number 1 position on the indicator disc is not used.

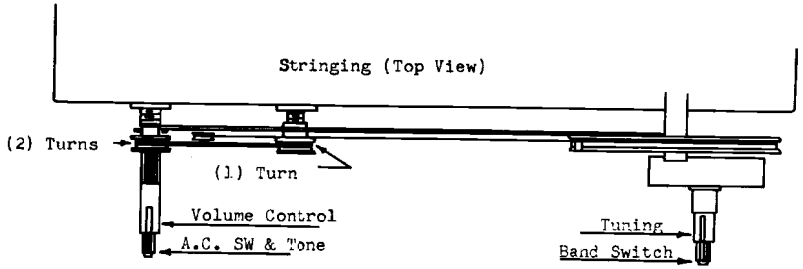
Figure 36 shows a top and front view for the proper stringing for both the fine tuning and channel indicator disc.

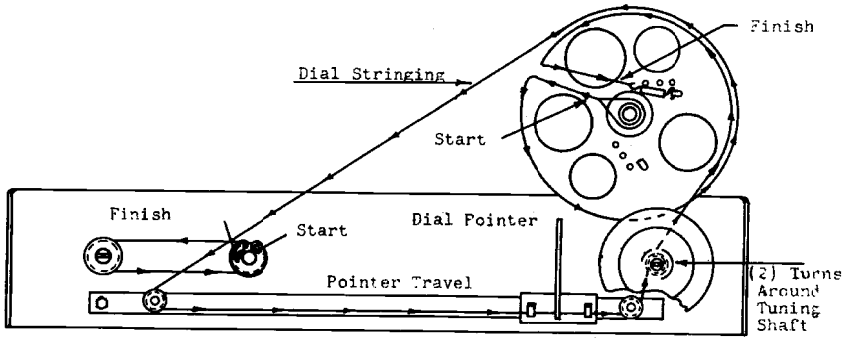


Stringing (Front View)

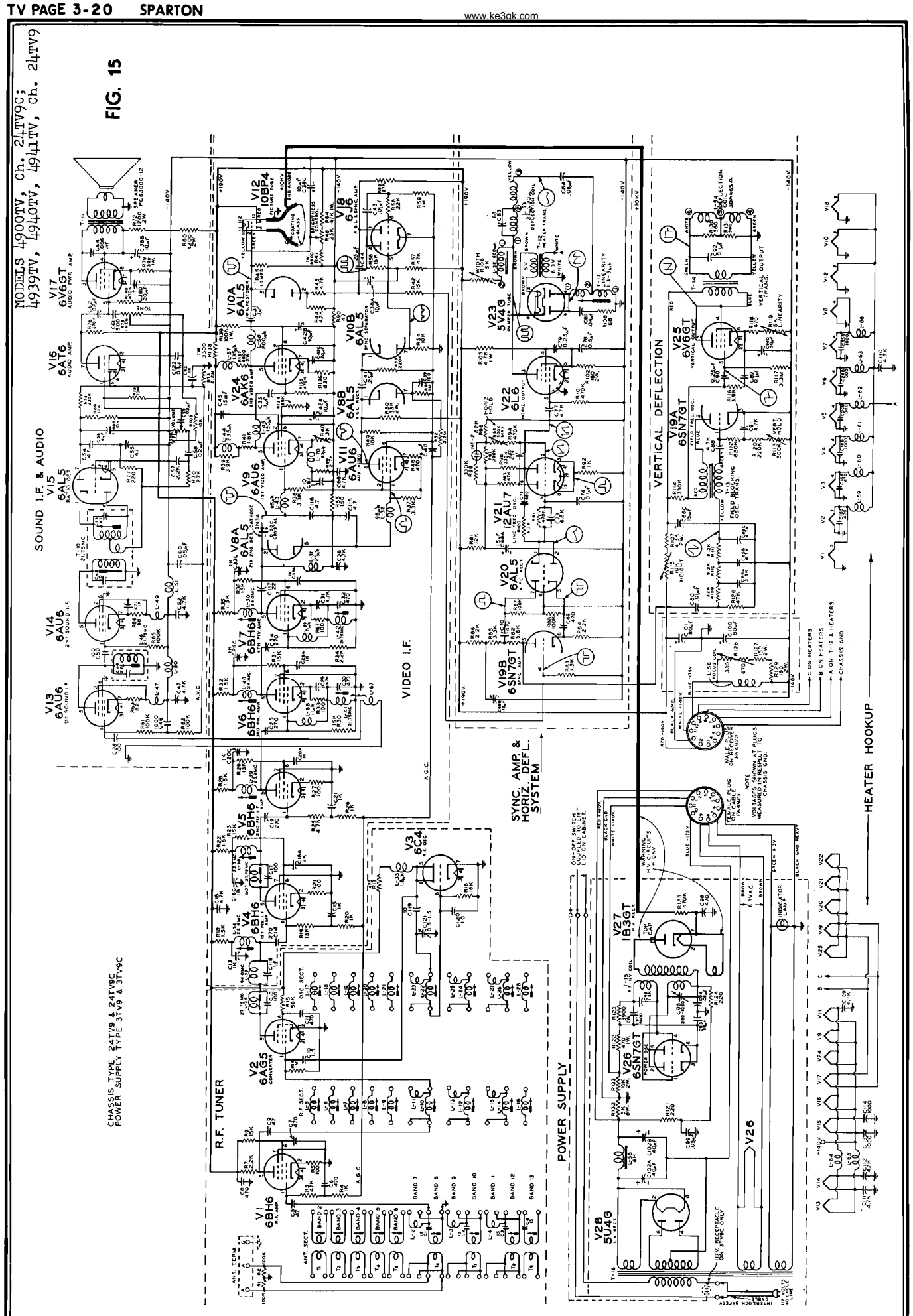


STRINGING FOR DIAL DRIVE AND VOLUME CONTROL





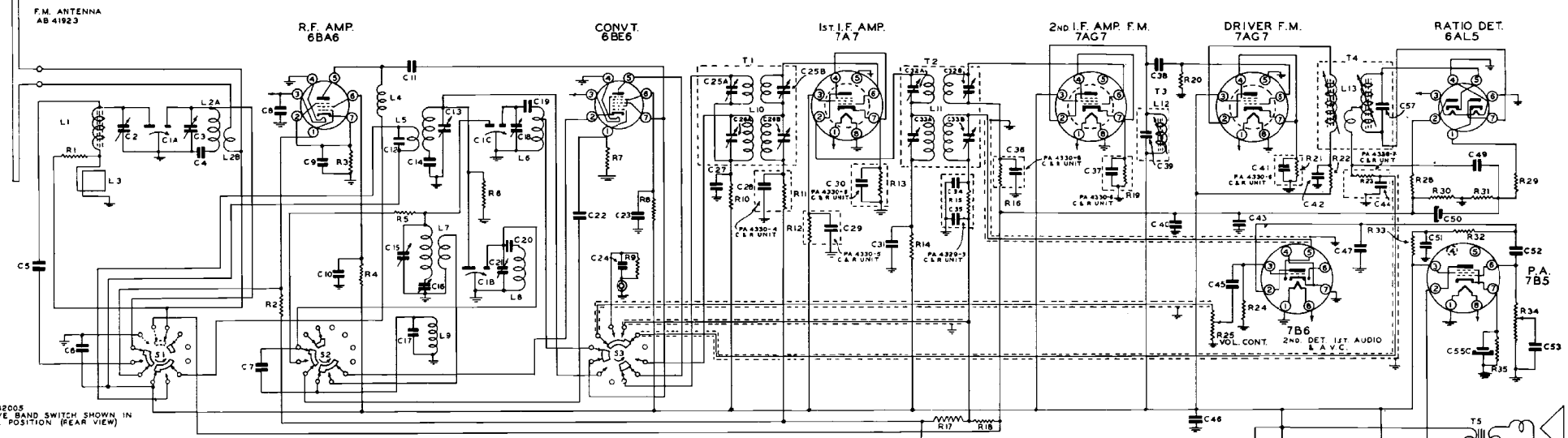
Stringing (Front View)



SPARTON SUPERHETERODYNE CHASSIS TYPE 9L8A

INTERMEDIATE FREQUENCY A.M. 456 Kc. F.M. 10.7 Mc.

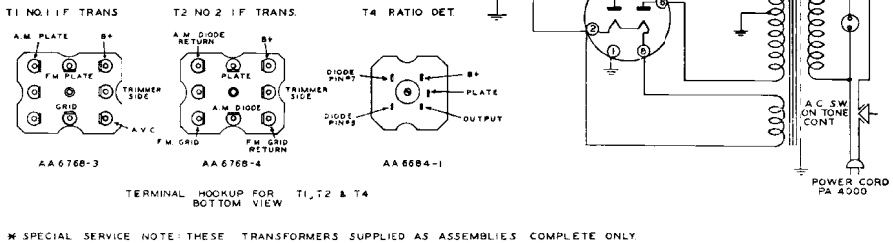
BOTTOM VIEWS OF ALL SOCKET CONNECTIONS



	DESCRIPTION	PART NO.	LOCATION
C1A,B,C	3 GANG CONDENSER	PC 65001	P-4,N-11,P-11
C2	A.M. ANT. TRIMMER	PA 4352-2	P-4
C3	F.M. ANT. TRIMMER	PA 4365	P-5
C4	F.M. ANT. PADDER 51 MMF	PA 4328-9	P-5
C5	51 MMF. MICA	MC 60S-510	N-2
C6	.02 MFD. CERAMIC	HK 35G-203	L-3
C7	10 MMF. CERAMIC	CC 31H-100K	L-7
C8	1000 MMF. MOLDED PAPER	PA 4325-2	Q-7
C9	10,000 MMF. MOLDED PAPER	PA 4325-1	P-8
C10	1000 MMF. MOLDED PAPER	PA 4325-2	M-8
C11	5 MMF. CERAMIC	PA 4328-5	P-10
C12	51 MMF. CERAMIC	CC 31H-510K	P-9
C13	B.C. R.F. TRIMMER	PA 4352-1	P-10
C14	.05 MFD. 200V. TUBULAR	PC 40GK-503	P-10
C15	A.M. OSC. TRIMMER	PA 4352-3	N-10
C16	B.C. OSC. PADDER	PA 4352-8	M-10
C17	15 MMF. CERAMIC	CC 31H-150K	L-10
C18	F.M. R.F. TRIMMER	PA 4366	P-12
C19	F.M. R.F. PADDER (46 MMF)	PA 4328-2	Q-12
C20	F.M. OSC. PADDER (65 MMF)	PA 4328-6	N-12
C21	F.M. OSC. TRIMMER	PA 4366	N-12
C22	51 MMF. MICA	MC 60G-510	O-13
C23	1000 MMF. MOLDED PAPER	PA 4325-2	O-14
C24	.002 MFD. CERAMIC	HK 35G-202	N-14
C25A&B	NO. 1 I.F. TRIMMER F.M.	PA 4359-1	Q-16,Q-17
C26A&B	NO. 1 I.F. TRIMMER A.M.	PA 4359-3	P-16, P-17
C27	.02 MFD. 600V. TUBULAR	PC 40GM-203	O-18
C28	.02 MFD. (C&R UNIT)	PA 4330-4	O-17
C29	.02 MFD. (C&R UNIT)	PA 4330-5	N-18
C30	.02 MFD. (C&R UNIT)	PA 4330-6	O-19
C31	.02 MFD. 600V. TUBULAR	PC 40GM-203	N-20
C32A&B	NO. 2 I.F. TRIMMER F.M.	PA 4359-1	Q-20,Q-21
C33A&B	NO. 2 I.F. TRIMMER A.M.	PA 4359-3	P-20,P-21
C34	100 MMF. (C&R UNIT)	PA 4329-3	Q-21,Q-21
C35	100 MMF.		
C36	.001 MFD. (C&R UNIT)	PA 4330-8	P-22
C37	.02 MFD. (C&R UNIT)	PA 4330-6	P-24
C38	100 MMF. MICA	MC 60G-101	R-25
C39	20 MMF. MICA	MC 65F-200	P-25
C40	.02 MFD. CERAMIC	HK 35G-203	N-25
C41	.02 MFD. (C&R UNIT)	PA 4330-6	P-28
C42	.02 MFD. 600V. TUBULAR	PC 40GM-203	O-28
C43	.01 MFD. 200V. TUBULAR	PC 40GK-103	O-27
C44	.002 MFD. (C&R UNIT)	PA 4330-7	O-30
C45	.02 MFD. CERAMIC	HK 35G-203	M-27
C46	.02 MFD. CERAMIC	HK 35G-203	J-26
C47	150 MMF. MICA	MC 60F-151	N-29

	DESCRIPTION	PART NO.	LOCATION
C49	330 MMF. CERAMIC	CC 30H-331A	P-32
C50	3 MFD. 50V. ELECT.	PA 4308-1	O-31
C51	.05 MFD. 400V.	PC 40GL-503	N-30
C52	.02 MFD. 400V.	PC 40GL-203	N-32
C53	.01 MFD. 200V. TUBULAR	PC 40GK-103	L-33
C54	.006 MFD. 1000V.	PC 40GN-602	J-30
C55A,B&C	40-40-20 MFD. ELECT.	PA 4307-3	J-21,G-27,L-32
C56	.01 MFD. 400V.	PC 40FL-103	K-21
C57	33 MMF. MICA	MC 65E-330	Q-30
L1	A.M. ANT. LOADING COIL	AA 6686-2	P-3
L2A	F.M. ANT. COIL (PRI)	AA 6786-1	P-6
L2B	F.M. ANT. COIL (SEC)	AA 6767-10	P-6
L3	A.M. ANT. LOOP	AC 67008-4	O-3
L4	F.M. R.F. CHOKE	AA 6769-2	Q-9
L5	B.C. R.F. COIL	AA 6756-7	P-10
L6	F.M. R.F. COIL	AA 6767-5	P-12
L7	B.C. OSC. COIL	AA 6759-4	N-10
L8	F.M. OSC. COIL	AA 6767-4	N-12
L9	F.M. CATHODE CHOKE	AA 6798-1	L-10
L10	NO. 1 I.F. COIL *	AA 6803-2	Q-17
L11	NO. 2 I.F. COIL *	AA 6803-3	Q-21
L12	TUNED CHOKE ASSEM. *	AA 6785-3	Q-25
L13	RATIO DET. COIL *	AA 6805-3	Q-29
L14	FILTER CHOKE	AB 47004-1	I-28

	DESCRIPTION	PART NO.	LOCATION
R1	2200 OHMS 5W	BR 125-222	P-3
R2	1 MEG " 5W	BR 125-105	M-7
R3	68 " 5W	BR 125-680	P-8
R4	33,000 " 5W	BR 125-333	N-9
R5	47 " 5W	BR 125-470	O-10
R6	1 MEG " 5W	BR 125-105	O-11
R7	22,000 " 5W	BR 125-223	P-14
R8	22,000 " 2W	DR 125-223	O-15
R9	1 MEG " 5W	BR 125-105	N-14
R10	1000 " 5W	BR 125-102	O-16
R11	100,000 " (C&R UNIT)	PA 4330-4	O-17
R12	82,000 " (C&R UNIT)	PA 4330-5	N-18
R13	270 " (C&R UNIT)	PA 4330-6	O-19
R14	1000 OHMS 5W	BR 125-102	N-20
R15	56,000 " (C&R UNIT)	PA 4329-3	O-21
R16	1 MEG " (C&R UNIT)	PA 4330-8	P-22
R17	680,000 " 5W	BR 125-684	K-21
R18	1.5 MEGOHM 5W	BR 125-155	J-21
R19	270 " (C&R UNIT)	PA 4330-6	P-24
R20	15,000 " 5W	BR 125-153	R-25
R21	270 " (C&R UNIT)	PA 4330-6	P-28
R22	1000 " 5W	BR 125-102	O-28
R23	39,000 " (C&R UNIT)	PA 4330-7	O-29
R24	10 MEG " 5W	BR 125-106	M-27
R25	VOLUME CONTROL	PA 4407-2	L-26
R28	2.20 OHMS 5W	BR 125-221	O-29
R29	470 " 5W	BR 125-471	O-32
R30	15,000 " 5W	BR 125-153	O-31
R31	12,000 " 5W	BR 125-153	O-32
R32	220,000 " 5W	BR 125-224	N-31
R33	56,000 " 5W	BR 125-563	N-30
R34	TONE CONTROL & SWITCH	PA 4400-7	M-32
R35	470 OHMS 2W	DR 125-471	L-32
T1	NO. 1 I.F. TRANS. ASSEM.	AA 6768-3	Q-17
T2	NO. 2 I.F. TRANS. ASSEM.	AA 6768-4	Q-20
T3	F.M. PLATE CHOKE	AA 6720-5	Q-25
T4	RATIO DETECTOR ASSEM.	AA 6684-1	Q-29
T5	OUTPUT TRANS.	AE 44056-2	J-32
T6	POWER TRANS.	AE 44010-1	

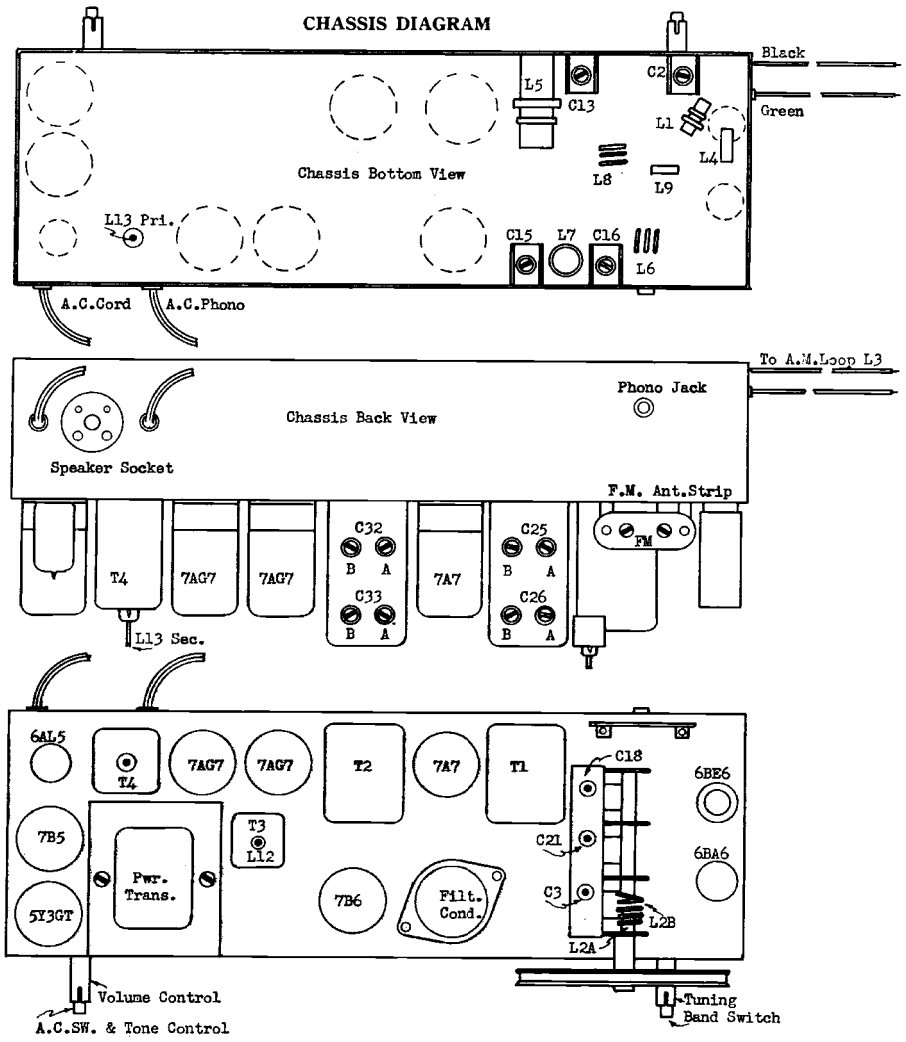


* SPECIAL SERVICE NOTE: THESE TRANSFORMERS SUPPLIED AS ASSEMBLIES COMPLETE ONLY.

STEP BY STEP ALIGNMENT PROCEDURE

OPER-ATION	ALIGNMENT OF	GENERATOR CONNECTED TO	DUMMY ANT.	GENERATOR FREQUENCY	BAND SWITCH SETTING	TUNING COND. SETTING	TRIMMER	REMARKS
1	Set dial pointer even with left-hand stop line with condenser gang closed.							
2	A.M.-I.F.	Pin #7 of 6BE6 Convt. Tube	.02 MFD. Cond.	456 KC.	BC.	Open	C33 A & B	Peak Accurately
							C26 A & B	" "
3	A.M.-R.F.	BC. Ant.	*	1500 KC.	BC.	1500 KC.	C15 Osc. Tr.	" "
							C13 R.F. Tr.	" "
							C2 Ant. Tr.	" "
4				600 KC.		600 KC.	C16 Osc. Pad.	**
5	Repeat operations 3 and 4.							
6	Check calibrations at 600, 1000 and 1500 Kc.							
7	SPECIAL NOTE: For complete F.M.-I.F. Visual alignment instructions please refer to pages 6, 7, 8, 9, 10, and 11.							
8	F.M.-I.F. Alignment using an A.M. Generator and Output Meter.							
9	T4 F. M. Ratio Det.	Pin #6 on 7AG7 Driver Tube	.05 MFD. Cond.	10.7 MC.	F.M.	Open 108 MC.	L13 Sec.	Max. Reading
							L13 Pri.	" "
10	NOTE: Operation #9 must be made with generator output as low as possible with maximum reading on output meter.							
11	T3 Plate Choke	Pin #6 on 7AG7 #2 I.F. Amp.	.05 MFD. Cond.	10.7 MC.	F. M.	Open 108 MC.	L12 Slug	Max. Reading
12	T2 F.M.-I.F.	Pin #6 on 7A7 I.F. Amp.	.05 MFD. Cond.	10.7 MC.	F. M.	Open 108 MC.	C32 B	Peak Accurately
							C32 A	" "
13	NOTE: Operation #11 & 12 must be made with generator output as low as possible with maximum reading on output meter.							
14	Connect a 15,000 ohm resistor between pin #6 (Grid) on 7A7 tube to ground.							
15	T1 F.M.-I.F.	Pin #7 on 6BE6 Tube or C.T. on L6 coil	.05 MFD. Cond.	10.7 MC.	F. M.	Open 108 MC.	C25 B	Peak Accurately
							C25 A	" "
16	NOTE: Operation #15 must be made with generator output as low as possible with maximum reading on output meter.							
17	Remove the 15,000 ohm resistor dummy from pin #6 on 7A7 tube, but leave generator coupled through .05 Mfd. condenser to pin #7 on 6BE6 tube or C.T. on L6 coil.							
18	Adjust L13 secondary slug on T4 ratio detector transformer to minimum deflection or dip on output meter. Under certain conditions it is possible to adjust L13 secondary slug to minimum noise with the receiver tuned to a weak station. This operation is very sharp and the receiver must be tuned to the center response only.							
19	F. M. - R. F. alignment using an A. M. Generator with frequencies of 88 to 108 Mc. and vacuum tube voltmeter, or D.C. Voltmeter. (20,000 ohms per volt).							
20	Place meter across C50 elect. condenser. (Meter reading approx. 1 volt.)							
21	F.M.-R.F.	F.M. Ant.	Match to 300 Ohms.	108 MC.	F. M.	108 MC.	C21 Osc. Tr.	Max. A.V.C. V.
							C18 R.F. Tr.	Peak Accurately
							C3 Ant. Tr.	" "
22	Check calibration at 88 Mc.							

NOTE:
* Use dummy antenna as described
** Rock dial while adjusting for maximum output.

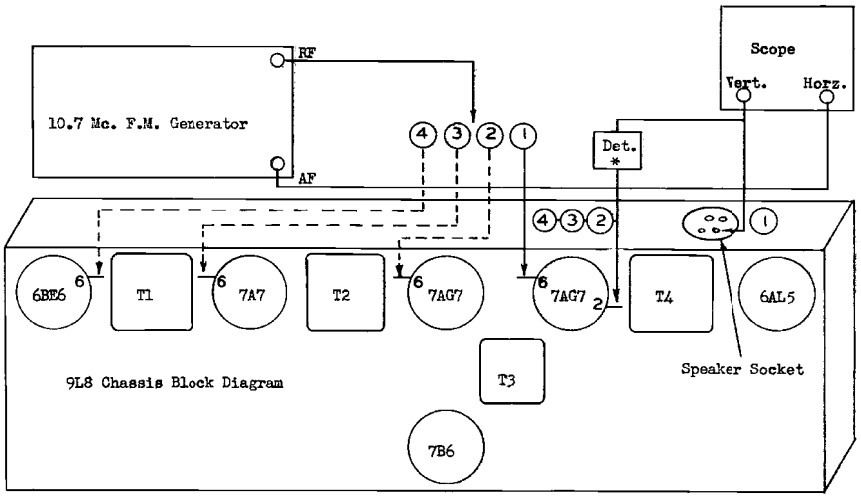


VISUAL I. F.-F. M. ALIGNMENT DATA

1. DESCRIPTION OF CIRCUIT USED:

This circuit consists of a 6BE6 Converter, 7A7 1st I.F. (A.M. & F.M.), two 7AG7 2nd F.M.-I.F. Amplifier and Ratio Detector Driver, a 6AL5 Ratio Detector for F.M. The A.M.-I.F. frequency is 456 Kc. and the F.M. frequency is 10.7 Mc.

The diagram below shows the correct hook-up for generator and scope to the receiver circuit.



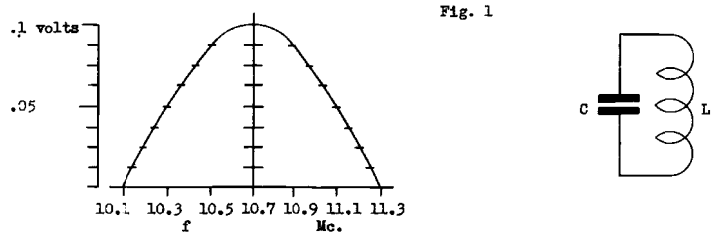
Gen. & Scope Position	Use
1	Align Ratio Det. - Adjust T4
2	Align Plate Choke - Adjust T3
3	Align I.F. - Adjust T2
4	Align I.F. - Adjust T1
*	See paragraph 3 (e) under equipment required.

2. THEORY OF VISUAL ALIGNMENT.

One of the characteristics of a tuned circuit is the fact that when it is excited or driven by a generator such as a vacuum tube or another tuned circuit, the voltage developed across it will vary with slight changes in frequency. This voltage will be greatest when the frequency is equal to the resonant frequency of the circuit and will be less if the frequency is higher or lower than the resonant frequency.

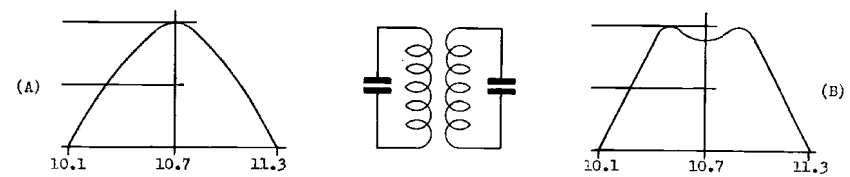
Thus if we were to shift the frequency from high to low or low to high across the resonant frequency and make a record of the voltage across the tuned circuit, we could plot the voltage against frequency and obtain a curve which might look like Fig. 1.

Fig. 1



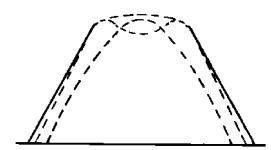
This is the selectivity curve or response curve for the circuit under discussion. This type of circuit may be aligned or adjusted to resonance by simply changing either L or C until maximum voltage is obtained at the resonant frequency. Now if another circuit tuned to the same resonant frequency is coupled to the simple case above, a number of things can happen. First current flowing in one circuit will induce current in the second circuit, the magnitude of this current depending on the degree or amount of coupling between the two circuits. This coupling may be in the form of mutual inductance, mutual capacitance or any impedance common to the two circuits. Now if we repeat the proceedure outlined for obtaining the response curve of a single tuned circuit using the voltage developed across the secondary of the coupled circuit while driving the primary, we may get either of two types of curves depending on the magnitude of the coupling, (a) in Fig. 2 is a typical curve for two circuits coupled below critical coupling and (b) is a representation of the curve for an overcoupled circuit.

Fig. 2



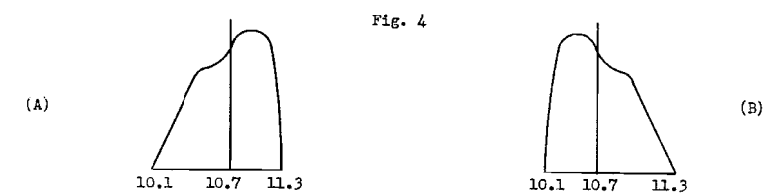
Overcoupled circuits producing a response curve like (b) Fig. 2 are often employed where it is important that the response curve remain approximately flat over a narrow band of frequencies near the resonant frequency. They are also frequently combined with single peaked circuits to produce a response curve like Fig. 3.

Fig. 3



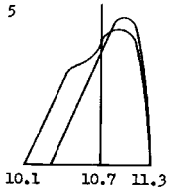
The dotted lines indicate the curves of the individual circuits and the solid curve shows the overall response of the two or more pairs of coupled circuits. Circuits like the above or approaching them in form are desirable in an F.M. receiver where the pass band should be of the order of 200 Kc. Now from the above it is evident that simple peaking both sides of a circuit coupled below critical for maximum voltage will provide optimum alignment but if this proceedure is followed with an overcoupled circuit it is almost a certainty that the two circuits will not be tuned to the resonant frequency but will instead be aligned so that either one or the other is accentuated. The response curve will then look like Fig. 4 (a) or (b).

Fig. 4



Now if this overcoupled circuit is combined with a single peaked circuit (where the coupling is below critical), the misalignment becomes worse, something like Fig. 5.

Fig. 5



From the above it appears that to properly align a receiver using overcoupled IF transformers it will be necessary to take a response curve of each stage and align the circuit so that the two peaks are symmetrical, that is, approximately equal in amplitude and displaced equally from the center frequency. To do this with a CW or AM signal would be laborious and time consuming whereas the use of visual equipment makes it nearly as simple as adjusting a simple single peaked amplifier.

Visual alignment test equipment performs the operation of plotting the response curve almost exactly as described above except that instead of manually changing the generator frequency, recording the voltage and then plotting the results, these operations are performed automatically and simultaneously by a combination of electronic circuits. The operation is briefly as follows.

In the signal generator a low AC voltage is applied to a reactance tube modulator which shifts the oscillator frequency from low to high or from high to low at a rate determined by the frequency of the AC voltage and by an amount determined by the AC voltage. The frequency at any instant is then dependant on the AC voltage present at that instant of time. An oscilloscope is provided which may be considered a voltmeter used to read the voltage across the tuned circuit, provided a detector is used to convert the RF to a low audio frequency. This voltage is then applied to the vertical plates and results in a vertical displacement of the spot on the screen. Some of the voltage used to shift the oscillator frequency is also applied to the horizontal plates of the oscilloscope providing a means of displacing the spot horizontally. It is now evident that since that for any given AC voltage only one frequency may be obtained and since that AC voltage will result in an exact amount of spot deflection on the scope we can read the result in an exact amount of spot deflection on the scope we can read the voltage across the circuit under examination by noticing the position of the spot at this exact instant.

Now if we consider the frequency as shifting from low to high 60 times per second and remember that the spot is moving across the screen of the scope 60 times per second at exact synchronization with the change in frequency it is only necessary to apply the voltage from our circuit to the vertical plates to obtain a replica of the response curve on the face of the cathode ray tube. This curve will be repeated 60 times per second if our sweep frequency is 60 cycles. Adjustments to the circuit may now be made and the effect on the response curve noted instantaneously.

3. EQUIPMENT REQUIRED.

(a) A sweep signal generator with a center frequency of 10.7 Mc. and a total sweep width of at least 400 Kc. This generator should be equipped with filters to remove all spurious oscillator frequencies and limiters should be provided to remove all amplitude modulation. There should also be a crystal oscillator to provide a marker frequency at 10.7 Mc. for accurate determination of the center frequency.

(b) An amplitude modulated signal generator tuned to 456 Kc. This generator should be either crystal controlled or means should be provided for accurate frequency calibration.

(c) An oscilloscope with either a 3" or 5" tube equipped with both vertical and horizontal amplifiers.

(d) A power output meter with an internal impedance to match the output transformer for use in 456 Kc. alignment.

(e) A diode detector for use in connection with the oscilloscope while aligning the F.M.-I.F. channel. This diode detector may be either a crystal or a two element vacuum tube such as the 6H6. A diode load resistor, coupling condenser, etc. will also be necessary.

4. ALIGNMENT OF THE 456 KC. I. F.

This alignment adjustment should be made before attempting to align the 10.7 I.F. circuit because of the possible effects on the operation of the F.M. I.F.

Connect the output meter to the receiver. Connect the signal generator output lead to the converter grid. Turn the wave band switch to Bc. and the generator to 456 Kc. Using the output meter as an indicator peak the A.M. I.F. trimmers for maximum output.

5. ALIGNMENT OF THE 10.7 I.F.

Turn the wave band switch to F.M. and the generator to 10.7 Mc. Move the signal generator lead to the grid of the ratio detector driver tube and the scope to the 1st audio plate. Now proceed to align the ratio detector transformer for maximum linearity and minimum noise. This operation can be faciliated by applying a small amount of amplitude modulation along with the F.M. and then adjusting the secondary trimmer for minimum noise. Please note that the adjustment of the secondary circuit, controls to a large extent, the linearity of the pattern and adjustment of the primary is responsible for the gain in the circuit. Fig. 6 will represent a linear detector curve and Fig. 7, a detector curve with noise or A.M. present.

Fig. 6

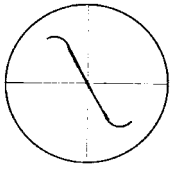
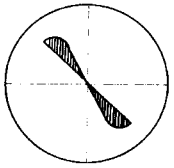


Fig. 7

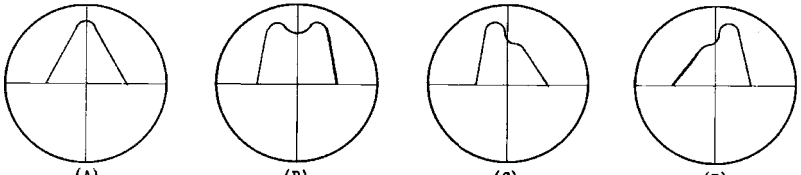


With the generator output lead connected to the grid of the next I.F. amplifier, connect the scope through the temporary detector mentioned previously (3e) to the ratio detector driver plate. Align for maximum output and symmetry.

*Move the generator lead to the grid of the next I.F. tube and align the next I.F. transformer. Adjust both trimmer screws for maximum gain, meanwhile maintaining symmetry in the curve. Observe that by alternately adjusting the primary and secondary trimmer, the vertical amplitude can be increased without allowing the response curve to become greatly distorted. Move the generator lead to the grid of the converter tube and align No. 1 I.F. transformer following the same proceedure as above.

Fig. 8, (A), (B), (C), & (D) below represent typical response curves of an overall I.F. amplifier.

Fig. 8



(A) Not Overcoupled Properly Aligned (Right)

(B) Overcoupled Properly Aligned (Right)

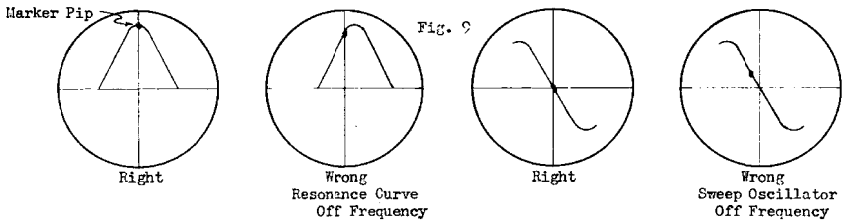
(C) Overcoupled Improperly Aligned (Wrong)

(D) Overcoupled Improperly Aligned (Wrong)

With the generator lead still connected to the converter grid, connect the scope to the 1st audio plate, and check the detector curve for linearity and noise. Should this appear unsatisfactory, a very slight readjustment of the detector secondary alignment may be made at this time. If, however, the adjustment required is very great the entire alignment procedure should be repeated in that the need for adjustment is an indication of incorrect alignment in one of the other stages.

6. USE OF MARKER FREQUENCIES.

A crystal controlled marker frequency should be provided at 10.7 Mc. The frequency of the sweep oscillator is correct when the pip will appear in the exact center of the sweep and so in the center of the resonance curve. See Fig. 9.



Note that either the sweep oscillator or the circuit alignment may be off frequency.

*This stage may or may not be included depending upon the particular model.

VOLTAGE CHART

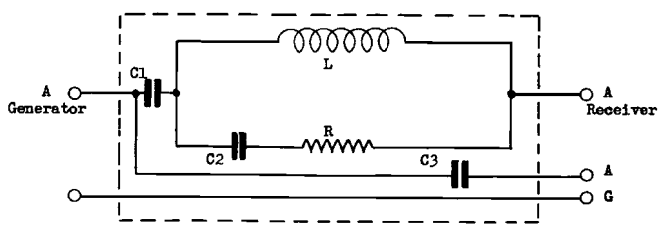
Line Voltage: 117 Volts AC

Position of volume control: Full with set tuned to quiet channel.
Position of Band Switch: Broadcast.

TUBE	FUNCTION	Voltage of Sockets Prongs to Ground. See Prong Nos. on schematic.							
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
6BA6	R. F. Amplifier	**	.8	6.3*	0	230	98	.8	-
6BE6	Converter	-1	0	6.3*	0	225	83	0	-
7A7	1st I. F. Amplifier	6.3*	225	75	2.2	0	**	2.2	0
7AG7	2nd I. F. Amplifier (F.M.)	6.3*	220	220	1.8	0	**	1.8	0
7AG7	Driver (F.M.)	6.3*	210	220	1.5	0	**	1.8	0
7B6	2nd Det., A.V.C., & 1st Audio	6.3*	95	**	0	0	.5	0	0
6AL5	Ratio Det.	.25	0	0	6.3*	0	0	0	-
7B5	Power Amp.	0	250	230	0	0	**	14	6.3
5Y3GT	Rectifier	0	270	0	250*	0	250*	0	304

NOTES: Voltage readings are for schematic diagram in this bulletin. Allow 15% + or - on all measurements. Always use meter scale which will give greatest deflection within scale limits. All DC measurements made with 20,000 ohms per volt voltmeter. All AC voltages made with rectifier type voltmeter.
* AC Volts.
** Cannot be measured with 20,000 ohms per volt voltmeter.

DUMMY ANTENNA



C1 - 200 mmf. Condenser 400 V.D.C.
C2 - 400 mmf. Condenser 400 V.D.C.
C3 - .02 mmf. Condenser 400 V.D.C.
R - 100 Ohms Resistor 1/4 Watt
L - Choke Coil

——Case Shield
Choke Coil Specification
Tubing - 3/8" Diameter Bakelite
Wire - No. 38 Enameled
Turns - 59 closely wound (Impregnated)

NOTE: When using this dummy antenna the generator output impedance should be 10 ohms or lower.

Description	Part Number
Choke-R.F.	AA6651-1
Choke-Feed Assembly (L52)	AA6660-1
Choke-Filter (L55)	AB77001-1
Coil Assembly (L31)	AA6650-1
Coil Assembly (L45)	AA6650-2
Coil Assembly (L32, 43)	AA6650-3
Coil Assembly (L58)	AA6650-4
Coil Assembly (L57)	AA6650-5
Coil Assembly (L70)	AA6650-6
Coil Assembly (L44)	AA6650-7
Coil-Adjacent Sound IF Trap (L37)	AB43524-1
Coil-Focus (L56)	PC70001
Coil-Picture IF Assembly (L36, 38)	AB43523-1
Coil-Picture IF Assembly (L30, 39, 40)	AB43523-2
Coil-Picture IF Trap Assembly (L42)	AB43524-2
Coil-Picture IF Trap Assembly (L41)	AB43524-4
Coil-Ratio Detector Complete Assembly	AA6684-2
Coil-R.F. Trap Assembly (L35)	AA6654-1
Condenser-Ceramic 10mmf. (C67)	CC30A-100F
Condenser-Ceramic 100mmf. (C17)	CC30A-101F
Condenser-Ceramic 22mmf. (C117)	CC30A-220K
Condenser-Ceramic 100mmf. (C23, 39)	CC32A-101A
Condenser-Ceramic 100mmf. (C50)	HK36G-101
Condenser-Ceramic 1000mmf. (C13, 15, 21, 46, 51, 63, 113, 114)	HK36H-102
Condenser-Ceramic 270 mmf. (C14, 19, 25, 34)	HK36M-271
Condenser-Ceramic 47mmf. (C54, 55)	CC30A-470F
Condenser-Ceramic 4.7mmf. (C115, 116)	PA4328-11
Condenser-Ceramic 4700mmf. (C29, 31, 91, 110)	PA4334-1
Condenser-Ceramic 2200 mmf. (C57)	PA4334-3
Condenser-High Voltage Filter (C98)	PA4338
Condenser-Electrolytic 10-10-20 mfd. (C42)	PA4300-10
Condenser-Electrolytic 10-10-10-20Mfd. (C38)	PA4307-5
Condenser-Electrolytic 40-40 Mfd. (C102)	PA4304-3
Condenser-Electrolytic 15-15-15-50 Mfd. (C66)	PA4307-6
Condenser-Electrolytic 4 Mfd. (C56)	PA4303-12
Condenser-Electrolytic 80 Mfd. (C100, 101)	PA4309-1
Condenser-Electrolytic 15 Mfd. (C45)	PA4309-2
Condenser-Herlec Type 3300, 4700, 4700 mmf. (C85)	PA4339-1
Condenser-Herlec Type 1000, 1000, 1000 mmf. (C16,20,26,33)	PA4339-2
Condenser-Mica 220 mmf. (C75)	MC60E-221
Condenser-Mica 470 mmf. (C30, 32, 69, 70)	MC60E-471
Condenser-Mica 1500 mmf. (C96)	MC61E-152
Condenser-Mica 680 mmf. (C76)	MC60F-681
Condenser-Mica 4700 mmf. (C18, 36, 47, 52, 68, 77, 88, 109, 111, 112)	MC61F-472
Condenser-Mica 5600 mmf. (C97)	MC61F-562
Condenser-Mica 6800 mmf. (C73)	MC61F-682
Condenser-Mica 5100 mmf. (C61)	MC61G-512

Description	Part Number
Condenser (C95)	PA4380
Control-Brightness (R46)	PA4412
Control-Focus (R128)	PA4410
Control-Horizontal Hold (R95)	PA4416
Control-Horizontal Size (R106)	PA4411
Control-Picture Contrast (R40)	PA4417
Control-Tone (R78)	PA4414
Control Vertical Hold (R113)	PA4415
Control Vertical Linearity (R119)	PA4411
Control Vertical Size (R115)	PA4413
Control Volume (R71)	PA4418
Cord-Power Interlock	PA4004
Cord & Spring Assembly (Channel Indicator)	AA6699-13
Cord & Spring Assembly (Fine Tuning)	AA6699-12
Crystal-Video Detector (1N34)	PA4206
Grommet-Chassis Mount	PA560-1
Grommet-Chassis Mount	PA560-2
Escutcheon-Channel Indicator	PB40002
Indicator-Channel	PB40003
Kinescope-Type 10BP4	PC63042
Kinescope-Type 12LP4	PD93160
Knob-Tuning	AA6641-3
Knob-Picture	AA6641-4
Knob-Channel Selector	AA6641-5
Knob-Tone	AA6641-1
Knob-Volume	AA6641-2
Lamp-Neon	PA4103
Mask-10 Inch Tube-Models 4939, 4940, 4941	PC63047
Mask-12 Inch Tube-Model 4900	PC63048
Mirror-Models 4939, 4940, 4941	PC63044-1
Mirror-Model 4900	PC63044-2
Power Supply-Complete Assembly	AD2-3TV9C
**Radio Chassis Assembly-Model 4900	AD2-9L8
*Record Playing Unit-VM402A Dual Speed	PD93109-1
Resistor-Tapped (R132-133)	PA4205
Socket-Kinescope	PB40202
***Speaker-Models 4939, 4940, 4941	PC63000-12
***Speaker-Model 4900	PC63000-21
Spring-Focus Coil	PA4135
Switch-A.C. Models 4939, 4940, 4941	PB42008
Switch-A.C. Transfer-Model 4900	PB42007
Transformer-Audio Output (T11)	AB44063-1
Transformer-Heater (T12)	AB47002-1
Transformer-High Voltage R.F. (T15)	AB43521-1
Transformer-Horizontal Linearity (T17)	AA6659-1
Transformer-Power (T16)	AB44014-1
Transformer-Vertical Blocking Oscillator (T13)	AB47003-1
Transformer-Vertical Output (T14)	AB44062-1
Trap-Ion	PA1175
Tuner-R.F. Complete with tubes	PD93150-2
Yoke-Deflection Assembly	AB43525-1

* Refer to service manual for VM402A Dual Speed changer for part numbers.

** Refer to service manual and parts list for chassis Type 9L8 for part numbers.

*** Complete Speakers may be returned to factory service department for repair or replacement.