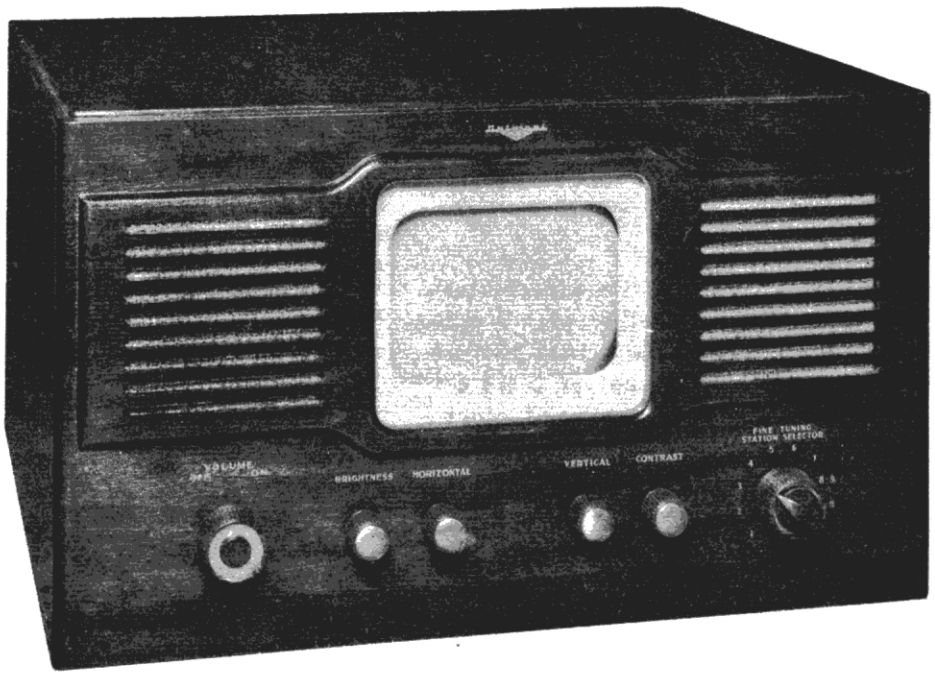
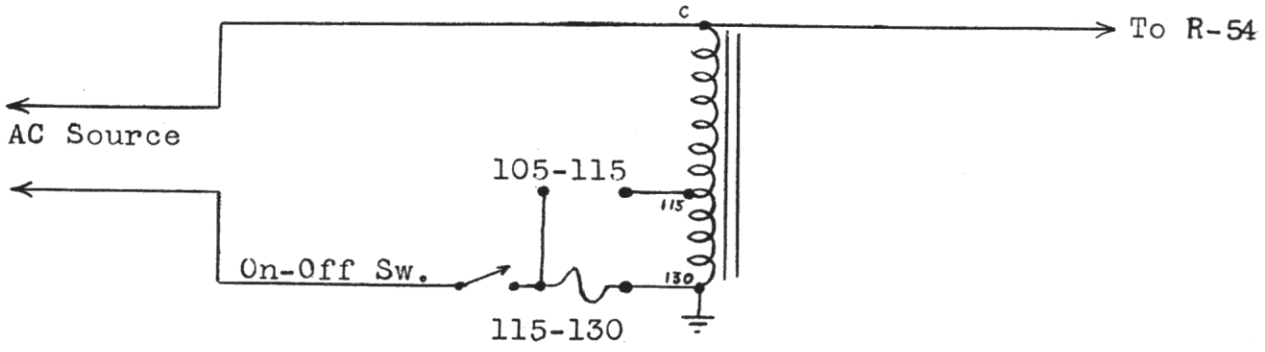
NATIONAL COMPANY, INC.

MODELS NC-TV7, NC-TV7M



The NC-TV 7 is designed to deliver optimum performance with an input of 115 volts, A.C. An auto-transformer has been added to the receiver to insure that the rated input voltage is delivered to the receiver circuits even though the available line voltage drops as low as 105 volts.

To provide a means for switching the transformer in or out, one of the A.C. line fuses has been deleted and the transformer is wired into the circuit as shown below. The Receiver is normally shipped from the factory with the fuse in the 115-130 volt position i.e., the transformer is out of the circuit. If an input line voltage below 115 volts is encountered, as will be evidenced by low brilliancy on the face of the picture tube, change the location of the fuse to the 105-115 volt position. Make Sure that the Receiver is turned OFF before removing the back of the Receiver and handling the fuse.



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MODELS NC-TV7, NC-TV7M

NATIONAL COMPANY, INC.

SERVICE MANUAL
for the
NC-TV 7 and NC-TV 7M
TELEVISION RECEIVER

SECTION 1. DESCRIPTION

1-1. General

The National model NC-TV 7 is a direct-viewing, table model Television Receiver with a complement of 22 tubes, including a 7 inch picture tube and three rectifiers. The Receiver tunes all thirteen television channels by means of eight, front-panel mounted controls. An efficient circuit provides a well-defined screen image bright enough for excellent visibility under all normal room lighting conditions. The two 6" oval loudspeakers reproduce the F.M. sound in a realistic manner with more than ample volume.

1-2. Summary

The following tabulations list in brief the pertinent data on the NC-TV 7.

Tube Complement

Tube	Function
6AU6	R.F. Amplifier
6AG5	Mixer
6C4	Local Oscillator
6AU6	First Video I.F. Amplifier
6AU6	Second Video I.F. Amplifier
6AU6	Third Video I.F. Amplifier
6AL5	Video Detector—Automatic Gain Control
6AU6	Video Amplifier
6AU6	Sync Clipper—D.C. Restorer
6AU6	4.5 Mc. Ratio Detector Driver
6AL5	Ratio Detector
6AT6	Audio Amplifier
25L6GT/G	Audio Output
12SN7GT	Vertical Sweep Generator
12SN7GT	Vertical Sweep Output
12SN7GT	Horizontal Sweep Generator
12SN7GT	Horizontal Sweep Output
12AU7	R.F. High Voltage Oscillator
1B3GT/8016	High Voltage Rectifier
25Z6GT/G	Low Voltage Doubler—B Minus Voltage Rectifier
6X5GT/G	Voltage Multiplier
7JP4	Picture Tube

Input Power Supply Rating
115 volts A.C., 60 cycles, 110 watts

Antenna Input Circuit Impedance
300 ohms balanced

Audio Output Power
2 watts

I.F. Frequency
37.3 Mc.

Picture Size
4-3/16" X 5-3/4"

Loud-Speaker (2)
Type — 6 inch Oval P.M.
Voice Coil Impedance — 3.2 ohms at 400 cycles

Fine Tuning Range
2 to 3 Mc. (varies on each channel)

Front-Panel Operating Controls
Off-On Switch
Volume — Dual Control
Station Selector
Fine Tuning — Dual Control
Contrast
Brightness
Horizontal
Vertical

Non-operating controls

Focus	At rear of chassis.
Horizontal Centering	At rear of chassis.
Vertical Centering	At rear of chassis.
Horizontal Size	At rear of chassis.
Vertical Size	At rear of chassis.
R.F. High Voltage Oscillator Output Adjustment	At rear of chassis.
Horizontal Linearity	At bottom of chassis.

Overall Dimensions
NC-TV 7 (wooden cabinet)
Width 20-3/4"
Height 12-3/4"
Depth 17-3/4"
NC-TV 7M (metal cabinet)
Width 19-3/4"
Height 11-1/2"
Depth 18"

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Channel	Freq. Mc.	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.	Receiver Local Osc. Freq. Mc.
1	44 - 50	45.25	49.75	82.55
2	54 - 60	55.25	59.75	92.55
3	60 - 66	61.25	65.75	98.55
4	66 - 72	67.25	71.75	104.55
5	76 - 82	77.25	81.75	114.55
6	82 - 88	83.25	87.75	120.55
7	174 - 180	175.25	179.75	141.25
8	180 - 186	181.25	185.75	147.25
9	186 - 192	187.25	191.75	153.25
10	192 - 198	193.25	197.75	159.25
11	198 - 204	199.25	203.75	165.25
12	204 - 210	205.25	209.75	171.25
13	210 - 216	211.25	215.75	177.25

SECTION 2. INSTALLATION

2-1. General

Installation of a television receiver differs greatly from the procedure followed with a conventional A.M. or F.M. receiver. The first and main requirement to be considered is the "know-how" of the installing technician. He should be thoroughly familiar with the installation requirements of your Receiver in all its aspects or, failing this, possess enough radio knowledge to carry out the instructions in this section in a capable manner.

Installation consists mainly of three parts: the selection of an antenna, erection of the antenna and initial adjustments in the NC-TV 7. Each of the three foregoing parts is of paramount importance and each has a direct bearing on the performance of your television receiver. Instructions for installation in its entirety are given in Section 2-6. The sections prior to this discuss, in detail, individual parts of the installation procedure.

2-2. Precautions

Due to the voltage requirements of the picture tube, extremely high voltages exist in the receiver. Operation of the NC-TV 7 outside its cabinet constitutes a dangerous shock hazard. High voltages are present inside the R.F. high voltage compartment and at points on the bottom of the chassis. Due caution must be employed to insure that bodily contact is not made to any high voltage point when working on the receiver. Make sure that the cover of the high voltage compartment is replaced in the event it is removed.

Precautions are required also in regards to the picture tube. Since the picture tube bulb has a large area and contains a high vacuum, considerable air pressure is exerted on the surface of the bulb. For this reason, never handle the picture tube unless it is absolutely necessary and then only when wearing shatter-proof glasses and heavy gloves. The bulb of the tube (particularly the large end) must never be struck, scratched or subjected to any pressure. In the receiver, the picture tube is amply protected by a shock-resistant mounting and a pane of shatter-proof safety glass in front of the viewing surface. If the picture tube is ever removed from the receiver, make sure it is replaced properly i.e., secure in its socket and mounting ring.

2-3. Selection of the Antenna

There are many good types of antennas commercially available. A specific type of antenna cannot be recommended since the antenna type should be determined by the location of the receiving antenna with respect to the transmitting antenna of the station or stations to be received. There are three main factors to be considered when selecting an antenna:

a. The directional characteristic of the antenna.
b. The gain or sensitivity of the antenna.
c. The frequency for which the antenna is designed.

Antennas are available which are uni-direct-

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ional, bi-directional or omni-directional and with various degrees of gain. Select an antenna with as restricted a directional characteristic as possible. For example, if all transmitting antennas in the area are located in one direction, the uni-directional type should be preferred. However, bearing in mind the line-of-sight propagation of the television signals, the antenna must be receptive towards all directions in which television transmitting antennas are located and the bi-directional or omni-directional type may be called for in some areas.

The gain of the selected antenna should not be in excess of what is required. For example, in metropolitan areas where the antenna is in close proximity to transmitting antennas, a high-gain antenna would not improve reception, but rather be detrimental because too strong a signal at the input of the receiver will cause overload. Conversely, in areas where the transmitting antennas are far removed, a high-gain antenna must be used for good reception.

Closely allied with the gain of the antenna is the frequency for which the antenna has been designed. An antenna designed for the lower frequency television band will have better gain at the designed frequency than on the higher frequency television band and vice versa. An antenna designed for both bands will give fair gain on both bands. After learning the frequency of the television stations in the area, an antenna may be selected which covers all the desired stations, or possibly is designed to favor a remote station against a station fairly close to the receiving antenna.

It should be noted, from the preceding discussion, that all three factors which enter into the selection of an antenna are closely interrelated and have a direct bearing on the efficiency of reception. Therefore, each factor must be considered equally and none can be neglected. In summation, determine the antenna requirements of the installation and select an antenna which most nearly meets all these requirements.

An all-band antenna worthy of consideration is the "High-Low" type. This type has two sets of antenna elements, one stacked above the other, with one set designed for the low-frequency television band, the other for the high-frequency. A unique feature of this antenna is that each set of elements may be oriented, as desired, independent of each other. Antennas of this type are currently being manufactured by the Technical Appliance Co., (Taco), their type "E284", and the Ward Products Corp., their type "High-Low". Antenna manufacturers issue data sheets, on the various types of antennas, which should be of great assistance in selecting the antenna.

2-4. *Erection of the Antenna*

Theoretically, the ideal installation would have the antenna mounted high enough so that there would be a clear, unobstructed path for the television signal to travel from the transmitting antenna to the receiving antenna. However, in this case the ideal is not usually possible nor practical. In general, the antenna should be mounted high enough to clear obstructions such as buildings, hills etc., in the immediate vicinity. Mount the antenna at least 6 feet (1/4 wavelength) above ground or any adjacent conducting structure. Make sure the antenna is firmly mounted to support its own weight and to withstand strong winds. The position of the antenna elements with respect to the transmitting antenna depends on the directional characteristic of the antenna and the receiving area. Only by trial can the antenna be positioned properly. The elements should be positioned so that all stations in the area are well received and that "ghosts" (multiple images) are absent from the viewing screen. Ghosts are generally encountered when secondary emission of the transmitted signal from nearby buildings etc. cause a signal to arrive at the receiving antenna a fraction of time later than the fundamental signal.

Ghosts are sometimes produced by mismatch between antenna and receiver whereby a secondary signal is reflected back from the receiver to the antenna and back again to the receiver. This effect can be minimized by proper matching of antenna to receiver and by keeping the antenna feeders as short as possible with no excess length. The antenna input circuit of the NC-TV 7 is designed for a 300 ohm balanced line. The impedance of most television antennas is also 300 ohms, so that matching the two impedances resolves into selecting a transmission line with a characteristic impedance of 300 ohms. Bring the transmission line out perpendicular from the antenna elements and keep it as far away as possible from metal objects in its travel to the receiver. In installations where the transmission line is, of necessity, very long, put a gradual twist in the line about once every foot to minimize the possibility of "ghost" production.

Installations may be encountered where, due to the restricted location for the antenna and/or the length of the transmission line, it is impossible to eliminate "ghosts". A possible solution in this case is to place the antenna in the

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same room with the receiver, thereby, changing the antenna location and shortening the transmission line to a minimum. An inside-the-room antenna is feasible only in receiving areas fairly close to the transmitting antennas. This type of antenna is usually a folded dipole, constructed of 300 ohm twin-lead, fastened to the wall or laid on the floor out of the way.

2-5. *Initial Adjustments*

The NC-TV 7 is carefully aligned at National Company laboratories and ordinarily requires no readjustment before being placed in operation.

The R.F. unit is calibrated so that ten of the thirteen television channels are tuneable by the Station Selector switch. Each receiver is tagged to indicate whether the R.F. unit has been calibrated to tune either the odd or even higher-frequency channels i.e., 8, 10 and 12 or 9, 11 and 13. Receivers are shipped to areas with stations corresponding to the channels pre-set in the NC-TV 7. The occasion may arise when it is desired to change from the odd to even, or even to odd, channels. Instructions follow to take care of this eventuality.

Equipment required:

R.F. Sweep Generator with a 10-12 Mc. sweep width.

Marker generator with the required frequencies (see below).

Oscilloscope (RCA type WO-60 or equivalent).

1. Remove the receiver from its cabinet and place it on its side.

2. Remove local oscillator tube, 6C4 and connect a jumper across the filaments, pins 3 and 4.

3. Unsolder the mixer, 6AG5, blue plate lead from the terminal board located just outside the R.F. compartment. See Figure No. 13. Connect the plate lead to B plus (junction of R-12 and C-15) through a 4700 ohm resistor.

4. Connect oscilloscope to the junction of the mixer plate lead and the 4700 ohm resistor (see step 3) and chassis.

5. Connect the sweep generator to the antenna input terminals. If the sweep generator is terminated in a 50 ohm single-ended output, the necessary balanced output may be obtained by installing a matching network as shown in Figure No. 1.

6. Connect the link on the A.G.C. terminal board between the center and right-hand (chassis) terminals to remove A.G.C. from the R.F. tube. See Figure No. 2.

7. Connect the A.C. line cord of the receiver to a 115 volt, 60 cycle supply source. It is recommended that this connection be made thrqugh a one-to-one isolation transformer with a rating of about 150 va. The use of the transformer will eliminate the possibility of shock to the technician and damage to the test equipment due to an improper connection. NOTE: one side of the A.C. input in the receiver is connected to chassis.

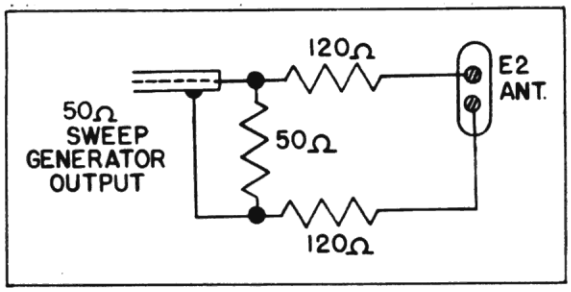

Figure No. 1. Sweep Generator Balanced Output

8. Turn the receiver On.

9. To adjust the receiver for the odd channels, set the Station Selector switch on channel 9; for the even channels set the Station Selector switch on channel 8.

10. Adjust the sweep generator to cover channel 8 or 9 corresponding to the setting of the Station Selector switch.

11. Adjust the marker generator to insert markers at the picture carrier and sound carrier frequencies of the channel being aligned. The picture carrier frequency of channel 8 is 181.25 mc., of channel 9, 187.25; the sound carrier frequency of channel 8 is 185.75, of channel 9, 191.75.

12. Adjust L-4 and L-6 for an approximately flat topped response curve located equal distance between the markers. See Figure No. 9 for location of L-4 and L-6. Check the response curve against that shown on the R.F. alignment table for channel 8 or 9. (Page 13.)

13. Check the response curves on the two higher frequency channels. There is no individual adjustment for the higher channels and if the response curve is not correct, a compromise might be made in the adjustment made on channel 8 or 9.

14. Restore the receiver to its original condition by removing the jumper from the oscillator socket, replacing the oscillator tube, removing the 4700 ohm resistor, soldering the mixer plate lead back to its original location and replacing the A.G.C. link to the A.G.C. position. Remove all test equipment and replace the receiver in its cabinet.

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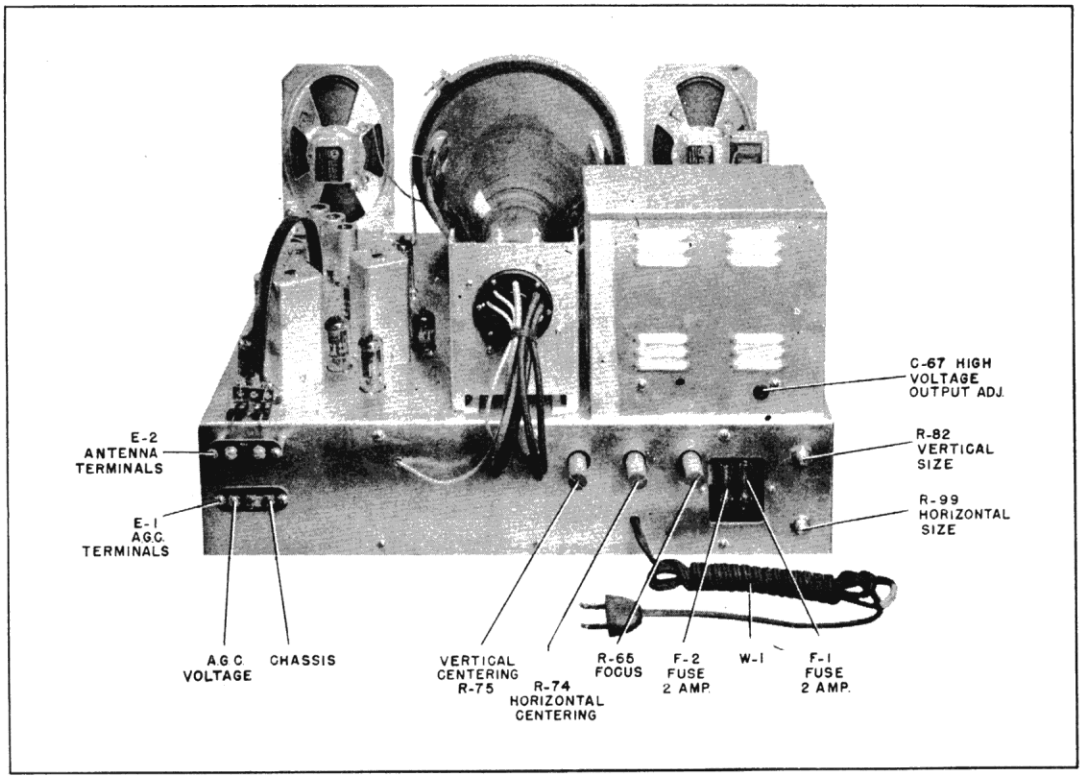

Figure No. 2. Rear View of Receiver (cabinet removed)

2-6. *Installation Procedure*

The NC-TV 7 is installed as follows:

1. Install the antenna as recommended in Section 2-4.

2. Place the receiver in its operating position, preferably with the viewing screen facing away from a strong light source, such as a window, etc.

3. Connect the transmission line from the antenna to the two posts on the antenna terminal board, E-2.

4. Operating the receiver with the A.G.C. link between the center and chassis terminals will provide an increase in sensitivity. This may be desirable in receiving areas far removed from transmitting antennas. Both settings should be tried in doubtful areas and the best setting used. The A.G.C. terminal board, E-1, is accessible after removal of the back of the cabinet.

5. Connect the A.C. line cord of the receiver to a 115 volt, 60 cycle, A.C. source of supply.

6. Set controls as recommended in Section 3 for the reception of signals.

SECTION 3. OPERATION

3-1. *Operating Instructions*

The NC-TV 7 is placed in operation by adjustment of the controls as follows:

1. Turn the Off-On Volume control On to about mid-position. Allow about 30 seconds for the receiver to reach normal operating condition.

2. Set the Station Selector switch at a channel on which there is no television broadcast.

3. Turn the Contrast control fully counterclockwise.

4. Turn the Brightness control clockwise until a glow appears on the viewing screen, then slowly counterclockwise to the setting where the glow first disappears.

5. Reset the Station Selector switch to a channel having a television broadcast. Initial tuning is best accomplished when the test pattern is being broadcast. Proper tuning is indicated when all lines on the test pattern are straight, when the circles are perfectly round, and when there is visible distinction between black, white and intermediate shades of gray.

6. Turn the Contrast control clockwise un-

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til the picture is seen on the screen.

7. Adjust the vertical control to a setting where all vertical movement of the picture stops.

8. Adjust the Horizontal control to a setting providing the clearest picture.

9. Adjust the Fine Tuning control for the sharpest and clearest picture.

10. Adjust the Contrast control for suitable contrast. The correct setting is indicated by the range of tones visible on the test pattern. The tones should range from white, through various shades of gray, to black.

Readjust the Brightness control, if necessary, to produce a better picture.

11. Readjust, if necessary, the Volume control for the desired volume.

12. Turn off the receiver by setting the Off-On switch at Off without disturbing any other control settings. Thus, when the set is turned on again, the controls will not require readjustment. If the settings of the controls are changed, it is recommended that the entire tuning procedure be repeated.

When switching from station-to-station it may be necessary to reset 9 and 10. If any difficulty is encountered in making the adjustments in 7 and 8, change the setting of the Contrast control by turning the control slightly counterclockwise.

3-2. Non-Operating Controls

The five controls at the rear of the cabinet are not normally used when operating the receiver and need not be adjusted unless there is evident indication that adjustment is required. The controls and their functions are as follows:

Focus	— Brings the picture into proper focus.
Horizontal Size	-- Adjusts the horizontal size of the picture.
Vertical Size	-- Adjusts the vertical size of the picture.
Horizontal Centering	— Centers the picture horizontally.
Vertical Centering	— Centers the picture vertically.

SECTION 4. CIRCUIT DESCRIPTION

4-1. General

This section discusses in detail the circuit employed in the NC-TV 7. Figure No. 3. is a block diagram of the receiver and the following discussion is divided up into sections as shown thereon. It is recommended that the Schematic Diagram at the back of this manual be unfolded so that it is completely visible, for ready reference, while reading this section.

4-2. R. F. Unit

The R.F. unit functions to select the desired signal, to amplify and convert the signal to provide an output at the plate of the mixer, consisting of heterodyned frequencies as follows:

Channels	Picture Carrier	Sound Carrier
1 thru 6	37.3 mc.	32.8 mc.
7 thru 13	34.0 mc.	38.5 mc.

The input circuit of the R.F. amplifier tube, V-1, is designed for a 300 ohm balanced line. The input signal is fed to the grid and cathode of the tube. A center-tapped coil with an iron core, L-3, is connected to the antenna terminals for coupling purposes on channels one through six. On the higher frequency channels, two small air-wound coils, L-1 and L-2, are switched across L-3 by S-2 to maintain the desired coupling. The plate circuit of the R.F. tube is resonated by an adjustable, brass core coil, L-4, in series with a multi-tapped coil, L-5, on channels 1 through 11 and by L-4 on channels 12-13. Switching of coils is accomplished by S-3. A.G.C. voltage may be applied to the grid of the R.F. tube through the terminal panel E-1. The panel is fitted with a link switch to remove A.G.C. from the tube in fringe areas etc. where an increase in sensitivity is desired. Coupling to the mixer grid is accomplished through capacitor, C-5, on channels 7 through 13, the coupling is inductive on the lower channels.

The mixer circuit employs a 6AG5 pentode, V-2, with grid leak bias. The grid of the mixer is resonated in the same manner as the plate circuit of the R.F. amplifier tube. L-6 tunes channel 12-13 and L-6 in series with L-7 tunes the lower channels. The switch associated with the mixer stage is S-4.

The local oscillator, V-3, employs a 6C4 triode in a modified ultra-audion circuit. B plus is fed to the plate of the tube through a 2200 ohm resistor, R-7. Each channel has a separate inductor made adjustable by a movable iron core. Switches S-5 and S-6 select the proper inductor

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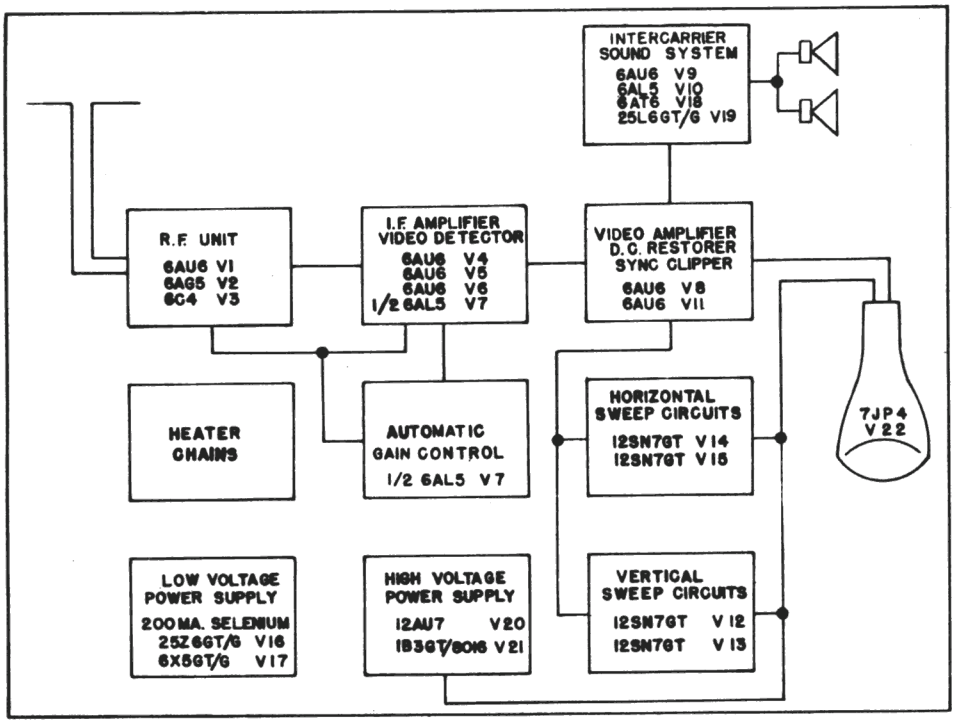

Figure No. 3. Block Diagram of Receiver

for each channel. A variable capacitor, C-14, connected in the grid of the oscillator, is the fine tuning adjustment. The oscillator operates on the high side of the picture carrier on channels 1 through 6 and on the low side of the picture carrier on the higher frequency channels.

4-3. I. F. Amplifier — Video Detector

The NC-TV 7 employs the intercarrier sound system. It differs mainly from the conventional system in that the hetrodyning frequency which determines the sound I.F. frequency is the picture carrier and the F.M. sound carrier is not separated from the picture carrier until just before the video signal is applied to the picture tube. The intercarrier sound is relatively independent of local oscillator tuning because the sound I.F. frequency is determined at the transmitter and not in the receiver. The system consists of three stages of symmetrical I.F. amplifiers and four stagger-tuned circuits with two alignment frequencies. Traps are not required in this system, thereby greatly simplifying the alignment procedure.

The three I.F. stages are similar for the most part. Tuning is accomplished by means of adjustable iron-core coils. The alignment frequency of L-19 and L-22 is 34.8 mc., of L-20 and L-24, 36.9 mc. The I.F. bandpass characteristic is shown in Figure No. 4. By use of the symmetrical curve, the local oscillator is operated on the low side on the high frequency channels to maintain oscillator stability. The plate supply to I.F. tubes V-5 and V-6 is shunt fed through R.F. chokes. This is done in the case of V-6 to keep the resistance in series with the I.F. plate and diode detector small. It is done in the case of V-5 to keep the impedance in the grid of V-6 small to prevent bias from developing on this grid by noise pulses which are of sufficient amplitude to draw grid current. If bias were produced, the gain would be reduced for a time following each noise pulse. Each noise pulse, which modulates the carrier towards the black level, is followed by a white tail which would prove objectionable on the picture. A.G.C. voltage is applied to the grids of the first and second I.F. tubes.

The video detector, V-7, is a conventional diode. The input to the detector is tapped down on L-24 to obtain the proper operating Q. The output of the detector is fed through a series peaking choke, L-25, and a shunt peaking choke, L-26, to the input of the video amplifier. In this manner a video response is obtained relatively flat to 3-1/2 mc. See Figure No. 5 for the video frequency response characteristic at the

output of the detector.

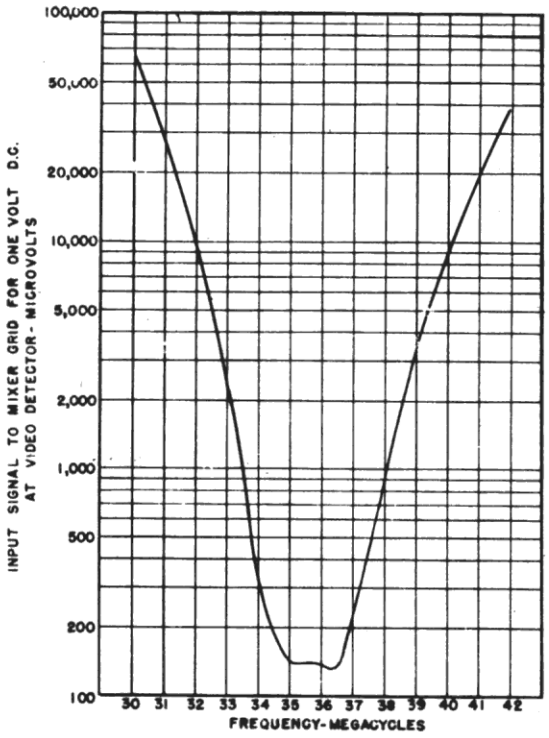

Figure No. 4. I.F. Amplifier Characteristic Curve

4-4. *Automatic Gain Control*

The automatic gain control circuit utilizes one-half of a type 6AL5 tube, V-7. The A.G.C. action in television receivers is comparable to that of A.V.C. in conventional receivers. A.G.C. voltage is applied to the first two I.F. tubes and the first R.F. tube to keep the contrast of the picture fairly constant with different signal input levels. This permits the operator to switch from station-to-station without having to reset the Contrast control each time.

Cathode bias is used to delay the application of A.G.C. voltage until the video output is sufficient for full contrast.

Two time constants are used: C-26, R-21 is the first with a time constant approximately one picture line long; C-24, R-20 is the other and is considerably longer. Because of the short time constant C-26 stores only a small amount of energy and at the end of each line the voltage across it has dropped to about the black level at which time C-26 is again charged. Due to the small amount of energy stored in C-26 it discharges quickly, even though it may charge to the peak of an interfering noise pulse, thereby minimizing the effect of relatively long noise pulses on receiver performance. The longer time constant, C-24 and R-20, filters out the A.C. component and the 60 cycle component caused by the vertical sync pulses.

4-5. *Video Amplifier, D. C. Restorer, Sync Clipper*

This system employs two type 6AU6 tubes. A sync-negative signal from the video detector is applied to grid of the video amplifier, V-8, so that noise pulses, with an amplitude greater than that of the signal, will have negative polarity. The video amplifier stage is so designed that, with a full contrast picture on the picture tube, the top of the sync signal will be at about cutoff and noise signals above this level will drive the stage beyond cutoff and be clipped. The Contrast control is placed in the cathode of the video amplifier tube and controls the contrast by controlling the gain of the video stage. The range of the gain adjustment is about 8 to 1. The gain is not allowed to go to zero since this would attenuate the intercarrier sound signal below a usable level. The bias for the video amplifier remains constant at approximately 1.5 volts and is independent of the setting of the Contrast control. Peaking coils, L-27 and L-28, are placed in the plate of the tube to maintain an output relatively flat to 3-1/2 mc. See Figure No. 5. The output is coupled through capacitor C-34 and resistor R-41 to the cathode of the picture tube.

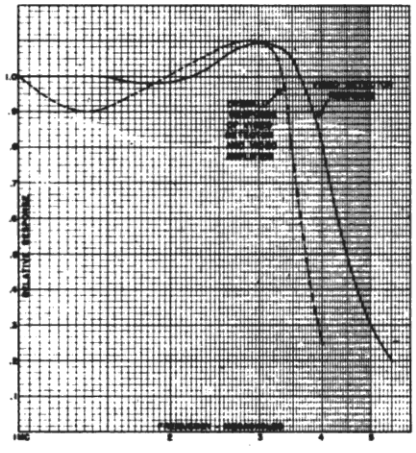

Figure No. 5. Response of Video Output Circuits

The other 6AU6 tube, V-11, functions to restore the D.C. component, clip the sync from the composite signal and then clip the sync on the other side. A D.C. voltage is developed across cathode resistor, R-33, which is proportional to the average value of the input signal. This voltage is applied to the grid of the picture tube to

re-insert the D.C. component. The value of cathode bias is such that all picture information is beyond the tube cutoff and only sync pulses appear in the plate. These pulses are clipped on both sides since their peak amplitude rises beyond the tube's cutoff. The pulses are then fed through a voltage divider network to obtain the desired voltage for application to the horizontal and vertical sweep oscillators.

4-6. *Horizontal Sweep Circuits*

The horizontal sweep oscillator employs a 12SN7GT type tube, V-15, in a Potter-type cathode coupled multivibrator circuit. The input sync signal is of negative polarity with a potential of about 1/4 to 1/2 volt. The method used in the initial adjustment of the controls associated with this circuit is of interest. The Horizontal Size control, R-99, is set for the largest possible size picture consistent with good linearity. The anode voltage on the picture tube is then adjusted by means of capacitor, C-67, to obtain the proper size picture. In this manner correct size is obtained along with the brightest possible picture. Thereafter, the Horizontal Size control is used for slight adjustment of the size of the picture. The saw-tooth output of the sweep oscillator is applied to one grid of the push-pull horizontal sweep output dual tube, V-14. Phase reversal is obtained by capacity coupling between the plate of the first triode to the grid of the other. A horizontal linearity adjustment is provided by capacitor, C-87.

4-7. *Vertical Sweep Circuits*

The vertical sweep oscillator circuit is the same as that employed for the horizontal circuit. The output of the sweep oscillator is applied to one grid of the push-pull vertical sweep output dual tube, V-12. Phase reversal is obtained by driving the same grid from a resistive voltage divider circuit from the plate of the first triode to ground. Good vertical linearity is obtained as follows: the voltage developed across the resistor in the R-86, C-78 time constant circuit is fed back to the input of the tube through capacitor, C-76; careful determination of this feedback compensates for any distortion caused by the time constant of C-81, R-92.

4-8. *Intercarrier Sound System*

Coupling from the video amplifier to the sound system is accomplished through capacitor, C-32, whose small value of 1 mmf. minimizes any possible effect on the gain of the video amplifier below 4.5 mc. A trap inductance, L-29, with an adjustable iron-core, is made resonant at 4.5 mc. for maximum transfer of the audio signal. The impedance in the grid circuit of the type 6AU6 ratio detector driver, V-9, is kept low by tapping down on inductor, L-29, to prevent self-oscillation of the tube. The detector circuit used is a conventional ratio type. The audio output of 2 volts rms. for 25 Kc. deviation at the detector necessitates the use of an audio amplifier ahead of the audio output tube. Degeneration is used in the audio output stage to improve the audio fidelity.

4-9. *Low Voltage Power Supply*

The low voltage power supply furnishes voltages to the receiver circuits with potentials of plus 120, 250, 400 volts and minus 140 volts. The plus 120 volt supply is obtained across capacitors C-63A and C-63B from selenium rectifier Z-1 after filtering by choke L-33. The rectified output of one-half the 25Z6GT/G, V-16, adds to the output of selenium rectifier, Z-1, to produce the 250 volts for the R.F. high voltage oscillator tube, V-20. The output of the 6X5GT/G, V-17, adds to the 250 volts to produce 400 volts across C-75A. The other half of V-16 is used as the B minus rectifier to furnish 140 volts negative. This negative supply is used as bias for the video amplifier and audio output stage and in addition is added to the 400 volt supply for a total of 540 volts for the deflection circuits. The drain is approximately 160 ma. at 120 volts, 25 ma. at 250 volts, 15 ma. at 400 volts and 15 ma. at 140 volts negative.

4-10. *High Voltage Power Supply*

The high voltage power supply is completely enclosed in a shield compartment to prevent emission of R.F. energy into the receiver circuits and as a safety measure. A type 12AU7 tube, V-20, is used as the R.F. oscillator and it is operated well within its maximum rating. The oscillator voltage is applied to the primary of the transformer, T-3. The high voltage is developed across the secondary of T-3, rectified by the type 1B3GT-8016 tube, V-21, and is then well filtered before being applied to the bleeder resistor network. The Horizontal Centering control, R-74, the Vertical Centering control, R-75 and the Focus control, R-65, function by controlling the voltage applied to one set of deflection plates and the second anode, respectively. The fixed voltage for the other set of deflection plates is also supplied by the high voltage system.

4-11. Heater Supply

Heater connections are shown on the Schematic Diagram. The picture tube and the 6X5GT/G rectifier are rated at 6.3 volts and 0.6 ampere. The balance of the tubes are arranged in two 0.3 ampere strings connected in parallel. The total voltage of one of the strings is 6.3 volts less than the other and a resistor, R-56, is added to make up the difference. Since the 6C4 heaters require 0.15 ampere, they are shunted by resistors, R-55, R-57, and thus draw 0.3 ampere at 6.3 volts. All the tubes in this series parallel combination draw approximately 103 volts. A resistor, R-54, is placed in series with the entire combination.

SECTION 5. ALIGNMENT

5-1. General

Instructions for complete alignment of the NC-TV 7 Receiver are given in this section. Alignment is divided into five sub-sections, each independent of the other. Alignment of any one sub-section does not necessitate alignment of any other sub-section.

(a) Video I.F. Amplifier Alignment.
(b) Sound System Alignment
(c) R.F. Amplifier and Mixer Alignment.
(d) Local Oscillator Alignment.
(e) Adjustment of the non-operating controls

The efficiency of alignment will depend in great measure upon the accuracy of the test equipment employed. It is strongly recommended that a one-to-one isolation transformer with a rating of about 150 va. be used between the NC-TV 7 and the A.C. line during alignment. Use of the transformer will eliminate the possibility of shock to the technician and damage to the test equipment due to an improper connection. The test equipment required to effect alignment is as follows:

1. Cathode-ray oscilloscope - Preferably a 5 inch tube such as the RCA type WO-60 or equivalent.

2. Marker Generator -- Accurate calibration is a must. The frequency range should be from 30 mc. to 215 mc.

3. Sweep Generator -- A 10-12 mc. sweep width is required with a frequency range of from 30 to 220 mc.

4. Signal Generator -- Here the accuracy of a crystal-controlled device and adjustable attenuation are recommended. The frequencies required are 4.5 mc., 34.8 mc. and 36.9 mc.

5. Vacuum tube voltmeter -- A good high-impedance voltmeter such as the RCA type "Voltohymst" or equivalent.

6. Heterodyne Frequency Meter -- Frequencies required range from 82 mc. to 180 mc. Crystal controlled accuracy is preferable. (Used only in local oscillator alignment.)

5-2. Video I. F. Amplifier Alignment

The preliminary procedure for alignment of the video I.F. stages in the NC-TV 7 is as follows:

1. Remove the local oscillator tube, V-3, and connect a jumper across the filaments, pins 3 and 4.

2. Connect the link of the A.G.C. terminal panel between the center and chassis terminals. See Figure No. 2.

3. Connect a negative supply of 2 volts to the A.G.C. bus (junction of C-20 and R-15) and chassis. This supply can be obtained by connecting two 1-1/2 volt batteries in series as shown on Figure No. 6.

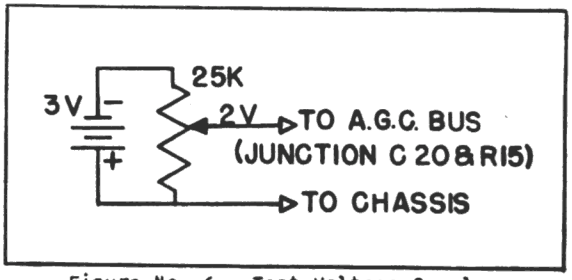

Figure No. 6. Test Voltage Supply

4. Connect the signal generator through a 0.01 capacitor to channel 5 contact of S-4A and chassis. (Junction of L-7D and L-7E, see Fig. 9.)

5. Connect the vacuum tube voltmeter to the junction of L-26 and R-26 and chassis.

After the preceding connections have been made procede as follows:

Step 1. Turn the Receiver On.

Step 2. Set the vacuum tube voltmeter on the lowest voltage scale (5 volts).

Step 3. Set the signal generator at 34.8 mc. with an output of approximately 0.3 volt.

Step 4. Adjust L-19 and L-22 for maximum reading on the voltmeter. Retard the output of the generator, as necessary, to keep an on-scale reading on the voltmeter. See Figure No. 7. for

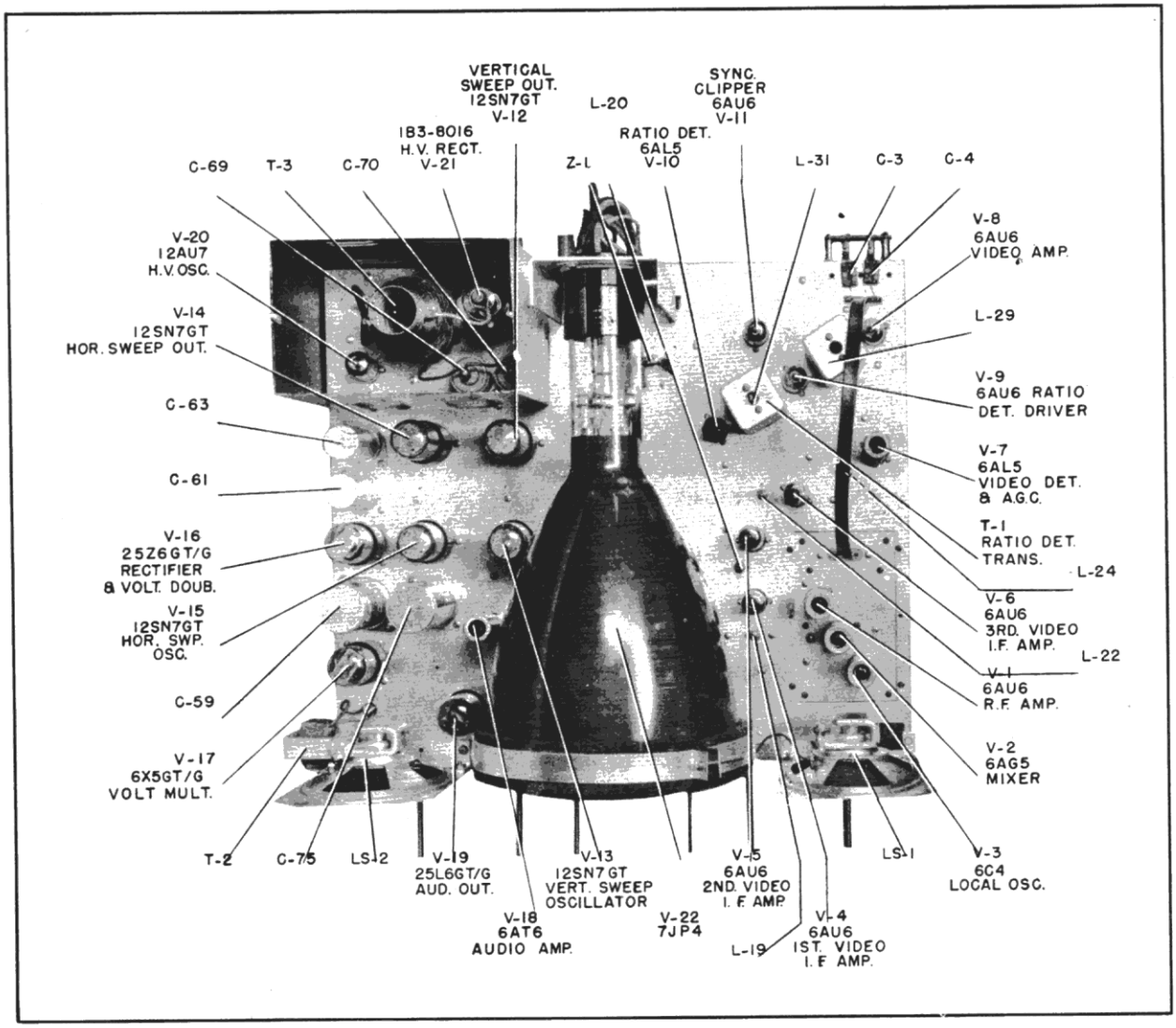

Figure No. 7. Top View of Receiver (cabinet removed)

location of L-19 and L-22.

Step 5. Set the signal generator at 36.9 mc.

Step 6. Adjust L-20 and L-24 for maximum reading on the voltmeter.

Step 7. Repeat steps 3, 4, 5 and 6 to check the accuracy of alignment.

After steps 1 through 7 are completed, the voltmeter should read approximately 15 volts with the generator set at 36.9 mc. and 0.3 volt output.

Step 8. Disconnect the signal generator and connect the sweep generator in its place. Adjust the sweep generator to sweep the I.F. frequencies.

Step 9. Disconnect the vacuum tube voltmeter and connect the oscilloscope in its place.

Step 10. Adjust the marker generator for an output of 34.8 and 36.9 mcs.

Check the response curve on the oscilloscope against the curve shown on Figure No. 8.

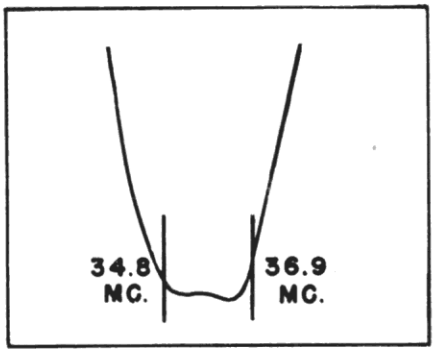

Figure No. 8. I.F. Response Curve

5-3. *Sound System Alignment*

The preliminary procedure for alignment of the sound system is as follows:

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1. Remove all test equipment pertaining to I.F. amplifier alignment and replace the local oscillator tube.

2. Connect the output lead of the signal generator to the junction of L-26 and C-30 through a 0.01 capacitor and connect the ground lead of the generator to the chassis of the receiver.

3. Connect the vacuum tube voltmeter to the junction of R-46 and C-45 and chassis.

4. Set the Contrast control on the receiver full on—extreme clockwise position.

After the preceding connections have been made procede as follows:

Step 1. Turn the Receiver On.

Step 2. Set the voltmeter on its lowest voltage scale (5 volts).

Step 3. Set the signal generator at 4.5 mc. with an output of 0.1 volt.

Step 4. Adjust L-29 (bottom of chassis) for maximum reading on the voltmeter.

Step 5. Adjust L-30 (bottom of chassis) for maximum reading on the voltmeter.

Step 6. Repeat steps 4 and 5 to assure accuracy of alignment.

Step 7. Adjust the output of the signal generator for a reading of 5 volts on the voltmeter.

Step 8. Move the voltmeter connection to the junction of R-47 and C-45.

Step 9. Adjust L-31 (top of chassis) for a reading of 2.5 volts on the voltmeter.

5-4. *R. F. Amplifier and Mixer Alignment*

The order in which R.F. alignment is accomplished is important and the order outlined in the Alignment Table must be followed since adjustment of the higher frequency channels affects those lower.

The preliminary procedure for R.F. alignment is as follows:

1. Remove the local oscillator tube, 6C4, and connect a jumper across the filaments, pins 3 and 4.

2. Unsolder the mixer, 6AG5, blue plate lead from the terminal board located just outside the R.F. compartment. See Figure No. 12. Connect the plate lead to B plus (junction of R-12 and C-15) through a 4700 ohm resistor.

3. Connect the oscilloscope to the junction of the mixer plate lead and the 4700 ohm resistor (see step 2) and chassis.

4. Connect the sweep generator to the antenna input terminals. If the sweep generator is terminated in a 50 ohm single-ended output, the necessary balanced output may be obtained by installing a matching network as shown on Figure No. 1 on page 4.

5. Connect the link on the A.G.C. terminal board between the center and inside (chassis) terminals to remove A.G.C. from the R.F. tube. See Figure No. 2.

After the preceding steps have been taken alignment is effected as shown on the R.F. Alignment Table. Adjustment of the two coil sections involved for any one channel are made simultaneously. The adjustments consist of varying the spacing between the turns of each coil and the coupling between the two coils. See Figure No. 9. for location of inductors. Note that two sets of frequencies are listed for the high frequency channel inductors. They should all be adjusted for either the odd or even channels; odd and even high-frequency channels cannot be intermixed.

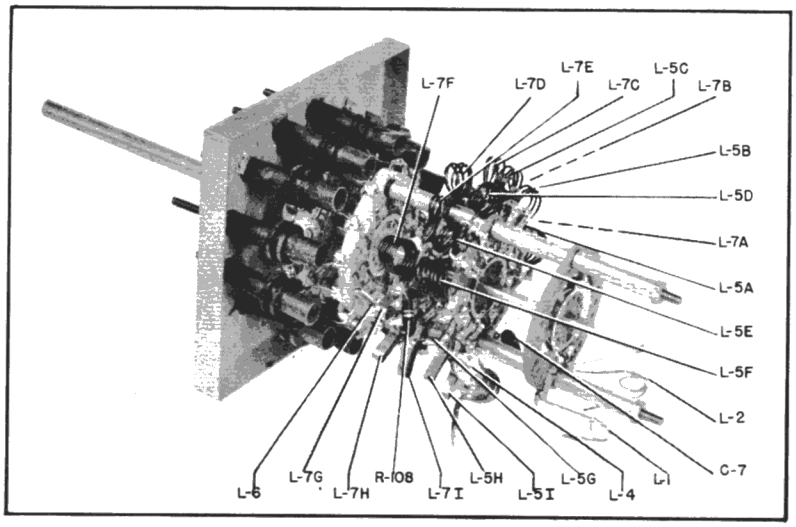

Figure No. 9. Detail of R.F. Unit Switch Assembly

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R.F. Alignment Table

Channel	Set Marker Generator At: Picture Carrier Mc.	Set Marker Generator At: Sound Carrier Mc.	Set Sweep Generator For:	Adjust	Response Curve
13 See Note A	211.25	215.75	12 Mc. width	L-4, L-6	
12 See Note B	205.25	209.75	12 Mc. width	L-4, L-6	
11 See Note A	199.25	203.75	12 Mc. width	L-5-I, L-7-I	
10 See Note B	193.25	197.75	12 Mc. width	L-5-I, L-7-I	
9 See Note A	187.25	191.75	12 Mc. width	L-5-H, L-7-H	
8 See Note B	181.25	185.75	12 Mc. width	L-5-H, L-7-H	

Note A: When aligning the Receiver to the odd high-frequency channels, namely channels 13, 11 and 9, do not perform the adjustments listed for channels 12, 10 and 8.

Note B: When aligning the Receiver to the even high-frequency channels, namely channels 12, 10 and 8, do not perform the adjustments listed for channels 13, 11 and 9.

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R.F. Alignment Table (continued)

Channel	Set Marker Generator At: Picture Carrier Mc.	Set Marker Generator At: Sound Carrier Mc.	Set Sweep Generator For:	Adjust	Response Curve
7	175.25	179.75	10 Mc. width	L-5-G, L-7-G	
6	83.25	87.75	10 Mc. width	L-5-F, L-7-F	
5	77.25	81.75	10 Mc. width	L-5-E, L-7-E	
4	67.25	71.75	10 Mc. width	L-5-D, L-7-D	
3	61.25	65.75	10 Mc. width	L-5-C, L-7-C	
2	55.25	59.75	10 Mc. width	L-5-B, L-7-B	
1	45.25	49.75	10 Mc. width	L-5-A, L-7-A	

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5-5. *Local Oscillator Alignment*

Alignment is effected as follows:

1. Loosely couple the probe of the heterodyne frequency meter to the local oscillator in the Receiver.

2. Turn the Receiver On and adjust the inductors listed on the Alignment Table to obtain a local oscillator frequency the same as that listed for the setting of the frequency meter.

The oscillator tuning inductors are accessible after removal of the cabinet. See Figure No. 10 for identification of the inductors. Note that two possible frequencies are listed for L-8, L-16 and L-17, the high-frequency channel inductors. As is the case in R.F. alignment they should all be adjusted for either the odd or even channels; odd and even high-frequency channels cannot be intermixed.

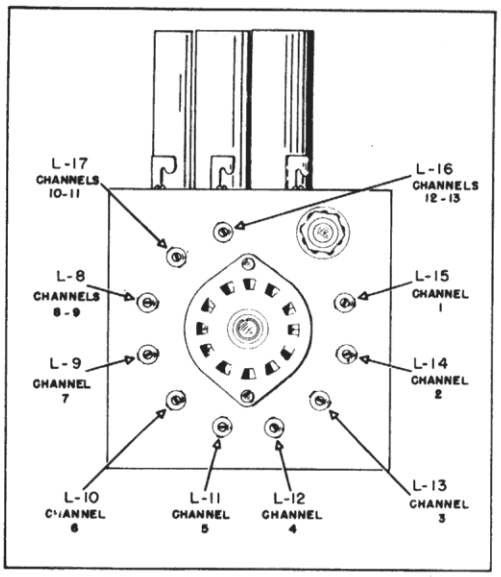

Figure No. 10. Local Oscillator Adjustments

Local Oscillator Alignment Table

Channel	Set Station Selector Switch At Channel:	Set Heterodyne Frequency Meter At:	Adjust
1	1	82.55 Mc.	L-15
2	2	92.55 Mc.	L-14
3	3	98.55 Mc.	L-13
4	4	104.55 Mc.	L-12
5	5	114.55 Mc.	L-11
6	6	120.55 Mc.	L-10
7	7	141.25 Mc.	L-9
8 See Note B	8-9	147.25 Mc.	L-8
9 See Note A	8-9	153.25 Mc.	L-8
10 See Note B	10-11	159.25 Mc.	L-17
11 See Note A	10-11	165.25 Mc.	L-17
12 See Note B	12-13	171.25 Mc.	L-16
13 See Note A	12-13	177.25 Mc.	L-16

Note A: When aligning the Receiver to the odd high-frequency channels, namely channels 13, 11 and 9 do not perform the adjustments listed for channels 12, 10 and 8.

Note B: When aligning the Receiver to the even high-frequency channels, namely channels 12, 10 and 8, do not perform the adjustments listed for channels 13, 11 and 9.

5-6. *Adjustment of Non-Operating Controls*

The adjustment of the non-operating controls is effected in the following manner and sequence. All controls are accessible from the rear of the cabinet except the Horizontal Linearity Control, C-87, and High Voltage Output adjustment, C-67. The latter, C-67, is accessible after removal of the back of the cabinet, see Figure No. 2, the former, C-87, is accessible after removal of the button plug at the bottom of the cabinet.

Step 1. Set the Horizontal Size control, R-99, and the Horizontal Linearity control, C-87 for the largest size picture consistent with good linearity.

Step 2. Adjust the High Voltage Output adjustment, C-67, for the correct horizontal size. Two settings of C-67 will give the correct picture size, but by using the setting on the low capacity side of resonance, the plate current of the 12AU7 will be lower resulting in longer tube life. To do so, adjust C-67 for resonance (indicated by smallest size picture) and then rotate C-67 in a counterclockwise direction for the correct size picture.

Step 3. Adjust the Vertical Size control, R-82, for the correct vertical size.

Step 4. Adjust the Horizontal Centering, R-74, and Vertical Centering, R-75, controls to center the picture horizontally and vertically.

Step 5. Adjust the Focus control, R-65, to bring the picture into proper focus.

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SECTION 6. SERVICE DATA

6-1. *Service Data*

The data in this section is presented to aid the technician in the event servicing of the NC-TV 7 is required. Contained herein is a Trouble Shooting Chart and tube socket to chassis. voltage readings. A normal test pattern is shown in Figure No. 11.

Note: Care should be exercised to make sure that the peaking coils and coupling capacitors in the video circuits are kept up and away from the chassis in the event their position is changed.

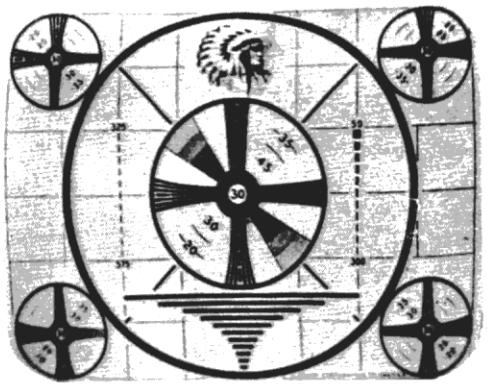
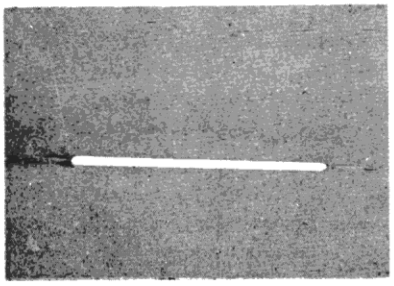
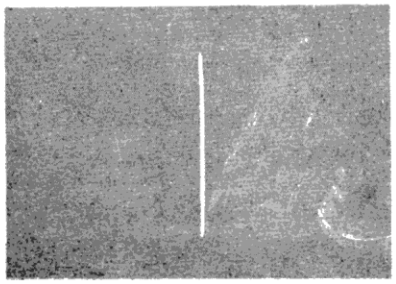


Figure No. 11. Normal Test Pattern

Trouble Shooting Chart

Trouble	Probable Cause
No raster, sound normal	1. Check H.V. power supply output by measuring voltage from junction of high voltage output lead and R-71 to chassis. Normal reading is approximately 4500 volts. 2. Check voltage between grid and cathode of picture tube. May be measured between pin 2 of V-11 and junction of C-34 and R-41. Normal reading is approximately 50 volts with the Contrast control fully clockwise. 3. Check picture tube, V-22. 4. Check socket voltages of picture tube V-22.
No vertical sweep 	1. Check tubes V-12 and V-13. 2. Check socket voltages of tubes V-12, V-13 and V-22. 3. Check capacitors C-81, C-77 and C-74.
No horizontal sweep 	1. Check tubes V-14 and V-15. 2. Check socket voltages of tubes V-14, V-15 and V-22. 3. Check capacitors C-88, C-89, C-86, and C-84.

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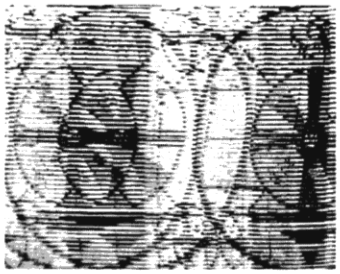
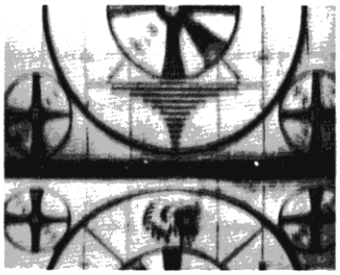
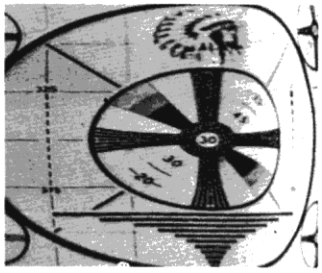
Trouble Shooting Chart (continued)

Trouble	Probable Cause
Raster and sound normal--no picture.	1. Check tubes V-8 and V-11. 2. Check socket voltages of tubes V-8 and V-11. 3. Check capacitors C-34, C-33, C-35, C-36. 4. Check I.F. Alignment.
No sound--raster and picture normal.	1. Check tubes V-9, V-10, V-18 and V-19. 2. Check socket voltages of above tubes. 3. Check audio output circuits by connecting an audio signal to junction of C-45 and R-47. Set the Volume control full On. 4. Check sound system alignment.
No horizontal sync 	1. Check tube V-11 and socket voltages. 2. Check horizontal sweep oscillator circuit by checking tube V-15 and all associated components. 3. Check capacitors C-36, C-83 and resistor R-93.
No vertical sync 	1. Check tube V-11 and socket voltages. 2. Check vertical sweep oscillator circuit by checking tube V-13 and all associated components. 3. Check capacitors C-36, C-72, C-73 and resistors R-76, R-78.
Improper horizontal linearity 	1. Check setting of Horizontal Linearity control, C-87. 2. Check tubes V-14, V-15 and associated components. 3. Check capacitors C-88 and C-89. 4. Check for correct setting of controls affecting horizontal size--R-99 and C-67. See steps 1 and 2 of Section 5-6. 5. Check H.V. power supply output by measuring voltage from junction of high voltage output lead and R-71 to chassis. Normal reading is approximately 4500 volts.

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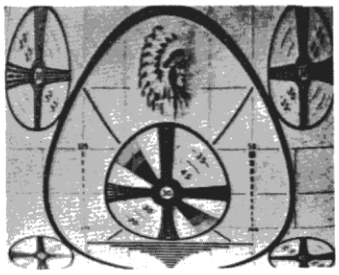
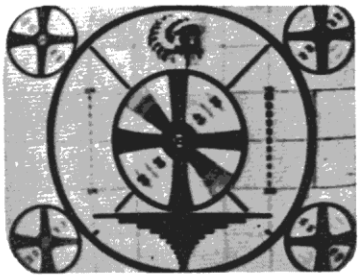
Trouble Shooting Chart (continued)

Trouble	Probable Cause
Improper vertical linearity 	1. Check tubes V-12, V-13 and associated components. 2. Check capacitors C-76 and C-78 for leakage. 3. Check capacitors C-81 and C-82. 4. Check setting of Vertical Size control, R-82. 5. Check H.V. power supply output by measuring voltage from junction of high voltage output lead and R-71 to chassis. Normal reading is approximately 4500 volts.
Small raster	1. Check tubes V-16 and V-17. 2. Check capacitors C-61A, C-61B and C-75A.
Picture stable but detail poor 	1. Check tubes V-7, V-8 and V-11. 2. Check d.c. resistance of peaking coils L-25, L-26, L-27 and L-28. Normal resistance of L-25 is 4 ohms, L-26--11 ohms, L-27--4.5 ohms and L-28--6.5 ohms. 3. Check the range of the Focus control, R-65, by ascertaining that the control operates on either side of the correct setting. 4. Check the ohmic value of resistors in the high voltage divider network, which includes R-63 through R-75. 5. Check R.F. and I.F. alignment. 6. Check setting of Fine Tuning control.
Picture unstable	1. Check setting of Contrast control, R-30, to make sure it is not advanced too far. 2. Check grid bias of video amplifier V-8, by measuring voltage across pins 1 and 7. Normal bias voltage is approximately 1.5 volts regardless of the Contrast control setting. 3. Check delay voltage on A.G.C. diode, V-7, by measuring voltage between pin 5 and chassis. Normal delay voltage is approximately 3 volts. 4. Loose connections in the receiver or in the external antenna system may cause instability. Also, strong noise pulses may produce this condition. 5. The transmitter may be at fault, check by tuning to another station.

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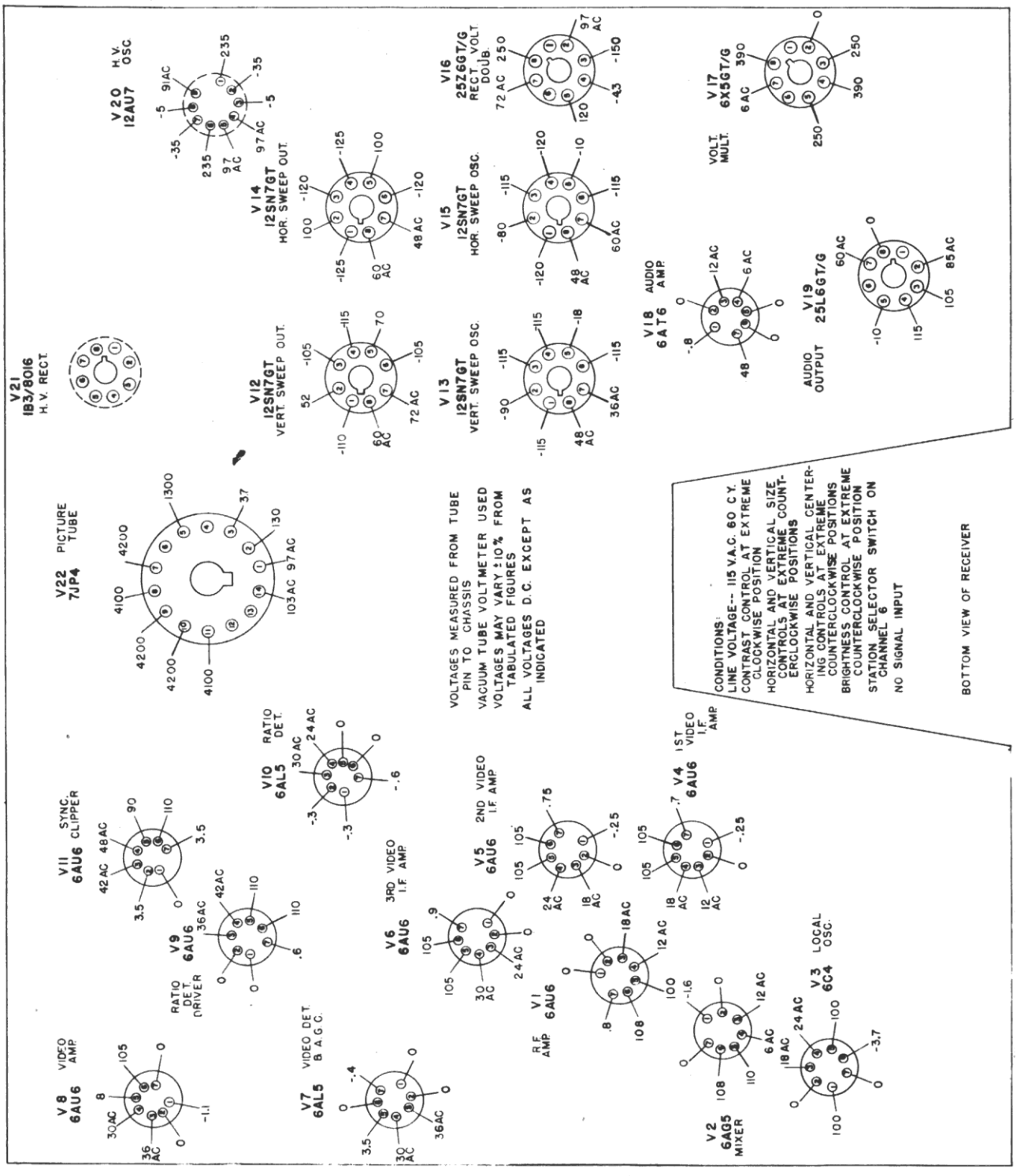

Figure No. 12. Tube Socket Voltages

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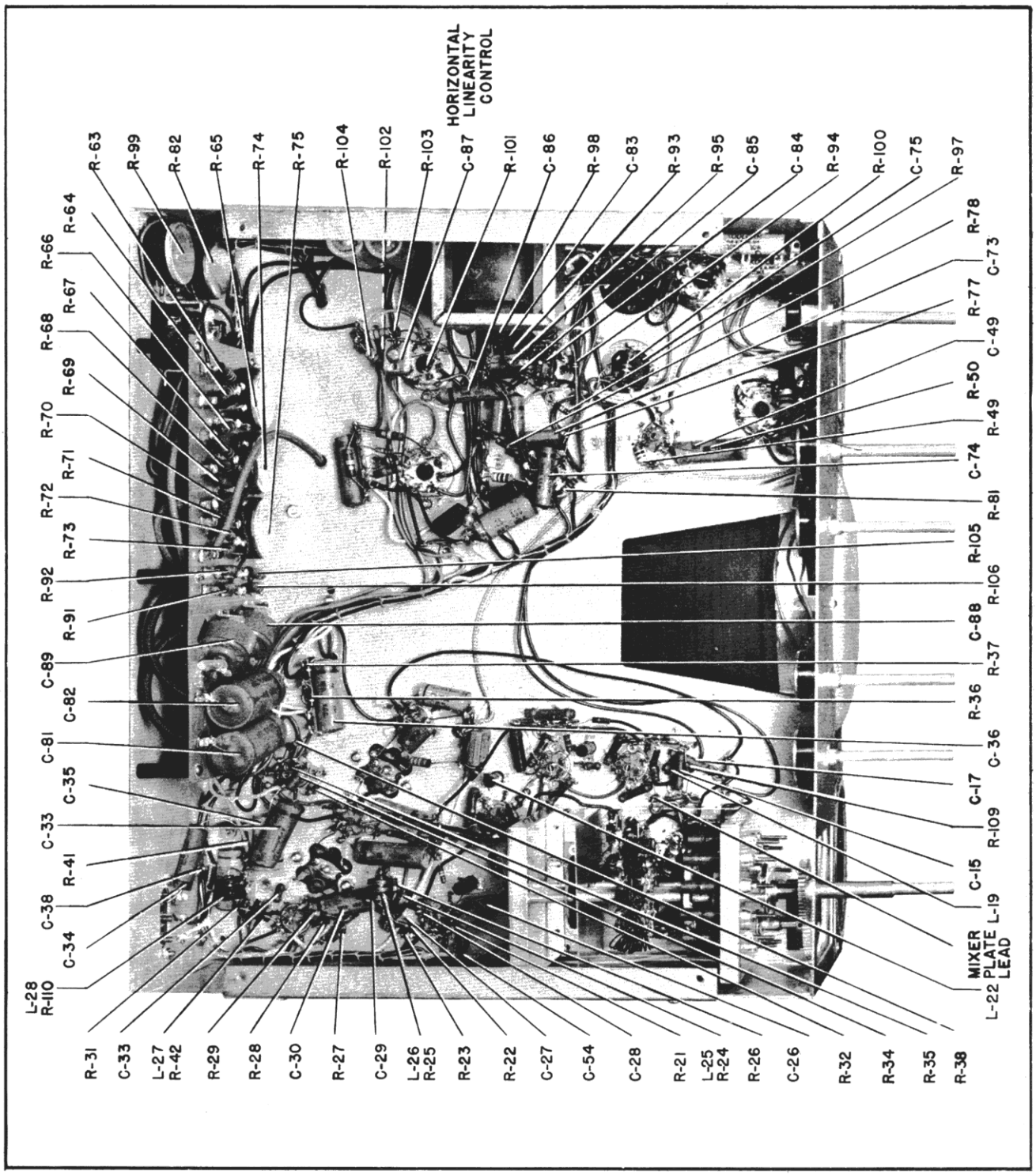

Figure No. 13. Bottom View of Receiver (cabinet removed)

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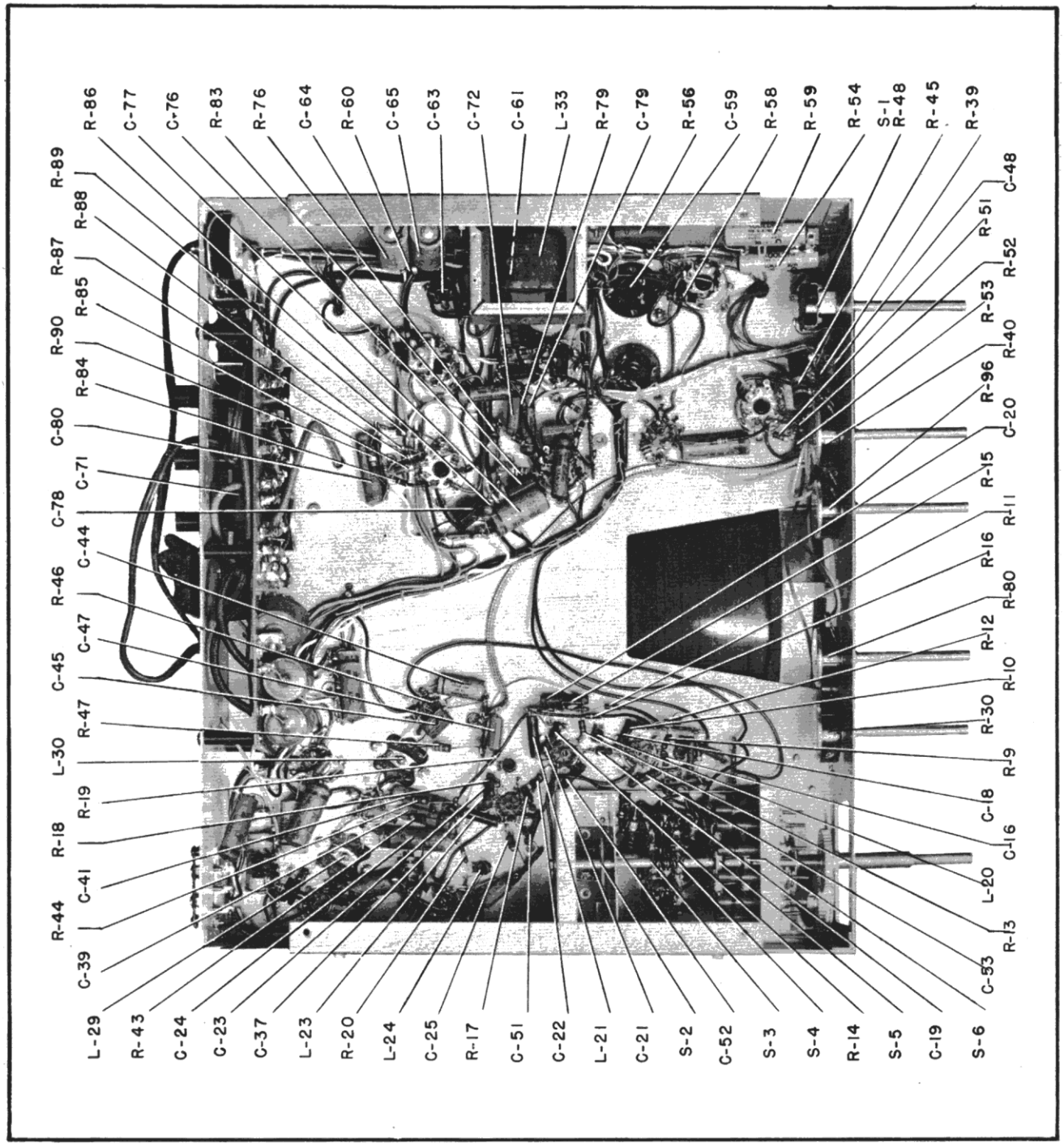

Figure No. 14. Bottom View of Receiver (cabinet removed)

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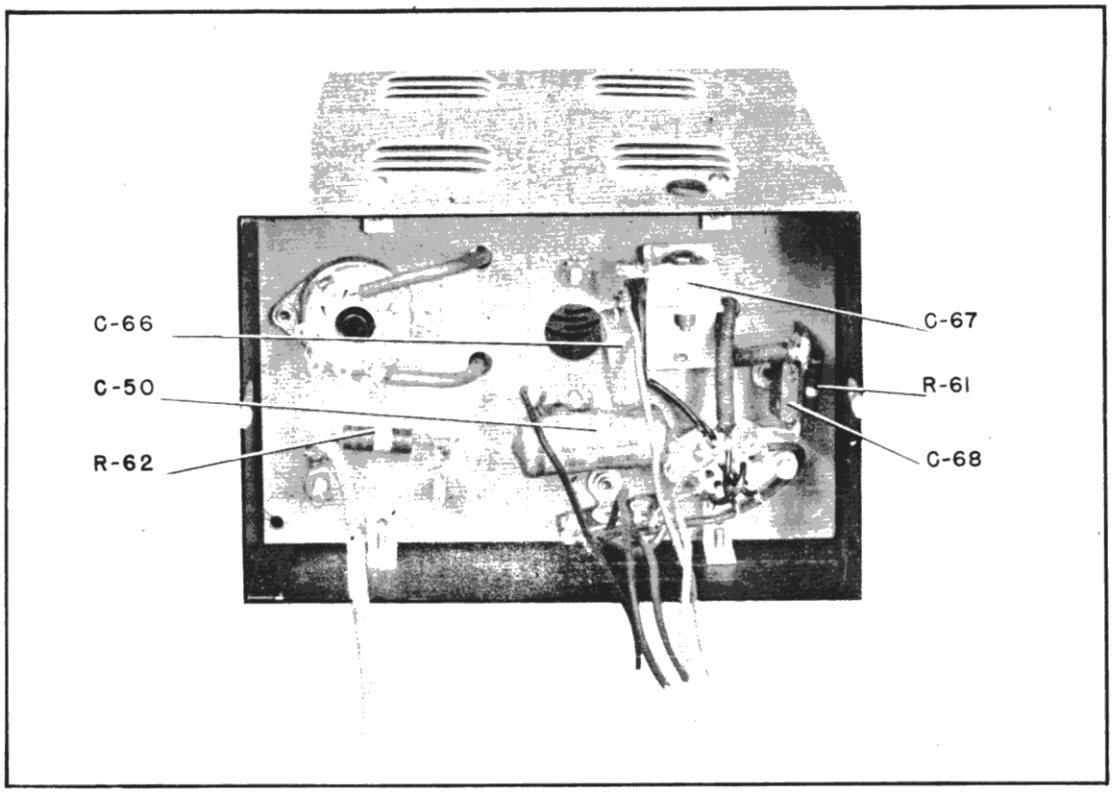

Figure No. 15. Bottom View of H.V. Power Supply Compartment (removed from chassis)

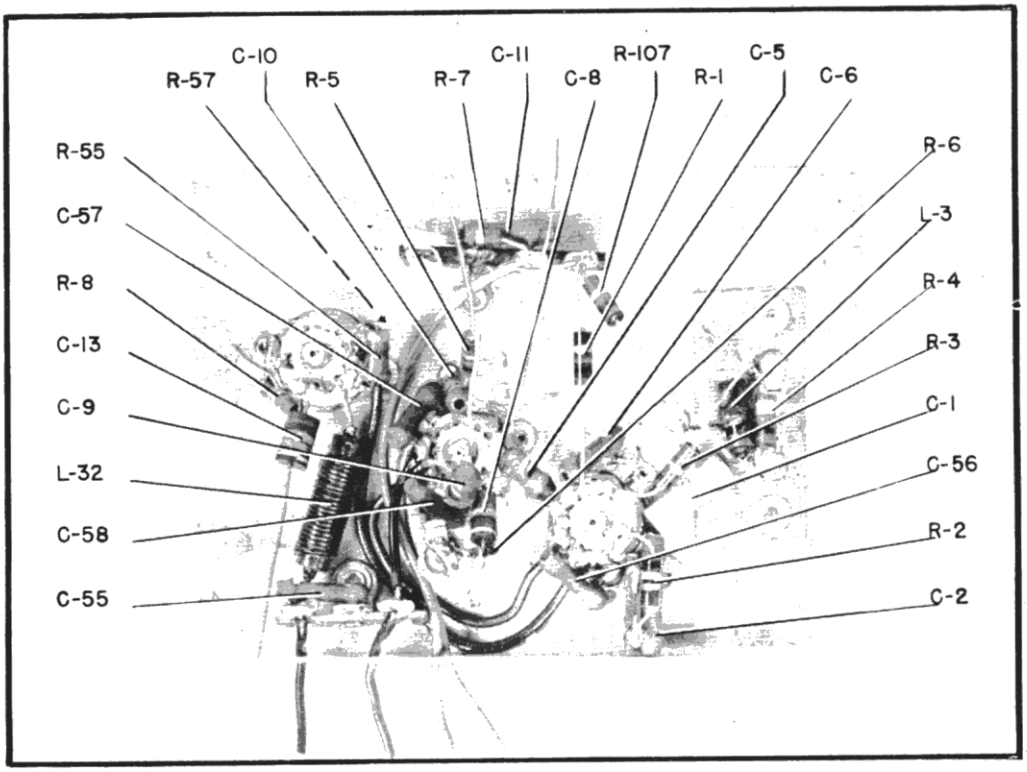

Figure No. 16. Bottom View of R.F. Unit (switch assembly removed)

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PARTS LIST

Symbol	Description	National Co. Type
	CAPACITORS	
C-1	Ceramic, 100 mmf., ±10%, 500 vdcw	
C-2	Ceramic, 0.005 mfd., 450 vdcw	
C-3	Mica, 470 mmf., ±10%, 500 vdcw	
C-4	Mica, 470 mmf., ±10%, 500 vdcw	
C-5	Ceramic, 1 mmf., ±10%, 500 vdcw	
C-6	Ceramic, 360 mmf., 500 vdcw	
C-7	Ceramic, 360 mmf., 500 vdcw	
C-8	Ceramic, 22 mmf., ±10%, 500 vdcw	
C-9	Ceramic, 1 mmf., ±10%, 500 vdcw	
C-10	Ceramic, 360 mmf., 500 vdcw	
C-11	Ceramic, 360 mmf., 500 vdcw	
C-12	Not Used	
C-13	Ceramic, 25 mmf., ±10%, 500 vdcw	
C-14	Variable (Special)	SA:4980
C-15	Ceramic, 0.005 mfd., 450 vdcw	
C-16	Ceramic, 100 mmf., ±10%, 500 vdcw	
C-17	Ceramic, 1500 mmf., 500 vdcw	
C-18	Ceramic, 0.005 mfd., 450 vdcw	
C-19	Ceramic, 100 mmf., ±10%, 500 vdcw	
C-20	Ceramic, 1500 mmf., 500 vdcw	
C-21	Ceramic, 0.005 mfd., 500 vdcw	
C-22	Ceramic, 100 mmf., ±10%, 500 vdcw	
C-23	Ceramic, 0.005 mfd., 500 vdcw	
C-24	Paper, 0.25 mfd., 400 vdcw	
C-25	Mica, 100 mmf., ±10%, 500 vdcw	
C-26	Mica, 2200 mmf., ±10%, 500 vdcw	
C-27	Mica, 330 mmf., ±10%, 500 vdcw	
C-28	Ceramic, 5 mmf., ±1 mmf., 500 vdcw	
C-29	Ceramic, 10 mmf., ±10%, 500 vdcw	
C-30	Paper, 0.1 mfd., 400 vdcw	
C-31	Ceramic, 5 mmf., ±1 mmf., 500 vdcw	
C-32	Ceramic, 1 mmf., ±10%, 500 vdcw	
C-33	Paper, .1 mfd., 400 vdcw	
C-34	Paper, 0.25 mfd., 400 vdcw	
C-35	Elect., 10 mfd., 25 vdcw	
C-36	Paper, .05 mfd., 600 vdcw	
C-37	Paper, 0.005 mfd., 500 vdcw	
C-38	Paper, 0.1 mfd., 600 vdcw	
C-39	Paper, .02 mfd., 400 vdcw	
C-40	Ceramic, 10 mmf., ±10%, 500 vdcw	
C-41	Paper, .02 mfd., 400 vdcw	
C-42	Ceramic, 75 mmf., ±10%, 500 vdcw	
C-43	Not Used	
C-44	Paper, 1 mfd., 200 vdcw	
C-45	Mica, 330 mmf., ±10%, 500 vdcw	
C-46	Not Used	
C-47	Mica, 2200 mmf., ±10%, 500 vdcw	
C-48	Mica, 1500 mmf., ±10%, 500 vdcw	
C-49	Paper, 0.05 mfd., 600 vdcw	
C-50	Paper, .1 mfd., 600 vdcw	
C-51	Ceramic, 0.005 mfd., 500 vdcw	

Symbol	Description	National Co. Type
	CAPACITORS (continued)	
C-52	Ceramic, 0.005 mfd., 500 vdcw	
C-53	Ceramic, 0.005 mfd., 500 vdcw	
C-54	Ceramic, 0.005 mfd., 500 vdcw	
C-55	Ceramic, 400 mmf., 500 vdcw	
C-56	Ceramic, 400 mmf., 500 vdcw	
C-57	Ceramic, 400 mmf., 500 vdcw	
C-58	Ceramic, 400 mmf., 500 vdcw	
C-59	Elect., 40+40 mfd., 450 vdcw	
C-59A	Part of C-59	
C-59B	Part of C-59	
C-60	Not Used	
C-61	Elect. 50+50 mfd., 150 vdcw	
C-61A	Part of C-61	
C-61B	Part of C-61	
C-62	Not Used	
C-63	Elect., 50+50 mfd., 150 vdcw	
C-63A	Part of C-63	
C-63B	Part of C-63	
C-64	Elect., 30 mfd., 150 vdcw	
C-65	Elect., 30 mfd., 150 vdcw	
C-66	Mica, 510 mmf., ±5%, 500 vdcw	
C-67	Variable Mica, 400-1100 mmf	
C-68	Mica, 220 mmf., ±10%, 500 vdcw	
C-69	Ceramic, 500 mmf., 10,000 vdcw	
C-70	Ceramic, 500 mmf., 10,000 vdcw	
C-71	Paper, .1 mfd., 400 vdcw	
C-72	Mica, 4700 mmf., ±10%, 500 vdcw	
C-73	Mica, 4700 mmf., ±10%, 500 vdcw	
C-74	Paper, .01 mfd., 600 vdcw	
C-75	Elect. 40+40 mfd., 450 vdcw	
C-75A	Part of C-75	
C-75B	Part of C-75	
C-76	Mica, 1500 mmf., ±10%, 800 vdcw	
C-77	Paper, .25 mfd., 400 vdcw	
C-78	Mica, 1500 mmf., ±10%, 800 vdcw	
C-79	Paper, .01 mfd., 600 vdcw	
C-80	Paper, .02 mfd., 600 vdcw	
C-81	Paper, .005 mfd., 5000 vdcw	
C-82	Paper, .005 mfd., 5000 vdcw	
C-83	Mica, 220 mmf., ±10%, 500 vdcw	
C-84	Mica, 100 mmf., ±10%, 500 vdcw	
C-85	Mica, 100 mmf., ±10%, 500 vdcw	
C-86	Paper, .01 mfd., 600 vdcw	
C-87	Variable Mica, 3.5-35 mmf	
C-88	Ceramic, 500 mmf., 10,000 vdcw	
C-89	Ceramic, 500 mmf., 10,000 vdcw	
	RESISTORS	
R-1	1,000 ohms, ±10%, 1/2 watt	
R-2	100,000 ohms, ±10%, 1/2 watt	
R-3	100 ohms, ±10%, 1/2 watt	
R-4	1000 ohms, ±10%, 1/2 watt	

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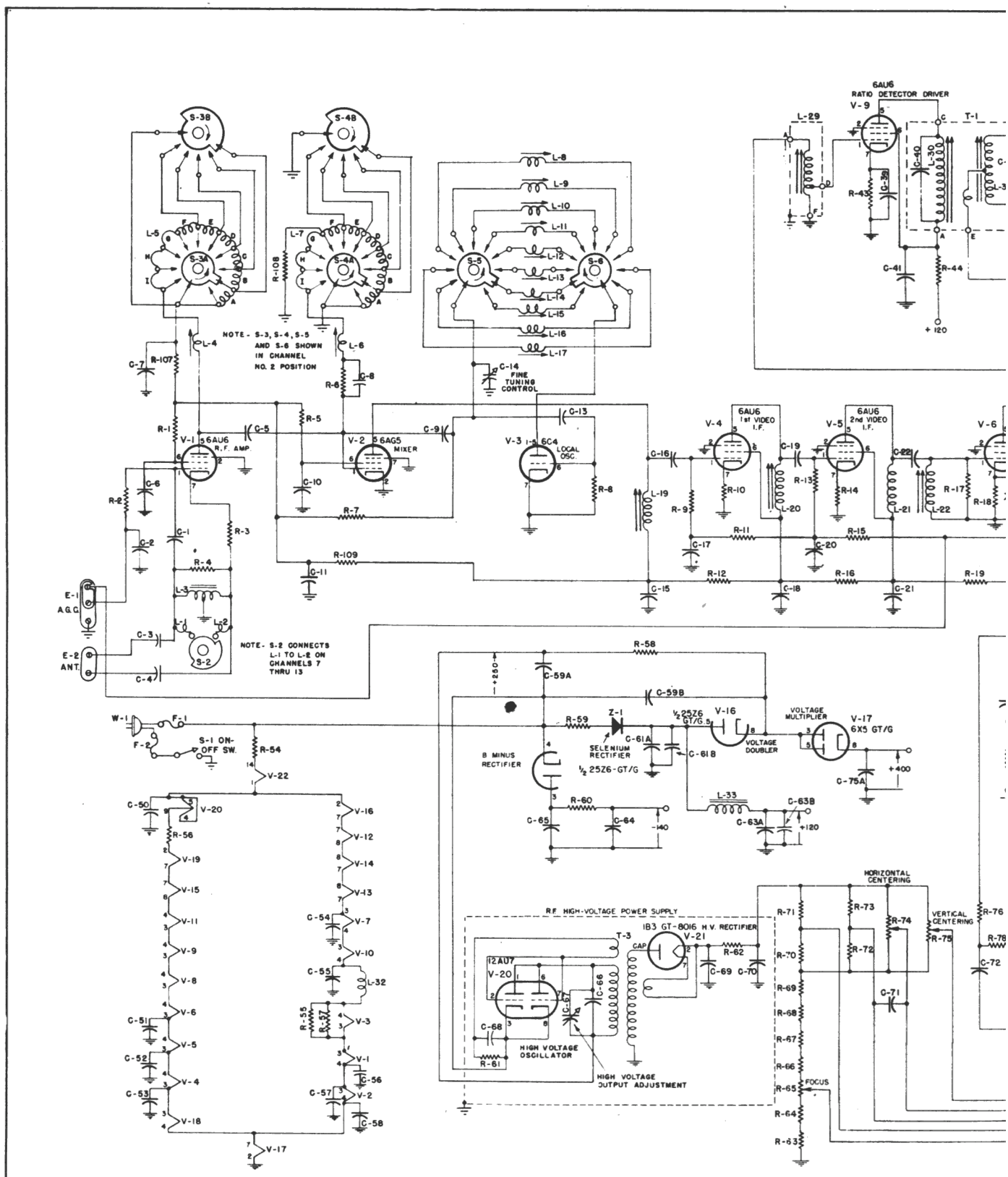
6AU6
RATIO DETECTOR DRIVER
V-9
L-29
T-1
R-43
C-41
R-44
+120
S-3B
S-4B
S-3A
S-4A
L-5
L-7
R-108
L-8
L-9
L-10
L-11
L-12
L-13
L-14
L-15
L-16
L-17
S-5
S-6
NOTE - S-3, S-4, S-5 AND S-6 SHOWN IN CHANNEL NO. 2 POSITION
L-4
L-6
C-7
R-107
C-8
R-6
C-14
FINE TUNING CONTROL
R-1
V-1 6AU6 R.F. AMP
C-5
R-5
C-9
V-2 6AG5 MIXER
V-3 6C4 LOCAL OSC.
C-13
R-8
C-10
R-7
R-2
C-6
C-1
R-3
C-2
R-4
R-109
C-11
L-3
L-1
L-2
S-2
E-1 A.G.C.
E-2 ANT.
C-3
C-4
NOTE - S-2 CONNECTS L-1 TO L-2 ON CHANNELS 7 THRU 13
V-4 6AU6 1st VIDEO I.F.
V-5 6AU6 2nd VIDEO I.F.
V-6
C-16
L-19
R-9
R-10
C-19
L-20
R-13
R-14
C-22
L-21
L-22
R-17
R-18
C-17
R-11
C-20
R-15
C-15
R-12
C-18
R-16
C-21
R-19
W-1
F-1
F-2
S-1 ON-OFF SW.
R-54
V-22
C-50
V-20
R-56
V-19
V-15
V-11
V-9
V-8
V-6
V-5
V-4
V-18
V-17
V-16
V-12
V-14
V-13
V-7
V-10
L-32
V-3
V-1
V-2
C-51
C-52
C-53
C-54
C-55
R-55
R-57
C-56
C-57
C-58
+250
R-58
C-59A
C-59B
R-59
Z-1
SELENIUM RECTIFIER
½ 25Z6 GT/G
C-61A
C-61B
V-16
VOLTAGE DOUBLER
VOLTAGE MULTIPLIER
V-17 6X5 GT/G
+400
C-75A
B MINUS RECTIFIER
R-60
C-65
C-64
-140
L-33
C-63B
C-63A
+120
R.F. HIGH-VOLTAGE POWER SUPPLY
1B3 GT-8016 H.V. RECTIFIER
V-21
T-3
CAP
R-62
C-69
C-70
12AU7
V-20
C-66
C-68
R-61
HIGH VOLTAGE OSCILLATOR
HIGH VOLTAGE OUTPUT ADJUSTMENT
HORIZONTAL CENTERING
VERTICAL CENTERING
R-71
R-73
R-74
R-75
R-76
R-70
R-72
C-72
R-69
C-71
R-68
R-67
R-66
R-65
FOCUS
R-64
R-63

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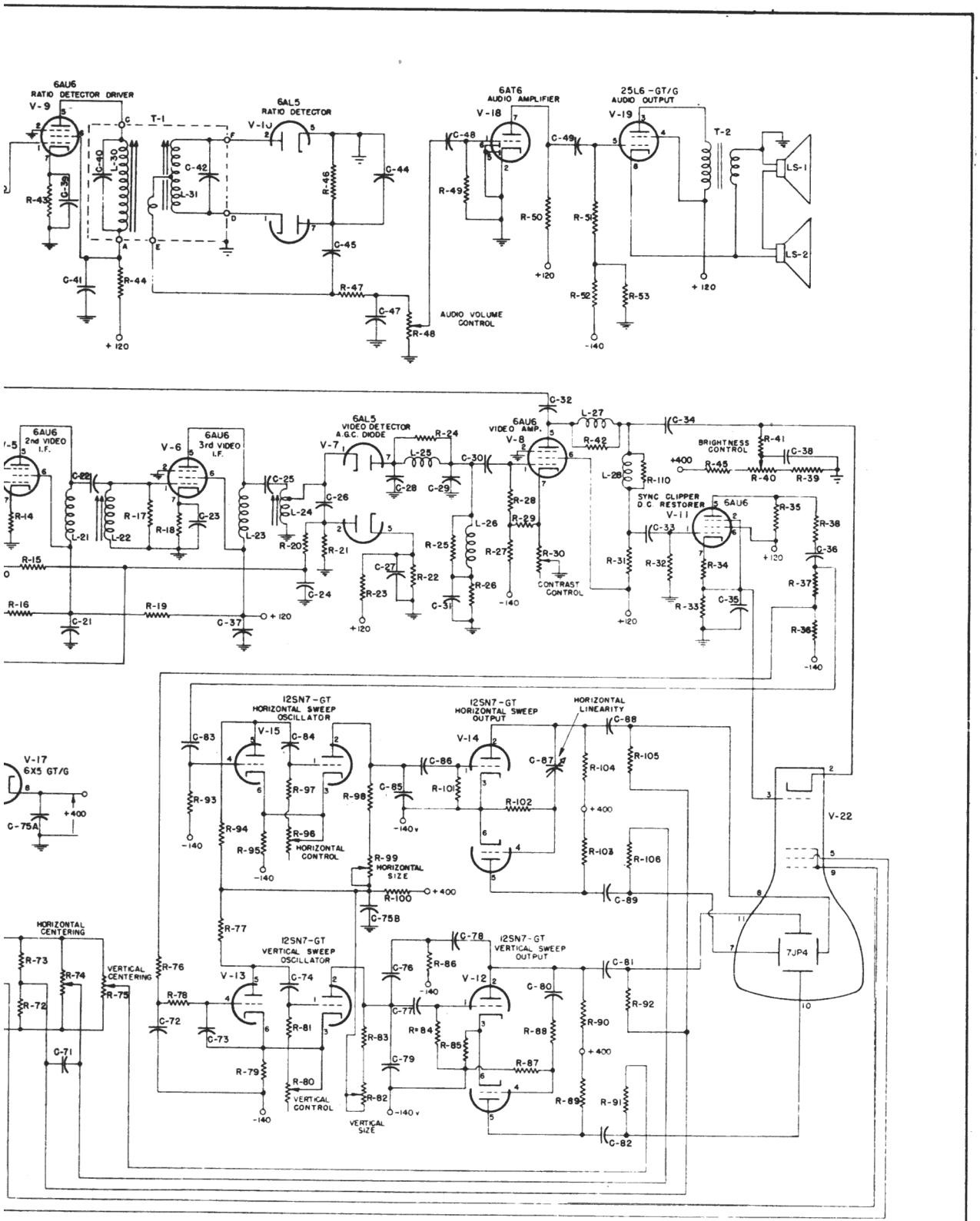
NAL COMPANY, INC.

MODELS NC-TV7,
NC-TV7M



PARTS LIST (Continued)

Symbol	Description	National Co. Type
	RESISTORS (continued)	
R-5	1000 ohms, ±10%, 1/2 watt	
R-6	1,000,000 ohms, ±10%, 1/2 watt	
R-7	2200 ohms, ±10%, 1 Watt	
R-8	18,000 ohms, ±10%, 1/2 Watt	
R-9	10,000 ohms, ±5%, 1/2 watt	
R-10	82 ohms, ±10%, 1/2 watt	
R-11	120 ohms, ±10%, 1/2 watt	
R-12	100 ohms, ±10%, 1/2 watt	
R-13	10,000 ohms, ±5%, 1/2 watt	
R-14	82 ohms, ±10%, 1/2 watt	
R-15	120 ohms, ±10%, 1/2 watt	
R-16	100 ohms, ±10%, 1/2 watt	
R-17	10,000 ohms, ±5%, 1/2 watt	
R-18	82 ohms, ±10%, 1/2 watt	
R-19	100 ohms, ±10%, 1/2 watt	
R-20	560,000 ohms, ±10%, 1/2 watt	
R-21	22,000 ohms, ±10%, 1/2 watt	
R-22	2,700 ohms, ±10%, 1/2 watt	
R-23	100,000 ohms, ±10%, 1/2 watt	
R-24	33,000 ohms, ±5%, 1 watt	
R-25	8,200 ohms, ±5%, 1 watt	
R-26	8,200 ohms, ±10%, 1/2 watt	
R-27	1,000,000 ohms, ±10%, 1/2 watt	
R-28	1,000,000 ohms, ±10%, 1/2 watt	
R-29	10,000 ohms, ±10%, 1/2 watt	
R-30	Variable, 1,000 ohms, ±10%	K915-1
R-31	6,800 ohms, ±10%, 1/2 watt	
R-32	1,000,000 ohms, ±10%, 1/2 watt	
R-33	22,000 ohms, ±10%, 1/2 watt	
R-34	270 ohms, ±10%, 1/2 watt	
R-35	220,000 ohms, ±10%, 1/2 watt	
R-36	560 ohms, ±10%, 1/2 watt	
R-37	560 ohms, ±10%, 1/2 watt	
R-38	180,000 ohms, ±10%, 1/2 watt	
R-39	15,000 ohms, ±10%, 1/2 watt	
R-40	Variable, 25,000 ohms	K915-6
R-41	150,000 ohms, ±10%, 1/2 watt	
R-42	33,000 ohms, ±5%, 1 watt	
R-43	82 ohms, ±10%, 1/2 watt	
R-44	470 ohms, ±10%, 1/2 watt	
R-45	68,000 ohms, ±10%, 2 watt	
R-46	33,000 ohms, ±10%, 1/2 watt	
R-47	33,000 ohms, ±10%, 1/2 watt	
R-48	Variable and switch, 1,000,000 ohms	K347-2
R-49	8,200,000 ohms, ±10%, 1/2 watt	
R-50	390,000 ohms, ±10%, 1/2 watt	
R-51	270,000 ohms, ±10%, 1/2 watt	
R-52	47,000 ohms, ±10%, 1/2 watt	
R-53	4,700 ohms, ±10%, 1/2 watt	
R-54	20 ohms, ±5%, 10 watts	
R-55	82 ohms, ±10%, 1/2 watt	
R-56	40 ohms, ±5%, 5 watts	
R-57	82 ohms, ±10%, 1/2 watt	
R-58	680 ohms, ±10%, 2 watts	
R-59	20 ohms, ±5%, 5 watts	
R-60	1200 ohms, ±10%, 1 watt	
R-61	8,200 ohms, ±10%, 1/2 watt	
R-62	120,000 ohms, ±10%, 1 watt	
R-63	3,900,000 ohms, ±10%, 1 watt	
R-64	3,900,000 ohms, ±10%, 1 watt	
R-65	Variable, 5,000,000 ohms	K915-4
R-66	4,700,000 ohms, ±10%, 1 watt	
R-67	4,700,000 ohms, ±10%, 1 watt	
R-68	3,300,000 ohms, ±10%, 1 watt	
R-69	3,300,000 ohms, ±10%, 1 watt	
R-70	1,800,000 ohms, ±10%, 1 watt	
R-71	1,800,000 ohms, ±10%, 1 watt	
R-72	2,700,000 ohms, ±10%, 1 watt	
R-73	2,700,000 ohms, ±10%, 1 watt	
R-74	Variable, 5,000,000 ohms	K915-4
R-75	Variable, 5,000,000 ohms	K915-4
R-76	4,700 ohms, ±10%, 1/2 watt	
R-77	100,000 ohms, ±10%, 1/2 watt	
R-78	4,700 ohms, ±10%, 1/2 watt	
R-79	1,000 ohms, ±10%, 1/2 watt	
R-80	Variable, 1,000,000 ohms	K915-3
R-81	470,000 ohms, ±10%, 1/2 watt	
R-82	Variable, 10,000,000 ohms	K915-5
R-83	10,000,000 ohms, ±10%, 1/2 watt	
R-84	4,700,000 ohms, ±10%, 1/2 watt	
R-85	15,000 ohms, ±10%, 1/2 watt	
R-86	1,800,000 ohms, ±10%, 1/2 watt	
R-87	150,000 ohms, ±10%, 1/2 watt	
R-88	2,200,000 ohms, ±10%, 1/2 watt	
R-89	820,000 ohms, ±10%, 1/2 watt	
R-90	820,000 ohms, ±10%, 1/2 watt	
R-91	2,700,000 ohms, ±10%, 1 watt	
R-92	2,700,000 ohms, ±10%, 1 watt	
R-93	4,700 ohms, ±10%, 1/2 watt	
R-94	100,000 ohms, ±10%, 1/2 watt	
R-95	1,000 ohms, ±10%, 1/2 watt	
R-96	Variable, 250,000 ohms	K915-2
R-97	220,000 ohms, ±10%, 1/2 watt	
R-98	1,200,000 ohms, ±10%, 1/2 watt	
R-99	Variable, 5,000,000 ohms	K915-4
R-100	10,000 ohms, ±10%, 1 watt	
R-101	4,700,000 ohms, ±10%, 1/2 watt	
R-102	4,700,000 ohms, ±10%, 1/2 watt	
R-103	47,000 ohms, ±10%, 2 watts	
R-104	47 000 ohms, ±10%, 1 watt	
R-105	2,700,000 ohms, ±10%, 1 watt	
R-106	2,700,000 ohms, ±10%, 1 watt	

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MODELS NC-TV7, NC-TV7M

NATIONAL COMPANY, INC.

PARTS LIST (Continued)

Symbol	Description	National Co. Type
	RESISTORS (continued)	
R-107	1,000 ohms, ±10%, 1/2 watt	
R-108	3,900 ohms, ±10%, 1/2 watt	
R-109	100 ohms, ±10%, 1/2 watt	
R-110	1,000,000 ohms, ±5%, 1 watt	
	MISCELLANEOUS	
E-1	AGC Terminal Board	E261-5
E-2	Antenna Input Terminal Panel	E265-18
F-1	Fuse, 2 Amp., 250 volts	
F-2	Fuse, 2 Amp., 250 volts	
L-1	Antenna Coupling Coil	K930-1
L-2	Antenna Coupling Coil	K930-2
L-3	Antenna Coupling Iron-Core Coil	SA5056
L-4	Adjustable Brass-Core Coil	SA5059-2
L-5	Multi-tapped coil	SA5055 & K908-1
L-6	Adjustable iron-core coil	SA5059-1
L-7	Multi-tapped coil	SA5060 & K908-1
L-8	Adjustable iron-core coil	SA5054-8
L-9	Adjustable iron-core coil	SA5054-7
L-10	Adjustable iron-core coil	SA5054-4
L-11	Adjustable iron-core coil	SA5054-6
L-12	Adjustable iron-core coil	SA5054-3
L-13	Adjustable iron-core coil	SA5054-2
L-14	Adjustable iron-core coil	SA5054-2
L-15	Adjustable iron-core coil	SA5054-1
L-16	Adjustable iron-core coil	SA5054-5
L-17	Adjustable iron-core coil	SA5054-9
L-18	Not Used.	
L-19	Adjustable iron-core coil	SA5002
L-20	Adjustable iron-core coil	SA5002
L-21	Choke coil	SA5069
L-22	Adjustable iron-core coil	SA5002
L-23	Choke coil	SA5069
L-24	Adjustable iron-core tapped coil	SA5003
L-25	Peaking coil	SA5065
L-26	Peaking coil	SA5066
L-27	Peaking coil	SA5067
L-28	Peaking coil	SA5068
L-29	Adjustable iron-core coil	SA:4950
L-30	Adjustable iron-core coil	Part of T-1
L-31	Adjustable iron-core coil	Part of T-1
L-32	Oscillator Filament choke	SA5057
L-33	Filter choke	K927-1
S-1	S.P.S.T. Switch	Part of R-48
S-2	Rotary Switch Wafer, D.P.S.T.	K888-1
S-3	Rotary Switch Wafer, 2 pole, 10 position	K900-1

Symbol	Description	National Co. Type
	MISCELLANEOUS (continued)	
S-3A	S.P. 10 position	Part of S-3
S-3B	S.P. 10 position	Part of S-3
S-4	Rotary Switch Wafer, 2 pole 10 position	K900-1
S-4A	S.P. 10 position	Part of S-4
S-4B	S.P. 10 position	Part of S-4
S-5	Rotary Switch Wafer, S.P. 10 position	K889-1
S-6	Rotary Switch Wafer, S.P. 10 position	K889-1
T-1	Discriminator Trans.	SA4997
T-2	Audio Output Trans.	Part of LS-2
T-3	High Voltage Inductor, 5 kv.	K890-1
V-1	6AU6, R.F. Amp.	
V-2	6AG5, Mixer	
V-3	6C4, Local Oscillator	
V-4	6AU6, 1st. Video I.F. Amp.	
V-5	6AU6, 2nd. Video I.F. Amp.	
V-6	6AU6, 3rd. Video I.F. Amp.	
V-7	6AL5, Video Det--AGC Diode	
V-8	6AU6, Video Amp.	
V-9	6AU6, Ratio Detector Driver	
V-10	6AL5, Ratio Detector	
V-11	6AU6, Sync Clipper - D.C. Restorer	
V-12	12SN7GT, Vertical Sweep Output	
V-13	12SN7GT, Vertical Sweep Oscillator	
V-14	12SN7GT, Horizontal Sweep Output	
V-15	12SN7GT, Horizontal Sweep Osc.	
V-16	25Z6GT/G, Voltage Doubler-B Minus Rectifier	
V-17	6X5GT/G, Voltage Multiplier	
V-18	6AT6, Audio Amplifier	
V-19	25L6GT/G, Audio Output	
V-20	12AU7, High Voltage Oscillator	
V-21	1B3GT-8016, High Voltage Rectifier	
V-22	7JP4, Picture Tube	
W-1	Two-wire A.C. cable with plug	E544-1
Z-1	Selenium Rectifier, 200 ma.	
LS-1	6" Oval Loud-speaker	K892-2
LS-2	6" Oval Loud-speaker with matching transformer	K892-1

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