MODELS CT270, CT271, CT272, CT273, CT274, CT275, CT276, CT277, CT278, CT279, CT280, CT281, CT282

INDEX

SECTION I

Features & Specifications

Magnavox television chassis CT 270, 271, 272, 273, 274 and 275 are 20 tube chassis. The CT 270, 272 and 274 include audio amplifiers and a speaker. The CT 271, 273 and 275 uses no audio amplifier or speaker, but is used in combination with a radio chassis audio system. However, as the audio output stage also acts as a voltage regulator, it appears in all models. All include direct viewing picture tubes. Special features are:

* Capacity coupled video amplifier.
* Intercarrier I F amplifiers for ease of alignment, simplified tuning, increased stability and freedom from the effect of oscillator drift.
* Automatic Gain Control.
* Magnalok type horizontal frequency control.
* Blocking oscillator type vertical scanning.
* Ratio detector sound detector.
* Cathode modulation of picture tube.
* Common chassis - ground and B-

General Description

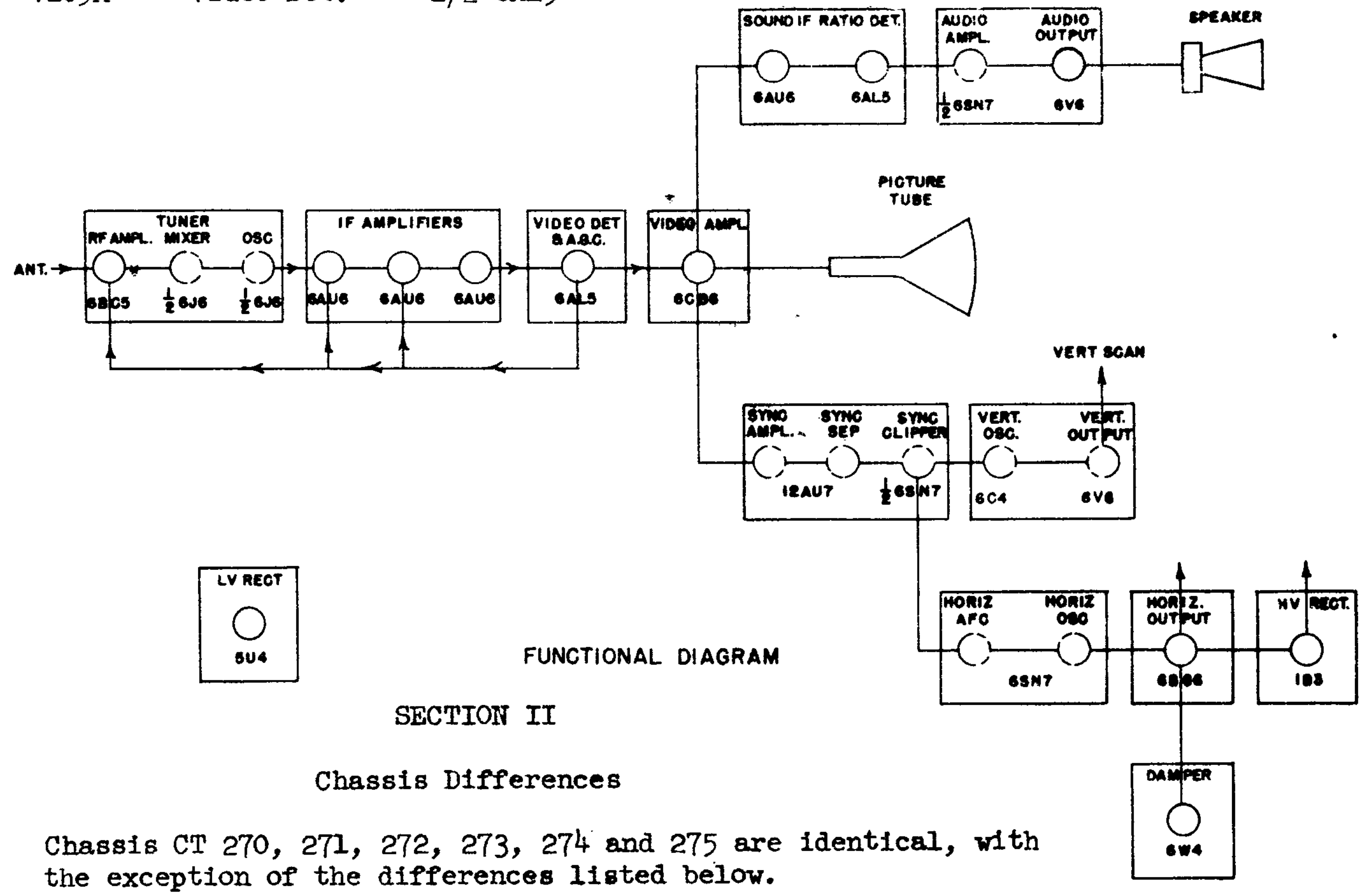
300 Ohm input----------Impedance--------------Speaker coil 3.2 ohms

185 Watts at 117V, 60CPS----------Power----------Audio 2.5 watts undist.

chassis 17" x 13½" ------------Size------------------------Pict. 3 sizes avail.

Tube Complement

V1	RF Ampl.	6BC5
V2A	Mixer	1/2 6J6
V2B	Oscillator	1/2 6J6
V101	Sound IF Ampl	6AU6
V102	Ratio Det.	6AL5
V103A	1st Audio Ampl	1/2 6SN7
V103B	Horiz.AFC	1/2 6SN7
V104	Audio Output	6V6
V105	Picture Tube	(See Chart)
V106	1st Video IF	6AU6
V107	2nd Video IF	6AU6
V108	3rd Video IF	6AU6
V109A	Video Det.	1/2 6AL5
V109B	AGC Det.	1/2 6AL5
V110	Video Ampl.	6CB6
V111A	Sync.Ampl.	1/2 12AU7
V111B	Sync.Sep.	1/2 12AU7
V112	Vert.Osc.	6C4
V113	Vert.Output	6V6
V114A	Sync.Clipper	1/2 6SN7
V114B	Horiz.Osc.	1/2 6SN7
V115	Horiz.Output	6BG6
V116	HV Rect.	1B3
V117	Damper	6W4
V118	LV Rect.	5U4



FUNCTIONAL DIAGRAM

SECTION II

Chassis Differences

Chassis CT 270, 271, 272, 273, 274 and 275 are identical, with the exception of the differences listed below.

	Picture Tube	Type	Audio Amplifiers
270	14BP4	Rectangular	Self Contained
271	14BP4	"	None needed, Used with radio chassis
272	(16TP4 (16KP4	"	Self contained
273	(16RP4 (16XP4	"	None Needed, Used with radio chassis
274	16GP4	Round	Self Contained
275	"	"	None needed. Used with radio chassis

SECTION III

Operation and Installation

1. Plug the receiver into power outlet.

2. The AC switch is on the contrast control. Turn the receiver on by turning the CONTRAST OFF-ON control to the right about 1/2 turn.

3. Adjust the BRIGHTNESS control for suitable picture brilliance. This control adjusts the bias on the picture tube. If no light appears, it may be limited by incorrect adjustment of the ion trap magnet, which may be aligned as follows:

   Advance the brightness control and adjust the ion trap until light appears on the screen. Then reduce the brilliance to a point near extinction by turning the brightness control counter-clockwise. Then re-adjust the ion trap until maximum brilliance is obtained. It may be necessary to turn the brightness control still further counter-clockwise.

4. Adjust the STATION SELECTOR to the desired channel number.

5. Adjust the FINE TUNING control for best picture quality. Do not tune for best sound as a distorted picture may result.

6. Adjust the CONTRAST control for the proper degrees of black, grey and white. This control adjusts the cathode degeneration on the video amplifier tube. With the brilliance at a point near extinction, adjust the control until sufficient picture detail appears without over-shading the light areas of the picture.

7. Adjust the VERTICAL HOLD control so the picture holds in vertical sync. If the picture "rolls" up or down, turn the vertical knob to the right so the roll is downward, then advance it to the left until the picture stops moving. Switching from channel to channel will not cause the picture to lose sync if the control is properly adjusted.

8. If the picture pulls out of sync in a horizontal direction, adjustment of the HORIZONTAL PHASING control (rear coil in the Magnalok transformer, rear panel of the instrument) and/or the HORIZONTAL SPEED coil (front adjustment of the transformer) may be necessary.

9. Adjust the FOCUS control so the lines making up the raster are clear and distinct.

10. Adjust the HEIGHT and VERTICAL LINEARITY controls so the picture just fills the mask and that linearity is uniform from top to bottom on all available channels. Adjustment of either the vertical hold, vertical linearity or height controls will slightly affect the other controls, and they may require a slight readjustment.

11. Adjust the HORIZONTAL DRIVE trimmer for the most drive consistant with good linearity. Turn it to a point where compression at the middle of the picture occurs, and then reduce it slightly.

12. Adjust the HORIZONTAL SIZE coil (top of chassis, adjacent to HV compartment) for proper width consistent with good linearity.

13. HORIZONTAL and VERTICAL CENTERING of the picture is accomplished in the conventional manner, using the controls on the rear panel. If it is impossible, loosen the small hex head screw on each side of the FOCUS MAGNET and slide the magnet around for proper centering with no shadows. If this adjustment is unsatisfactory, loosen or tighten one or more of the three #1/4-20 adjusting screws on the focus magnet assembly. Readjustment of the ion trap may be necessary.

14. Adjust the HORIZONTAL LINEARITY control for the most linear picture. CAUTION: There may be two positions of the slug which seems to provide proper horizontal linearity. Use the one which places the slug nearest all the way in.

15. Proper horizontal frequency adjustments can be made only after the other horizontal adjustments have been made. Note addenda, page 36.

    Connect a weak signal of 100-1000 microvolts to the antenna terminals. Turn the horizontal hold control to one end of its range. Interrupt the signal by switching off channel. Turn the horizontal hold control to the other end of its range and again interrupt the signal. If the picture pulls out of sync. or shows any tendency to pull out, proceed as follows:

    a. Set the HORIZONTAL LOCK trimmer 3 turns out from tight.

    b. Connect a clip lead across the horizontal phasing coil and capacitor (terminals C and D of the Magnolok transformer) and adjust the horizontal speed coil (front of the transformer) so the picture holds over the entire range of the horizontal hold control when the signal is interrupted.

    c. Remove the clip lead and adjust the horizontal phasing coil so the picture holds over the entire range of the horizontal hold control when the signal is interrupted. CAUTION: If the horizontal phasing coil requires more than a slight adjustment, repeat the horizontal speed coil adjustment.

CABINET ANTENNA CONNECTIONS

A power line antenna and a cabinet antenna are included in this model. They may be used separately or together, depending on local conditions. Each should be tried on all available channels, and that antenna or combination giving the best results should be selected.

1. Connect the power line antenna lead (grey wire extending from the rear of the chassis) to first one and then the other terminal of the antenna terminal board, tune for all local television stations and note which gives the better results.

2. Remove the power line antenna lead from the terminal board, connect the cabinet antenna leads first one way and then reversed, tune for all available stations, and note the results.

3. Leave the cabinet antenna leads connected, then try the power line antenna to first one side of the terminal board and then the other. Reverse the cabinet antenna leads and repeat the two power line connections. Tune for all available stations in each condition (4) and note the results.

4. Select the one connection as described in 1, 2 or 3 that gives the best overall performance for all available stations.

5. Disconnect power line antenna and cabinet antenna when an outside antenna is ued.

PICTURE TUBE REPLACEMENT

1. From the rear of the cabinet, remove the back cover, the tube socket, the ion trap, and the high voltage anode connector.

2. The front glass assembly is held in position with a single horizontal support rail. In some models the rail is fastened to the glass support brackets with two small hex head screws, and in others the rail is secured to the cabinet sides with four small wood screws. Remove these screws and take off the rail. Exercise caution when the rail is removed that the glass does not drop of its own weight.

3. Loosen the nuts that hold the tube strap over the perimeter of the tube, and lift out the tube.

4. Install the new tube, replace the tube support strap, anode connector, ion trap, tube socket and the back cover. Make sure the strap is tight, as a loose tube will result in a distorted picture, and is subject to damage.

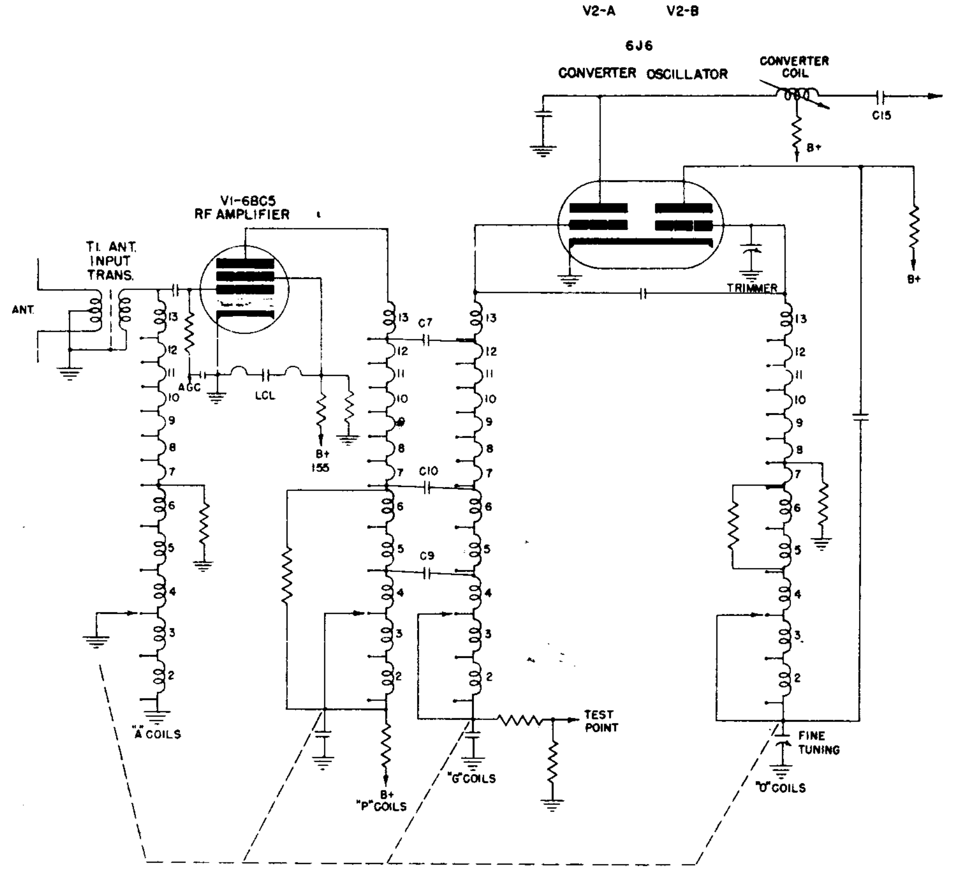
5. Be sure the deflection yoke is as far forward as it will go, that the grounding spring on the yoke makes contact with the grounding coating on the glass tube, and that the neck of the tube is parallel to the deck of the chassis. The shoulder of the tube should be tight against the kinescope retaining ring support.

6. Replace the safety glass and support rail.

SECTION IV

CIRCUIT DESCRIPTION

The Magnavox M-1 tuner consists basically of two tubes, four sets of coils and a four section, twelve position wafer switch. The tubes are V1, the RF amplifier 6BC5, and a dual triode 6J6, V2-A and V2-B. One triode section, V2-A is the converter or mixer, and V2-B is the oscillator. The antenna input transformer T1 is provided to match a balanced 300 ohm antenna to the tuner. The ANTENNA COILS A-13 to A2 are in the grid circuit of the RF amplifier stage, and are grouped around the rear wafer of the unit. The RF amplifier PLATE coils P-13 to P-2 are mounted on the second wafer from the rear. The converter GRID coils G-13 to G-2 are on the third wafer from the rear. The OSCILLATOR coils O-13 to O2 are on the front wafer. In each case, coil 13 is tuned for channel 13; coils 13 plus 12 are for channel 12; coils 13 plus 12 and 11 are for channel 11, etc. The following simplified diagram outlines its design and operation.



SIMPLIFIED MAGNAVOX M-1 TUNER DIAGRAM

Antenna coils A-13 to A-2 are tuned to their respective channels, with a band pass pattern sufficiently wide to accept all the information therein, and with sides of the pattern sufficiently steep so as to reduce signals on adjacent channels. The same applies to coils P-13 to P-2. The L-C-L unit is to provide regeneration on the higher channels to overcome degeneration due to tube loading. Under weak signal conditions, the RF amplifier stage is capable of a gain of 15 times its input. In the presence of a strong signal, the automatic gain control bias on the grid limits its output to a fraction of its input.

The oscillator is tuned on a frequency 25.75 mc. higher than the video carrier, and when hetrodyned with the carriers in the converter, produces a modulated video IF signal of 25.75 mc. and a modulated sound IF signal of 21.25 mc. These are applied to the IF amplifiers through C-15. L-4 in the mixer plate circuit is series tuned, with the tube capacities of the converter and first IF tubes, to prevent oscillator voltage from being applied to the IF amplifiers.

The fine tuning control, a variable dielectric capacitor, shifts the oscillator frequency about 1.5 mc. on channel 2, and relatively more on the other channels up to 13, where it is about 4.5 mc. The trimmer capacitor, accessible from the front of the chassis by removal of the channel scale and fine tuning knobs, is provided to compensate for different tube capacities when the oscillator tube is replaced. It will shift the oscillator frequencies on all channels in the same direction (depending on the direction of adjustment) in the event that tuning occurs too close ot the end of the fine tuner rotation one one or more channels.

The oscillator signal is applied to the converter grid through a capacitor from the oscillator plate. The amplified RF signal is applied to the converter grid coils through capacitors C-7, C-9 and C-10, depending on the position of the channel selector switch. These capacitors are used to provide adequate bandpass coupling. The converter stage is capable of a gain of about 5 times its input.

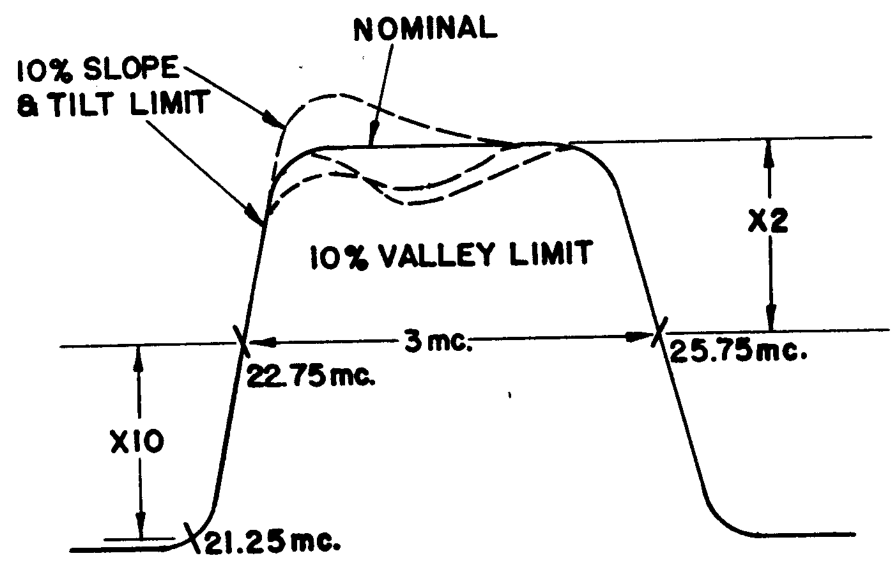
A test point is provided that is accessible through a hole in the right side of the tuner cover for connecting an oscilloscope to be used in alignment of the antenna, RF and converter coils. A complete schematic diagram of the 700340 RF unit, alignment procedure and service instructions are included in a later chapter.

The tuner is capable of a gain of about 75 times from the antenna to the first IF amplifier grid.

The IF amplifier strip passes both video and sound IF signals to the common detector. It consists of three 6AU6 tubes, V-106, V-107 and V-108, coupled by IF transformers T-102, T-103 and T-104. The video IF signal is 3 mc. wide, extending from the picture IF carrier of 25.75 mc. to 22.75 mc., which is 6db down.

The primary and secondary winding of the IF transformers are bi-filar wound (in the same direction), and coupling between stages is by the capacity and inductance between windings. Each transformer is tuned with an adjustable iron core.

The converter coil and the three IF transformers are appropriately loaded, stagger tuned, and resonate at various IF frequencies to provide maximum gain for the desired bandpass characteristic, thus eliminating the need for over-coupled transformers, traps and filters.



IDEAL OVERALL IF CURVE

The converter coil and T-104 are high Q coils, and contribute to the steep sides of the overall bandpass curve. T-102 and T-103 are also high Q coils, but are sufficiently loaded to pass a broad band of frequencies, and contribute to the overall IF gain.

Each IF stage has an LC isolation network in its filament circuit to prevent interaction between stages and coupling of the IF voltages into the stages of the receiver through the heater-capacitance of the tubes in the common filament line.

AGC bias is applied to V-106 and V-107, and control their gain inversely proportional to the applied signal strength. V-108 is operated at fixed bias. The output of the IF system has a rising characteristic as the input level increases.

Complete alignment instructions are included in a later chapter.

The video detector, V-109A consists of 1/2 of a 6AL5. On negative cycles of the IF carriers, the diode conducts and current will flow through R-125. This current develops a voltage across R-125, which varies with modulation of the IF carrier. The high frequency IF component is bypassed to ground through C-122.

The same detector operates as a mixer for the video IF and sound IF signals. The resultant FM and AM 4.5 mc. beat appears across R-125 along with the video signal. As the IF carriers result from crystal controlled frequencies at the television transmitter, their resultant beat is much more stable than if the sound IF were produced by beating the sound carrier with a local oscillator.

The video amplifier has an essentially flat characteristic up to 3 mc., and then tapers off to 0 at 5 mc. L-108, L-109, L-106and L-111 provide peaking necessary for this broad-band output, which is adequate for both the video signal and the sound IF. It has a gain of 30 times, and with a normal input of 2 volts, will present 60 volts video modulation to the kinescope.

The contrast control is in the cathode return circuit, and serves as a direct control over the input to the tube. As the output from the detector is in a negative direction, noise pulses drive the video amplifier beyond cutoff, so it also acts as a noise limiter.

The picture tube operates on a second anode potential of 12.5 KV. As the output from the video amplifier is in a positive direction, the signal is applied to the kinescope cathode through C-129. This is equivalent to grid modulation with a negative signal. R-178 and R-177 maintain a DC voltage on the cathode. The brightness control adjusts the DC bias on the grid, and governs the emission from the electron gun, which produces the brilliance.

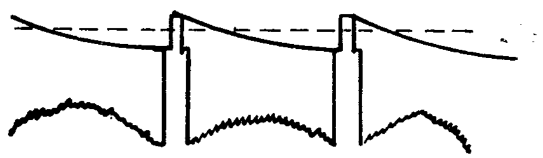
The series parallel resonant sound IF pick-off coil, composed of L-107 and C-126 samples the 4.5 mc. signal from the video amplifier plate, and it is applied to V-101, the sound IF amplifier, where it is amplified sufficiently to drive the ratio detector. The latter stage accepts the frequency modulated audio signal and provides a high degree of rejection to amplitude modulation.

The audio amplifier and audio output stages are conventional, except for the DC potentials present on the output tube, which are 360 on the plate, 155V on the cathode, 230V on the filament and only a slightly negative voltage on the grid. A separate filament winding in the power transformer is used for V-104 and V-117.

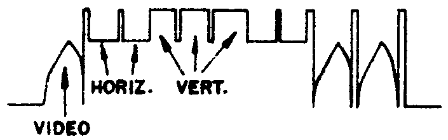
The other section of the 6AL5, V-109B serves as the Automatic Gain Control Rectifier.

Its cathode is maintained at approximately 1.5 volts positive by direct connection to the cathode resistor of V-108. The modulated RF envelope is applied to its plate. Because its plate resists being driven positive in respect the cathode, the resultant current causes C-158 to be charged to a potential that causes the AC axis of the RF envelope to fall below zero to an extent that the positive sync pulses of the envelope exist above zero by a voltage slightly greater than the bias on the AGC diode cathode. C-120 then becomes charged through R-122 as the resultant of the AGC diode plate existing at an average level below zero. R-122 and C-120 provide a sufficiently long line constant to eliminate ripples in the AGC Bus.

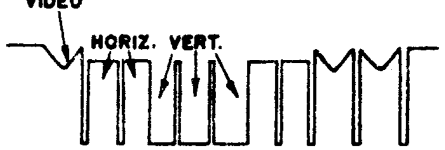
The time constant of C-158 and R-151 is such that the positive peaks of the RF envelope are able to follow the horizontal sync pulses.



Thus far, no mention has been made of the vertical and horizontal sync pulses, which appear on the video carrier, through the IF amplifiers, detector and video amplifier, between scanning lines of video modulation. Their appearance at the picture tube grid is always during retrace time, and cuts the beam to blanking level at those intervals.



The signal output from the video amplifier is in a positive direction, and applied to the sync amplifier grid produces a greatly amplified negative sync signal at its plate. The video information is greatly compressed due to the cutoff of the sync amplifier.



The sync separator stage follows, which is biased high enough to pass only the sync pulses. Everything else is below the cut-off portion of the tube characteristic. Here again, the output is in a negative direction.

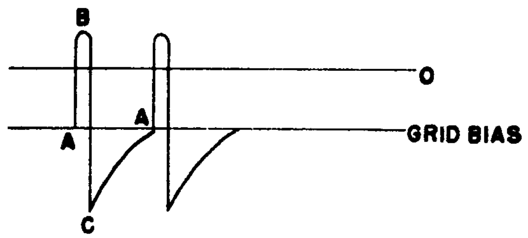
Noise and distortion if any, rides the peaks of the sync pulses. These pulses are applied to the sync clipper stage, which has sufficient cut-off to remove the peaks and present clean, square wave pulses to the deflection stages.

The sync clipper output is fed directly to the AFC and horizontal stages through C-135, which is sufficiently low in value so as to pass only the high frequency horizontal sync pulses. The same signal is applied to the vertical oscillator through RC-101, a filter network which passes only the low frequency vertical pulses.

The vertical oscillator and output stages provide a sawtooth current wave of proper shape and frequency through the deflection yoke for vertical scanning of the picture tube.

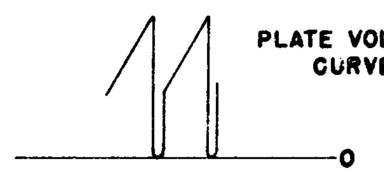
The first section, the 6C4 (V-112), is a blocking oscillator and discharge circuit. During non-conduction, the grid voltage is negative with respect to the cathode. The plate draws current during discharge at a rate determined by the setting of the height control (R-148). Due to the coupling of the oscillator transformer, there is a corresponding voltage rise on the grid (A to B on following curve). When the grid becomes more positive than the cathode, it draws grid current. This quickly charges C-136, which drives the grid negative and cuts off the plate current (see B to C). Then the charge on C-136 is slowly discharged through the vertical hold control R-144, and R-150, which allows the grid voltage to slowly rise to its normal bias (see C to A). Then plate current begins to flow again, and the cycle is repeated, at a frequency depending on the rate of C-136 discharge, which is controlled by the setting of R-144.

GRID VOLTAGE CURVE



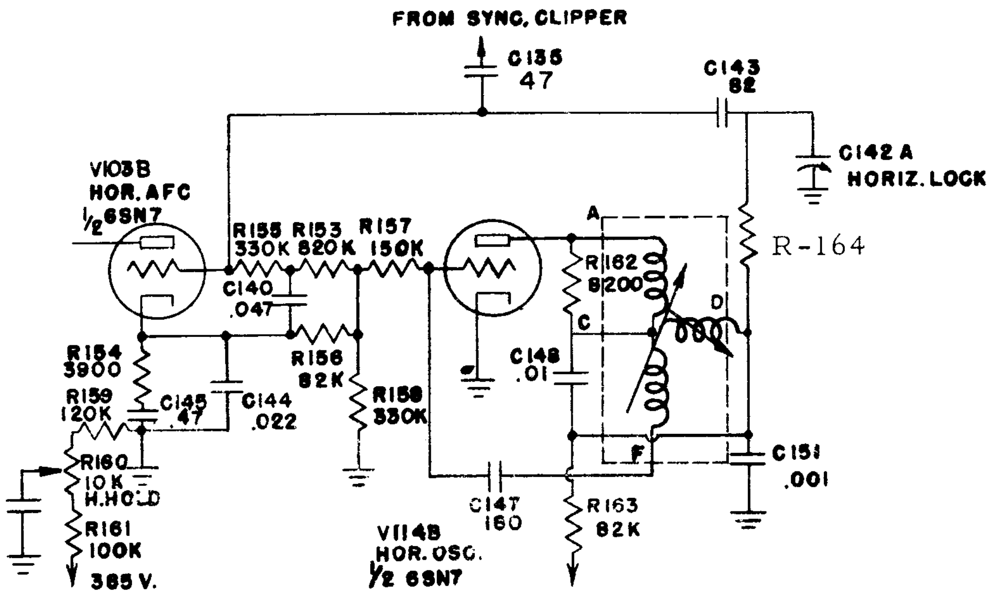
The frequency is set at slightly slower than 60 c.p.s. During the charging period of C-136 (C to A), the vertical sync pulse is applied, just before it would "trip" in its free-running cycle. The magnitude of the sync pulse is sufficient to drive the tube into conduction, and therefore controls the frequency of oscillation.

The oscillator plate voltage consists of a series of sawtooth waves. A sharp negative pulse appears because R-146 prevents C-137 from complete discharge to ground when the tube is conducting. When the tube becomes non-conducting, the plate voltage does not have to rise slowly from zero, but instead immediately rises to a value determined by the value of R-146, principally because the instantaneous changes do not charge C-137. The plate voltage then slowly rises from this value as C-137 charges. Adjustment of the height control (R-148) varies the amplitude of the sawtooth voltage by controling the rate at which C-137 can charge.



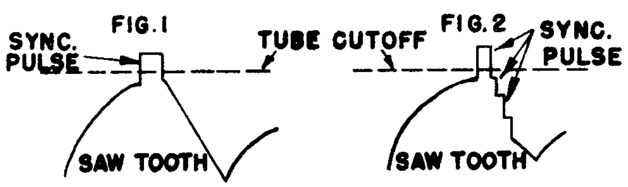
The voltage present on the plate is of the basic shape required to produce a sawtooth of current in the deflection coil, and is amplified by the 6V6 output stage, V-113.

V-114B is a blocking oscillator. Its frequency is controlled by adjustment of the frequency coil (front adjustment of the Magna-lok transformer). The horizontal speed coil (rear adjustment) is included to stabilize oscillation, especially in the presence of noise. The bias on V-114B is obtained through a voltage divider network from the cathode of V-103B, and any bias variation will change the oscillator frequency.



The sawtooth wave is fed to the grid of the automatic frequency control stage V-103B, through R-164, along with the horizontal sync pulses from C-135. C-143 and the horizontal lock trimmer comprise a capacity voltage divider which controls the amplitude of the fed back sawtooth waves and sync pulses.

V-103B is biased to nearly cut-off. When the oscillator frequency is the same as that of the sync pulses, the pulse rides on the crest of the fed back wave, and is above the cut-off level of the tube. It is then at maximum width, V-103B conducts during its appearance at that level, and cathode capacitors C-144 and C-145 charge to a DC potential proportional to plate conduction time. This voltage is used to bias the oscillator grid. In this example, the bias is of such value so as to sustain oscillation at its present frequency.



However, if the oscillator frequency changes, due to component warm up, etc., the sync pulse will reach the AFC grid slightly ahead or behind the saw tooth wave. Part of the pulse will ride the slope of the wave and will appear below the tube cut-off level. The portion of the sync pulse on the crest of the saw tooth wave will be at less than maximum width, and will limit tube conduction proportionately. V-103B cathode condensers will charge to a different voltage than in the previous example, the bias on V-114B will be changed, and the oscillator frequency will be pulled into sync.

The horizontal hold control will vary the frequency about the mean horizontal sweep by varying the AFC tube plate voltage.

METHOD OF OBTAINING REQUIRED DC VOLTAGES

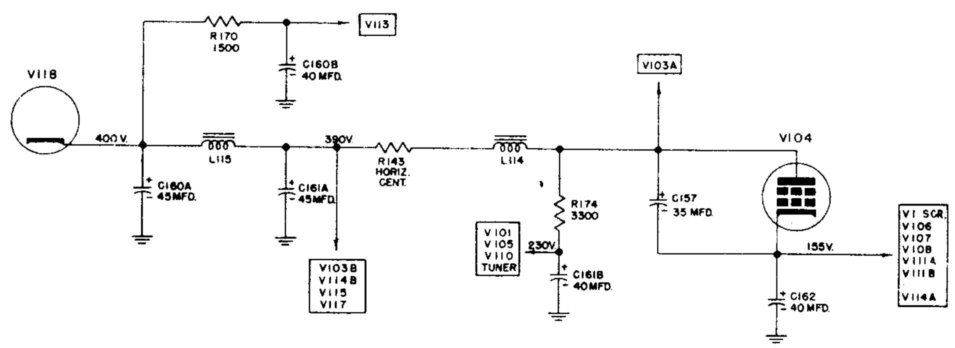
This chassis contains a highly efficient voltage divider network, which eliminates the necessity for power consuming and heat producing bleeder resistors.

The input condenser C 160A is at 400 V, which is applied to the vertical amplifier stage. The first filter choke L115 drops it to 390, which is used for the Horizontal AFC, Horizontal Oscillator, Horizontal Output and Damper stages. The second filter choke drops it to 385 V, which is needed for the audio amplifier and audio output stages. R 174 drops the voltage to the required 230 for the sound IF, picture tube grid, video amplifier and the tuner.

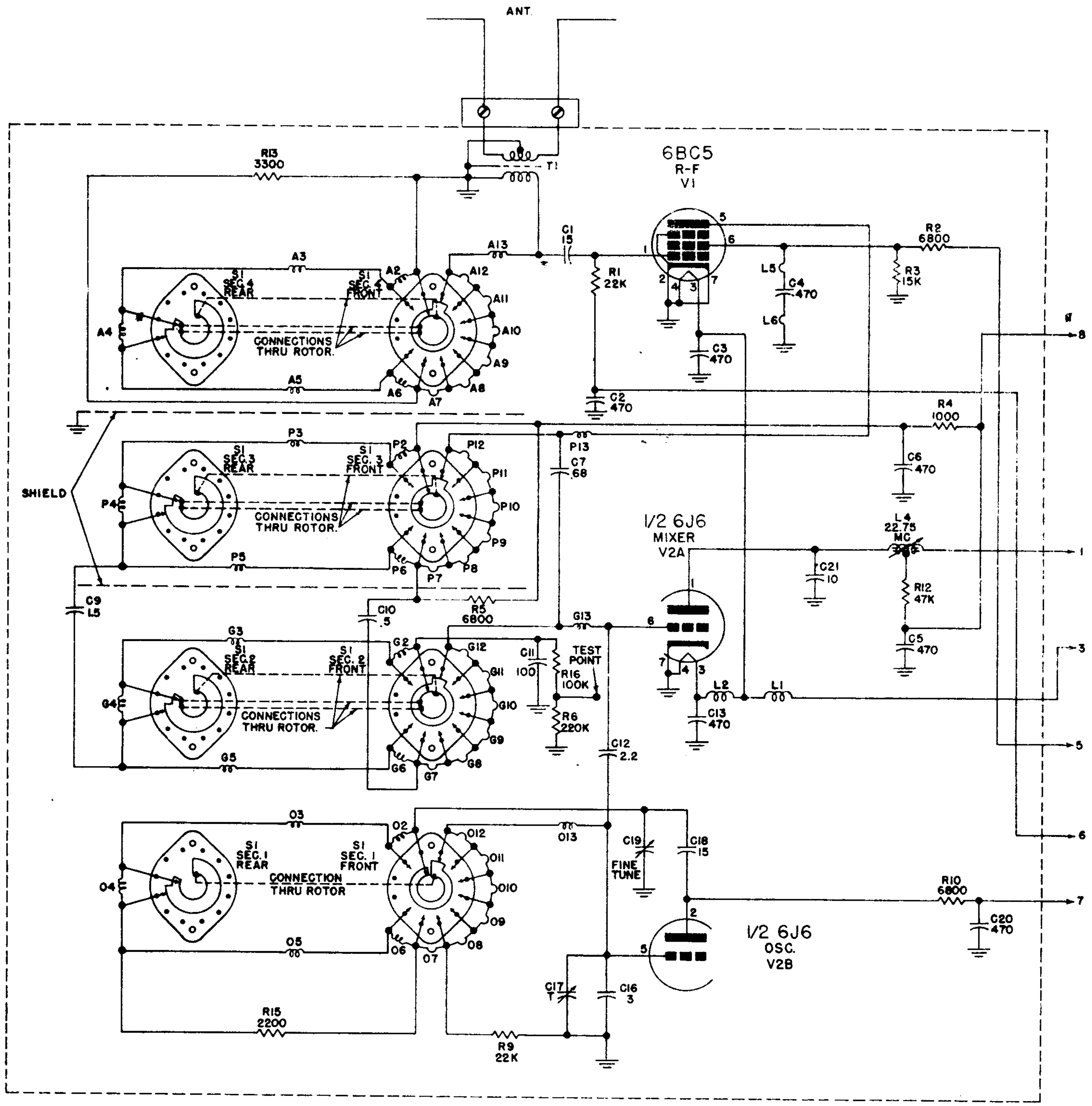
The audio output stage is also a voltage regulator. The RF amplifier screen, 1st, 2nd and 3rd IF amplifiers, sync amplifier, sync separator, sync clipper comprise its cathode load, and are maintained at 155V.

The damper tube produces boosted B + in the conventional manner, which is applied to the horizontal output plate and the picture tube screen.

A separate filament winding on the power transformer for V 117 and V 104 is required to eliminate excessive heater cathode voltage.



MODELS CT270, CT271, CT272, CT273, CT274, CT275, CT276, CT277, CT278, CT279, CT280, CT281, CT282



SECTION 5

R-F AND I-F ALIGNMENT

TEST EQUIPMENT. For proper television alignment, it is recommended that the following test equipment be available.

1. R-F Sweep Generator meeting the following requirements:

   a. Frequency — 18 to 30 MC; 40 to 90 MC; 170 to 225 MC

   b. Sweep width adjustable from 1 to 12 MC

   c. Output at least .1 volt maximum.

2. Cathode Ray Oscilloscope - Wide band vertical deflection.

3. Electronic Voltmeter with high voltage probe.

4. 500,000 ohm potentiometer with clip leads and 3 volt battery.

5. Signal generator to cover the following frequency ranges.

   I-F range from 19.75 MC to 27.25 MC.
   R-F range from 55.25 MC to 87.75 MC and 171.25 MC to 215.75 MC

R-F UNIT ALIGNMENT

Oscillator alignment should be made only when the fine tuning control tunes in the extreme clockwise or counter-clockwise position, or if it will not tune at all within its tuning range.

1. TOUCH UP OSCILLATOR ALIGNMENT

   a. If some channels do not tune at all, or not near enough to the center of the fine tuning range, adjust the oscillator trimmer for the best compromise tuning on all channels. If, for example, all channels tune to one side of the control, adjustment of the trimmer will bring them all toward the center. However, if some channels tune at one end of the control and others tune at the other end, adjustment of the trimmer will bring the former to the center of the tuning range and will force the latter beyond the range of the control. In this case, the oscillator coils must be aligned individually as follows:

Channel No.	Band Width (MC)	Picture Carrier	Sound Carrier	Local Oscillator
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204.210	205.25	209.75	231
13	210.216	211.25	215.75	237

2. COMPLETE OSCILLATOR ALIGNMENT

a. Connect a sweep generator to the antenna terminals.

b. Connect an unmodulated signal generator to the antenna terminals and tune it to the channel 13 video carrier frequency. TV signals may be used.

c. Loosely couple an unmodulated signal generator to the first IF grid, and tune it to 25.75 mc.

d. Connect an oscilloscope across the video detector load resistor.

e. Turn on the receiver and set the straight edge of the vernier to straight up position (mid range). After the receiver has warmed up and if there are two markers on the scope, determine which rotation of the vernier causes the markers to move closer together. If it is clockwise, move the fine tuner back to the straight up position and close the channel 13 oscillator coil. If it is counter-clockwise, open the coil. Adjust for zero beat. See note 1.

f. Tune the signal generator connected to the antenna terminals to the video carrier frequency for channel 12, switch the tuner channel selector switch to its channel 12 position and adjust the channel 12 oscillator loop for a zero beat of the markers.

g. Repeat the procedure for channels 11 through 2, and recheck 13 through 7. The high channel loops are adjusted by moving them up or down and the low channel coils by spreading or pushing together.

ANTENNA, RF AMPLIFIER AND CONVERTER ALIGNMENT

1. There are three variables which will give the desired pattern to be ap-

NOTE 1. Usually, if the oscillator is off in the same direction for the high channels, adjustment of Channel 13 will bring in all high band channels. The same applies to all low channels if they are off in the same direction and Channel 6 is re-adjusted.

plied to the IF amplifiers. If the ANTENNA COIL (wafer nearest the rear of the tuner) is first adjusted, then the RF COIL (second wafer from the rear), and finally the CONVERTER COIL (third wafer from the rear), the proper pattern will appear.

These coils must be very carefully adjusted with only slight movement, particularly the converter coil. The RF wafer has B+ on it and should not be touched with the hand or a metal tool. The coils around the first (oscillator) wafer are properly adjusted and should not be touched.

The following alignment instructions are for use where over-all alignment is necessary. When a partial touch-up is necessary, follow the test patterns through the outline until the one is found that most nearly matches the curve shown on the oscilloscope, and then complete the rest of the alignment procedure.

2. HOOKUP

a. Attach a VTVM to the AGC terminal (green wire, bottom terminal on left side) of the tuner and chassis ground. Using battery and 500K potentiometer, adjust the bias for -2V.

b. Connect a sweep generator to the antenna terminals, using a balanced resistor network if the generator has an unbalanced output cable.

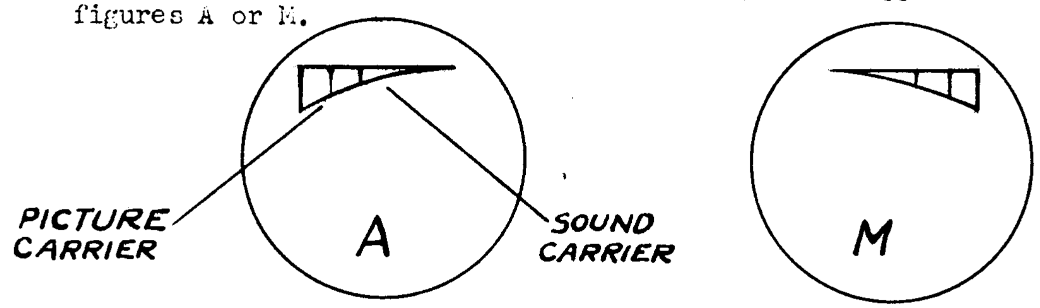
c. Loosely couple a signal generator to the antenna terminals, either by wrapping a few turns of insulated wire around the terminals and connecting the signal generator to it, or through a small capacitor.

d. Connect an oscilloscope, through an isolating resistor of about 47 K ohms, to the test point, which is accessible through the hole in the right side of the tuner, top side of chassis.

3. ALIGNMENT, MODEL M TUNER

a. Turn the channel selector switch on the tuner and the sweep generator to Channel 13.

b. Adjust the signal generator to first the video carrier frequency and then to the sound carrier frequency for channel 13. If the coils are badly adjusted, the pattern on the scope will appear as in figures A or M.

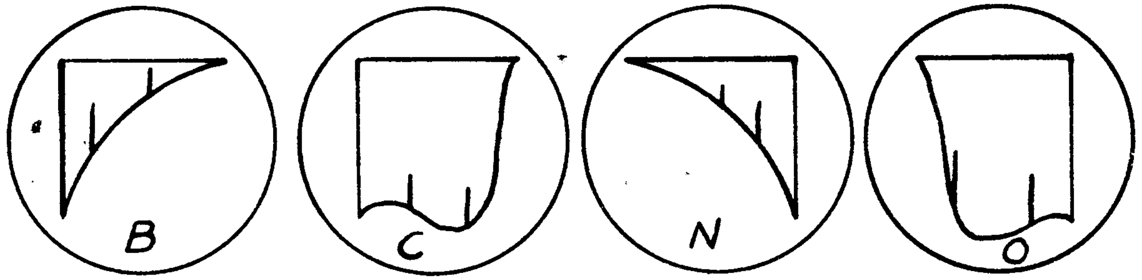


The meaning of A is that some coils must be opened and of M that some must be closed. When the coils are far off from their proper tuning, all three have their main effect on pattern height, so tune for increasing height of pattern.

c. As a coil is changed, one side of the picture will get higher and a hump will start to move across the screen. When starting with a pattern like A, first B, then C, will appear as a coil is opened.

When starting with a pattern like M, first N, then O will appear as a coil is closed.

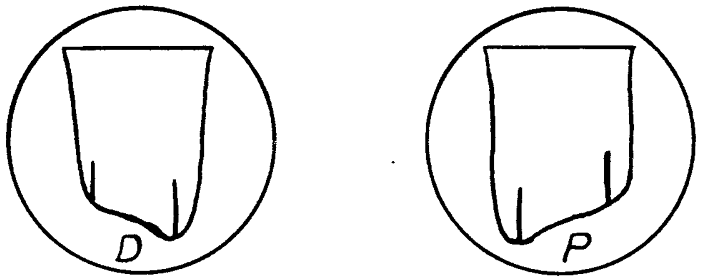
When the hump which is due to tuning a coil is between the markers, it indicates that this coil is very close to where it should be tuned. <u>Leave it as it is and go immediate to another coil.</u>



d. The lower side of the pattern shows what to do to the next coil. In C, the left side is lower, which shows that the next coil should be opened.

In O, the right side is lower, which shows that the next coil should be closed.

After this adjustment, a pattern like D or P should be on the screen.



The fact that there are now two humps in the pattern shows that both converter and RF wafers are nearly right. If the pattern height is near what it usually is with the scope setting that you have been using, the antenna wafer is probably near correct, but it should be adjusted a bit to see if pattern height improves.

4. ROUGHLY ALIGN THE LOW BANDS.

a. Now that Ch. 13 is roughly aligned, go immediately to Ch. 6 and roughly align it for the pattern in E. Do the same for Channels 5, 4, 3, and 2.

5. FINAL ALIGNMENT OF CHANNELS 13 DOWN TO 2.

a. Now go back to Ch. 13. Do it the easy way on the tuner by going clockwise one step from 2.

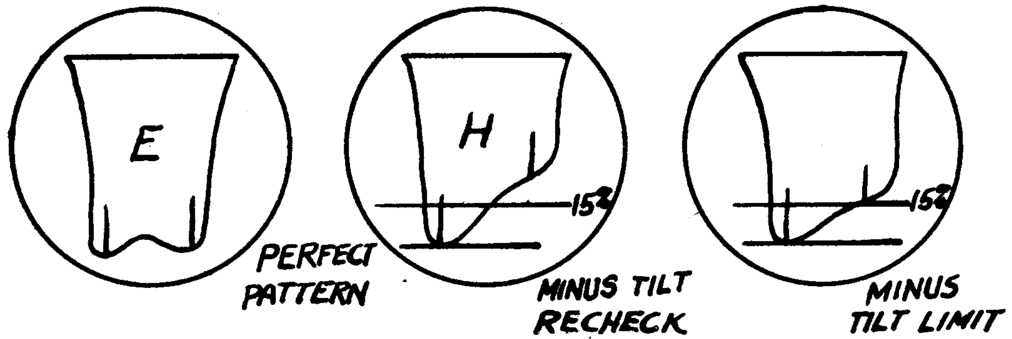
b. Align the Ch. 13 coils for the highest and narrowest picture you can get. You will notice that the narrower the pattern is, the higher it is also. The narrowest pattern you can get should be like E. Then align channels 12 down to 2, trying for a flat pattern with markers on the peaks in each case.

c. You will be able to move the pattern to right and left by using the RF wafer. Tilts may be corrected by adjusting antenna wafer, converter wafer, or both of them. The adjustment should be used which gives best pattern height. Notice that although the antenna and converter wafers both control tilt, they have opposite effects on it. Opening an antenna low channel coil or pushing down an antenna high channel loop will bring down the right side of a pattern. Closing a converter low channel coil or pulling up a converter high channel loop will do the same thing.

Closing an antenna low channel coil or pulling up an antenna high channel loop will bring down the left side of a pattern. Opening a converter low channel coil or pushing down a converter high channel loop will have the same effect. Again, the adjustment to use is the one which will give the highest pattern.

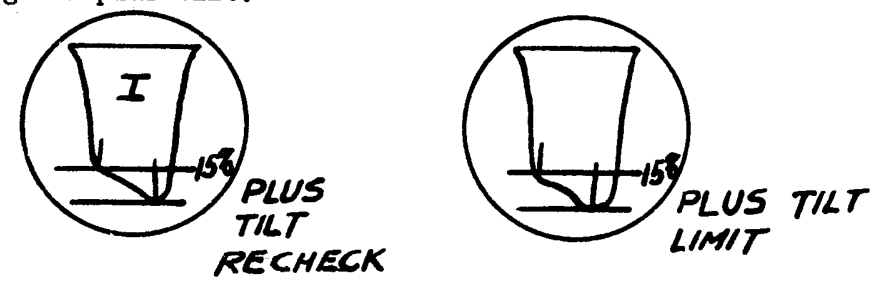
6. HOW TO CORRECT THE PATTERNS FOR RIGHT CENTERING AND RIGHT TILT.

a. Correcting for minus tilt.



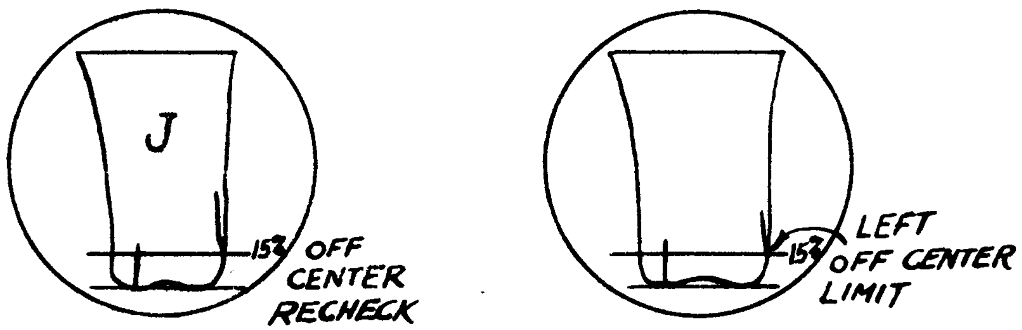
For minus tilt as in H, open a low channel coil, or push down a high channel loop of the antenna wafer. It can also be corrected by closing a low channel coil or pulling up a high channel loop on the converter wafer. It should be done in the way that gives best pattern height. You should always try to get a flat pattern if it can be done.

b. Correcting for plus tilt.



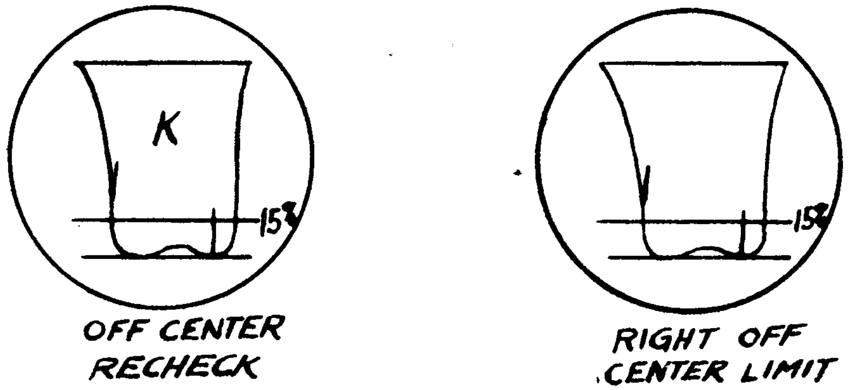
For a pattern like I, which has too much plus tilt, close a low channel antenna coil or pull up a high channel loop. It can also be adjusted by opening a low channel converter coil or pushing down a high channel converter loop. Always try for a flat pattern if you can get one.

c. Correcting for off center left.



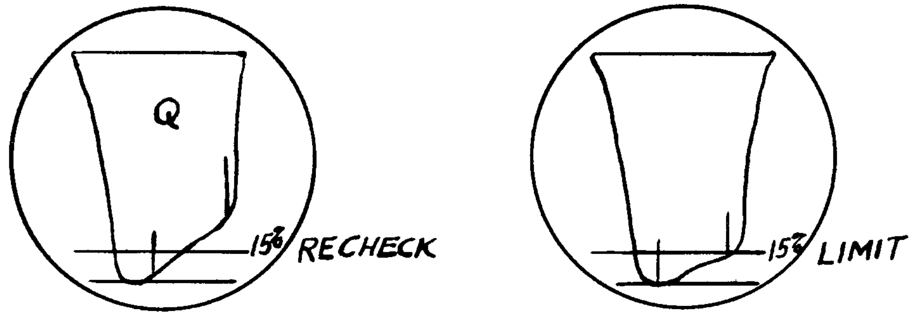
For a pattern like J, which is off center left, open a coil, or push down a loop on the RF wafer. Adjust until the pattern is symmetrical about the markers, that is until the markers are in the center of the pattern, instead of over to one side. Always try to get the markers as near centered as you can.

d. Correcting for off center right.



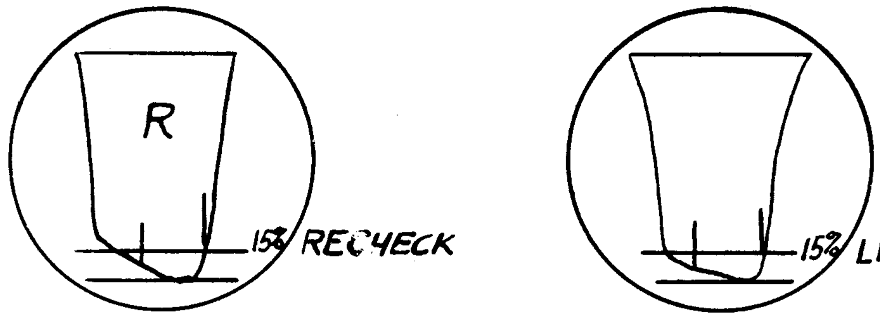
For a pattern like K, close a low channel coil or pull up a high channel loop on the RF wafer. Adjust until the pattern is symmetrical about the markers.

e. Correcting combination faults.
1. Off center left and minus tilt:



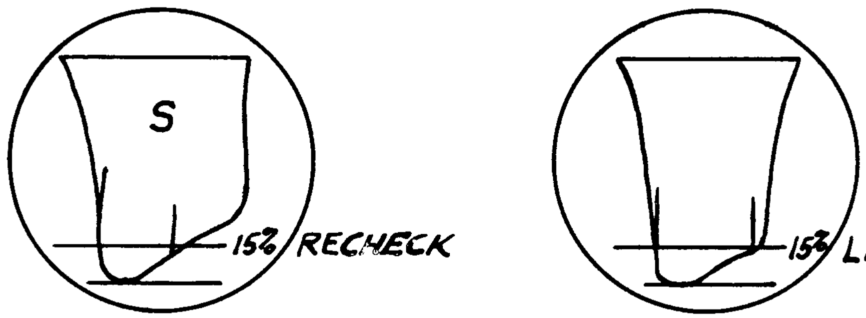
Note that Q is a combination of J and H. First correct the RF wafers for centering as in section C, then correct for tilt as in section A.

2. Off center left and plus tilt:



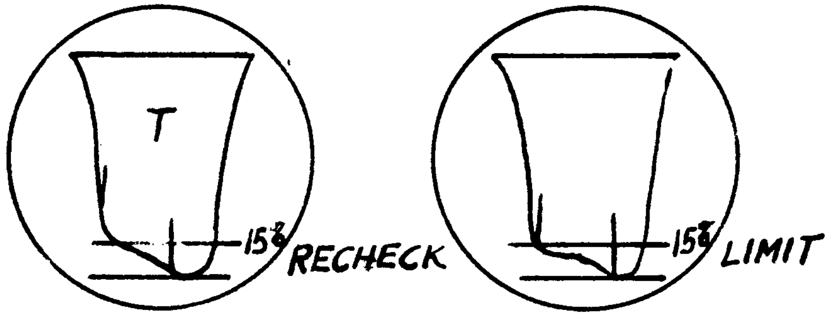
Note that R is a combination of J and I. First, correct the RF wafer for centering as in section C, then correct for tilt as in section B.

3. Off center right and minus tilt:



Note that S is a combination of K and H. First, correct for centering as in section D, then correct for tilt as in section A.

4. Off center right and plus tilt:



Note that T is a combination of K and I. First correct for centering as in section D, then correct for tilt as in section B.

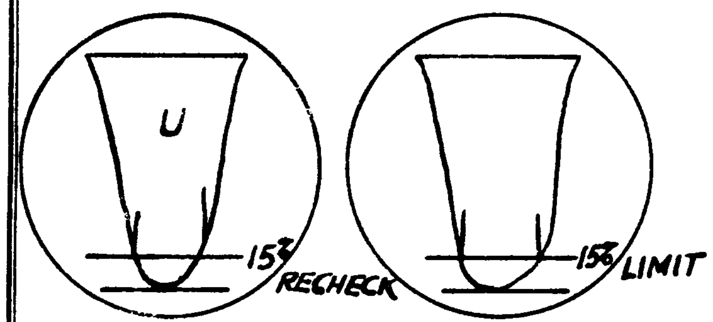
Don't try to make every channel come in by adjusting one coil. Usually, at LEAST TWO WAFERS MUST BE ADJUSTED TO GET THE RIGHT PATTERN.

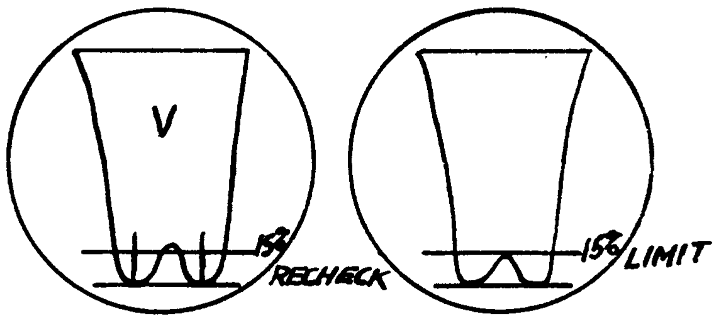
7. HOW TO CORRECT ROUND BOTTOM AND DEEP VALLEY.

a. For RB as in U, open a low channel coil or push down a high channel loop on both the antenna and converter wafers. Then correct for off center by adjusting the RF wafer.

If that doesn't correct it, try closing a low channel coil or pulling up a high channel loop on both antenna and converter wafers. Then correct for centering by adjusting the RF wafer.

b. For deep Valley as in V, try the same thing as:





for RB, that is, moving antenna and converter in one direction and RF in the opposite direction. Again, if moving the three coils in first trail doesn't correct it, then try the second way, just as for RB.

Video I-F Alignment

a. Adjust the bias on the first & second IF grids at -3 volts by connecting a 3 volt battery from the grid return of either tube to ground.

b. Connect the IF Signal Generator to the converter grid wafer (through the hole provided in the bottom of the tuner shield) and chassis ground.

c. Connect an oscilloscope to the high side of the detector load resistor R-125, 4700 ohms (junction of R-125 and L-106), and to chassis ground.

d. Tune converter coil T-102 for maximum at 22.9 mc. The purpose of the oscilloscope is to observe the demodulated signal and thus make sure that no overload condition develops because of too much signal input. This condition, of course, is evidenced by no increase in output voltage for an increase in signal, and a badly distorted wave form.

e. Tune first I-F coil T-102 for maximum at 23.4 mc.

f. Tune second I-F coil T-103 for maximum at 25.2 mc.

g. Tune third I-F coil T-104 for maximum at 25.3 mc.

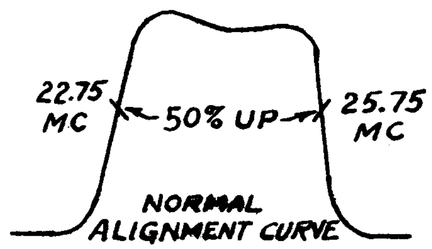
h. Remove the I-F signal generator, and connect the R-F sweep generator to the antenna terminals.

i. Tune the receiver and R-F sweep generator to channel 6.

j. The I-F frequencies can now be retouched if necessary to obtain a standard response curve, with the picture carrier at 50% of maximum response.

The IF marker may be injected by connecting the IF signal generator to the tuner frame and turning the gain high enough so it will appear on the curve without causing overload.

The converter coil T-102 will correct the low frequency side, as will T-103 and T-104 correct the high frequency side when necessary. Proper positioning of the markers on the response curve is important since no traps are used.



k. All twelve channels should be checked for alignment. The nominal curve shall be flat with respect to the base line of the sweep. The tilt limit shall be 10% with respect to the flat portion of the curve.

SOUND IF ALIGNMENT

Test Equipment Required:

4.5 mc. signal generator.
Voltohmyst type VTVM.

a. Connect the signal generator to the video amplifier grid (pin 1 of V 110) and chassis.

b. Connect probe of VTVM to the high side of detector load resistor R-105, 6800 ohms (at pin 7 of V-102), and negative lead to chassis.

c. Turn contrast control fully counter-clockwise.

d. Adjust signal generator to 4.5 mc.

e. Tune slug in 4.5 mc. sound take off transformer (L-107) for maximum reading.

f. Tune ratio detector primary (bottom slug of T-101) for maximum reading.

CAUTION: Keep the 4.5 mc. signal input low enough so the VTVM reading does not exceed -5 V, to prevent overload and misalignment.

g. Remove VTVM connections and connect negative lead to the junction of R-105 and R-129 (both 6800 ohm 5%), and the probe to the junction of R-103 (220 ohms) and C-104 (470 mmf). Adjust secondary of ratio detector (top slug of T-101) for zero reading.

If the secondary is too far out of alignment, (4 or 5 turns either direction) repeat peaking of primary as described in steps b, e and f.

SOUND IF ALIGNMENT, USING AIR SIGNAL

If a station is transmitting a continuous-tone modulated signal, it may be used instead of the signal generator in the procedure just described. Keep in mind the -5 V maximum reading on the VTVM.

This method may also be used to check the accuracy of a signal generator. Align the sound IF and ratio detector using an air signal, then substitute the signal generator as described in step 1. Adjust the frequency of the signal generator in the neighborhood of 4.5 mc. until the maximum reading on the VTVM is obtained. Mark that point on the signal generator dial as 4.5 mc.

Ref. No.	Part No.	Description
T101	360482-1	Ratio Detector Transformer
T102	360461-1	1st Video IF Coil
T103	360461-1	2nd Video IF Coil
T104	360461-1	3rd Video IF Coil
T105	320030-6	Vertical Blocking Oscillator Transformer
T106	320056-2	Vertical Output Transformer
T107	320055-1	H.V. Transformer
T108	300059-1	Power Transformer
T109	360479-1	Horiz. Sync. & Osc. Reactor
RC101	250186-1	Printed Circuit
	180475-1	Fuse 1/4 Amp.
	360485-1	Focus Magnet
C101	250187-50	Capacitor, Mica, 56 mmf., 500 V.
C102	250175-1	Capacitor, Ceramic, 5000 mmf., 450 V.
C104	250159-90	Capacitor, Mica, 470 mmf., 500 V.
C105	250088-46	Capacitor, Ceramic, 1000 mmf., 350 V.
C106	250175-2	Capacitor, Ceramic, 10,000 mmf., 450 V.
C107	270027-4	Capacitor, Electrolytic
C108	250175-2	Capacitor, Ceramic, 10,000 mmf., 450 V.
C109	250175-2	Capacitor, Ceramic, 10,000 mmf., 450 V.
C110	250205-11	Capacitor, Paper, .047 mfd., 200 V.
C111	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C112	250203-6	Capacitor, Paper, .0068 mfd., 600 V.
C113	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C114	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C115	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C116	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C117	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C118	250175-1	Capacitor, Ceramic, 5000 mmf., 450 V.
C119	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C120	250205-13	Capacitor, Paper, .1 mfd., 200 V.
C121	250159-82	Capacitor, Mica, 100 mmf., 500 V.
C122	250207-3	Capacitor, Ceramic, 10 mmf., 450 V.
C125	250187-19	Capacitor, Mica, 75 mmf. 5%, 500 V.
C126	250164-10	Capacitor, Ceramic, 1.5 mmf., 500 V.
C128	270027-14	Capacitor, Electrolytic
C129	250203-11	Capacitor, Paper, .047 mfd., 600 V.
C130	250175-3	Capacitor, Ceramic, 1500 mmf., 450 V.
C131	250159-56	Capacitor, Mica, 240 mmf., 5%, 500 V.
C132	250203-7	Capacitor, Paper, .01 mfd., 600 V.
C133	250203-11	Capacitor, Paper, .047 mfd., 600 V.
C134	250203-7	Capacitor, Paper, .01 mfd., 600 V.
C135	250187-49	Capacitor, Mica, 47 mmf., 500 V.
C136	250161-24	Capacitor, Mica, 4700 mmf., 5%, 500 V.
C137	250203-13	Capacitor, Paper, .1 mfd., 600 V.
C138	250203-11	Capacitor, Paper, .047 mfd., 600 V.
C139	250159-95	Capacitor, Mica, 33 mmf., 500 V.

MODELS CT270, CT271, CT272, CT273, CT274, CT275, CT276, CT277, CT278, CT279, CT280, CT281, CT282

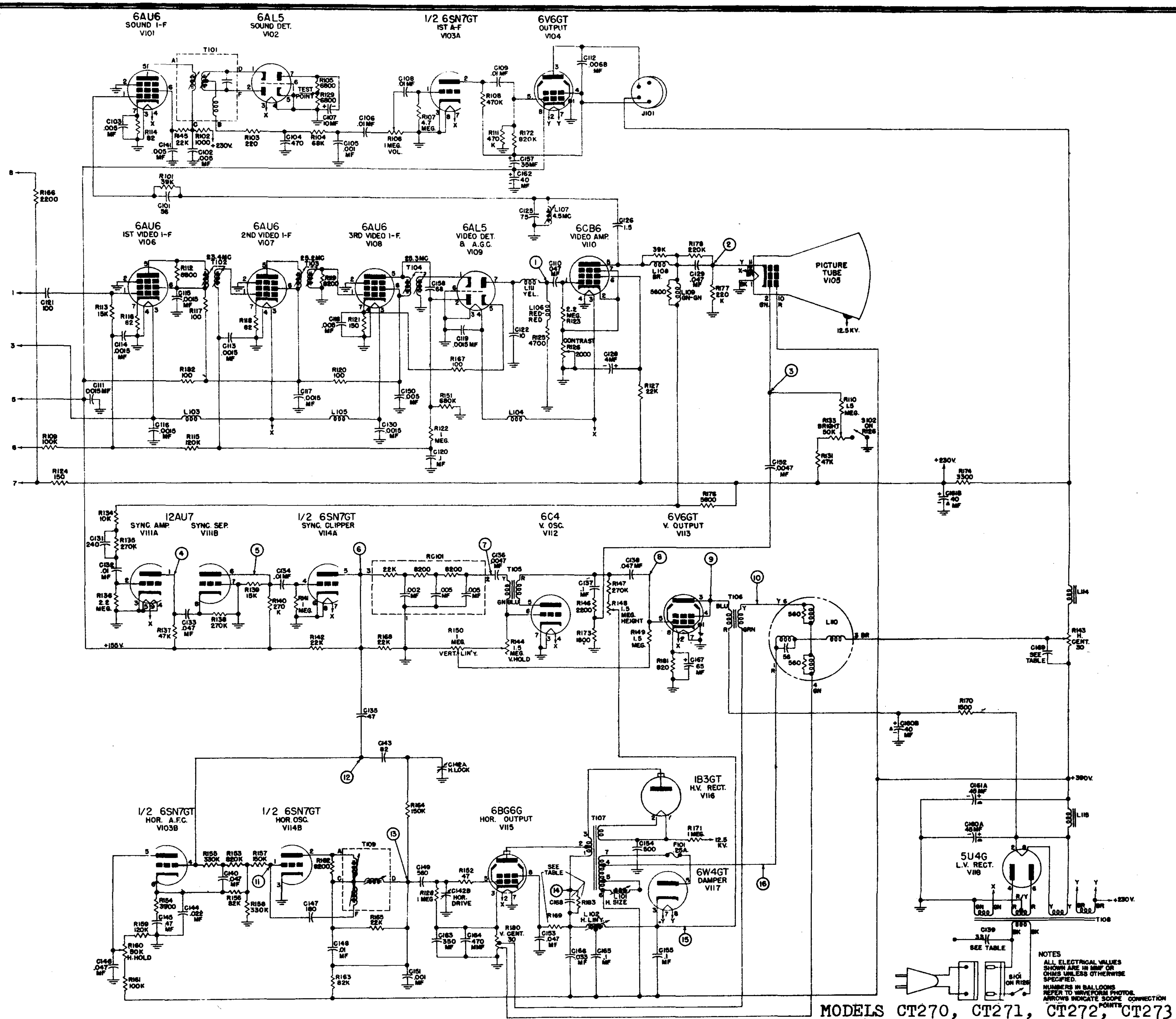
VOLTAGE CHART

Measurements made with receiver operating on 117 volts 60 cycles AC, with a strong signal input. Measurements made with Voltohmist type VTVM, between indicated terminal and chassis ground.

TUBE NO.	TUBE TYPE	FUNCTION	PLATE PIN NO.	PLATE VOLTS	SCREEN PIN NO.	SCREEN VOLTS	CATHODE PIN NO.	CATHODE VOLTS	GRID PIN NO.	GRID VOLTS
V-101	6AU6	Sound IF	5	215	6	150	7	1.1	1	0
V-102	6AL5	Sound Det.	7	-0.6			1	-0.4		
V-102	6AL5	Sound Det.	2	-0.3			5	0		
V-103A	6SN7GT	1st A.F.	2	215			3	0	1	-0.7
V-103B	6SN7GT	Hor. AFC	5	195			6	-8	4	-35
V-104	6V6GT	Output	3	368	4	392	8	158	5	140
V-105		Picture Tube	x	13KV	10	400	11	74	2	26
V-106	6AU6	1st Video IF	5	168	6	168	7	0.2	1	-3.8
V-107	6AU6	2nd Video IF	5	170	6	170	7	0.18	1	-3.9
V-108	6AU6	3rd Video IF	5	168	6	168	7	1.55	1	0
V-109	6AL5	Video Det.	7	-3.1			1	0		
V-109	6AL5	AGC	2	-4			5	1.55		
V-110	6CB6	Video Amp.	5	135	6	132	7	2	1	1
V-111A	12AU7	Sync. Amp.	1	130			3	0	2	-43
V-111B	12AU7	Sync.Sep.	6	8.3			8	81	7	0
V-112	6C4	Vert. Osc.	5	200			7	0	6	-81
V-113	6V6GT	Vert.Output	3	378	4	378	8	11.5	5	-24.5
V-114A	6SN7GT	Sync. Clipper	5	47			6	0	4	-1.1
V-114B	6SN7GT	Hor. Osc.	2	225			3	0	1	-94
V-115	6BG6G	Hor. Output	Do not meas.		8	290	3	2.6	5	-26
V-117	6W4GT	Damper	Do not meas.				3	600		

RF tube voltages vary with AGC.
Osc. and Mixer voltages vary with switch setting.
Video Ampl. plate and screen varies with different tubes.
Do not measure Horiz. Output plate or Damper plate with VTVM. Pulses cause grid rectification in meter so reading is meaningless and HV pulses may damage meter.

Ref. No.	Part No.	Description
	700349-1	RF Tuner Unit
T1	360490-2	Antenna Input Transformer
L1	360372-1	Insulated RF Choke
L4	360468-1	Converter Coil
C1	250176-4	Capacitor, ceramic, 15 mmf., 500 V.
C2	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C3	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C4	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C5	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C6	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C7	250164-7	Capacitor, ceramic, .68 mmf., 500 V.
C9	250164-8	Capacitor, ceramic, 1.5 mmf., 500 V.
C10	250164-6	Capacitor, ceramic, .5 mmf., 500 V.
C11	250176-6	Capacitor, ceramic, 100 mmf., 500 V.
C12	250164-13	Capacitor, ceramic, 2.2 mmf., 500 V.
C13	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C16	250088-57	Capacitor, ceramic, 3 mmf., 500 V.
C17	250188-1	Trimmer
C18	250176-4	Capacitor, ceramic, 15 mmf., 500 V.
C19		Fine Tuner
C20	250176-18	Capacitor, ceramic, 470 mmf., 500 V.
C21	250176-12	Capacitor, ceramic, 10 mmf., 500 V.
R1	230104-78	Resistor, carbon, 22K ohm, 1/2 W.
R2	230105-72	Resistor, carbon, 6800 ohm, 1 W.
R3	230105-76	Resistor, carbon, 15K ohm, 1 W.
R4	230104-62	Resistor, carbon, 1000 ohm, 1/2 W.
R5	230104-72	Resistor, carbon, 6800 ohm, 1/2 W.
R6	230104-90	Resistor, carbon, 220K ohm, 1/2 W.
R9	230104-78	Resistor, carbon, 22K ohm, 1/2 W.
R10	230105-72	Resistor, carbon, 6800 ohm, 1 W.
R12	230104-82	Resistor, carbon, 47K ohm, 1/2 W.
R13	230104-68	Resistor, carbon, 3300 ohm, 1/2 W.
R15	230104-66	Resistor, carbon, 2200 ohm, 1/2 W.
R16	230104-86	Resistor, carbon, 100K ohm, 1/2 W.
L101	360357-1	Horiz. Size Coil
L102	360358-1	Horiz. Lin. Coil
L103	360332-11	Filament Choke
L104	360372-1	Filament Choke
L105	360372-1	Filament Choke
L106	360443-2	Peaking Coil
L107	360481-1	4.5 Mc. Trap
L108	360443-13	Peaking Coil
L109	360443-14	Peaking Coil
L110	360462-6	Deflection Yoke
L111	360443-12	Peaking Coil
L114	320041-3	Filter Choke
L115	320041-3	Filter Choke



C169	OMIT	80MF					
C168	OMIT	.1MF					
R183	OMIT	1000					
R169	39K	28,300					
ITEM	A	B					
	ELECTRICAL VALUES						

CT270
LESS R-F UNIT
595435

MODELS CT270, CT271, CT272, CT273, CT274, CT275, CT276, CT277, CT278, CT279, CT280, CT281, CT282

MODELS CT270, CT271, CT272, CT273, CT274, CT275, CT276, CT277, CT278, CT279, CT280, CT281, CT282

ADDENDA

Ref. No.	Part No.	Description
C140	250203-11	Capacitor, Paper, .047 mfd., 600 V.
C141	250175-1	Capacitor, Ceramic, 5000 mmf., 450 V.
C142	260106-3	Trimmer Condenser
C143	250187-52	Capacitor, Mica, 82 mmf., 500 V.
C144	250203-9	Capacitor, Paper, .022 mfd., 600 V.
C145	250205-17	Capacitor, Paper, .047 mfd
C146	250203-11	Capacitor, Paper, .047 mfd., 600 V.
C147	250159-53	Capacitor, Mica, 180 mmf., 5%, 500 V.
C148	250161-47	Capacitor, Mica, 10,000 mmf., 300 V.
C149	250159-130	Capacitor, Mica, 560 mmf., 500 V.
C150	250175-1	Capacitor, Ceramic, 5000 mmf., 450 V.
C151	250160-64	Capacitor, Mica, 1000 mmf., 500 V.
C152	250203-5	Capacitor, Paper, .0047 mfd., 600 V.
C153	250203-11	Capacitor, Paper, .047 mfd., 600 V.
C154	250189-1	H.V. Condenser
C155	250203-13	Capacitor, Paper, .1 mfd., 600 V.
C156	250203-4	Capacitor, Paper, .0033 mfd., 600 V.
C157	270027-16	Capacitor, Electrolytic
C158	250207-13	Capacitor, Ceramic, 68 mmf., 500 V.
C160	270021-39	Capacitor, Electrolytic
C161	270021-39	Capacitor, Electrolytic
C162	270027-15	Capacitor, Electrolytic
C163	270027-18	Capacitor, Electrolytic
C164	250159-90	Capacitor, Mica, 470 mmf., 500 V.
C165	250203-13	Capacitor, Paper, .1 mfd., 600 V.
C166	250203-10	Capacitor, Paper, .033 mfd., 600 V.
C167	270027-17	Capacitor, Electrolytic
R101	230104-81	Resistor, carbon, 39K ohm, 1/2 W.
R102	230104-62	Resistor, Carbon, 1K ohm, 1/2 W.
R103	230104-54	Resistor, Carbon, 220 ohm, 1/2 W.
R104	230104-84	Resistor, carbon, 68K ohm, 1/2 W.
R105	230094-179	Resistor, carbon, 6800 ohm, 5%, 1/2 W.
R106	220076-19	Potentiometer, Volume
R107	230104-106	Resistor, carbon, 4.7 megohm, 1/2 W.
R108	230105-94	Resistor, carbon, 470 K ohm, 1 W.
R109	230104-86	Resistor, carbon, 100K ohm, 1/2 W.
R110	230104-86	Resistor, carbon, 100K ohm, 1/2 W.
R111	230094-223	Resistor, carbon, 470K ohm, 5%, 1/2 W.
R112	230104-72	Resistor, carbon, 6800 ohm, 1/2 W.
R113	230104-76	Resistor, carbon, 15K ohm, 1/2 W.
R114	230104-49	Resistor, carbon, 82 ohm, 1/2 W.
R115	230104-87	Resistor, carbon, 120K ohm, 1/2 W.
R116	230104-49	Resistor, carbon, 82 ohm, 1/2 W.
R117	230104-50	Resistor, carbon, 100 ohm, 1/2 W.
R118	230105-49	Resistor, carbon, 82 ohm, 1/2 W.
R119	230104-73	Resistor, carbon, 8200 ohm, 1/2 W.
R120	230104-50	Resistor, carbon, 100 ohm, 1/2 W.
R121	230104-52	Resistor, carbon, 150 ohm, 1/2 W.
R122	230104-98	Resistor, carbon, 1 megohm, 1/2 W.
R123	230104-102	Resistor, carbon, 2.2 megohm, 1/2 W.
R124	230104-52	Resistor, carbon, 150 ohm, 1/2 W.

Ref. No.	Part No.	Description
R125	230104-70	Resistor, carbon, 4700 ohm, 1/2 W.
R126	220076-42	Potentiometer, Contrast
R128	230104-98	Resistor, Carbon, 1 Meghohm, 1/2 W.
R129	230094-179	Resistor, Carbon, 6800 ohm, 5%, 1/2 W.
R131	230105-82	Resistor, Carbon, 47K ohm, 1W.
R133	220076-15	Potentiometer, Brightness
R134	230104-74	Resistor, carbon, 10K ohm, 1/2 W.
R135	230104-91	Resistor, Carbon, 270 K ohm, 1/2 W.
R136	230104-102	Resistor, Carbon, 2.2 Meghohm, 1/2 W.
R137	230104-82	Resistor, Carbon, 47K ohm, 1/2 W.
R138	230104-91	Resistor, Carbon, 270K ohm, 1/2 W.
R139	230104-76	Resistor, Carbon, 15K ohm, 1/2 W.
R140	230104-91	Resistor, Carbon, 270K ohm, 1/2 W.
R141	230104-98	Resistor, Carbon, 1 Meghohm, 1/2 W.
R142	230105-78	Resistor, Carbon, 22K Ohm, 1 W.
R143	220076-9	Potentiometer, Horiz. Centering
R144	220076-37	Potentiometer, Vertical Hold
R145	230104-78	Resistor, Carbon, 22K ohm, 1/2 W.
R146	230104-69	Resistor, Carbon, 3900 ohms, 1/2 W.
R147	230104-91	Resistor, Carbon, 270K ohm, 1/2 W.
R148	220076-28	Potentiometer, Vertical Height
R149	230104-100	Resistor, Carbon, 1.5 Meghohm, 1/2 W.
R150	220076-41	Potentiometer, Vertical Linearity
R151	230104-96	Resistor, Carbon, 680K ohm, 1/2 W.
R152	230104-46	Resistor, Carbon, 47 Ohm, 1/2 W.
R153	230104-97	Resistor, Carbon, 820K ohm, 1/2 W.
R154	230104-69	Resistor, Carbon, 3900 ohm, 1/2 W.
R155	230104-92	Resistor, Carbon, 330K ohm, 1/2 W.
R156	230104-85	Resistor, Carbon, 82K ohm, 1/2 W.
R157	230104-88	Resistor, Carbon, 150K ohm, 1/2 W.
R158	230104-92	Resistor, Carbon, 330K ohm, 1/2 W.
R159	230104-87	Resistor, Carbon, 120K ohm, 1/2 W.
R160	220076-15	Potentiometer, Horiz. Hold
R161	230104-86	Resistor, Carbon, 100K ohm, 1/2 W.
R162	230104-73	Resistor, Carbon, 8200 ohm, 1/2 W.
R163	230105-85	Resistor, Carbon, 82K ohm, 1 W.
R164	230104-88	Resistor, Carbon, 150K ohm, 1/2 W.
R165	230104-78	Resistor, Carbon, 22K ohm, 1/2 W.
R166	230105-66	Resistor, Carbon, 2200 ohm, 1 W.
R167	230104-50	Resistor, Carbon, 100 ohm, 1/2 W.
R168	230104-78	Resistor, Carbon, 22K ohm, 1/2 W.
R169	240021-19	Resistor, W.W., 38K ohm, 10%, 10W.
R170	230106-64	Resistor, Carbon, 1500 Ohm, 2 W.
R171	230105-98	Resistor, Carbon, 1 Meghohm, 1 W.
R172	230094-229	Resistor, Carbon, 820K ohm, 5%, 1/2 W.
R174	240021-18	Resistor, W.W. 3300 ohm, 10%, 10 W.
R176	230106-71	Resistor, Carbon, 5600 ohm, 2 W.
R177	230104-90	Resistor, Carbon, 220K ohm, 1/2 W.
R178	230104-90	Resistor, Carbon, 220K ohm, 1/2 W.
R180	220076-10	Potentiometer, Vertical Centering
R181	230105-61	Resistor, Carbon, 820 ohm, 1 W.
R182	230104-50	Resistor, Carbon, 100 ohm, 1/2 W.

The chassis described herein are referred to as the 102 series. Several modifications have been proposed or added to the list. The complete series at this writing includes:

CHASSIS	PICTURE TUBE	TYPE	AUDIO AMPLIFIERS	HEIGHT OF PICTURE TUBE CENTER
CT270	14"	Rectangular	Self Contained	9"
"271	"	"	None needed. Radio used	9
"272	16"	"	Self Contained	9 1/2
"273	"	"	None needed. Radio used	9 1/4
"274	"	Round	Self Contained	11 1/4
"275	"	"	None needed. Radio used	11 1/4
"276	14"	Rectangular	Self Contained	9 1/2
"277	16"	"	Self Contained	10 1/8
"278	"	"	None needed. Radio used	10 1/8
"279	"	"	Self Contained	11 1/4
"280	17"	"	Self Contained	10 1/8
"281	"	"	None Needed. Radio used	10 1/8
"282	"	"	Self Contained	11 1/4

Due to the different methods of electron gun structure, the rectangular tubes require different gauss ion traps. The following chart identifies the trap required for each type of tube.

TUBE			ION TRAP	
RECTANGULAR	BRAND	RMA CODE	PART NO.	CODE
14BP4	Nat. Video		360492-2	Yellow
14BP4	Rauland		360492-2	Yellow
14CP4	General Electric	188	360492-2	Yellow
14CP4	Nat. Union	247	360492-2	Yellow
14CP4	Dumont	157	360492-2	Yellow
16KP4	General Electric	188	360492-2	Yellow
16KP4	Sheldon	636	360492-1	Blue
16TP4	Arcturus		360492-1	Blue
16TP4	Dumont	157	360492-2	Yellow
16TP4	Hytron	210	360492-1	Blue
16TP4	Nat. Video		360492-1	Blue
16TP4	Rauland		360492-2	Yellow
16TP4	Remington Rand	283	360492-1	Blue
16TP4	Sheldon	636	360492-1	Blue
16TP4	Sylvania	312	360492-1	Blue
16RP4	American TV	551	360492-1	Blue
16RP4	Eureka		360492-1	Blue
16RP4	Hytron	210	360492-2	Yellow
16RP4	Raytheon	280	360492-2	Yellow
16RP4	Thomas		360492-1	Blue
16RP4	Federal T&R	179	360492-2	Yellow
17AP4	Dumont	157	360492-2	Yellow
17AP4	Thomas Electr.		360492-1	Blue
17BP4	General Electric	183	360492-2	Yellow
17BP4	Nat. Union	247	360492-2	Yellow

Round	Brand	Ion Trap
16GP4	All	360450-3 Yellow