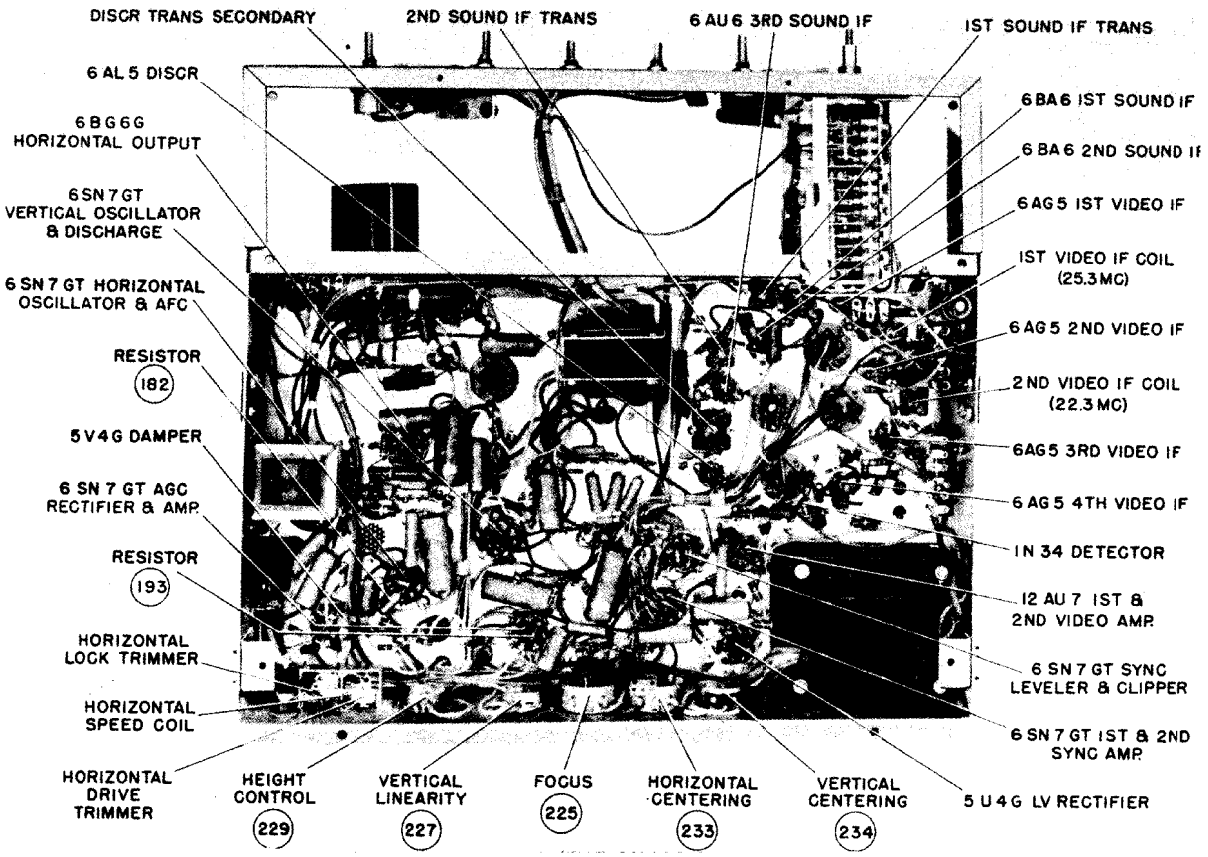


BOTTOM VIEW OF THE CHASSIS

TUBE COMPLEMENT*

(Tubes in R-F Units Given in a Later Section)

FUNCTION	TYPE	TYPE	FUNCTION
1st Sound I-F Amplifier	6BA6	½ 12AU7	2nd Video Amplifier
2nd Sound I-F Amplifier	6BA6	6SN7GT	Sync Amplifier
3rd Sound I-F Amplifier	6AU6	6SN7GT	Sync Leveler & Clipper
Sound Discriminator	6AL5	6SN7GT	Vertical Oscillator, Amp.
1st Audio Amplifier	6SF7	6SN7GT	Horizontal Oscillator, A. F. C.
Audio Output	6V6GT	6BG6G	Horizontal Sweep Output
1st Video I-F Amplifier	6AG5	6SN7GT	AGC Rect., Amp.
2nd Video I-F Amplifier	6AG5	1B3GT/8016	High Voltage Rectifier
3rd Video I-F Amplifier	6AG5	5V4G	Horizontal Damper
4th Video I-F Amplifier	6AG5	5U4G	Power Supply Rectifier
1st Video Amplifier	½ 12AU7	12KP4, 10BP4, 10FP4, 12LP4	Picture Tube
Total	24 Tubes		

*See tube complement of R-F units.

TELEVISION FREQUENCIES, MC.

Picture I-F	25.75	21.25	Co-channel sound trap
Sound I-F	21.25	19.75	Adjacent channel picture trap
Adjacent channel sound trap	27.25	.30	Discriminator band width
Video Amplifier Compensation	to 4 mc.		

PART I
DESCRIPTION AND SPECIFICATIONS

The Magnavox CT 219-220-222 chassis is a 24 tube receiver incorporating either a 10" or 12½" direct viewing picture tube, optional without electrical or mechanical modifications. The three chassis are identical excepting the R-F unit subassembly:

CT 219 Television chassis with 13 channel R-F unit, coil-selection of channels.

CT 220 Television chassis with 12 channel R-F unit, coil-selection of channels, adjustment of coils in the upper channels by compression of coils. Underside of unit is enclosed by a metallic shield.

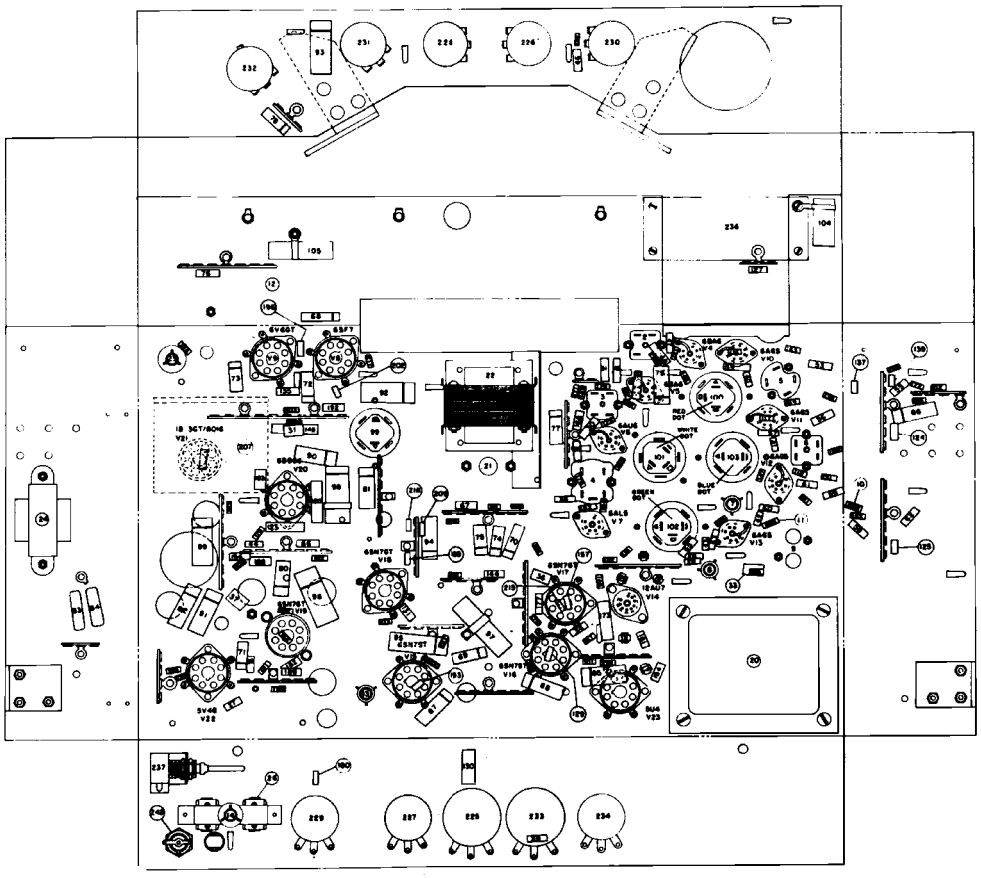
CT 222 Television chassis with 12 channel R-F unit, continuous condenser-tuning between channels in either group.

The service technician will be pleased to note the ready accessibility of component parts for servicing, including removal of the front cabinet panel for picture tube exchange and installation.

In this manual will be seen no technical circuit analysis. Since basic analytical information is common between this and some other Magnavox television receiver products, this is presented in a separate technical manual covering such discussion.

No sacrifice has been made in engineering design or performance characteristics, in the interests of tube-economy; the receiver exhibits equal or more sensitivity than do instruments employing from 5 to 7 more tubes, and noise-immunity is improved over that of systems using variable pulse-amplitude in horizontal AFC circuits. Technical features include:

- 4 stages of video I-F amplification, stagger-tuned for reduced phase distortion and for increased stability and for ease of alignment.
- Three stages of high gain sound I-F amplification.
- Two stages of video amplification, two stages of audio amplification.
- Direct-coupled video amplifiers, eliminating necessity for DC reinsertion.
- Either self-contained audio system (used in modular units) or plug connection to use the audio amplifier and speaker system of a companion radio-chassis.
- MAGNALOK horizontal AFC circuit. Frequency control is by variable width of a converted sync pulse, rather than variable amplitude. Since interference is for the most part AM, this results in improved noise immunity in horizontal scanning.
- Amplified automatic gain control. Affords maximum uniformity of reproduction when switching between stations and reduces fading. Less necessity for adjusting picture and brightness controls.
- Non-hazardous high voltage supply.
- Choice of 10 or 12½ inch picture tube without circuit modification.

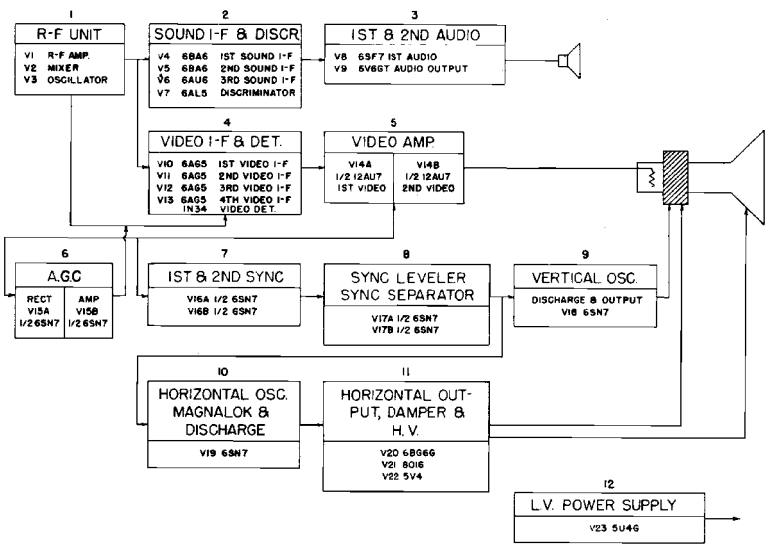


BOTTOM VIEW OF THE CHASSIS

Channel No.	Limits	Picture Carrier	Sound Carrier	Local Osc.
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

300 ohm—Antenna input **IMPEDANCE** Speaker Coil 3.2 ohm
250 W. at 115 V., 60 c.p.s. **POWER** Audio—2.5 W. undistorted, 4 W. Max.
Chassis 19" wide, 17" deep, 10⅝" high **SIZE** Picture—7⅞"x10½" (12KP4)
7"x9" (10FP4, 10BP4)

FUNCTIONAL DIAGRAM



RECEIVER OPERATING INSTRUCTIONS

1. Turn the SOUND OFF-ON volume control to the right ½ turn.

2. Set the STATION SELECTOR to the desired channel number.

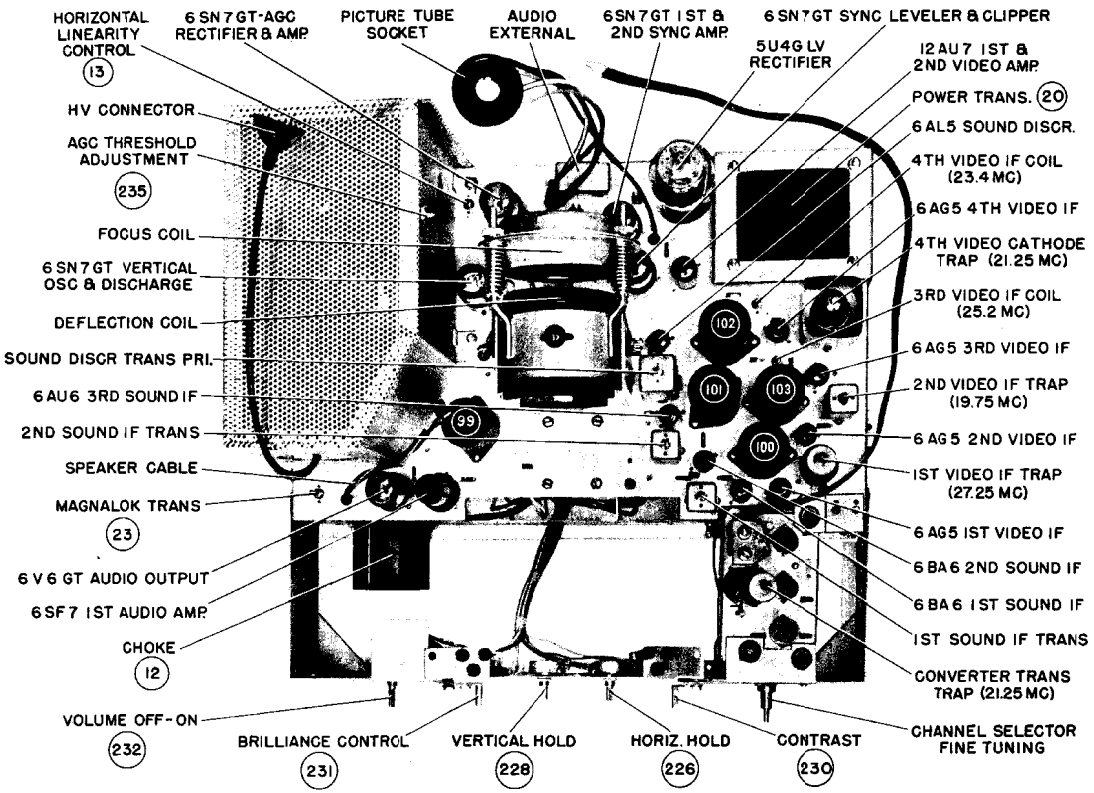
3. Adjust the FINE TUNING control for best quality sound.

4. Adjust the BRIGHTNESS control for suitable picture brilliance.

5. Now adjust the PICTURE control until the picture has the proper degree of contrast.

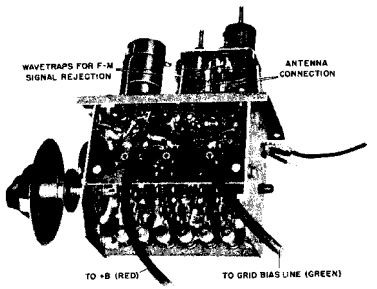
5. If necessary adjust the BRIGHTNESS and PICTURE controls for best picture quality.

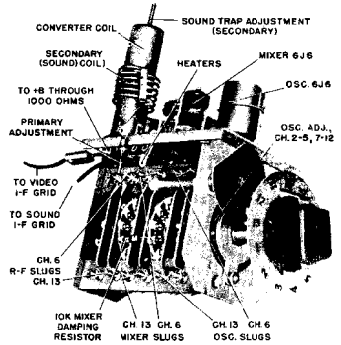
The small control knobs marked VERTICAL and HORIZONTAL will rarely require adjustment after they are properly set. If the picture "rolls" up or down, turn the VERTICAL knob to the left as far as possible then advance to the right until the picture stops moving. If the picture is not centered horizontally or if it is broken up, adjust the HORIZONTAL control knob to frame the picture.



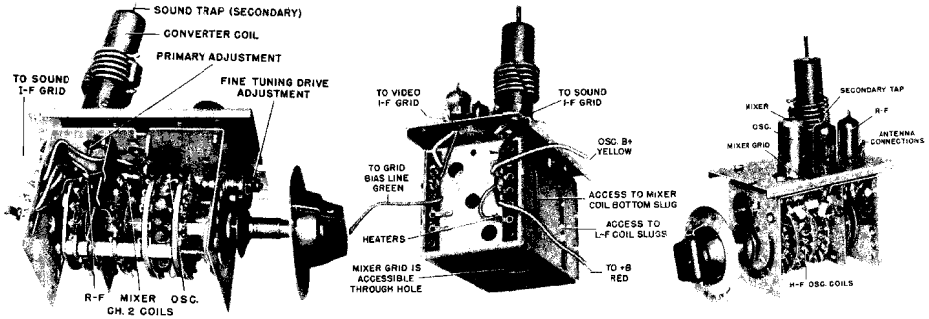
TOP VIEW OF THE CHASSIS

PART II
PARTS IDENTIFICATION



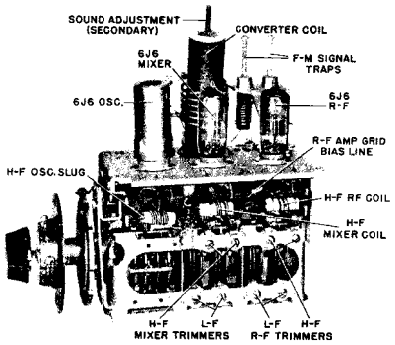


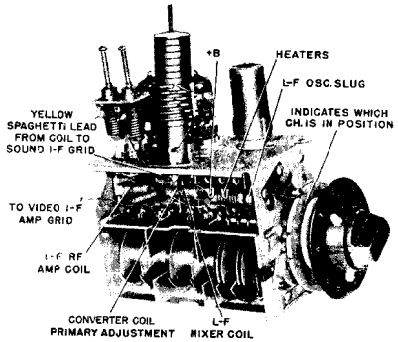
R-F UNIT OF THE CT 219 CHASSIS



OSC 6C4, MIXER 6AG5, R-F AMP 6BH6

R-F UNIT OF THE CT 220 CHASSIS





R-F UNIT OF THE CT 222 CHASSIS

PART III
INSTALLING THE PICTURE TUBE

SETTING UP FOR OPERATION

The receiver chassis is designed to incorporate either the 10" (10FP4, aluminized, or 10BP4) or the 12½" (12KP4 aluminized, or 12LP4) tubes. It is necessary, in changing tube size, to make the mechanical adjustments necessary, to properly center the tube within the proper mask. Instructions for gaining access to the chassis for tube insertion without removing the chassis from the cabinet are given in published specification sheets applicable to the several cabinet styles.

In using the 12LP4 tube which is longer than the 12KP4, it is necessary that the tube extend through the cabinet back-cover. A metallic cup then is placed over the tube socket for protection. Part No. of the metallic cup with black finish is 633857-5.

There have been in production, two styles of deflection coil mounting brackets. These are shown – – – – representing early and late production.

It is seen that there are two nut-secured tube support brackets having rubber buffer pads which raise or lower the bell-end of the tube. Wing-nut adjustments raise or lower the deflection and focus coils. Note that the angle-bracket below the focus coil is reversed between 10" and 12½" installations. Furthermore, coil-alignment along the axis of the tube is permitted by slotted sections. It is important that the deflection coil be pushed forward as far as it will go, with the tube in place. If the spring-loops at the front of the coil assembly do not touch the tube surface, they should be bent inward; these are grounding springs.

A single wing-screw atop the deflection coil permits loosening the deflection coil for angular rotation, in rotating the overall picture upon the face of the tube.

INSERTING THE TUBE

The tube is inserted into the coil assembly with the anode terminal up.

The strap with a spring at each end is attached to the tube support brackets, and slipped over the bell of the tube. (It is convenient to attach the strap before tube insertion, allow the strap to hang over the neck of the tube as it is inserted, then pull the strap over the bell after insertion.) Attach the anode plug and tube socket. After determining that tube positioning is such that it is centered in the front-panel mask and making any adjustments necessary to this end, and that the picture is "squared" within the mask, tighten all adjustments.

ADJUSTING THE ION TRAP

10FP4 and 12KP4 tubes incorporate an aluminized screen and so do not use an ion trap. 10BP4 and 12LP4 tubes use the ion trap, which should be installed and adjusted as follows:

Slip the trap magnet over the neck of the tube, behind the focus coil, with the arrow pointing forward. With the receiver turned on and the brightness control advanced, move the magnet back and forth on the tube and at the same time, rotate slightly while watching the tube face.

As soon as some light appears, move the magnet carefully to obtain a square-cornered raster simultaneous with maximum screen brightness.

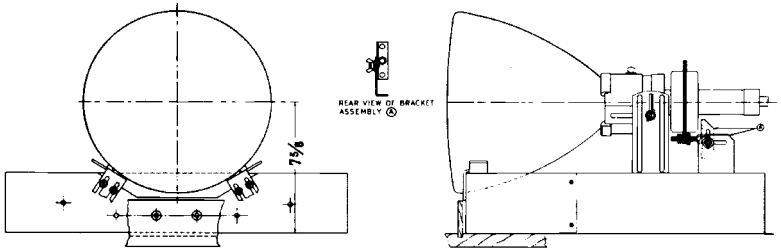
Adjust focus and brightness controls until maximum screen brightness is had, *with sharp focus.*

Again, adjust magnet for square-corners and maximum brightness evenly-distributed over screen.

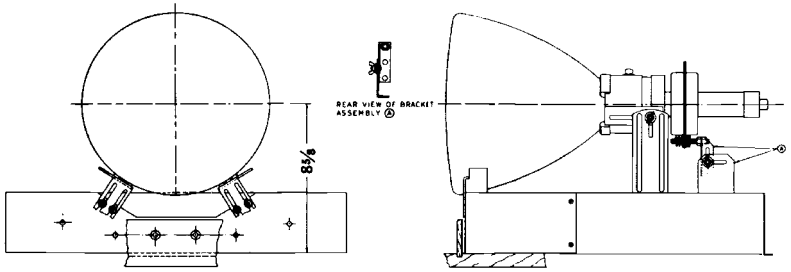
ALIGNMENT OF HORIZONTAL DEFLECTION CIRCUITS

a. Check of Horizontal Hold Control.
   (1) Allow a five minute warm up period before making this check.
   (2) Rotate the Horizontal Hold Control from its extreme counterclockwise position. The picture should remain in synchronization. Return the control to its extreme counterclockwise position and momentarily interrupt the signal by switching to another channel and back again. The picture should fall out of synchronization and show from 4 to 5 bars slanting *upward to the right.*
   (3) If this condition does not occur adjust the Horizontal Speed Control (rear chassis adjustment) until synchronization of the picture is obtained as described above.

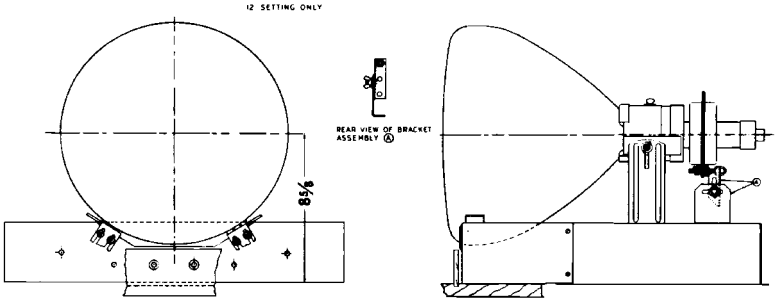
b. Alignment of Horizontal Sync Circuits.
If the Horizontal Hold Control fails to perform as described above and it cannot be corrected by adjusting the Horizontal Speed Control it will be necessary to make the foling adjustments:
   (1) Set the Horizontal Hold Control to the full clockwise position.
   (2) Adjust the Horizontal Lock Trimmer to at least two turns counterclockwise from maximum tightness. Do not force the tight adjustment to determine this setting.
   (3) Short circuit the Horizontal Speed Coil which is mounted between the Horizontal Drive and Lock trimmers. Access to this coil may be attained by removing the metal shield located on the bottom of the receiver cabinet.
   (4) With an RMA video signal introduced and with the manual Horizontal Hold Control at full CLOCKWISE position, set the iron core adjustment of the Magnalok transformer to frame the picture. This adjustment is located di-



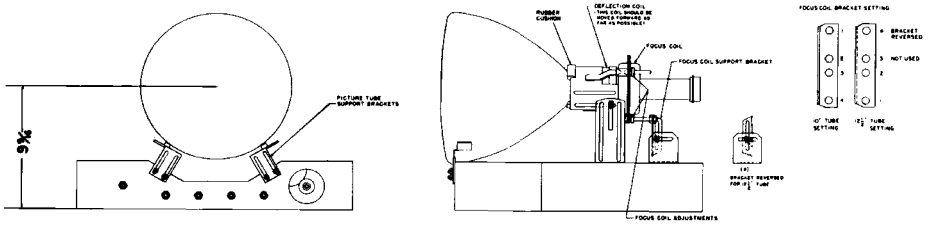
10" ALIGNMENT FOR METROPOLITAN MV9 ONLY, EARLY PRODUCTION



10" TUBE ALIGNMENT FOR ALL EXCEPT METROPOLITAN MV9, EARLY PRODUCTION



12" TUBE ALIGNMENT, EARLY PRODUCTION



10", 12" TUBE ALIGNMENT, LATE PRODUCTION

rectly in front of the high voltage compartment near the 6V6 audio output tube.

(5) Remove the short from the Horizontal Speed Coil and adjust the Horizontal Speed Control for proper synchronization as described in check of Horizontal Hold Control.

FIELD SERVICE ADJUSTMENT

If the circuit proves unstable in service it may be advantageous to either change the 6SN7 horizontal oscillator tube (V-19) or to reset to allow for more drift. Repeat adjustment 5 so that the picture just moves over intact with the manual control on the front panel at maximum clockwise rotation.

This will result in the loss of sync at the maximum counterclockwise position of the control when the signal is removed momentarily. However, more manual control is provided to take care of drift and the owner can be advised to set this control at approximately mid position for best stability.

PICTURE ADJUSTMENT

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS:

Adjust the HEIGHT control until the picture just fills the mask vertically. Adjust VERTICAL LINEARITY control until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering control to align the picture with the mask.

WIDTH AND LINEARITY:

The screw driver control marked HORIZONTAL DRIVE should be adjusted for best width and linearity. Adjust the HORIZONTAL LINEARITY control (located at rear of chassis near high voltage compartment) for best linearity of right side of picture.

CENTERING CONTROLS:

The VERTICAL and HORIZONTAL centering controls (located on the rear chassis apron) should be adjusted so that the picture is correctly centered with the mask. If the centering control settings are too close to one side, the focus coil is incorrectly positioned and it should be re-oriented.

CHECK OF RF OSCILLATOR ADJUSTMENTS:

The FINE TUNING control should be checked to determine the accuracy of tuning. If adjustments are required, they should be made by the method outlined in the oscillator alignment.

AUTOMATIC GAIN CONTROL

AGC Threshold adjustment (control mounted on side of high voltage compartment).

a. Apply a 1000 to 50,000 microvolt television signal to the antenna terminals.
b. Connect an oscilloscope to the grid of the picture tube.
c. Set the PICTURE control to its maximum clockwise position.
d. Adjust the AGC THRESHOLD control for a 40 volt peak to peak signal on the oscilloscope.

If an oscilloscope is not available, the following method may be used:

a. Apply a 1000 to 50,000 microvolt television signal to the antenna terminals.
b. Set the PICTURE control in the middle of its range.
c. Using the BRILLIANCE control to adjust picture brilliance and the AGC THRESHOLD control to adjust contrast, adjust for a medium brilliance picture having the proper contrast.

ADJUSTING THE ANTENNA TRAPS

In some instances interference may be encountered from FM stations that are on the image frequency of a television station.

The CT 219 and CT 222 incorporates a series resonant trap across the R-F amplifier grid circuit to eliminate this type of interference.

To adjust the trap, tune in the station on which the interference is observed, tune both cores of the trap for minimum interference in the picture. Keep both cores approximately the same by visual inspection, then turn one core ½ turn from the original position and repeak the second for maximum rejection. Repeat this process until the best rejection is obtained.

FINAL INSPECTION

Check all adjustments and tighten for permanency. Tune in all available television stations and observe the picture for detail and for the presence of interference or reflections.

SOUND REPRODUCTION

As will be noted by inspection of the schematic diagram, a two-stage audio amplifier is incorporated. There is audio take-off ahead of these stages, so that sound reproduction may be through the audio reproducing system of an AM-FM chassis, either that included in the instrument, or another. There is available for such connection to a separate unit, a connecting cable, Part No. 460562-2 (2′ long) or 460562-4 (4′ long) is used.

In the event that the "TV" or other audio input connection to the separate instrument are already in use for an FM converter, wire-recorder or other signal-source, a switching relay is available. This incorporates an adapter which should be inserted into the 6SN7GT (V-18) socket to pick up 6.3V for relay excitation, and the tube plugged into the adapter. This switch assembly is Part No. 160195-1, and may be ordered from the factory service department. Thereby, two signal-sources (one the television receiver) may be applied to a single input connection on the AM-FM chassis. Installation instructions are supplied with each switching unit.

PART IV
CIRCUIT MODIFICATIONS

The following circuit modifications have been made in the receiver, designated on the chassis by a "B" suffix to the model number on the rear of the chassis:

CT 219A, CT 220A, CT 222A.

In production, the "A" suffix is not attached to the model number; a stamp "CT 220" in reality indicates the first-run chassis or "CT 220A". It differs from the later chassis, marked "CT 220B" only as noted below.

CT 219B, CT 220B, CT 222B.

(1) H. F. response of the audio system is reduced by (a) placing a 270 mmfd. condenser from the "high" side of the volume control to ground. (b) changing the value of R176 in the audio discriminator output from 22 K to 100 K.

(2) The bottom of R192 (220K), 6SF7 audio amplifier plate load, connects to pin 1 of the speaker socket instead of to pin 2.

(3) There are some physical changes in the chassis; relocation of some terminal (tie lug) strips and lead length of the power transformer is not the same. These changes do not, of course, appear in the schematic. The bottom-chassis views – – – – – – show the "A" chassis, CT 222.

PART V
I-F, R-F ALIGNMENT

In aligning the amplifiers, it must be remembered that feedback between output and input circuits leads to regeneration and, if feedback be appreciable, to oscillation. It may be determined whether the amplifier is oscillating as follows:

Increasing signal generator output by a factor of (for example) two should result in a rise in output voltage in approximately the same degree. If, instead, a decrease in output with increased input is noted and if there be a steady output voltage as indicated on the V.T.V.M. even without input signal, the circuit is oscillating.

Regeneration insufficient to cause oscillation gives rise to distortion of the reproduced response curve, and proper alignment is not possible in such event.

Regeneration may be caused by poor bonding between the chassis of the receiver and of test equipment being used. Connection should be made by short, heavy leads. Many service organizations use a metallic sheet (galvanized iron is satisfactory) atop the bench which affords good R-F grounding between chassis, even though they are not conductively connected thereto.

After the several connections of equipment are made and a pattern being reproduced, it must be possible to place the hand at various points of the equipment chassis and along the interconnecting cables, with no visible change in output potential or wave form. Failure to attain this probably means that regeneration is present, better grounding is necessary and subsequent alignment adjustments are questionable.

It may be necessary, to realize such a condition in the absence of a metal-topped bench, to employ two or more short bonding wires between chassis, connected at different points.

SOUND DISCRIMINATOR ALIGNMENT

Connect output of the signal generator to the third I-F grid and set output of signal generator for approximately one volt at 21.25 mc. Connect Voltohmyst Jr. in series with one megohm resistor to junction of diode load resistors (183) and (184). Adjust primary core of 3rd Sound I-F Transformer (4) for maximum d-c output. Move Voltohmyst to output of discriminator (V7 Pin 1) and adjust secondary core of 3rd Sound I-F Transformer (4) for zero d-c output. Readjust transformer (4) primary for symmetrical plus or minus d-c output on either side of 21.25 mc.

The sweep, in conjunction with marker signals, can also be used to align the discriminator but the center cannot be set as accurately using this method.

The peak to peak bandwidth of the discriminator should be approximately 350 kc and it should be linear from 21.175 mc to 21.325 mc.

To observe the response curve on the oscillograph, connect the sweep generator to the 3rd I-F grid and the oscilloscope to the audio takeoff point, pin 1 of the 6AL5 discriminator, V-7. The sweep should center at 21.25 mc, with sweep width sufficient to produce the "S" curve.

SOUND I-F ALIGNMENT

Connect sweep output to first I-F grid. Connect oscilloscope to third I-F grid return (high end of resistor 175) and adjust transformer (2) and (3) for maximum gain at 21.25 mc and symmetry about 21.25 mc. The output level from the sweep should be set to produce approximately 0.3 volt peak to peak at the third sound I-F grid return. The bandwidth at seventy per cent response from the first sound I-F grid to the third sound I-F grid should be approximately 200 kc. If a 60 cycle sweep rate is used, it will be necessary to reduce the time constant in the second sound I-F grid circuit in order to reproduce the response curve. To do this, shunt resistor (175) with approximately 5600 ohms.

R-F UNIT ALIGNMENT

Since there are represented, three distinctly separate R-F units, alignment procedures must be covered in three parts. However, basic considerations remain throughout, common between the three.

For example, local oscillator adjustment is made by inserting into the antenna terminals an R-F signal of frequency equal to that of the sound carrier of the particular channel being aligned. Assuming that the sound discriminator has been previously carefully aligned, adjustment is such that the converted R-F signal falls at the center of the discriminator "S" curve. It should, thus, be converted to precisely 21.25 mc. Local oscillator tuning is to zero discriminator output, between two peaks, indicated either by listening to the speaker (using an A-M generator), or by measure of D-C discriminator output (using unmodulated signal generator).

CONNECTING THE GENERATOR

If generator output is not a 300 ohm balanced circuit, a balanced condition for push-pull operation as shown should be established.

The terminating resistor is equal to the cable impedance and the two line resistors are such that the receiver "sees" about 300 ohms. For example, given generator cable of 50 ohms, the line resistors should total 250 ohms, or 125 ohms each.

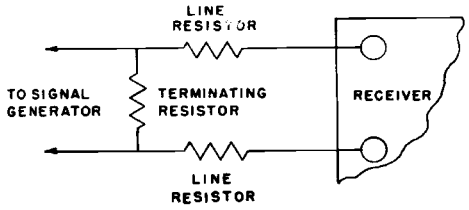
By such padding, both signal generator and receiver "look into" resistance equal to their respective impedances, and a nearly balanced (push-pull) condition is established.

Normally, only the oscillator will require the attention of the service technician with respect to alignment. Although adjustments are provided for the R-F amplifier and converter circuits, these are broadly-tuned and factory-adjustments should suffice for the life of the instrument.

It is well to remember that local oscillator frequency is subject to variation in exchange of oscillator tubes. Therefore, trial of several tubes (even of the same manufacturer) is sometimes necessary before finding one which does not materially change oscillator frequency, in the event that replacement is necessary. Should all channels appear to be detuned (the effect of off-capacity tubes is greatest on the higher frequency channels) as evidenced by optimum sound reproduction near the end of rotation of the fine tuning control, tube-exchange should be made until correct tuning is realized.

ALIGNMENT OF THE TUNER, CT 219 RECEIVER

This is the tuner having 13-channel positions with coil-selection between channels. It uses 6J6 tubes in balanced circuit. The oscillator tube is covered by a lead microphonic-shield.



Resistor network for use with an unbalanced generator cable

OSCILLATOR ALIGNMENT

Oscillator alignment is predicated upon exact alignment of the sound discriminator circuits.

Alignment must start with channel 13 and progress in consecutive channels toward the lowest-frequency channel, since any adjustment to a coil will also affect all channels of lower frequency.

With RF signal supplied to the antenna terminals, set the signal generator (crystal calibrated) to the R-F sound carrier frequency of the channel being aligned. Set the fine tuning control about midway in its rotation. Adjust the oscillator adjustments (slug or screw) so that the sound I-F is 21.25 mc as indicated by

(a) Sound in the speaker, a zero-null between two peaks. In this, an A-M generator is required.

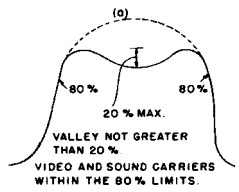
(b) Zero voltage on a V.T.V.M. between a positive and a negative peak. An unmodulated generator should here be used.

Access to oscillator adjustments, with the exception of channels 6 and 13, is from the front of the tuner. These are revealed without necessity for chassis or front-panel removal, by removing the two knobs, CHANNEL and FINE TUNING.

R-F AMPLIFIER, CONVERTER ALIGNMENT, CT 219

1. Connect sweep generator to antenna input, noting the precaution regarding termination. Connect the oscilloscope to the grid of the converter through a 10,000 ohm resistor. Bypass the converter plate circuit to ground through approximately 1000 mfd.
2. With the channel switch in position 13, and the sweep covering this channel (see Part I for frequencies), adjust L25 and L26, L51 and L52 for the normal over coupled circuit curve. As illustrated, the curve should be symmetrical between the sound and video carrier frequency markers, which should occur at approximately the 90 to 100 per cent points. L25 and L26 stud extensions should be maintained approximately equal, to maintain symmetry, as should L51 and L52 adjustments.

Next, channels 12 to 7 should be checked for frequency. Normally, these curves appear somewhat overcoupled or double-humped with a 10 or 15 per cent peak-to-valley excursion. Sound and



TYPICAL R-F PASSBAND, ALL UNITS
CT 220 IS ROUNDED ON HIGH CHANNELS, AS AT (a)

video markers should occur at approximately 90% response. Tolerances allow some shift in these curves but in no case should the markers fall at less than 70% response points. Channel 7 is generally the worst offender in this respect and in some few cases it may be necessary to compromise on the adjustment of channel 13 to realize all markers about the 70% point.

Channel 6 is next aligned as was channel 13, tuning L11 and L12, L37 and L38.

Channels 5 to 2 should then be checked as were 12 to 7, above.

ALIGNMENT OF THE TUNER, CT 220 RECEIVER

This tuner is the 12 channel unit using 6BH6, 6AG5 and 6C4 tubes, with coil-selection between channels. A metallic shield encloses the below-chassis components. Therefore, in alignment, in order to eliminate repeated removal and replacement of the shield during coil adjustment, the fine tuning control may be set about 120° from its mid-position in the direction of less capacity (clockwise in production units, but the split stator fine tuning rotor may be toward the rear of the chassis from the stator plates, making this rotation counterclockwise).

Note that the fine tuning wheel is secured to its shaft by two set-screws. Therefore, if all stations tune toward the end of rotation, it is possible to reset this control by loosening the screws.

OSCILLATOR COILS, CT 220

Oscillator coils in the five lower channels are tunable by means of slug-adjustments which are sealed in wax. Those of the seven higher channels are variable by adjusting the wire loops, spreading the loop apart or making it smaller. Coils should not be permitted to touch another coil or circuit element, nor to fold back upon itself in mechanical connection, else variable contacts may give rise to intermittent operation.

Alignment is by the same process as was used in connection with the CT 219 chassis:

Connect signal generator to the antenna terminals, set at the sound carrier frequency of the channel being aligned (see Part I) and adjust the coil for zero-null in the sound-discriminator. The discriminator must have been first determined to be properly aligned.

Reheat the L-F slugs after adjustment, to secure the adjustments against vibration.

R-F AMPLIFIER, CONVERTER ALIGNMENT, CT 220

Connect sweep generator to the antenna terminals, observing proper termination to the generator cable as outlined in connection with the CT 219 chassis. Connect the oscilloscope to the grid of the 6AG5 converter (pin 1, nearest the right-hand side facing the unit) through a 10,000 ohm resistor.

Through a 1000 mmfd. (approx.) condenser, ground the plate of the 6AG5 mixer. Connection may be made to the plate side of C19 (270 mmfd. coupling to video I-F grid).

With the channel switch in position 13 and the sweep covering this channel, adjust P-13 and G13 (3 turn coils) by spreading or compressing turns for the normal curve as illustrated.

Next, channels 12 to 7 should be checked for frequency response. They should fulfill the limits of the typical curve shown and, if they do not, it will be necessary to readjust P13 and G13.

Channel 6 is next aligned as was channel 13, tuning P6 and G6 (9 turn coils near the switch spacer bars). Check channels 5 to 2 as were 12 to 7 above.

ALIGNMENT OF THE CT 222 RECEIVER

OSCILLATOR ADJUSTMENT

The fine tuning control may be rotated through 360° and it will therefore be found that the sound carrier may be tuned in two positions which should be separated by greater than ½ inch as measured on the circumference of the fine tuning knob. If this condition is not met:

1. An oscillator tube being off-capacity causes all stations to tune near one end of rotation.
2. If the notched dial wheel has been removed and replaced, improper relationship of the gear teeth will cause a like effect, or cause a station to tune on the wrong channel. A like effect is noted if the slotted dial-mount shaft has been rotated before locking with the Allen screws.
3. Tune the oscillator slugs as follows:
   (a) Assuming proper alignment of the discriminator, connect an electronic D-C voltmeter to the sound output point of the discriminator (pin 1 to ground, V7).
   (b) Feed an unmodulated RF signal at the sound carrier frequency of channel 7 (179.95 mc) into the antenna terminals, setting selector to No. 7.
   (c) Tune High-band oscillator slug so that zero output between two peaks is had, when the Fine Tuning is near the center of its range.
   (d) It may be necessary to compromise the setting of Channel 13, to attain the most-uniform positioning on channels 12-7.
   (e) Low-band slug-tuning is by the same process.

The slug is adjusted on channel 2, whose sound carrier lies at 59.75 mc. Again, some compromise may be necessary to approximate center-of-the fine tuning scale on channels 2-6.

There are provided, trimmer condensers for alignment of R-F amplifier and converter stages on both high and low channels. Adjustment is as follows:

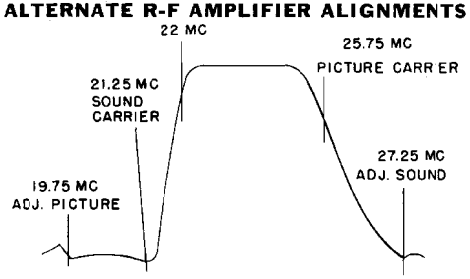
(a) Connect sweep and marker generators to the antenna terminals, through a resistor network if necessary as outlined in connection with the CT 219 R-F alignment.

(b) Connect the mixer plate to ground through approximately 1000 mmfd. Access to the plate is at the plate-side of the condenser coupling to the video I-F grid, using a miniature insulated clip and keeping it as far from the coil as possible.

(c) Connect the oscilloscope to the mixer grid coil center-tap, across the grid-leak resistor. Since the two coils have their center-taps connected, scope-connection should be to the coil which is not being used (connect to the low-band coil when checking high bands, etc.).

(d) Adjust R-F amplifier and converter trimming condensers to approximate the typical curve shown. Turn the two condenser screws associated with either circuit by approximately the same amount, to maintain electrical symmetry.

ALTERNATE R-F AMPLIFIER ALIGNMENTS



VIDEO-I-F SELECTIVITY CURVE
AND OVERALL IF-RF CURVE

If the available sweep generator has insufficient output potential to observe a pattern through the R-F amplifier, connection of the oscilloscope may be made to the video detector load resistor, generator to the antenna terminals and the unit aligned by observing the receiver's overall characteristic. On all three types of R-F unit, the curve obtained should approximate that here shown. This is based upon assurance that video I-F alignment is correct.

Switch between R-F channels, correcting the sweep generator frequency to correspond. There may be some differential between reproduced curves, which is permissible. If, however, there be major differential, the R-F amplifier is in need of some retouching. It is seldom that R-F amplifier adjustments will require adjustment.

VIDEO I-F ALIGNMENT

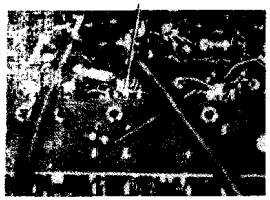
Connect the oscilloscope across the video detector load resistor (R152). This is between the "low" end of the black peaking coil of the detector circuit, and ground. (If the signal generator to be used has not provision for amplitude modulation, use a V.T.V.M. instead of the oscilloscope*). Apply AM to the generator.

The signal generator is to be connected into the grid of the converter, through a small mica capacitor for D-C isolation. Access to the grids in the three types of R-F unit assemblies is as illustrated.

*The load resistor is "above" ground, as will be the case of a Voltohmyst when connected.

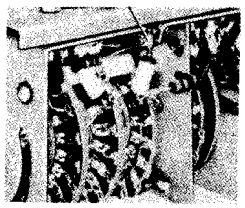
Set bias on I-F bus by adjusting the control _ _ _ _ _ _ to approximately 3 volts. Make the following adjustments, in order:

Gen. Frequency, MC	*Adjust*	*For*
21.25	Converter trap (top slug)	minimum
21.25	Cathode trap, V15 (top)	minimum
19.75	2nd I-F trap (top)	minimum
27.25	1st I-F trap (top)	minimum
21.3	Converter plate (bottom)	maximum
25.3	1st I-F (bottom)	maximum
22.3	2nd I-F (bottom)	maximum
25.2	3rd I-F (top of chassis)	maximum
23.4	4th I-F (top of chassis)	maximum



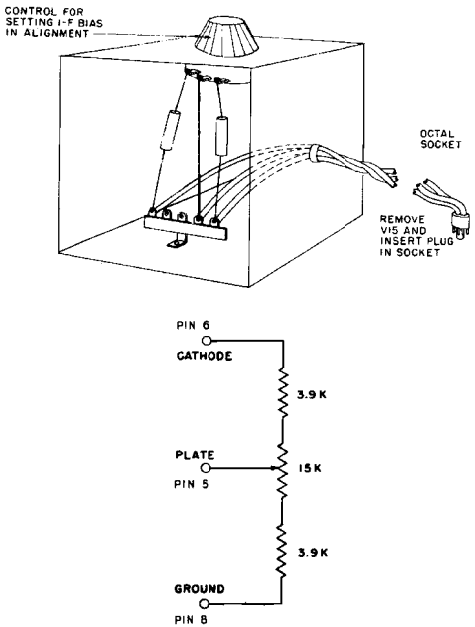
CT219 TUNER

WHEN L-F COIL IN
CT 222 TUNER



CT 220 TUNER

ACCESS TO CONVERTER GRID FOR ALIGNMENT



Control for setting I-F bias. Use Plug Adaptor to plug into AGC tube socket, V15. AGC tube is removed.

It is necessary from this point in the video I-F alignment, to assume proper alignment of the R-F unit, which is a prerequisite. The local oscillator must be fixed by the fine tuning control, so that an R-F signal at the sound-carrier frequencies of one of the lower-frequency channels appears as a null in the speaker, between two peaks (the center of the discriminator "S" curve). Furthermore, the R-F amplifier alignment must be proper, so that the R-F video and sound carriers are above the 90% amplitude points on the R-F response curve.

Connect the oscilloscope across the video detector load resistor (R152) and the R-F sweep generator to the antenna terminals. Observe the connections indicated under "R-F alignment" regarding the use of single-ended signal generator cable.

If necessary, retouch the I-F amplifier slugs to give the proper response curve as shown:

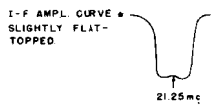
In making any final touch-up adjustments, it should be remembered that the converter and 2nd video I-F coils are relatively high "Q" circuits and tend to control the I-F response at the high and low frequency ends of the band respectively, while the 1st and 3rd video I-F coils are low "Q" and tend to control overall response over the center position of the pass band.

Since there is some slight shift in response with change in bias, the recommended level (-3 volts) should always be used when aligning this circuit.

TABULATED ALIGNMENT

ALIGNMENT, SOUND I-F, DISCRIMINATOR

	CONNECT SIG. GEN.	AMCW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V.T. METER	TUNE	FOR	COMMENTS
1.	SOUND TAKEOFF, MIXER OUTPUT TRANS. (TAP)	√		STEP (1) MAKES FREQUENCY SAME AS TRAPS, THEREFORE, TRAPS SHOULD BE PROPERLY SET.	VIDEO DET. LOAD RESISTOR		GENERATOR	MIN. NEAR 21.25 mc	BOTH 'SCOPE AND METER SERVE AS INDICATOR. AVOID OVERLOAD IN I-F AMPLIFIERS AS SHOWN BY FLATTENING OF PEAKS
2.	SAME	√			GRID RESISTOR, LAST I-F AMP. (LIMITER)	SAME AS 'SCOPE	SOUND I-F TRANSFORMERS	MAX.	
3.							RETOUCH I-F TRANSFORMERS	PROPER CURVE *	
4.	SAME	√	WITH GEN. AT SOUND TAKEOFF, MIXER TRANS.		AUDIO TAKEOFF, DISCRIMINATOR	SAME AS 'SCOPE	a. DETUNE SEC. (BOTTOM) SLUG OF DISC. TRANS. b. PRI. (TOP) SLUG. c. SEC. SLUG.	MAX. MIN.	
5.	USE AS MARKER, LOOSELY COUPLED	√	SAME				RETOUCH DISC. TRANS., PRI. AND SEC. AS REQUIRED	SYMMETRY OF "S" CURVE MARKER AT CENTER	



DISCRIMINATOR
CURVE

ALIGNMENT, VIDEO I-F

SET BIAS ON GRID RETURN BUS TO NEGATIVE 3 VOLTS

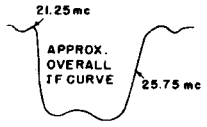
	CONNECT SIG. GEN.	AM	CW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V.T. METER	TUNE	FOR	COMMENTS
1.	CONVERTER (MIXER) GRID	✓			21.25	VIDEO DET. LOAD RESISTOR	VIDEO DETECTOR LOAD RESISTOR	(a) DETUNE MIXER TRANS. TOP SLUG (b) 21.25 mc TRAP (4th. I F CATHODE)	MIN.	AVOID OVER LOAD AS SHOWN BY FLAT-TENING OF CURVE ON 'SCOPE. STEP 4 MAY FOLLOW STEP 1.
2.		✓			19.75			TRAP, 2nd. I F PLATE (TOP)	MIN.	
3.		✓			27.25			TRAP, 1st. I F PLATE (TOP)	MIN.	
4.		✓			21.25			MIXER OUTPUT TOP SLUG	MIN.	
5.		✓			21.8			MIXER OUTPUT (BOTTOM SLUG)	MAX.	
6.		✓			25.3		CONNECT ACROSS RESISTOR—NOT TO CHASSIS GROUND. METER WILL BE 100 VOLTS TO GROUND.	PLATE SLUG, 1st. I F AMPL.	MAX.	BOTTOM SLUG
7.		✓			22.3			PLATE SLUG, 2nd. I F AMPL. (BOTTOM SLUG)	MAX.	2 PEAKS PRESENT. USE PEAK WITH SLUG IN.
	REPEAT STEP 2 AFTER STEP 7 IS COMPLETED									
8.		✓			25.2			4th. I F AMPL. GRID.	MAX.	TOP-OF-CHASSIS SLUG.
9.		✓			23.4			4th. I F AMPL. PLATE	MAX.	TOP-OF-CHASSIS SLUG
10.	USE AS MARKER IF NECESSARY		✓	MIXER GRID	AS NECESSARY			SLUGS AS REQUIRED, EXCEPT TRAPS (SEE NOTES)	PROPER CURVE	LOOSELY COUPLE MARKERS

SLUG	TUNES	MOSTLY AFFECTS
21.8	SHARP	LOW FREQUENCY END OF CURVE
25.3	SHARP	HIGH FREQUENCY END OF CURVE
22.3	BROAD	LOW-CENTER END OF CURVE
25.2	BROAD	HIGH-CENTER END OF CURVE
23.4	VERY BROAD	MIDDLE OF CURVE

NOTES

IN RETOUCHING, 23.4 SLUG IS USUALLY THE ONLY ONE REQUIRING ADJUSTMENT. THE 25.2 SLUG IS OF NEXT IMPORTANCE.

DO NOT RETOUCH 22.3 mc SLUG!



ALIGNMENT, R-F UNITS

IF ALL STATIONS TUNE NEAR ONE END OF DIAL, CHANGE OSCILLATOR TUBE OR ADJUST FINE TUNE DRIVE OF CT 220 UNIT

ADJUST BIAS LINE TO NEGATIVE 1½ VOLTS FOR R-F ALIGNMENT

	CONNECT SIG. GEN.	AM	CW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V.T. METER	TUNE	FOR	COMMENTS
1.	ANTENNA		✓		SOUND CARRIER CH. 13		AUDIO TAKEOFF DISCRIMINATOR	OSCILLATOR, * CH. 13 ADJUSTMENT	ZERO BETWEEN TWO PEAKS	OSCILLATOR ADJUSTMENT: COVER OF S-T UNIT INFLUENCES FREQUENCY.
2.			✓		SAME, CH. 12-7			SAME, CH. 12-7 *	SAME	
3.			✓		SAME, CH. 6			SAME, CH. 6 *	SAME	
4.			✓		SAME, CH. 5-2			SAME, CH. 5-2 *	SAME	
* ADJUST OSC. OF CT 222 UNIT ON CH. 2 AND 7. OTHERS SHOULD FALL INTO LINE.										
5.	USE AS MARKER IF NECESSARY			ANTENNA	AS REQUIRED FOR MARKER	VIDEO DET. LOAD RESISTOR.		R-F AMPL. ADJUSTMENTS, CH. 13	PROPER CURVE	R-F AMPL. ADJUSTMENT: R-F AMP. RARELY NEEDS ADJUSTMENT
6.			✓					SAME, CH. 12-7 +	SAME	
7.			✓					SAME, CH. 6	SAME	
8.			✓					SAME, CH. 5-2 +	SAME	

+ ADJUSTMENT FOR CHANNELS 5-2 IS ONLY ON CT 220 UNIT. ON OTHERS, COMPROMISE IF NECESSARY, TO KEEP SOUND, VIDEO CARRIERS WITHIN LIMITS.

PART VI

MAINTENANCE OF THE TELEVISION RECEIVER

In this section, there is not an enumeration of general complaints and their remedy, since this information is contained in the manual presenting a technical analysis of the television receivers. There are included, however, some items which will not be encountered in all receivers, and which are listed upon the basis of field-experience with the CT 219-220-222 chassis.

1. BURN OUT OF H.V. FILTER (LIMITING) RESISTOR

Should the H.V. plug be placed against the chassis, the H.V. filter resistor No. 194 will be damaged due to a high voltage across its extremities. To test for high voltage, do not draw an arc from the chassis; allow a spark discharge from the plug to the H.V. socket on the bell of the tube, or connect a H.V. meter (15KV scale).

2. INSUFFICIENT DEFLECTION AMPLITUDE

Some 6SN7 tubes have been found which, although they appear to be normal in the tube tester, afford too-little deflection pulse amplitude. Check by exchange, 6SN7 tubes in either horizontal or vertical deflection circuits, depending upon which is deficient.

3. 6BG6G TUBES

These tubes have in some cases, developed internal short-circuit which is capable of causing burnout of the deflection—H.V. transformer. For this reason, a .25 amp. fuse has been added in the plate circuit, in later production.

These tubes also have been known to develop spurious oscillation, causing the picture to show small segments, regularly-spaced, displaced from the main body of the picture.

A bluish glow on the inside surface of the glass envelope is caused by fluorescence of the glass and is not an indication of gas; gas is evidenced by a blue glow between the tube elements.

Another manifestation of improper 6BG6G tube operation is an elongation (stretching) of the picture on the left side, after about ten minutes operation. After the tube has cooled, proper linearity is restored. Under such operation, the adjustment of rear-chassis controls (especially the "speed" and "drive" controls) may cause the left-hand side of the picture to be "jumpy" or to move suddenly. The picture may in some cases move back and forth without adjustment of the controls.

In these cases, replacement of the tube is prescribed; the complaint is most evident with tubes of certain manufacture.

4. APPARENT POOR SENSITIVITY

Improper setting of the AGC Threshold control results in operation as though the receiver sensitivity were low. Check the control as in section III.

5. SMEARING OF PICTURE.

In addition to the usual causes of picture smear, it may result from incorrect value of R152, detector load resistor, or R148, grid resistor for V14B. These may also result in a negative picture reproduction.

6. BURNED OUT CRYSTALS.

Servicemen sometimes "probe" a chassis with a metal screwdriver. Note that shorting the circuit associated with the crystal detecor (conrol grid of V14A, for example) to ground will result in a damaged crystal and perhaps, 23.4 mc coil and R152.

7. VIDEO AMPLIFIER IS OVERLOADED OR OUTPUT IS TOO HIGH AND AGC ADJUSTMENT CANNOT HELP IT. POSSIBLY, NEGATIVE PICTURE.

In case the test scope shows an overload condition which cannot be adjusted, right reason suggests that the I-F bias is not high enough. The following may cause it:

a. 5.6K (156) shorted to circuit.
b. 18K (172) open or shorted to chassis.
c. 25 uf (104) shorted to chassis.
d. 270K (193) open or shorted to chassis.
e. 6SN7 (15B) not conducting, bad tube or back socket contacts.
f. 470K (197) or 200K pot (235) too low in resistance, causing the grid of 15B to be too negative.
g. 560K (200) too high in resistance causing the grid of 15B to be too negative.
h. 6SN7 (15A) not conducting, due to bad tube or bad socket contact.
i. .002 uf (69) open, causing proper adjustment of threshold to be unattainable.
j. No-90V. on P2 of V15, plate circuit of V16A open, 68K (181) open; these three may all cause the condition, just as 9 above. In general, they cause the threshold to need setting to a higher resistance value than it normally would be. So if the pot is on the low side of its tolerance or the 470K is low or both, the overload condition will exist regardless of threshold setting. It is suggested that where that condition exists, the faults of 9 and 10 be eliminated before it is assumed to be one of the more usual faults of 1 to 8.
k. Contrast pot shorted to chassis.

8. PIX SIGNAL OUTPUT IS TOO LOW OR ABSENT AND CANNOT BE ADJUSTED HIGH ENOUGH.

In case the test scope shows a pix signal of low amplitude or none at all, the following may cause it:

1. 5.6K (156) too high resistance.
2. 18K (172) too low resistance.
3. 270K (193) too low resistance.
4. 6SN7 (15B) shorted.
5. 470K (197) or 200K pot (235) too high resistance.
6. 560K (200) too low resistance.

7. No-100V. connection to threshold pot.
8. 10K (167) open or disconnected.
9. 4.7K (154) or green coil (17) open.
10. .05 uf (85) open.
11. Contrast pot (230) or 220 ohms (128) open.
12. Contrast pot (320) miswired.

9. AGC CONTROL HAS NO EFFECT.

In case the AGC control has no effect, many of the causes listed under A and B have this result. In addition, the threshold pot may be wired to both ends instead of one end and center.

10. PICTURE CONSISTS MOSTLY OF SYNC PULSES.

If the pix signal is mostly sync pulses and all the picture components are missing, red coil (19) is open.

11. AGC WILL WORK AT ONE SETTING OF CONTRAST AND NOT AT ANOTHER.

There is a rare case where AGC will work at one contrast setting and not at another. It occurs when the contrast pot is grounded at some point.

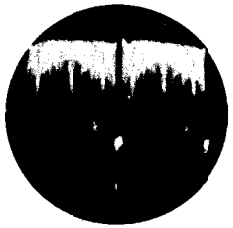
12. AGC WORKS PROPERLY, BUT THRESHOLD POT SETS TOO CLOSE TO ONE END OR THE OTHER.

Setting of a threshold pot at a spot too near one end has been covered rather thoroughly in 7 and 8. Be sure that none of the defect of 7i and j are present.

13. In case the 25 uf condenser is open, the vertical blanking pulse will have a steep slope instead of being straight horizontal, and the test scope will show an integrated vertical sync pulse in the I-F bias.

PART VII

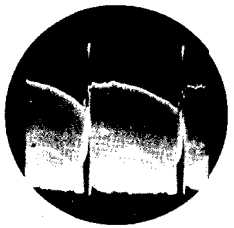
VOLTAGES AND WAVEFORMS



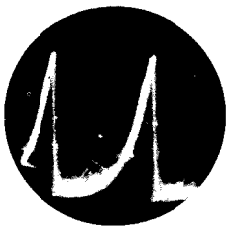
INPUT 1st VIDEO AMPL. PIN 2, V14A 'SCOPE AT 30 C.P.S. 3V. P-P

INPUT, 2nd VIDEO AMPL. PIN 7, V14B 'SCOPE AT 30 C.P.S. 16V. P-P

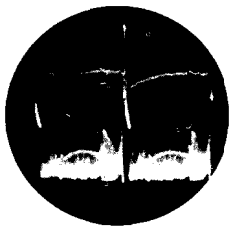
CONTROL GRID, PICTURE TUBE 'SCOPE AT 30 C.P.S. 32V. P-P



INPUT OF SYNC. AMPL. PIN 4, V16A 'SCOPE AT 30 C.P.S. 29V. P-P

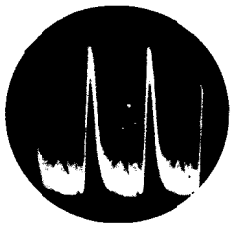


INPUT OF SYNC. AMPL. PIN 4, V16A 'SCOPE AT 7875 C.P.S. 26V. P-P

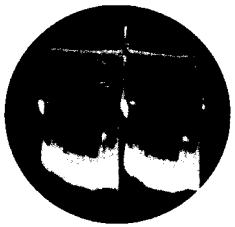


OUTPUT OF SYNC. AMPL. PIN 5, V16A 'SCOPE AT 30 C.P.S. 120V. P-P

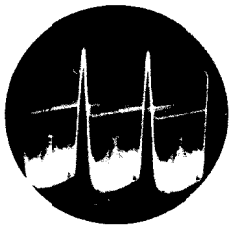
VOLTAGES AND WAVEFORMS



OUTPUT OF SYNC. AMPL. PIN 5, V16A 'SCOPE AT 5250 C.P.S. 90V. P-P

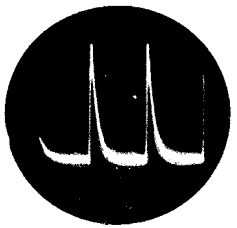


INPUT OF SYNC. CLIPPER PIN 1, V17B 'SCOPE AT 30 C.P.S. 80V. P-P

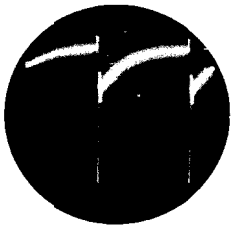


INPUT OF SYNC. CLIPPER PIN 1, V17B SCOPE AT 5250 C.P.S. 67V. P-P

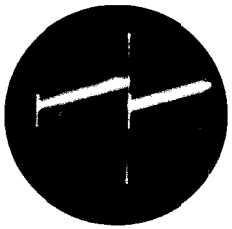
OUTPUT, SYNC. CLIPPER PIN 3, V17B 'SCOPE AT 30 C.P.S. 27V. P-P



OUTPUT, SYNC. CLIPPER PIN 3, V17B 'SCOPE AT 5250 C.P.S. 15V. P-P



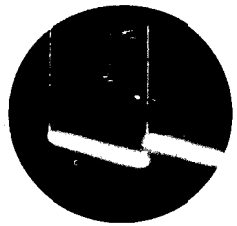
GRID, VERT. OSCILLATOR PIN 1, V18A 'SCOPE AT 30 C.P.S. 440V. P-P



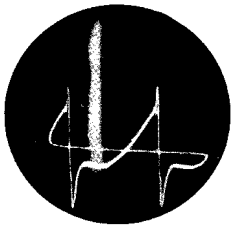
VERT. OSCILLATOR PLATE PIN 2 V18A 'SCOPE AT 30 C.P.S. 120V. P-P

GRID, VERT. AMPL. PIN 4, V18B 'SCOPE AT 30 C.P.S. 55V. P-P

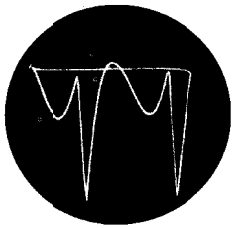
PLATE OF VERT. AMPL., PIN 5, V18B 'SCOPE AT 30 C.P.S. 1100V. P-P



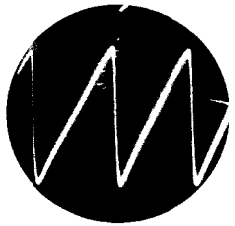
SECONDARY, VERT. OUTPUT TRANSFORMER GREEN WIRE 'SCOPE AT 30 C.P.S. 72V. P-P



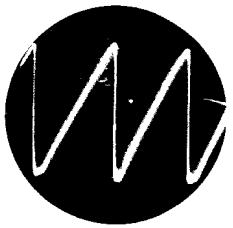
ACROSS HORIZ. LOCK CONDENSER 'SCOPE AT 7875 C.P.S. 30V. P-P



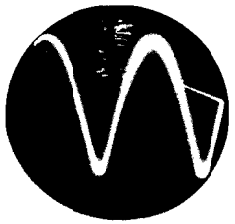
CENTER TAP, HORIZ. SPEED COIL 'SCOPE AT 7875 C.P.S. 75V. P-P



ACROSS C66, .0022 MFD, HORIZ. OSCILLATOR OUTPUT 'SCOPE AT 5250 C.P.S. 63V. P-P

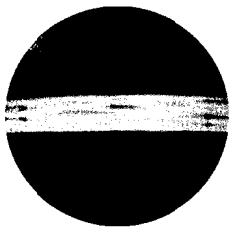


ACROSS HORIZ. DRIVE CONDENSER 'SCOPE AT 5250 C.P.S. 33V. P-P

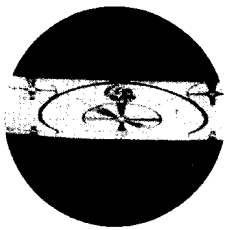


LUG No. 1 HORIZ. OUTPUT TRANSFOEMER 'SCOPE AT 7875 C.P.S. 46V. P-P

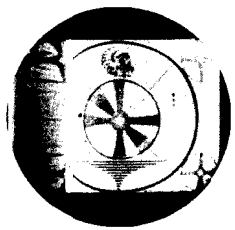
PICTURE DEFECTS



OPEN PEAKING NETWORK VERT. OUTPUT GRID C94 R149



OPEN CATHODE BYPASS, VERT OUTPUT, C103

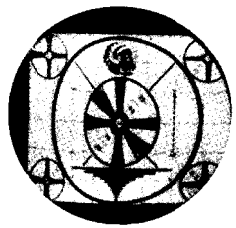


C91 (HORIZ. LINEARITY CIRCUIT) OPEN

DEFECTIVE DAMPING RESISTOR, HORIZ. OSCILLATOR, R165. UNABLE TO SYNC. HORIZ.

IMPROPER VALUE OF GRID RESISTOR, 2nd VIDEO AMPL. EXPANDED TO BETTER SHOW H.F. PHASE SHIFT, SMEARING

LEAKY SAWTOOTH FORMING CONDENSER, C94



LEAKY COUPLING CONDENSER, GRID OF HORIZ. OUTPUT TUBE, C44

LEAKY COUPLING CONDENSER, VERT. OUTPUT GRID, C95 (FOLDOVER AT BOTTOM)

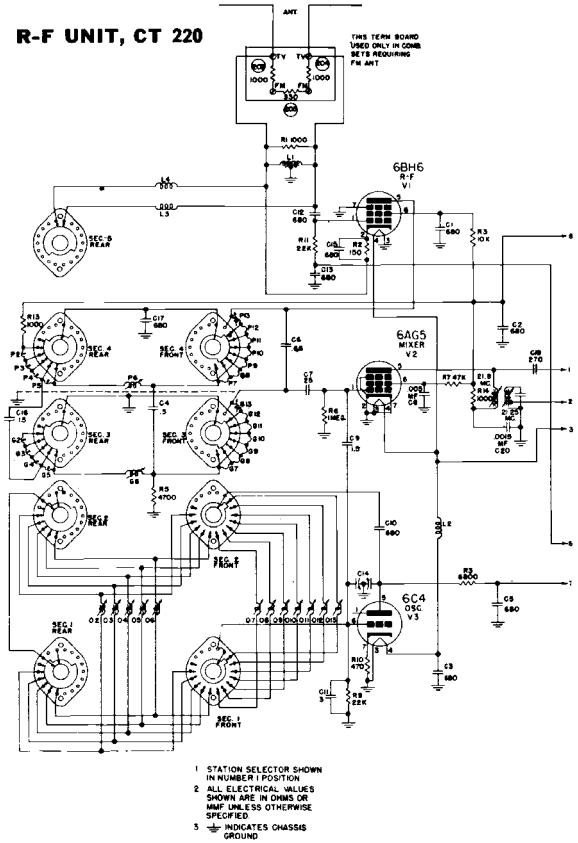
GROUNDING SPRINGS NOT CONTACTING THE PICTURE TUBE SHELL. PICTURE EXPANDED TO SHOW STREAKING, DISTORTION.

VOLTAGE CHART

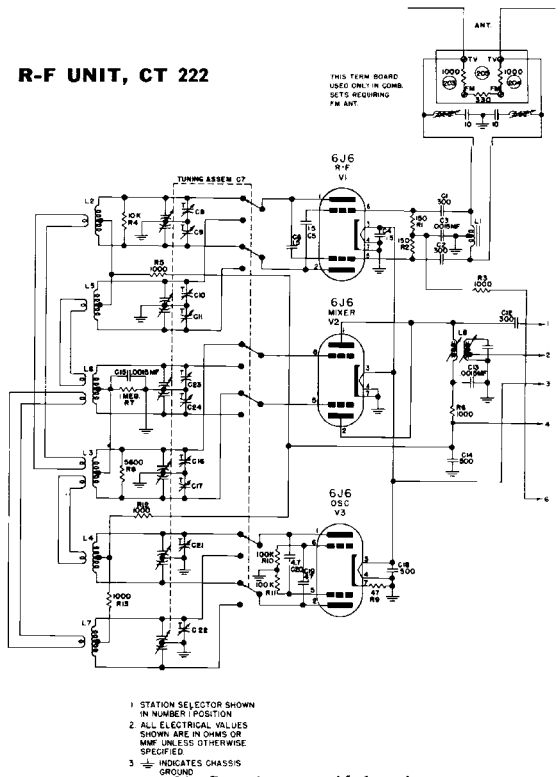
Measurements made with receiver operating on 117 volts 60 cycles a-c and with no signal input. Voltages shown are read with RCA VoltOhmyst Jr. between indicated terminal and chassis ground except where otherwise noted. Voltage and current readings are nominal values.

Tube No.	Tube Type	Function	Operating Condition	Plate		Screen		Cathode		Grid		Notes on Measurement
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	
V4	6BA6	1st Sound I-F		5	120	6	120	7	1.5	1	0	
V5	6BA6	2nd Sound I-F		5	140	6	115	7	1.5	1	0	
V6	6AU6	3rd Sound I-F		5	22	6	22	GND	—	1	−5	
V7	6AL5	Disc.		2 & 7	−.4	—	—	1 & 5	0	—	—	
V8	6SF7	1st A-F		6	40	4	19	GND	—	2	−1	
V9	6V6GT	Audio Out.		3	160	4	175	8	−88	5	−110	
V10	6AG5	1st Video I-F		5	.140	6	140	7	.35	1	.9-1.9*	*Variation with Threshold control varies .5 V. with picture control.
V11	6AG5	2nd Video I-F		5	140	6	140	7	.25	1	.9-2*	*Variation with Threshold control varies .4 V. with picture control.
V12	6AG5	3rd Video I-F		5	130	6	140	7	.35	1	.9-2*	*Variation with Threshold control varies .4 V. with picture control.
V13	6AG5	4th Video I-F		5	100	6	140	7	1.4	1	.9-1.9*	*Variation with Threshold control.
V14A	½12AU7	1st Video Amp.		1	−20	—	—	3	−110	2	−110	
V14B	½12AU7	2nd Video Amp.		6	170-210*	—	—	8	−1.5 to −12*	7	−20	*Variation with picture control.
V15A	½6SN7GT	AGC Rect.		2	80	—	—	3	−14	1	−20	
V15B	½6SN7GT	AGC Amp.		5	−4 to −7*	—	—	6	−50	4	−47 to −65*	*Variation with Threshold control.
V16A	½6SN7GT	1st Sync. Amp.		5	80	—	—	6	−15	4	−20	
V16B	½6SN7GT	2nd Sync. Amp.		2	90	—	—	3	1.2	.1	.1 to −.3*	*Variation with Threshold control.
V17A	½6SN7GT	Sync. Leveler		5	20-45*	—	—	6	GND	4	Tied to plate	*Variation with Threshold control.
V17B	½6SN7GT	Sync. Clipper		2	210	—	—	3	.5	1	20-45*	*Variation with Threshold control.
V18A	½6SN7GT	Vert. Osc.		2	37 to −12*	—	—	3	.110	1	−150	*Variation with Vertical control.
					−30 to −15"							"Variation with Height control.
V18B	½6SN7GT	Vert. Out.		5	200	—	—	6	−98	4	−110 to 88*−	*Variation with Height control.
V19A	½6SN7GT	Hor. A. F. C.		2	0-35*	—	—	3	−88 to −100*	1	−80	*Variation with Hor. control.
V19B	½6SN7GT	Hor. Osc.		5	78	—	—	6	−110	4	−180	
V20	6BG6G	Hor. Out.		Cap.	320	8	140	3	−100	5	−110	
V21	8016	H. V. Rect.		Cap.	*	—	—	2	7800"	—	—	*9200 volt pulse present. "Measured with electrostatic voltmeter.
V22	5V4G	Damper		4 & 6	260	—	—	8	340	—	—	
V23	5U4G	Rect.		4 & 6	380 A.C.	—	—	2	270	—	—	
V24		Pix. Tube		RED	340	—	—	YELLOW	0 to 110"	GREEN	27 to 39*	*Variation with picture control. "Variation with brightness control.

R-F UNIT, CT 220



R-F UNIT, CT 222



PARTS LIST

1	Focus coil	360341-2
2	First sound i-f coil assembly	360332-12
3	Second sound i-f coil assembly	360332-12
4	Sound discriminator assembly	360332-13
5	First video i-f coil assembly	360332-3
6	Second video i-f coil assembly	360332-5
7	Third video i-f coil assembly	360332-6
8	Fourth video i-f coil assembly	360332-6
9	Fourth video cathode trap coil assembly	360332-4
10	Filament choke	360332-11
11	Filament choke	360332-11
12	Choke, 60 ohms	360340-1
13	Horizontal linearity coil	360334-1
14	Horizontal speed coil	360346-1
15	Peaking coil, black	360332-14
16	Peaking coil, black	360332-14
17	Peaking coil, green	360332-10
18	Peaking coil, white	360332-9
19	Peaking coil, red	360332-8
20	Power transformer	300045-1
21	Vertical blocking oscillator transformer	320030-1
22	Vertical output transformer	320024-1
23	Syncro-guide transformer	360337-1
24	Audio output transformer	320027-2
25	Horizontal output & hi voltage transformer	320026-1
26	Capacitor, variable 2 gang trimmer	260101-2
27	Capacitor, molded mica, 5 mmf.	250159-91
28	Capacitor, ceramic, 5 mmf. 500 V.	250088-44
29	Capacitor, molded mica, 10 mmf.	250159-92
30	Capacitor, ceramic, 36 mmf. 500 V.	250088-43
31	Capacitor, molded mica, 47 mmf. ±10%	250159-78
32	Capacitor, molded mica, 56 mmf. ±10% 800 V.	250174-1
33	Capacitor, molded mica, 75 mmf. ±5%	250159-44
34	Capacitor, molded mica, 100 mmf.	250159-98
35	Capacitor, molded mica, 120 mmf. ±10%	250159-83
36	Capacitor, molded mica, 180 mmf. ±10%	250159-85
37	Capacitor, molded mica, 180 mmf. ±10%	250159-85
38	Capacitor, molded mica, 270 mmf. ±10%	250159-87
39	Capacitor, molded mica, 270 mmf. ±10%	250159-87
40	Capacitor, ceramic, 270 mmf. 500 V.	250088-45
41	Capacitor, ceramic, 270 mmf. 500 V.	250088-45
42	Capacitor, ceramic, 270 mmf. 500 V.	250088-45
43	Capacitor, ceramic, 270 mmf. 500 V.	250088-45
44	Capacitor, molded mica, 390 mmf. ±10%	250159-89
45	Capacitor, hi voltage, 500 mmf. 15K Volt	250173-1
46	Capacitor, molded mica, 560 mmf. ±10%	250160-61
47	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
48	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
49	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
50	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
51	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
52	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
53	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
54	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
55	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
56	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
57	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
58	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
59	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
60	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
61	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
62	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
63.	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
64		
65	Capacitor, ceramic, 1000 mmf. 350 V.	250088-46
66	Capacitor, molded mica, 2200 mmf. ±5%	250160-46
67	Capacitor, molded mica, 4700 mmf. ±5%	250161-24
68	Capacitor, tubular paper, .001 mfd. 600 V.	250151-45
69	Capacitor, tubular paper, .002 mfd. 600 V.	250151-44
70	Capacitor, tubular paper, .002 mfd. 600 V.	250151-44
71	Capacitor, tubular paper, .002 mfd. 600 V.	250151-44
72	Capacitor, tubular paper, .003 mfd. 600 V.	250151-43
73	Capacitor, tubular paper, .005 mfd. 600 V.	250151-41
74	Capacitor, tubular paper, .005 mfd. 400 V.	250151-30
75	Capacitor, tubular paper, .005 mfd. 400 V.	250151-30
76	Capacitor, molded mica, .01 mfd. 300 V.	250161-53
77	Capacitor, tubular paper, .01 mfd. 400 V.	250151-27
78	Capacitor, tubular paper, .01 mfd. 400 V.	250151-27
79	Capacitor, tubular paper, .01 mfd. 600 V.	250151-38
80	Capacitor, tubular paper, .02 mfd. 400 V.	250151-26
81	Capacitor, tubular paper, .03 mfd. 600 V.	250151-36
82	Capacitor, tubular paper, .03 mfd. 600 V.	250151-36
83	Capacitor, molded paper, .05 mfd. 400 V.	250129-15
84	Capacitor, molded paper, .05 mfd. 400 V.	250129-15
85	Capacitor, tubular paper, .05 mfd. 400 V.	250151-24
86	Capacitor, tubular paper, .05 mfd. 400 V.	250151-24
87	Capacitor, tubular paper, .05 mfd. 400 V.	250151-24
88	Capacitor, tubular paper, .05 mfd. 400 V.	250151-24
89	Capacitor, tubular paper, .05 mfd. 600 V.	250151-35
90	Capacitor, tubular paper, .05 mfd. 600 V.	250151-35
91	Capacitor, tubular paper, .05 mfd. 600 V.	250151-35
92	Capacitor, tubular paper, .1 mfd. 400 V.	250151-22
93	Capacitor, tubular paper, .1 mfd. 400 V.	250151-22
94	Capacitor, tubular paper, .1 mfd. 400 V.	250151-22
95	Capacitor, tubular paper, .25 mfd. 400 V.	250151-21
96	Capacitor, tubular paper, .25 mfd. 400 V.	250151-21
97	Capacitor, paper, with mtg. strap, .25 mfd. 400 V.	250172-2
98	Capacitor, paper, with mtg. strap. .25 mfd. 400 V.	250172-2
99	Capacitor, electrolytic, 25 mfd. 475 V.-10 mfd. 475 V.	270021-20
100	Capacitor, electrolytic, 30 mfd. 475 V.-30 mfd. 475 V.-10 mfd. 475 V.	270021-13
101	Capacitor, electrolytic, 40 mfd. 475 V.-10 mfd. 475 V.-10 mfd. 475 V.	270021-14
102	Capacitor, electrolytic, 30 mfd. 475 V.-40 mfd. 475 V.-10 mfd. 475 V.	270021-15
103	Capacitor, electrolytic, 72 mfd. 475 V.-50 mfd. 50 V.	270021-16
104	Capacitor, electrolytic, 25 mfd. 50 V.	270027-7
105	Capacitor, electrolytic, 20 mfd. 150 V.	270027-6
106	Coil, deflection	360330-1
107	Capacitor, mica, 270 mmf. ±10%	250159-87
115	Resistor, carbon, 10 ohms, ½ W.	230084-1
116	Resistor, carbon, 39 ohms, ±10%, ½ W.	230084-45
117	Resistor, carbon, 39 ohms, ±10%, ½ W.	230084-45
118	Resistor, carbon, 39 ohms, ±10%, ½ W.	230084-45
119	Resistor, carbon, 43 ohms. ±5%, ½ W.	230084-126
120	Resistor, carbon, 82 ohms, ±10%, 2 W.	230086-49
121	Resistor, carbon, 100 ohms, ½ W.	230084-7
122	Resistor, carbon, 100 ohms, ½ W.	230084-7
123	Resistor, carbon, 120 ohms, ±10%, 2 W.	230086-51

124	Resistor, carbon, 150 ohms, ±10%, ½ W.	230084-52
125	Resistor, carbon, 150 ohms, ±10%, ½ W.	230084-52
126	Resistor, carbon, 150 ohms, ±10%, ½ W.	230084-52
127	Resistor, carbon, 150 ohms, ±10%, ½ W. (Use on CT219 & CT222)	230084-52
128	Resistor, carbon, 220 ohms, ±10%, ½ W.	230084-54
129	Resistor, carbon, 220 ohms, ±10%, ½ W.	230084-54
130	Resistor, carbon, 330 ohms, 2 W.	230086-10
131	Resistor, carbon, 560 ohms, ±10%, 1 W.	230085-59
132	Resistor, carbon, 560 ohms, ±10%, ½ W.	230084-59
133	Resistor, carbon, 560 ohms, ±10%, ½ W.	230084-59
134	Resistor, wire wound, 520-520 ohms	240044-1
135	Resistor, carbon, 680 ohms, ±10%, 2 W.	230096-60
136	Resistor, wire wound, 800 ohms.	240046-1
137	Resistor, carbon, 1000 ohms, ±10%, ½ W.	230084-62
138	Resistor, carbon, 1000 ohms, ±10%, ½ W.	230084-62
139	Resistor, carbon, 1000 ohms, ±10%, ½ W.	230084-62
140	Resistor, carbon, 1000 ohms, ±10%, ½ W.	230084-62
141	Resistor, carbon, 1000 ohms, ±10%, ½ W.	230084-62
142	Resistor, carbon, 1000 ohms, ½ W.	230084-13
143	Resistor, carbon, 1000 ohms, ½ W.	230084-13
144	Resistor, carbon, 1000 ohms, 1 W.	230085-13
145	Resistor, carbon, 1500 ohms, 2 W.	230086-14
146	Resistor, carbon, 2200 ohms, ½ W.	230084-15
147	Resistor, carbon, 2700 ohms, ±10%, ½ W.	230084-67
148	Resistor, carbon, 2700 ohms, ±10%, ½ W.	230084-67
149	Resistor, carbon, 3300 ohms, ½ W.	230084-16
150	Resistor, carbon, 3300 ohms, ½ W.	230084-16
151	Resistor, carbon, 4700 ohms, ±10%, ½ W.	230084-70
152	Resistor, carbon, 4700 ohms, ±10%, ½ W.	230084-70
154	Resistor, carbon, 4700 ohms, ±10%, 1 W.	230085-70
155	Resistor, carbon, 5600 ohms, ±10%, ½ W.	230084-71
156	Resistor, carbon, 5600 ohms, ±10%, ½ W.	230084-71
157	Resistor, carbon, 6800 ohms, ½ W.	230084-18
158	Resistor, carbon, 6800 ohms, ½ W.	230084-18
159	Resistor, carbon, 6800 ohms, ±10%, 1 W.	230085-72
160	Resistor, carbon, 8200 ohms, ±10%, ½ W.	230084-73
161	Resistor, carbon, 8200 ohms, ±10%, ½ W.	230084-73
162	Resistor, carbon, 8200 ohms, ±10%, ½ W.	230084-73
163	Resistor, carbon, 10,000 ohms, ±10%, ½ W.	230084-74
164	Resistor, carbon, 10,000 ohms, ±10%, ½ W.	230084-74
165	Resistor, carbon, 10,000 ohms, ±10%, ½ W.	230084-74
166	Resistor, carbon 10,000 ohms, ½ W.	230084-19
167	Resistor, carbon, 10,000 ohms, ½ W.	230084-19
168	Resistor, carbon, 10,000 ohms, 1 W.	230084-19
169	Resistor, carbon, 10,000 ohms, 1 W.	230084-19
170	Resistor, carbon, 10,000 ohms, ±10%, 2 W.	230086-74
171	Resistor, carbon, 12,000 ohms, ±10%, ½ W.	230084-75
172	Resistor, carbon, 18,000 ohms, ±10%, ½ W.	230084-77
173	Resistor, carbon, 18,000 ohms, ±10%, 2 W.	230084-77
174	Resistor, carbon, 22,000 ohms, ½ W.	230084-21
175	Resistor, carbon, 22,000 ohms, ½ W.	230084-21
176	Resistor, carbon, 100,000 ohms, ½ W.	230084-25
177	Resistor, carbon, 22,000 ohms, ±10%, 1 W.	230085-78
178	Resistor, carbon, 27,000 ohms, ±10%, ½ W.	230084-79
179	Resistor, temperature compensating, 38,000 ohms, ½ W.	230091-1
180	Resistor, carbon, 56,000 ohms, ±10%, ½ W.	230084-83
181	Resistor, carbon, 68,000 ohms, ±10%, 1 W.	230085-84
182	Resistor, temperature compensating, 100,000 ohms, ½ W.	230092-1
183	Resistor, carbon, 100,000 ohms, ½ W.	230084-25
184	Resistor, carbon, 100,000 ohms, ½ W.	230084-25
185	Resistor, carbon, 100,000 ohms, ½ W.	230084-25
186	Resistor, carbon, 100,000 ohms, ½ W.	230084-25
187	Resistor, carbon, 120,000 ohms, ±10%, ½ W.	230084-87
188	Resistor, carbon, 120,000 ohms, ±10%, 2 W.	230084-87
189	Resistor, carbon, 150,000 ohms, ±5%, 1 W.	230085-211
190	Resistor, carbon, 150,000 ohms, ½ W.	230084-26
191	Resistor, carbon, 180,000 ohms, ±5%, ½ W.	230094-213
192	Resistor, carbon, 220,000 ohms, ±10%, 1 W.	230085-90
193	Resistor, carbon, 270,000 ohms, ±10%, ½ W.	230084-91
194	Resistor, carbon, 270,000 ohms, ±10%, 1 W.	230090-1
195	Resistor, carbon, 470,000 ohms, ½ W.	230084-29
196	Resistor, carbon, 470,000 ohms, ½ W.	230084-29
197	Resistor, carbon, 470,000 ohms, ½ W.	230084-29
198	Resistor, carbon, 560,000 ohms, ±5%, ½ W.	230094-225
199	Resistor, carbon, 560,000 ohms, ±10%, ½ W.	230084-95
200	Resistor, carbon, 560,000 ohms, ±10%, ½ W.	230084-95
201	Resistor, carbon, 680,000 ohms, ½ W.	230084-30
202	Resistor, carbon, 1 megohm, ½ W.	230084-31
203	Resistor, carbon, 1 megohm, ½ W.	230084-31
204	Resistor, carbon, 1 megohm, ½ W.	230084-31
205	Resistor, carbon, 1 megohm, ½ W.	230084-31
206	Resistor, carbon, 1 megohm, ½ W.	230084-31
207	Resistor, carbon, 1 megohm, 1 W.	230085-31
208	Resistor, carbon, 1 megohm, ±5%, ½ W.	230084-231
209	Resistor, carbon, 1.5 megohm, ½ W.	230084-32
210	Resistor, carbon, 2.2 megohm, ½ W.	230084-33
211	Resistor, carbon, 2.2 megohm, ½ W.	230084-33
212	Resistor, carbon, 2.2 megohm, ½ W.	230084-33
213	Resistor, carbon, 2.2 megohm, ½ W.	230084-33
214	Resistor, carbon, 3.3 megohm, ±10%, ½ W.	230084-104
215	Resistor, carbon, 3.9 megohm, ±10%, ½ W.	230084-105
216	Resistor, carbon, 4.7 megohm, ½ W.	230084-35
217	Resistor, carbon, 15 megohm, ½ W.	230084-256
218	Resistor, carbon, 33,000 2 W.	230086-80
219	Resistor, carbon, 33,000 2 W.	230086-80
225	Potentiometer, focus control, 2200 ohms, 4 W.	220076-1
226	Potentiometer, horizontal hold, 50,000 ohms, ½ W.	220076-11
227	Potentiometer, vertical linearity control, 5000 ohms, 1 W.	220076-3
228	Potentiometer, vertical speed control, 1 megohm, ½ W.	220076-12
229	Potentiometer, height control, 2.5 megohm, ½ W.	220076-5
230	Potentiometer, contrast control, 10,000 ohms, ½ W.	220076-14
231	Potentiometer, brilliance control, 50,000 ohms, ½ W.	220076-7
232	Potentiometer, volume & switch control, 1 megohm, ½ W.	220076-8
233	Potentiometer, horizontal centering control, 30 ohms, 3 W.	220076-9
234	Potentiometer, vertical centering control, 30 ohms, 3 W.	220076-10
235	Potentiometer, AGC threshold, ¼ W.	220076-13
236	Tuner, R. F. (CT 219A only) RF 11	700317-1
237	Push button switch	160192-1
238	Connector, television tube	180441-2
239	Connector, speaker	180382-7
240	Connector, anode	180454-1
241	Socket, ext. audio	180060-1
242	Fuse, ¼ amp.	180157-15
243	Fuse, 5 amp.	180157-9
244	Tuner, R.F. (CT 220A only) RF 12	700320-1
245	Tuner, R.F. (CT 222A only) RF 13	700318-1

This maintenance information covers Magnavox television receiver chassis models CT 237 and CT 238, and is supplementary to Manual No. 7201 covering the CT 218-CT 220-CT 222 chassis. All data of 7201 is applicable to the CT 237-238 chassis excepting as noted below:

	CT 219-20-22 Chassis	CT 237-238 Chassis
(1)	C82, .03 mfd in horizontal linearity circuit, part No. 250151-36.	C64 changed to .02 mfd. 600 V. paper, part No. 250151-37.
(2)	C45, H.V. filter condenser, output of H.V. rectifier connects to terminal 4, horizontal output transformer.	Same condenser, connects to chassis ground. Connects between terminals 5 and 6, horizontal output transformer, a .03 mfd condenser item No. 82 part No. 250151-36. A switch at the rear of the H.V. compartment, permits switching this condenser in or out of the circuit to control size.
(3)	No circuit connection between terminals 5 and 6 horizontal output transformer.	Connection of the bottom of R144 is made to bottom end of vertical centering control (positive terminal of C100, 10 mfd filter condenser). This increases voltage applied to the vertical output tube.
(4)	Bottom of R144, 1000 ohm between +B and red lead of vertical output transformer connects to +225 volts.	In the video detector output circuit, a variable-inductance trap coil is placed in series with the 10 mmfd condenser, item 29 of the CT 219-20-22 schematic. Part No. of the trap coil and 10 mmfd condenser assembly is 360417-1. This eliminates, by adjusting the coil slug, a variable beat-pattern on the screen caused by the third harmonic of the intermediate frequency, at 77.25 mc. Peaking coil is violet, item 15, part No. 360332-17. Resistor is 3300 ohms, item 152, part No. 230084-68.
(5)	Trap coil not used.	
(6)	Item 15, black peaking coil, video detector output circuit. In series is a 4700 ohm resistor, item 152.	

The CT 237 chassis uses the same tuner as does the CT 220 and the CT 238 chassis uses the same tuner as does the CT 219. Otherwise, the CT 237 and CT 238 chassis are identical.

ADDENDA

As continuation of PART IV, CIRCUIT MODIFICATIONS, recently-incorporated chassis modifications have been made:

"C" chassis change the video detector load resistor (152) from 4700 to 3300 ohms. Also, the black peaking coil (15) is now changed to violet.

"D" chassis omits the 4700 ohm resistor (153) in series with the 6BG6 screen grid. There is, instead, two 33,000 ohm 2 watt in parallel, connecting between the screen (pin 8) and terminal 1 of the horizontal deflection transformer.

These changes are shown in the accompanying schematic diagram.

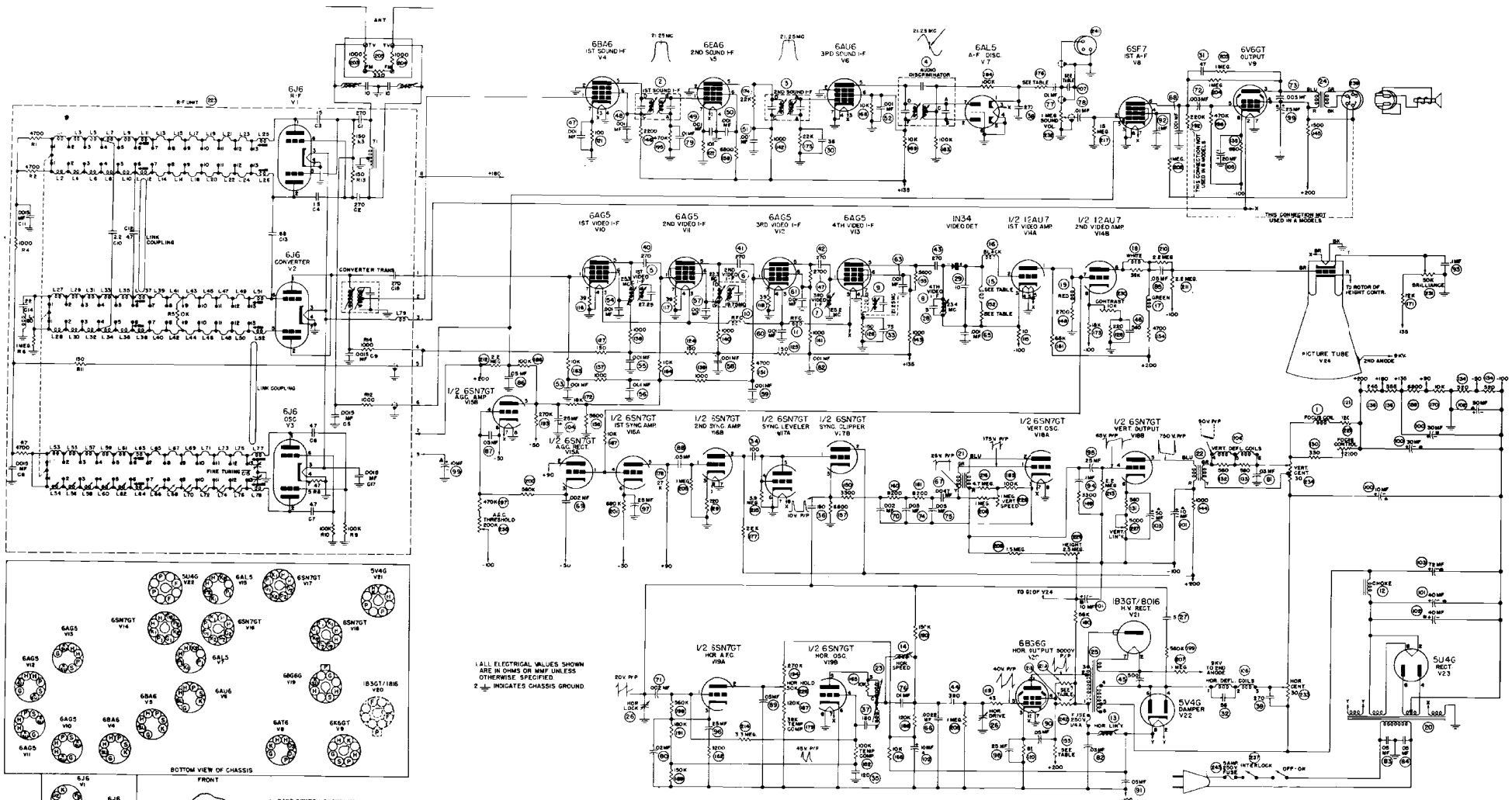
MICROPHONISM IN THE TUNER, CT 220

In recent production, the oscillator socket has a pin added in the number 1 position, with connection to pin 5. Therefore, a 6AB4 tube may be used instead of a 6C4 if tube microphonism is experienced. The 6AB4 is less subject to microphonics than is the 6C4.

If such a modification is made by the serviceman to existing tuners, some adjustment to the fine tuning wheel will be necessary to re-establish correct tuning after the change is made.

INCREASING HORIZONTAL SCANNING

In using a 12½" tube, it is sometimes impossible to obtain sufficient picture width. If items 2 and 3, Part IV - - - - do not correct the condition, connect a condenser between terminals 5 and 6 of the horizontal deflection transformer in the H. V. compartment. The condenser should be between .01 and .05 mfd; use as low a value of capacity as possible to obtain the necessary width, 600 volt rating or higher.



ITEM	A	B	C	D
	CT219-CT220-CT222			
219	OMIT	OMIT	OMIT	33K
218	OMIT	OMIT	OMIT	33K
153	4700	4700	4700	OMIT
152	4700	4700	3300	3300
15	BLACK	BLACK	VIOLET	VIOLET
176	22K	100K	100K	100K
107	OMIT	270	270	270

MODELS CT 237, CT 238