**BOTTOM VIEW OF THE CHASSIS TUBE COMPLEMENT**
(Tubes in R-F Units Given in a Later Section)

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>TYPE</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Sound I-F Amplifier</td>
<td>6B6</td>
<td>½ 12AU7</td>
</tr>
<tr>
<td>2nd Sound I-F Amplifier</td>
<td>6B6</td>
<td>Sync Amplifier</td>
</tr>
<tr>
<td>3rd Sound I-F Amplifier</td>
<td>6SN7GT</td>
<td>6SN7GT</td>
</tr>
<tr>
<td>Sound Discriminator</td>
<td>6A15</td>
<td>6SN7GT</td>
</tr>
<tr>
<td>1st Audio Amplifier</td>
<td>6G9</td>
<td>Horizontal Oscillator, A.C.</td>
</tr>
<tr>
<td>Audio Output</td>
<td>6V6GT</td>
<td>6G9GT</td>
</tr>
<tr>
<td>1st Video I-F Amplifier</td>
<td>6A5</td>
<td>6SN7GT</td>
</tr>
<tr>
<td>2nd Video I-F Amplifier</td>
<td>6A5</td>
<td>1B4/CT/804</td>
</tr>
<tr>
<td>3rd Video I-F Amplifier</td>
<td>6A5</td>
<td>5V4</td>
</tr>
<tr>
<td>4th Video I-F Amplifier</td>
<td>6A5</td>
<td>5V4</td>
</tr>
<tr>
<td>1st Video Amplifier</td>
<td>⅓ 12AU7</td>
<td>12AP4, 103P4, 10FP4, 12FP4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24 Tubes</td>
<td></td>
</tr>
</tbody>
</table>

*See tube complement of R-F units.

**TELEVISION FREQUENCIES, MC.**

- Picture I-F: 2575 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 sub-assembly:

**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.
- **MAGNALOCK** 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.

© John F. Rider
<table>
<thead>
<tr>
<th>Channel No.</th>
<th>Limits</th>
<th>Picture Carrier</th>
<th>Sound Carrier</th>
<th>Osc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>54-60</td>
<td>55.25</td>
<td>59.75</td>
<td>81</td>
</tr>
<tr>
<td>3</td>
<td>60-66</td>
<td>61.25</td>
<td>65.75</td>
<td>87</td>
</tr>
<tr>
<td>4</td>
<td>66-72</td>
<td>67.25</td>
<td>71.75</td>
<td>93</td>
</tr>
<tr>
<td>5</td>
<td>76-82</td>
<td>77.25</td>
<td>81.75</td>
<td>103</td>
</tr>
<tr>
<td>6</td>
<td>82-88</td>
<td>83.25</td>
<td>87.75</td>
<td>109</td>
</tr>
<tr>
<td>7</td>
<td>174-180</td>
<td>175.25</td>
<td>179.75</td>
<td>201</td>
</tr>
<tr>
<td>8</td>
<td>180-185</td>
<td>181.25</td>
<td>185.75</td>
<td>207</td>
</tr>
<tr>
<td>9</td>
<td>186-192</td>
<td>187.25</td>
<td>191.75</td>
<td>213</td>
</tr>
<tr>
<td>10</td>
<td>192-198</td>
<td>193.25</td>
<td>197.75</td>
<td>219</td>
</tr>
<tr>
<td>11</td>
<td>198-204</td>
<td>199.25</td>
<td>203.75</td>
<td>225</td>
</tr>
<tr>
<td>12</td>
<td>204-210</td>
<td>205.25</td>
<td>209.75</td>
<td>231</td>
</tr>
<tr>
<td>13</td>
<td>210-216</td>
<td>211.25</td>
<td>215.75</td>
<td>237</td>
</tr>
</tbody>
</table>

300 ohm—Antenna input

**IMPEDANCE** Speaker Coil 3.2 ohm

**POWER** Audio—25 W. undistorted, 6 W. Max.

Chassis 19" wide, 17" deep, 10¼" high.

**SIZE** Picture—754" x 1012" (12FIP4)

7" x 9" (10FP4, 10B14)

---

**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. 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.
PART II

TOP VIEW OF THE CHASSIS

R-F UNIT OF THE CT 219 Chassis

R-F UNIT OF THE CT 220 Chassis

R-F UNIT OF THE CT 222 Chassis

© John F. Rider
PART III

INSTALLING THE PICTURE TUBE

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 63857-5.

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 coils is reversed between 10" and 12½" installations. Furthermore, coil-rotation 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 the tube is positioned so 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.

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 (from 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 following 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 Magnavox transformer to frame the picture. This adjustment is located di-
FIELD SERVICE ADJUSTMENT
If the circuit proves unstable in service it may be advisable to change the 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 sync 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 (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 reoriented.

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)
1. Apply a 1000 to 50,000 microvolt television signal to the antenna terminals.
2. 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 46 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 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 same frequency of a television station.
The CT 219 and CT 222 incorporate 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 distance on visual inspection, then turn one core 1/2 turn from the original position and repeat the second for maximum rejection of interference 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 now.

UNDISTORTED 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, permitting 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. 46562-2 (7' long) or 46562-4 (4' long) is used.
In the event output of other audio input connection to the separate instrument are already in use for an FM converter, wire-recorder or other signal-source, 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. Switching relay is available.

PART IV
CIRCUIT MODIFICATIONS
The following circuit modifications have been made in the receiver, designated on the chassis with 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 230" in reality indicates the first-run chassis or "CT 220A." It differs from the latter: 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 250 mfd. condenser from the "high" side of the volume control to ground.
(b) changing the value of R76 in the audio discriminator output from 22 K to 100 K.
2. (2) The bottom of R192 (220K, 65F) audio amplifier plate load, connects to pin 1 of the speaker socket instead of to pin 2.
3. (3) There are some physical changes in the chassis: relocation of some terminal (tie lug) strips and connections of disc oscillator terminals 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 voltage rejection of voltage as indicated on the V.T.V.M. even with maximum feedback, the circuit is not 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 that 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 chassis 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 waveform. Failure to attain this probably means poor grounding. Slow regeneration 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 Voltvoltmcr Jr. in series with one meghohm resistor to the output of discriminator (V-7) and adjust secondary core of 3rd Sound I-F Transformer (4) for maximum -d-c output. Set Voltvoltmcr Jr. to output of discriminator (V-5) and adjust primary core of 3rd Sound I-F Transformer (4) for zero -d-c output. Residual transformer (3) may be used 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 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 oscilloscope, connect the sweep signal from 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 "B" 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 135) and adjust transformer to the 3rd and (3) and (18) Adjust primary core of 3rd Sound I-F Transformer (4) for maximum gain at 21.25 mc and symmetry about 21.25 mc. The output level from the sweep output to the discriminator should be set to produce approximately 0.3 volt peak to peak at the third sound I-F grid return. The bandwidth at seventy percent response from the discriminator to the signal source is the frequency of the discriminator grid return should be approximately 200 kc. If a 50 cycle sweep rate is used, it will be necessary to reduce the shunt resistor (175) to approximately 5000 ohms.

John F. Rider
R-F UNIT ALIGNMENT

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

For example, local oscillator alignment is made by inserting into the antenna terminals an R-F signal of frequency identical to that of the sound carrier of the particular channel being aligned. Assuming that the sound discriminator has been previously correctly 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 metering 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 would be 150-ohm units.

By such padding, both signal generator and receiver "look into" a resistance equal to their respective impedances, 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 F-1 through 12.

It is well to remember that local oscillator frequency is subject to variation in exchange of oscillator tubes. Therefore, trials of several tubes (even of the same manufacturer), or 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 coils. It also utilizes 6J1 tubes in balanced circuit. The oscillator tube is covered by a lead microphone-shield.

R-F AMPLIFIER, CONVERTER ALIGNMENT, CT 220

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.

With the converter in position 13, and the sweep covering this channel (see Part I for frequencies), adjust L25 and L26, L51 and L52 for normal over coupling to CRT. In addition, it is illustrated, the curve should be symmetrical between the sound and video carrier frequency markers, which should, of course, be equal to approximately the 90 to 100 per cent points. L25 and L26 stud extensions should be maintained approximately equal, so that L51 and L52 adjustments are symmetrical, as should L51 and L52 adjustments.

Next, channels 12 to 7 should be checked for normal frequency. Normally, these curves appear somewhat overcoupled or double-humped with a 10 or 15 per cent peak-to-valley excursion. Sound and 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 75% 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 75% point.

Channel 6 is now aligned as was channel 13, tuning P11 and L12, L13 and L14. Channels 5 to 2 should then be checked as were channels 12 to 7, above.

ALIGNMENT OF THE TUNER, CT 220 RECEIVER

This is the 12 channel unit using 6876, 6AG6 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 knob may be set about half way from its mid-position in the direction of less capacity (clockwise in production units, but the split-stator fine tuning control knob is parallel to 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. The 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:

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

(c) The 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 sound carrier frequency to obtain over-uniform positioning on channels 1-27.

(e) Low-band slug-tuning is by the same process.
**ALTERNATE R-F AMPLIFIER ALIGNMENTS**

- **22 MC**
- **25.75 MC**
- **21.25 MC**
- **1975 MC**
- **27.25 MC**
- **25 MC**
- **PICTURE CARRIER**
- **ADJ. SOUND**

**VIDEO I-F SELECTIVITY CURVE AND OVERALL I-F 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, generating sweeping 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 (R112). This is between the "low" end of the black peaking coil of the detector and the ground. (If the signal generator must be used, provision for amplitude modulation must be made.)

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 grid is in the three types of R-F unit assemblies as illustrated.

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

**TABULATED ALIGNMENT**

<table>
<thead>
<tr>
<th>CONNECT MADE</th>
<th>CONNECT OTHER END WHERE MADE</th>
<th>DETECTOR TO BE ADJUSTED</th>
<th>DETECTOR ADJUSTED</th>
<th>VOLTAGE TESTED</th>
<th>TUNE FOR</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SAME</td>
<td>SAME</td>
<td>MINIMUM</td>
<td>MINIMUM</td>
<td>MINIMUM</td>
<td>MINIMUM</td>
<td>MAX</td>
</tr>
<tr>
<td>2 SAME</td>
<td>2nd I-F (sweep)</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MINIMUM</td>
<td>MINIMUM</td>
<td>MAX</td>
</tr>
<tr>
<td>3 SAME</td>
<td>3rd I-F (out)</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MINIMUM</td>
<td>MINIMUM</td>
<td>MAX</td>
</tr>
<tr>
<td>4 SAME</td>
<td>4th I-F (out)</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MINIMUM</td>
<td>MINIMUM</td>
<td>MAX</td>
</tr>
</tbody>
</table>

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 at 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 (R112) 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 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 lower "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.
### ALIGNMENT VIDEO 1-F

<table>
<thead>
<tr>
<th>CONNECT</th>
<th>DETECTOR</th>
<th>GENERATOR</th>
<th>TUNE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIDEODET</td>
<td>LOADRESIST</td>
<td>Freq</td>
<td>DETUNEMIXER</td>
<td>TRAP VCD TONE</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SLUGS MOSTLY AFFECTS NOTES**

- 1A: ... SHARP ... LOW FREQUENCY END OF CURVE
- 1B: ... BROAD ... HIGH FREQUENCY END OF CURVE
- 2A: ... BROAD ... LOW FREQUENCY END OF CURVE
- 2B: ... BROAD ... HIGH FREQUENCY END OF CURVE
- 3A: ... BROAD ... MIDDLE OF CURVE

**ALIGNMENT, R-F UNITS**

<table>
<thead>
<tr>
<th>CONNECT</th>
<th>TUNE</th>
<th>ADJUST БIAS TO NEGATIVE 3 VOLTS FOR H-F &amp; F-# OPTIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIAL V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PART VI

**MAINTENANCE OF THE TELEVISION RECEIVER**

In this section, there is not an enumeration of general complaints and remedies, 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, CT-220, and CT-222 chassis.

1. **BURN OUT OF H-V FILTER (LIMITING)**
   - **RESISTOR**
     - Should the H-V plug be placed across the chassis, the H-V filter resistor No. 149 will be damaged due to high voltage across its terminals. To test for high voltage, do not make 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 DEFORMATION 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. **6BG6 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 A fuse has been added in the plate circuit, in later production.

### ALIGNMENT

If all stations tune near one end of dial, change oscillator tube or adjust fine-tune drive of CT 220 for optimum alignment.

<table>
<thead>
<tr>
<th>CONNECT</th>
<th>TUNE</th>
<th>CONNECT DIAL V</th>
<th>CONNECT</th>
<th>TUNE</th>
<th>ADJUST DIAL V TO NEGATIVE 3 VOLTS FOR H-F &amp; F-# OPTIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTENNA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOUND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER CH. 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ADJUST DIAL V OF CT 222 UNIT ON CH 2 AND 7; OTHERS SHOULD FALL INTO LINE.**

### PART VII

**SOUND CARRIER**

- The sound carrier is the most evident with tubes of certain manufacturer.

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 V148. 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 detector (control grid of V14A, for example) to ground will result in a damaged crystal and perhaps, 23.4 mc coil and 560k (200) too low resistance.
7. No-100V. connection to threshold pot.
8. 10K (167) open or disconnected.
9. 47K (154) or green coil (17) open.
10. .05 uf (85) open.
11. Contrast pot (223) or 220 ohms (128) open.
12. Contrast pot (330) miswired.
13. The picture is mostly sync pulses.

If the p.s. 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 in a spot too rear one end has been covered rather thoroughly in 7 and 8. Be sure that none of the defects of 71 and 72 are present.

10. Picture consists mostly of sync pulses.

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 OF SYNC. AMPL. PIN 4, V16A 'SCOPE AT 30 C.P.S. 20V. P-P**

**INPUT OF SYNC. AMPL. PIN 4, V16A 'SCOPE AT 30 C.P.S. 20V. P-P**

**OUTPUT OF SYNC. AMPL. PIN 4, V16A 'SCOPE AT 30 C.P.S. 20V. P-P**

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

**GRID, VERT. OSCILLATOR PIN 1, V16A 'SCOPE AT 30 C.P.S. 400V. P-P**

**GRID, VERT. OSCILLATOR PIN 1, V16B 'SCOPE AT 30 C.P.S. 400V. P-P**

**OUTPUT, SYNC. CLIPPER PIN 5, V16B 'SCOPE AT 30 C.P.S. 27V. P-P**

**OUTPUT, SYNC. CLIPPER PIN 5, V16B 'SCOPE AT 30 C.P.S. 27V. P-P**

**GRID, VERT. OSCILLATOR PIN 1, V16A 'SCOPE AT 30 C.P.S. 400V. P-P**

**GRID, VERT. OSCILLATOR PIN 1, V16B 'SCOPE AT 30 C.P.S. 400V. P-P**

**INPUT OF SYNC. CLIPPER PIN 5, V16A 'SCOPE AT 8500 C.P.S. 20V. P-P**

**INPUT OF SYNC. CLIPPER PIN 5, V16B 'SCOPE AT 30 C.P.S. 30V. P-P**

**INPUT OF SYNC. CLIPPER PIN 5, V16B 'SCOPE AT 30 C.P.S. 30V. P-P**
**VOLTAGE CHART**

Measurements made with voltmeter operating on 11 volts 60 cycles a-c and with no signal input. Voltage shown are read with RCA Voltagemeter Jr. between indicated terminal and chassis ground except where otherwise noted. Voltage and current readings are nominal values.

<table>
<thead>
<tr>
<th>Tube No.</th>
<th>Tube Type</th>
<th>Function</th>
<th>Operating Condition</th>
<th>Plate</th>
<th>Screen</th>
<th>Cathode</th>
<th>Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>5B6D</td>
<td>1st Sound I.F.</td>
<td>120</td>
<td>6</td>
<td>20</td>
<td>7</td>
<td>1.5</td>
</tr>
<tr>
<td>V2</td>
<td>5B6D</td>
<td>2nd Sound I.F.</td>
<td>140</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td>1.5</td>
</tr>
<tr>
<td>V3</td>
<td>5A6D</td>
<td>3rd Sound I.F.</td>
<td>160</td>
<td>6</td>
<td>22</td>
<td>GND</td>
<td>1</td>
</tr>
<tr>
<td>V4</td>
<td>5A6G</td>
<td>Disc</td>
<td>140</td>
<td>6</td>
<td>40</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>V5</td>
<td>5A6G</td>
<td>4th Sound I.F.</td>
<td>160</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>1.4</td>
</tr>
<tr>
<td>V6</td>
<td>5A6G</td>
<td>5th Sound I.F.</td>
<td>180</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>1.3</td>
</tr>
<tr>
<td>V7</td>
<td>5A6G</td>
<td>6th Sound I.F.</td>
<td>200</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>1.2</td>
</tr>
<tr>
<td>V8</td>
<td>5A6G</td>
<td>7th Sound I.F.</td>
<td>220</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>V9</td>
<td>5A6G</td>
<td>8th Sound I.F.</td>
<td>240</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>1.0</td>
</tr>
<tr>
<td>V10</td>
<td>5A6G</td>
<td>9th Sound I.F.</td>
<td>260</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>0.9</td>
</tr>
<tr>
<td>V11</td>
<td>5A6G</td>
<td>10th Sound I.F.</td>
<td>280</td>
<td>6</td>
<td>40</td>
<td>7</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Notes on Measurement:
- *Variation with threshold control varies 3 V. with picture control.
- *Variation with threshold control varies 4 V. with picture control.
- *Variation with threshold control varies 5 V. with picture control.

**PICTURE DEFECTS**

- **ACROSS C66, 0.022 MFD. HORIZ. OSCILLATOR OUTPUT SCF**
  Scope at 3250 C.P.S. 65V. P-P

- **ACROSS HORIZ. DRIVE CONDENSER. SCF AT 3250 C.P.S. 65V. P-P**

- **LUG No. 1 HORIZ. OUTPUT TRANSFORMER SCF AT 3750 C.P.S. 46V. P-P**

- **PICTURE DEFECTIONS**

- **OPEN PEAKING NETWORK VERT. OUTPUT GRID C34 B149**

- **OPEN CATHODE BYPASS, VERT. OUTPUT, C105**

- **C91 (HORIZ. LINEARITY CIRCUIT) OPEN**

- **DEFECTIVE DAMPING RESISTOR. HORIZ. OSCILLATOR, R166. UNABLE TO SYNC. HORIZ.**

- **MISMATCHED VALUE OF GRID BYPASS, 2nd VIDEO AMPLIFIER, EXPANDED TO SHOW BRIGHTNESS, SMUDGING PHASE SHIFT, SMEARING**

- **LEAKY SAWTOOTH FORMING CONDENSER, C39**

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

- **LEAKY COUPLING CONDENSER, VERT. OUTPUT GRID, C36 (FOLD-OVER AT BOTTOM)**

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

© John F. Rider
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 219-220-22

1. C82, 0.03 mfd in horizontal linearity circuit, part No. 250151-36.

2. C45, H.V. filter condenser, output of H.V. rectifier connects to terminal 4, horizontal output transformer.

3. No circuit connection between terminals 5 and 6 horizontal output transformer.

4. Bottom of R144, 1000 ohm between +B and red lead of vertical output transformer connects to +225 volts.

5. Trap coil not used.

6. Item 15, black peaking coil, video detector output circuit. In series is a 4700 ohm resistor, item 152.

C64 changed to .02 mfd. 600 V. paper, part No. 250151-37.

Same conditions, 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. component, permits switching this condenser in or out of the circuit to control size.

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.

In the video detector output circuit, a variable-inductor trap coil is placed in series with the 10 mfd condenser, item 29 of the CT 219-220-22 schematic. Part No. of the trap coil and 10 mfd condenser assembly is 250417-1. 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. 26332-17. Resistor is 3300 ohms, item 152, part No. 26384-08.

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.

ADDENDUM

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 68G6 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 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 12" tube, it is sometimes impossible to obtain sufficient picture width. If items 2 and 5 are "-" do not correct the condition, connect a condenser between terminals 5 and 6 of the horizontal deflection transformer in the H.V. component. 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.