MODELS 235B1, 235M1, 325M8; Codes A, B, C, D, E, F, G, H, I, J, K, L, M, MA, MB, MC, MD

Band Width (Cont’d)
Ant. input to picture tube 3.25 MC
Sound Diac., peak to peak 400 KC

Deflection
Focus & Vert.
Magnetic
Magnetic
Scanning Interlaced, 525 lines

Horiz. Freq. 15750 CPS
Vert. Freq. 60 CPS
Frame Freq. 30 CPS
Dimensions: Table model: Width 18-1/8";
Height 17-3/4"; Depth 20-7/8"
Weight: Table model with picture tube
installed 87 lbs. less packing

235M1, Mahogany; 235B1, Blonde; and 325M8

SPECIFICATIONS
Power Requirements: 105-120 Volts, 60 cycles AC
Power Consumption: Television Chassis only: 180 watts

2 54-60 55.25 59.75 91.375 8 180-186 181.25 185.75 217.375
3 60-66 61.25 65.75 97.375 9 186-192 187.25 191.75 223.375
4 66-72 67.25 71.75 103.375 10 192-198 193.25 197.75 229.375
5 72-78 77.25 81.75 109.375 11 198-204 199.25 203.75 235.375
6 82-88 83.25 87.75 115.375 12 204-210 205.25 209.75 241.375
7 174-180 175.25 179.75 211.375 13 210-216 211.25 215.75 247.375

IF Frequencies: Television picture carrier 36.125MC
Television sound carrier 31.625MC

TUBE COMPLEMENT

<table>
<thead>
<tr>
<th>Tube</th>
<th>Type</th>
<th>Function</th>
<th>Tube</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>6J6</td>
<td>PF Amplifier</td>
<td>V14</td>
<td>6SN7GT</td>
<td>Sync sep. &amp; amplifier</td>
</tr>
<tr>
<td>V2</td>
<td>6J6</td>
<td>Oscillator</td>
<td>V15</td>
<td>6SN7GT</td>
<td>Sync clipper &amp; AGC ampl</td>
</tr>
<tr>
<td>V3</td>
<td>6J6</td>
<td>Mixer</td>
<td>V16</td>
<td>6SN7GT</td>
<td>Vert. sweep osc.</td>
</tr>
<tr>
<td>V4</td>
<td>6AG5</td>
<td>Sound IF</td>
<td>V17</td>
<td>6SN7GT</td>
<td>discharge and output</td>
</tr>
<tr>
<td>V5</td>
<td>6AL6</td>
<td>Sound Limiter</td>
<td>V18</td>
<td>7A5</td>
<td>Sync phase and Horiz.</td>
</tr>
<tr>
<td>V6</td>
<td>6T8</td>
<td>Disc. lat. audio &amp; AGC Delay</td>
<td>V19</td>
<td>7A5 or Horizon output</td>
<td></td>
</tr>
<tr>
<td>V7</td>
<td>6YG6</td>
<td>Audio output</td>
<td>*</td>
<td>68G6</td>
<td>Horizon output</td>
</tr>
<tr>
<td>V8</td>
<td>6AG5</td>
<td>1st pic. IF amplifier</td>
<td>V20</td>
<td>18B3G/8016</td>
<td>HV Rectifier</td>
</tr>
<tr>
<td>V9</td>
<td>6AG5</td>
<td>2nd pic. IF amplifier</td>
<td>V21</td>
<td>6W4GT</td>
<td>Regenerative damper</td>
</tr>
<tr>
<td>V10</td>
<td>6AG5</td>
<td>3rd pic. IF amplifier</td>
<td>V22</td>
<td>6W4GT</td>
<td>HV Rectifier</td>
</tr>
<tr>
<td>V11</td>
<td>6AG5</td>
<td>4th pic. IF amplifier</td>
<td>V23</td>
<td>6W4GT</td>
<td>LV Rectifier</td>
</tr>
<tr>
<td>V12</td>
<td>6AC7</td>
<td>Video amplifier</td>
<td>V13</td>
<td>10BP4</td>
<td>Picture CRT</td>
</tr>
</tbody>
</table>

* See Code Changes

FIG. 1 - BLOCK DIAGRAM

Chassis coded A, B, C, D and E use 7AS5's for V18 and V19; all other coded chassis use a 6BG6G for V18, and V18 is deleted.

FIG. 2 - VOLTAGE BLOCK DIAGRAM

Chassis coded A, B, C, D and E use 7AS5's for V18 and V19; all other coded chassis use a 6BG6G for V19, and V18 is deleted.

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<table>
<thead>
<tr>
<th>Table/Chart Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiber/Type</td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Description 1</td>
<td>120V/60Hz</td>
</tr>
<tr>
<td>Description 2</td>
<td>230V/50Hz</td>
</tr>
</tbody>
</table>

Note: The table above includes the following columns: Description, Value, R, C, L, 120V/60Hz, 230V/50Hz. Each row represents a different configuration or specification for the Tiber/Type.
<table>
<thead>
<tr>
<th>Chassis</th>
<th>Description (Chassis Differences)</th>
<th>Main Chassis &amp; IF-RF Chassis Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF-RF</td>
<td>Value of Resistor R48 connected in grid circuit of V11 (ohms 1/2W).</td>
<td>MI</td>
</tr>
<tr>
<td></td>
<td>39K</td>
<td>39K</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Chassis includes Resistor R67, 8.2K ±10% 1/2W, connected to pins §6 and §6 of V11.</td>
<td>No</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Value of Resistor R51 connected to pin §6 of V11 (ohms 1/2W).</td>
<td>12K</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Alignment frequency of Coils L20 and L24 (megacycles).</td>
<td>35.2</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Value of Resistor R44 connected to pin §1 of V9 (ohms 5% 1/2W).</td>
<td>8.2L</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Chassis includes IF test point and accompanying Resistor R129, 200K 1/2W, connected to plate circuit of V3.</td>
<td>No</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Value of Resistor R5 connected to pin §6 of V12 (ohms 1/2W).</td>
<td>220K</td>
</tr>
<tr>
<td>Main</td>
<td>Chassis includes socket and tube V18 (6AL5) with the accompanying components: Resistor R6B, 2.2 meeg 110% 1/2W, and Capacitor C134, .05 mfd 600V.</td>
<td>No</td>
</tr>
<tr>
<td>Main</td>
<td>Value of Capacitor C88 connected to terminal &quot;N&quot;.</td>
<td>68K mfd</td>
</tr>
<tr>
<td>Main</td>
<td>Chassis includes Capacitor C134, .05 mfd 600V, connected between terminal 7 of Transformer T7 and pin §7 of tube V18 (6AL5).</td>
<td>No</td>
</tr>
<tr>
<td>Main</td>
<td>Value of Resistor R120 (ohms 1/2W).</td>
<td>129</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Chassis includes Resistor R16, 100 ohms 1/2W, connected to terminal &quot;R&quot;.</td>
<td>Yes</td>
</tr>
<tr>
<td>IF-RF</td>
<td>Chassis includes Resistor R10:</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>a. 33K 1/2W, connected to pin §5 of V2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. 220K 1/2W, connected to ground and junction of R12 and R13.</td>
<td></td>
</tr>
<tr>
<td>IF-RF</td>
<td>Chassis includes Resistor R11, 6.2K ±5% 1/2W, connected:</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>a. In parallel with Coil L2 and C9.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. To Switches S1 and S2 moveable arm terminals.</td>
<td></td>
</tr>
<tr>
<td>IF-RF</td>
<td>Chassis includes Resistor R17, 47 ohms 1/2W, connected between pin §7 of V1 and ground.</td>
<td>No</td>
</tr>
</tbody>
</table>

**Adjust channel button set screws until the 81.75 MC marker coincides with the dip in the sound trap.**

**Set marker at 77.75 MC. It should fall between .4 and .6 of the peak amplitude on the response curve.**

**Set marker at 80.05 MC. It should fall between .4 and .7 of the peak amplitude on the response curve.**

**Check through channels 3, 5, 8 and 12 for a flat top response of the overall curve.**

**Check discriminator band width by connecting VTVM from terminal 'B' to chassis and a 31.625 MC CV signal to antenna input. Voltage peaks (one positive and one negative) should occur as the CV signal is manually varied above and below the 31.625 MC center. These peaks should occur a minimum of 150 KC plus and minus of the center frequency. It is very important that the crossover point of the discriminator occurs at exactly the same frequency to which the sound trap L28 is dipper. (This frequency is 31.325 MC.)**

**Check discriminator linearity by applying a sweep frequency approximately 200 KC wide (31.625 MC center) to antenna input and connecting oscilloscope to terminal 'B' to observe results. If a sweep greater than 200 KC in width is used it is necessary to disconnect C41 to prevent overloadng of the discriminator circuit, but this is not recommended.**

**ALIMENT PROCEDURE**

**Preliminary**

In order to better understand the following detailed alignment procedure it is necessary to explain why this procedure has been prepared in this way. Any receiver alignment problem may be classified either as minor or major. In other words, it is either only slightly out of adjustment and therefore requires minor adjustments of one or more of the coils; or, some of the coil cores have been removed, or are badly out of adjustment, which will necessitate a thorough check through the entire circuit. The following procedure is given for a set that is badly out of alignment and which must be aligned without the aid of a screen room with only a CV signal generator and a vacuum tube voltmeter as an indicating instrument. In the absence of a screen room, external noise and signals may be very troublesome during alignment. Therefore a stage-by-stage procedure is recommended, in which the signal is injected just preceding the stage under alignment. If it is known that the set is not badly out of alignment, it may be possible and practical to abbreviate the following procedure considerably by applying the input signal directly to the antenna input during the entire alignment procedure, instead of applying it to the different tubes as each individual stage is aligned.

One important point should be kept in mind when making all adjustments. That is to align all the individual coils at the same frequency setting of the generator rather than changing the generator setting and having to go back and try to reset the generator at the same frequency. For example, when you start making adjustments at 31.625 MC, do not change the generator setting from the time you start these adjustments until you have completed all adjustments on all coils that are to be aligned at this particular frequency. The exact frequency to which the coils are aligned is not as important as it is to be sure that all coils of identical frequency are aligned at exactly the same frequency. The frequency tolerance of ±.5% in signal generator frequency can be tolerated if the coils are aligned at the same relative frequencies.
Before attempting to make any alignment and adjustments, check the physical position of all of the iron core slug in the different IF transformers and wave traps. Refer to the chart given below for their approximate correct positions.

This, of course, is not necessary if the receiver is not badly out of line, or if none of the transformers or cores have been replaced. To make any adjustments, be very careful not to turn the cores in too far, since the threads in the coil forms will be disengaged and the core will drop to the bottom of the transformer can. If this occurs, the metal cover on the bottom of the RF and IF sub-chassis must be removed and a small wire inserted through the bottom of the chassis into the coil form to force the iron core back up to the point where it will engage the threads as it is turned back out.

<table>
<thead>
<tr>
<th>Symbol No.</th>
<th>Color Dot</th>
<th>Position of iron core referenced to top edge of coil form</th>
</tr>
</thead>
<tbody>
<tr>
<td>L14</td>
<td>Brown</td>
<td>3/32&quot; out 1-1/4&quot; in</td>
</tr>
<tr>
<td>L16</td>
<td>Orange</td>
<td>1/16&quot; in</td>
</tr>
<tr>
<td>L17</td>
<td>Yellow</td>
<td>1/32&quot; in</td>
</tr>
<tr>
<td>L20</td>
<td>Green</td>
<td>1/16&quot; out</td>
</tr>
<tr>
<td>L21</td>
<td>Blue</td>
<td>1/64&quot; in</td>
</tr>
<tr>
<td>L22</td>
<td>Purple</td>
<td>3/32&quot; out</td>
</tr>
<tr>
<td>L24</td>
<td>Slate</td>
<td>1/4&quot; in</td>
</tr>
<tr>
<td>L25</td>
<td>Red</td>
<td>1/16&quot; in</td>
</tr>
<tr>
<td>L26</td>
<td>White</td>
<td>5/8&quot; in</td>
</tr>
</tbody>
</table>

During the alignment of all the IF stages the antennas should be shorted to prevent pick-up of extraneous noises. If any local station still causes interference, another pushbutton should be pressed.

Short out the AGC by connecting a clip lead jumper from pin 4, V15 to terminal 1, R26. This latter point may be found on a terminal board under the chassis just back of the speaker. Adjust the contrast control, R28, to produce 5 to 4 volts from terminal 'Q' to chassis and maintain this voltage throughout the entire alignment procedure.

IF SECTION

Briefly, the detailed procedure may be analyzed as follows: the tube shield on V10 is removed far enough to disengage the grounding clips on the tube socket and the high side of the signal generator lead connected to this tube shield with the low or grounded side of the generator connected directly to chassis ground. (There is enough capacitive coupling between the tube shield and the plate of the tube to feed the signal through at these frequencies.) The first adjustment is made at 34.5 megacycles, adjusting L29 for maximum output with the vacuum tube voltmeter connected between terminals 'G' and 'E' or the terminal strip of the IF sub-chassis assembly. The input signal should be adjusted to a 1-1/2 to 2-1/2 volt reading on the VTVM. The signal generator is then adjusted to 32.9 MC and L24 adjusted to produce the maximum output voltage. This adjustment is not critical for it will be repeated and checked later when the signal generator input is moved farther back towards the RF end of the receiver.


The signal generator is then adjusted to 31.625 MC and L26 adjusted to produce a maximum voltage at 'G' and 'E'. If L26 is adjusted near the minimum point, it may be very difficult to obtain a satisfactory reading between 'G' and 'E' when adjusting L26. This again is not important, for L26 will be rechecked and adjusted when the voltmeter is connected to the output of the sound discriminator. With L26 peaked roughly to 31.625 MC, adjust L21 to terminals 'G' and 'E'. Then connect the VTVM from terminal 'A' to chassis and peak L26, L27, L19 and L16 to 31.625 MC. The signal input level should be adjusted to maintain a maximum of 4 volts from 'A' to chassis at all times, to prevent limiting. These adjustments should be repeated several times to be sure that all coils are peaked at exactly the same frequency. If they are badly out of adjustment, it is advisable to return the VTVM to terminals 'G' and 'E' and check L28 to be sure that it is adjusted to produce a minimum voltage at exactly the same frequency. Notice that L26 is still not accurately aligned since the input signal is being applied to the plate circuit of V10. Therefore the plate-to-ground capacitance of the loading does not correspond to actual conditions with the tube shield permanently in place over the tube. Since L26 is a very critical adjustment and may cause the set to oscillate if the iron core is very far out of position, it is important that this coil be aligned as accurately as possible before the signal input is removed from V10. Oscillation within the receiver circuits may be detected by an excessive and unstable voltage output at terminals 'G' and 'E' exceeding 5 or 6 volts as a minimum and very often exceeding 10 volts. To be sure the set is not oscillating and adjustments made to produce this oscillation rather than eliminate it, vary the signal generator input and notice if the voltage output varies correspondingly with the signal input. If it does not, some circuit must be oscillating.

After L29, L24, L26, L28, L27, L19, and L16 have all been adjusted as outlined above, change the VTVM to terminal 'B' and chassis and turn signal generator completely off. Notching input should be used to prevent any signal pickup through the RF stage.) Turn signal generator on and adjust L17 to produce the same voltage on the VTVM noted when no signal was applied. This point should occur approximately in the center (zero voltage) of the voltmeter reading, as it passes sharply from a positive to a negative voltage. Adjustment of L17 to this zero voltage should also produce minimum background noise and best tone quality from an FM signal of 31.525 MC center frequency.

With the circuits following V10 properly aligned, except L26, the signal generator output may be removed from the tube shield on V10 and connected in a similar manner to change the signal generator frequency setting from 31.625 MC, because L26 must be rechecked with a signal applied to V9 because of the loading effect on V10 when the signal generator was connected to this stage. The VTVM should be connected from 'A' to ground when making the final adjustment on L26, since L26 has been adjusted to minimum response with the VTVM connected from 'G' to 'E'. If L2 requires considerable adjustment in order to peak it, check L28 again with the VTVM connected between 'G' and 'E'. This voltage should be a minimum after L26 is peaked to a maximum. Now adjust the signal generator to 35.7 MC, and adjust L21 for maximum output with the VTVM connected from 'G' to 'E'. This will peak the signal generator output to the maximum voltage when L21 is adjusted to maximum voltage between 'G' and 'E'. If L2 is correctly adjusted for minimum response, it may be impossible to obtain a satisfactory reading at 'G' and 'E' for adjustment of L21. Therefore, L22 should be detuned slightly, but be very careful not to detune it any great amount, for it must be adjusted finally to an absolute minimum, and if its adjustment is changed greatly after L21 is adjusted, the initial adjustment of L21 will be altered. In other words, adjust L21 for maximum output with L22 adjusted to as near a minimum output as is possible to obtain a satisfactory reading between 'G' and 'E'.

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The signal generator input now may be moved back to V8, and L21 may be rechecked to be sure that it is at maximum response and L22 at minimum.

Alignment of the mixer outputs: stage L14 may be accomplished roughly by applying the signal to the mixer tube V3. But since access to this tube is rather difficult with the picture tube in place, it is suggested that the signal be applied to the antenna input directly. However, if any difficulty is encountered in adjustments, indicating that it is badly out of adjustment or that oscillation is taking place in the RF stage, then go back to V3 and apply the signal generator output to the tube shield of this tube in a similar manner as was done throughout the previous IF alignment. Erratic meter readings may be caused by the signal generator not being firmly grounded to the TV chassis, especially when the generator is connected to the IF. The signal generator must be maintained between the signal generator and the TV chassis at all times. With the signal generator applied to the antenna output, adjust its frequency to 32.9 MHz and adjust L14 and recheck L24 for maximum output voltage on VTVM connected from 'G' to 'E'. Return the signal generator setting to 35.7 MHz and recheck L23 and L20 for maximum output. Normally, no difficulty should be encountered in feeding an IF signal through from the antenna terminals into the IF; but in case the antenna wave traps (C141, C142, and L50 and L51) are tuned to the particular frequency one is attempting to apply to the IF, a very strong signal may be necessary unless the antenna plug is pulled out of the RF chassis and the signal generator input applied directly to the chassis jack. Even though the signal generator output is unbalanced to ground, this will make no difference as far as IF alignment is concerned, but it should be balanced when making RF alignments which will be discussed in the next section.

**RF Section**

In aligning the RF and oscillator sections, the signal generator output must be applied to the antenna input, and should be applied directly to the antenna terminals with the IF sound traps connected into the circuit, for these traps have some effect on the RF tuning characteristics. If the signal generator output is unbalanced to ground, a balanced-to-ground network should be connected between the signal generator and the antenna terminals. A suggested method of making this network is shown in the sketch below. Resistors used must be non-inductive at the TV carrier frequencies.

![FIG. 4 - SIGNAL GENERATOR MATCHING NETWORK](image)

The fine tuning control C22 is set at its mid-position and left at this position throughout all RF and oscillator adjustments. The AGC amplifier is still shorted out as for IF alignment and the RF bias adjusted to -3.5 to -4.0 volts at 'A'. The output will be detected at 'C' and removed from the IF strip and replaced with the AM-100. A thin non-metalic screwdriver is required for adjusting these trimmers. Press channel number 2 pushbutton and then retrip it to be sure that all of the tuning sleeves are in the lowest frequency position on the low frequency band. This adjustment is a check to be sure that the oscillator will tune to the low frequency limit that is necessary. Set the signal generator to 54 MC and adjust C25 to produce zero voltage on the VTVM at the sharp cross-over point of the meter. In other words, the oscillator is adjusted until the meter reading is zero on the VTVM at the sharp cross-over point of the meter. Channel number 6 is then adjusted with the signal generator set at 81.75 MC. The HF bias measured at terminals 'S' to chassis should be -3.5 to -4.0 volts with the AGC shorted out. Now adjust this pushbutton adjustment screw to zero voltage at the sharp cross-over point. (VTVM connected from 'H' to chassis.) Change the signal generator output to very carefully adjust the tunings with the set set at the sharp cross-over points of the meter. The HF bias measured at terminals 'G' and 'E' is the signal source when it is reduce 2 volts or less between these terminals. (C9 and C23 are accessible with a small non-metalic screwdriver through the opening of the focus and hold controls. C9 is the 3rd trimmer from the left and C23 is the 5th from the left.)

The high frequency channels are adjusted in the same manner as the low frequency channels were adjusted, except that different buttons are used and different frequencies. Channel number 7 pushbutton is pressed to operate the band switch (S1, S2, S3, S4, S5 and S6) and then one of the other high frequency pushbuttons is pushed slightly to trim the meter. This is to be sure that it is in the correct coil. The high frequency position and the tuning sleeves are in the lowest frequency position on this high frequency band. The VTVM is again connected to the meter 'B' to chassis, and 174 MC signal is applied. The HF bias remains at approximately 4 volts. C24 (input trimmer from left) is then adjusted to produce zero signal at the sharp cross-over point of the meter. This requires considerable care must be exercised in making it to be sure the setting is not disrupted when the screwdriver is removed from the trimmer.

Press channel number 13 pushbutton and apply a 218 MC signal. Adjust pushbutton screw to produce zero output at the cross-over point. This is to check the band coverage. Press channel number 8 pushbutton and apply 185.75 MC signal to the pushbutton set screw for zero output at the cross-over point. Change the VTVM from terminal 'B' and chassis back to terminals 'G' and 'E', and apply 183 MC signal. Adjust antenna trimmers C8 and C12 for maximum output keeping the signal input at a value that will produce approximately one volt. C8 is the fourth trimmer from the left above the pushbutton, and C12 is the sixth trimmer. The individual pushbuttons may be set to their proper channels by tuning in a test pattern from a local television broadcast station, and adjusting the set screw to produce best tone quality rather than adjusting it for maximum picture brilliance. In fact, maximum picture brilliance should not occur at the exact position of best tone. It is difficult for the average service technician to properly adjust these pushbuttons without a test pattern from a local broadcast station because of the lack of an accurate frequency source. If a signal generator must be used it should be crystal controlled at the exact sound carrier frequency of the individual channels. (See SOUND CARRIER frequencies under SPECIFICATIONS on cover page.)

In making all of the preceding adjustments, a point of caution must be emphasized. Be sure to check the output indication as an output obtained from the receiver when the same type of signal is actually produced from oscillation within the receiver. If oscillation still occurs when the relays are properly adjusted, then it may be caused by the incorrect connection of the relays. In the preceding chart, oscillation may be stopped by increasing the IF and RF signals.
bias above the specified three or four volts. The bias should be returned to the lower value as soon as oscillation can be stopped, and the circuits aligned to prevent it from recurring with the lower bias. The signal source should be maintained as low as possible throughout the entire alignment. A good general rule to follow is to keep the signal source at such a value that not greater than two volts are produced between terminals 'G' and 'E'. It is very important to maintain a good ground connection between the signal generator and TV chassis.

Again it is emphasized that although the procedure outlined above is rather long, it will not be necessary to go through it in this same step-by-step manner. In fact, in many cases, the signal generator may be connected directly to the antenna input and all adjustments at one particular frequency made without changing the signal generator setting from this particular frequency once it is made. The step-by-step procedure given above is recommended only when it is necessary to use this procedure in order to obtain sufficient signal input, to overcome oscillation, or in areas of high noise level.

**Sweep Oscillator Adjustments**

The following adjustments are best performed with a received TV signal and test pattern but can be made with any received program signal.

1. Turn Off-Volume control and Contrast control clockwise until a picture modulates on the raster, generally out of sync until the following adjustments are complete. (Line voltage should be 117V 60 cycle AC.)

2. Adjust Height control (R53) on front panel to produce a pattern that exceeds the height of the picture tube mask by approximately 1/8" top and bottom.
   Linearity control R82 must be adjusted after step 12.

3. Set the Vertical Hold control (R71) (behind the removable panel over the pushbuttons) to eliminate in the picture any horizontal gray or black bands (vertical blanking) which may be several in number when not vertically synchronized. At vertical synchronization, the horizontal bands will decrease in number to a single, approximately half-inch high strip which will move up or down when the control is displaced slightly from its correct setting.

4. The remaining break-up of the picture as a unit is characterized by diagonal parallel streaks inclined toward the horizontal axis as the horizontal sweep is farthest from synchronization with the transmitter. Turn the 'horizontal hold' control, (behind the removable panel over the pushbuttons) and observe the changing slope of the diagonal streaks.

5. Set the Horizontal Hold control at approximately mid-position.

6. Starting with maximum clockwise position set Horizontal Drive trimmer (C108C) to produce at the high voltage terminal on picture tube:
   a. 9.2KV to 10.2KV for chassis using two 7A5 tubes for V18 and V19.
   b. 9.3KV to 9.6 KV for chassis using one 6B66 for V19.

   This will usually occur at a trimmer position one to two turns out from maximum capacitance. Line voltage when making this adjustment is 117 volts.

   When an electrostatic or low current (draws less than 25 microamperes) high voltage voltmeter is not available, adjust Horizontal Drive trimmer (C108C) until picture fills mask, or provides picture width of 8-7/8" if chassis is out of cabinet. The focus control R91 should then provide proper focusing when the control is in normal operating position. This normal position is within approximately 100° either side of the mid-position. To arrive at this setting the focus coil may have to be physically adjusted (see section headed PICTURE TUBE COMPONENT ADJUSTMENT).

7. Adjust Horizontal Frequency (C108A) to approximately mid-range (about one turn out from the maximum clockwise position which gives maximum capacitance). Also set Horizontal Lock Range (C1083) to 1/2 turn out from maximum clockwise position.

8. With a small screwdriver, turn the Horizontal Oscillator core (T6) adjustment on the top of the chassis below the picture tube socket. This is a coarse oscillator frequency adjustment and will pass through a setting where the diagonal streaks on the screen decrease in number and become erect; finally, producing a single picture which slides sidewise to a stop when properly synchronized.

9. With the picture synchronized as in step 7, drop synchronism by turning the Horizontal Hold control fully counterclockwise. If this does not drop synchronism, push a different station selector button, then return to the original station button.

10. Slowly turn the Horizontal Hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

11. If more than 6-1/2 bars appear just before picture synchronism, adjust the trimmer on the rear chassis apron marked Horizontal Lock Range slightly clockwise (toward higher capacitance). If fewer than 4 bars appear just before sync, turn the trimmer slightly counterclockwise.

12. Increase picture Contrast (clockwise), momentarily remove the signal by detuning and recheck the number of bars present at the pull-in point. Repeat the Lock adjustment until 4 to 6-1/2 bars are present at pull-in.

13. Check the range of the front panel horizontal hold control, starting at full counterclockwise position. Interrupt the signal momentarily by detuning or by turning contrast control to minimum and then back to half clockwise position. Normally the picture will then be cut of sync horizontally. Turn the hold control clockwise slowly until 6-1/2 to 4 diagonal bars (aoping downward to the left) appear on the screen. A slight additional clockwise rotation of the hold control should produce full synchronization. This should occur at about 90° from the counterclockwise end and hold for at least 120° more clockwise rotation of the control. As the picture jasies out of sync with further clockwise rotation, a diagonal bar or bars (downward to the right) will immediately appear. This is an optimum adjustment of the oscillator. Recheck previous steps if Step 12 is not fulfilled.

14. Check interlace by observing interspacing of alternate field lines. Over at least half of the Vertical Hold range of sync lock-in, the interlace shall be sufficiently good so that the alternate lines appear generally evenly spaced. The spacing between alternate lines shall differ by no more than 50%, that is, the larger spacing shall be no more than 50% greater than the smaller spacing. This may be more easily checked by temporarily expanding the vertical sweep by turning the Vertical Line-
arity control full clockwise and observing the expanded portion of the sweep. Since many factors, including faults in the transmitted signal, may upset interface of the receiver, considerable care and judgement are required in this test.

REMOVAL & INSTALLATION OF PICTURE TUBE

CAUTION: Be sure power cord is removed from wall receptacle and wear goggles.

1. Remove the high voltage lead and plug (M10) from the socket on top of the picture tube.
2. Remove the tube socket (M4) from the base of the picture tube.
3. Remove the ion trap from the neck of the picture tube, just above the tube base.
4. Remove spring and 'J' clamps from either side of picture tube. Be very careful not to strike the tube when removing these springs for they are quite strong and could easily break the tube if allowed to snap as they are unhooked.
5. Loosen the machine screw on the right side (viewed from the front) of the picture tube front clamp (N33).
6. Grasp rim of picture tube face and gently pull the tube forward from its mounting. Do not allow the tube to rest on its neck or base and do not attempt to carry or handle the tube holding it only by the neck.
7. To replace the tube reverse the above procedure noting ion trap installation instructions that follow.

* Ion Trap Magnet Installation

1. Before placing the socket on the tube base, slide the permanent magnet ion trap on the tube neck with the blackened magnet nearest the tube base, or with the indicator arrow pointing toward the screen end of the tube. The poles of the magnet nearest the base should be aligned with the 'L' shaped 'flags' welded on the side of the cathode ray gun. When the second anode contact in the tube's glass cone is directly on top, the ion trap magnet will generally be suspended below the tube neck. On a few picture tubes, the magnet will be correctly mounted above the neck. These few tubes were made before standardization of tube construction and no raster will appear if the magnet is placed in the conventional position below the neck.
2. Tighten the magnet clamps partially and place the socket on the tube base.
3. Make sure that the two springs riveted on the side of the yoke mounting hood (M17) are in contact with the external paint coating of the picture tube cone.

PICTURE TUBE COMPONENT ADJUSTMENTS

To adjust the picture tube yoke, focus coil, and ion trap magnet it is desirable to have a test pattern signal available from a television transmitter. Most adjustments can be approximated with the receiver not connected to an antenna, however, with a raster of unmodulated trace lines appearing on the screen.

1. Before turning on power, set the two centering controls on the rear chassis apron, and the focus control on the front chassis apron (behind the removable panel above the pushbuttons) at mid-position. Also set the Brilliance and Contrast front panel controls at mid-position.
2. Turn on power with the Off-Volume control knob turned clockwise.
3. Allow approximately a half-minute for the receiver warm-up and look for the development of a raster on the picture tube screen.
4. If no raster appears: (a) Make sure that the high voltage rectifier tube (V-20) in the shield compartment is lit, indicating sweep amplifier activity. (b) If the rectifier filament is lit, grasp the ion trap magnet and slide it along the tube neck slightly. Sliding the magnet around the neck may also be necessary to produce a raster. The position of the magnet giving the brightest raster will be optimum. (c) The two previous checks may fail to produce a raster unless the Brilliance control is rotated farther clockwise to less than picture tube grid-cutoff bias. Repeat (b) if raster appears upon advancing Brilliance control setting.
5. Tighten clamp on ion trap magnet with brightest raster visible.
6. Loosen deflection yoke mounting wing nut and rotate yoke on the tube neck to produce raster edges parallel to the picture mask edges. Tighten the wing nut again.
7. Slide the focus coil forward and backward along the neck of the tube until the best compromise is reached between picture center and edge focus, adjusting the 'Focus' control at the same time, at the desired setting of the Brilliance control.
8. Tighten the focus coil mountings if no corner of the raster is in shadow. If a corner or edge shadow appears: (a) Make sure deflection yoke is mounted as far forward on the picture tube neck as possible. (b) Loosen all focus coil mountings and move the coil sideways and vertically with some tilt if needed, to direct the beam over the interference in the tube neck which caused the shadow.
9. Tighten all focus coil adjustments after repeating Step 7.

SERVICE NOTES

The speaker is now mounted to the chassis on 4 rubber shockmounts which will eliminate speaker rattle experienced with some receivers on which the speaker is mounted rigidly to the chassis. In order to shock mount the speaker, the mounting holes in the speaker frame must be enlarged to accommodate rubber grommets.

In case the Brilliance control R117 will not blank out the raster when turned completely counterclockwise, place a jumper across R112. Do not remove R112 as the jumper may have to be removed if the picture tube is changed at some later date.

In some sets the high voltage rectifier tube V20 has pin #5 soldered in the socket. This must, of course, be unsoldered before the tube can be removed.

Extreme care must be exercised in making any of the repairs on this receiver for an excessive amount of heat, for instance, may ruin the ceramic capacitors causing them to open or short circuit. For example, if C37, which is connected across
terval 2 and 1 of the discriminator transformer, T1, is replaced, an excessive amount of heat from the soldering iron may cause C36 (6.8 mmf) inside the transformer to open. Indication of this trouble will be that audio will be available from the secondary of T1 (L17) but not tuned properly. The same precaution applies to C100 which is a 6.8 mmf ceramic capacitor connecting the horizontal sync pulse from the junction of R16 and R74 to C101 at sync phase tube V17. In trouble shooting this receiver, too much emphasis cannot be placed upon the need for checking both positive and negative B supplies before making any actual component tests, because a low B-supply down around -90V, will introduce troubles into the picture circuit and high voltage supply that in many cases will not be evident directly from the visible or audio symptoms. It is impossible in this space to list all of the probable causes of low or high voltage on either the positive or negative supply for most any of the by-pass capacitors may be at fault. For example, if C40 connected from the audio output lead from the 270 ohm to ground is shorted, the -15V bus will vary considerably as the volume control is changed from a minimum to a maximum position. In the minimum position, the grid is at a cadmium potential, but as the volume control is advanced the grid becomes more positive causing the audio output tube V7 to draw excessive current thus dropping the -150 volt line, in many cases, to below -100 volts.

A rapid check on the current drain of the B supply may be made by measuring the voltage drop across the speaker field (Choke LA47 in the console models). As noted on the schematic diagram, the resistance of this coil is approximately 98 ohms and the voltage drop should be about 22-1/2 volts. If the voltage drop is not within 5 volts, one may be reasonably certain that a short exists somewhere in the system.

A question may arise as to what changes listed under Code Changes are absolutely necessary to obtain optimum performance from the receiver. The following is a list of the changes which should be incorporated in every receiver. They are given in detail in the code changes preceding the alignment procedure. In order to improve both vertical and horizontal sync. C88 should be 680 ohm paralleled by R125 which is a 10 meg resistor. R127 and R126 connecting the cathode, pin 6, of V14 to the grid resistor of the same section of this tube to chassis ground should be deleted. In all cases, R124 should be 8200 ohms and R139 from pin 1 to pin 6 of V14 should be installed. The connection from R76 should be made to the junction of R74 and R65 instead of directly to the plate of the sync clipper tube. The AGC amplifier circuit should be modified to conform to the schematic given with these notes. Considerable fluctuation on the picture may occur in receivers in which R4, a 7500 ohm, 5 watts; and R141, 7500 ohms, 10 watts, stabilize this B+ and B- voltage supplies. It is very important that these two resistors be added at the same time that the chassis resistor R135 connected across the focus coil, is changed from 3300 ohms, 1 watt, to 1500 ohms, 2 watts. Otherwise it may be impossible to obtain proper focusing.

It is not recommended that any of the changes shown in the RF section, deleting R4 in the cathode of V1 and changing R5 and R9 and adding R34, be made unless the receiver is operating in fringe areas of low signal strength and trouble with excessive snow on the screen is encountered. These changes will minimize the amount of snow on the screen but are rather difficult to make, for LB may be damaged while removing R5. If these changes are made, only Allen Bradley resistors must be used. On receivers in which the high voltage output transformer T7 is identified with a blue dot, an 8200 ohm resistor is connected between terminal 6 of the transformer and the wide control L45. These blue dot transformers are not stocked for replacement and therefore this resistor should not be used when the transformer is replaced.

Pushbutton and RF-IF Sub-assemblies

Removal of assemblies

The removal of the pushbutton and RF-IF assembly is a relatively easy matter if the following instructions are adhered to. The pushbutton, RF, and IF units are mounted as one assembly and should be removed as such.

1. Remove picture tube. Follow precautions and instructions given under INSTALLATION OF PICTURE TUBE.

2. Tone controls may be swung out of way by removing one screw of its bracket and pushing it aside.

3. Carefully unsolder and remove all wiring connected to the IF sub-assembly. Make note of the wire positions.

4. Unbolt and remove bottom IF plate cover.

5. Remove screw located in the front center of the main chassis. Be sure to support the assembly to prevent dropping.

6. Allow IF assembly to drop down and slowly slide unit in a back and down movement, until it is clear of the chassis.

RESISTANCE CHART

For Coxe F Chassis

All measurements to chassis ground.
All tubes in socket except 10BP4.
All potentiometers set to maximum clockwise position.
N.C. = No connection.

<table>
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<th>Tube &amp; No.</th>
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<th>4</th>
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<th>6</th>
<th>7</th>
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<td>10k</td>
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<td>N.C.</td>
<td>N.C.</td>
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</table>

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A wavetrap consisting of a series resonant circuit for each side of the balanced antenna line is mounted near the chassis antenna receptacle for the purpose of eliminating any undesired signal in the IF band (30 to 40 MC). To avoid blocking any signal in the low television band, this trap is usually set for the FM band (88 to 108 MC) when there is no interfering IF signal. It is possible for the wavetrap to be adjusted to block the audio signal of one of the low band television channels, which results in obtaining a good picture but no sound. If such a condition exists, adjust trimmers to position 4 to 5 turns out from maximum clockwise position. Position is the point of minimum capacitance and the trap is then harmlessly set in the FM band.

When a signal, such as a police call, causes interference in the IF band, adjust trimmers CI41 and CI42 of the wavetrap as follows:

a. Set both trimmers fully clockwise (maximum capacitance).

b. Turn capacitor CI41 counterclockwise 1/4 turn, and then turn capacitor CI42 counterclockwise 1/4 turn.

c. Follow procedure of "b" until interference disappears.

CAUTION: Often an interfering signal, such as a police call, operates intermittently, and, therefore, it is necessary to make sure the signal is present when attempting to block it with the antenna wavetrap.

After making adjustments, check all low and all high channels for proper picture quality and correct sound.

REMOVAL OR REPLACEMENT OF PUSHBUTTON TUNER

A. Removal


2. Referring to diagram of tuner switch positions, Fig. 8, remove the following components in the order designated:

   a. Remove CI43 and CI from center arm of S2.
   
   b. Remove C4 and CI44 from center arm of S1.
   
   c. Remove C20 and bus wire from center arm of S3.
   
   d. Remove CI4 and bus wire from center arm of S4.
   
   e. Remove CI6 from center arm of S5 and S6.
   
   f. Remove copper strap from center arm of S5.
   
   g. Remove copper strap from center arm of S6.
   
3. Remove six mounting screws.

4. Remove R8 from center arm of S3 and S4.

5. Remove R3 from Low Frequency arm of S1 and S2.
B. Replacement in IF-RF Chassis:

a. Replace pushbutton tuner in IF-RF chassis in reverse of the order of removal under A.

C. Disassembly of Pushbutton Tuner:

1. Remove latch bar spring M121. See Figure 5 of Preliminary Service Manual.
2. Remove latch bar M110 and notice that the flange of the latch has to be straightened before removal can be accomplished.
3. Loosen mounting plate M100 by pinching or filing atking burrs that secure it at four points to the frame.
4. Pull forward mounting plate M100 with top, M105, and bottom, M106, shanks.
5. Disconnect springs M123 and M122 and link M118 from tuning sleeve mounting bar M116.
6. Remove four mounting screws of the high and low band switch assembly, noticing that the upper and lower mounting screw makes use of a washer or spacer to keep screw from interfering with movable switch arm.
7. Remove switch assembly with accompanying coils and trimmers.
8. Push and fasten tuning sleeve mounting bar actuating lever M117 (both) towards rear and fasten in this position.
9. Remove tuning sleeve mounting bar M116 by rotating it within the slide groves in the frame.

D. Assembly of Pushbutton Tuner:

1. To reassemble this tuner, follow the procedure in reverse order for disassembly as given in section C. Use the following additions in procedure.
   a. After tuning sleeve mounting bar M116 is replaced in the groove make sure tuning sleeve mounting bar actuating lever M117 is fastened in rear position to allow M116 to have full length of travel.
   b. To replace switch assembly, slide sleeve bar M116 to rear position and carefully replace tuning sleeves of bar M116 in coils of switch assembly. This can be done by working carefully from one end, replacing one sleeve at a time.


DESCRIPTION OF TUNING SLUGS

<table>
<thead>
<tr>
<th>BENDIX STOCK NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST0101</td>
<td>SLUG - Tuning Discriminator Transformer. Identified by a green dot.</td>
</tr>
<tr>
<td></td>
<td>Characteristics:</td>
</tr>
<tr>
<td></td>
<td>a. Low permeability - high frequency (30-100 MC) - high Q.</td>
</tr>
<tr>
<td>ST0102</td>
<td>SLUG - Tuning IF Coils and 4.5 MC Trap. Identified by a red dot.</td>
</tr>
<tr>
<td></td>
<td>Characteristics:</td>
</tr>
<tr>
<td></td>
<td>a. Higher permeability - lower frequency (up to 30 MC) - lower Q required.</td>
</tr>
<tr>
<td>ST0103</td>
<td>SLUG - Tuning for Sync, Width, and Horizontal Linearity.</td>
</tr>
<tr>
<td></td>
<td>Has screw but not color coded.</td>
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</table>

TROUBLE SHOOTING PROCEDURES

CAUTION: DO NOT REMOVE ANY OF THE FOLLOWING TUBES UNDER ANY CIRCUMSTANCES WHILE THE TELEVISION RECEIVER IS TURNED ON.

| V2     | 6J6      | RF Oscillator          |
| V13    | 10BP4    | Picture Tube           |
| V15    | 6SN7-GT  | AGC Amplifier and Sync Chipper |
| V16    | 6SN7-GT  | Vertical Osc. & Disch. and Vert. Output |
| V17    | 6SN7-GT  | Hor. Osc. & Disch. and Sync Phase |
| V19    | 6H6G6G   | Hor. Output            |
| V22    | 6W4-GT   | Rectifier              |
| V23    | 6W4-GT   | Rectifier              |

Serious damage to the television receiver will result when any of these tubes are pulled from the socket while the power is turned on. By referring to Fig. 2 (Voltage Block Diagram) of the Preliminary Service Manual, it can readily be seen that all voltages are obtained from a series and parallel arrangement of the tubes. Removing one of the listed tubes will overload and burn-out components in these circuits.
I. Receiver Dead
   A. Be sure the plug and receptacle of the AC power cord interlock are making contact.
   B. Examine fuse 4A.
   C. Check low voltage rectifier tubes V22 and V23. Do not remove tubes with power on.
   D. Check for shorts in 105-120 volts AC power line. Be certain wires are not caught under IF-RF strip.
   E. Check all tube filament wiring for shorts.
   F. If fuse is not blown, check all power transformer voltages.
      Caution: Plate to plate voltage of rectifier tubes is approximately 500 volts AC.
   G. Check for shorts all electrolytic capacitors in low voltage power supply (transformer T8 and associated circuits).
   H. Check all B+ and B- voltages. See step 18 of "Practical Trouble Shooting Hints."

II. Soundbut no Raster
   A. Check all B+ and B- voltages. See step 18 of "Practical Trouble Shooting Hints."
   C. Be certain filament of high voltage rectifier V20 is lit. This is an indication that the horizontal sweep circuits are properly operating.
   D. If scope of at least one megacycle bandwidth is available, determine if there is at least 55 volts peak to peak present at pin #5 of tube V19 (6B66G).
   E. Check adjustments of horizontal oscillator coil T6, horizontal drive trimmer C108C, horizontal lock range trimmer C108B, and horizontal frequency trimmer C108A. See "Sweep Oscillator Adjustments," page 11 of Preliminary Service Manual. T6 should tune with the core adjusting screw one-half to three-quarters of an inch exposed. If this coil tunes with the screw less than one-half inch exposed, there is definitely trouble in some other part of the circuit.
   F. Check the following tubes
      V17 --- 6SN7-CT
      V19 --- 6B66G
      V20 --- 1B3-CT
      V21 --- 6W4-CT
      CAUTION: Do not remove these tubes with power on.
   G. Check voltage drop across R111 (cathode of V19). It should be 6 to 8 volts.
   H. Check T6 for continuity. Be certain that one end of R102 is lifted when making this check.
   I. Check C109 in horizontal sync input circuit for leakage which is indicated by a weak and drifting horizontal sync.
   J. An open in T6 between start and tap terminals would cause the horizontal oscillator to appear weak, and the slug would tune all the way in, if at all.
   K. Leaky C110, across terminals 4 and 9 of T7 would cause the horizontal oscillator to run off frequency or jerk. Caution: High Voltage.
   L. If C112 attached to junction of L46 and terminal 1 of T7 is open, resistor R116 connected to pin 5 of V21 would burn out after a few hours of operation.

M. If C107 mounted on high voltage transformer board is open, it would cause a reduction in high voltage. Caution: Check by substitution and be careful of high voltage. If the plate of V19, 6B66G, shows too much current, R106 and R114 will burn out although the fuse will not blow. If the screen draws too much current, R109 will burn out. The voltage drop across the screen resistor R109 should be 100-120 volts and across the cathode resistor R111 should be 6-8 volts.

Under no circumstances operate the receiver with tubes V17 or V19 removed. Serious damage to the unit will result.

Check plate caps of tubes V19 (6B66G) and V20 (1B3) for tight connection.

III. Picturebut no Sound
   A. Check audio output tube V7 (6Y6G).
   B. Check continuity of speaker voice coil. (Disconnect output transformer T2.)
   C. Check continuity of audio output transformer T2.
   D. Check audio output circuit components R31, R30, R64, and R28R.
   E. Examine audio circuit wiring for shorts.
   F. Check tube V6 (6T8) and examine tube socket for poor contact.
   G. Check tubes V5 (6AU6) and V4 (6AG5).
   I. Check tuned circuit of lst sound IF (V4) and the sound takeoff transformer for continuity.
   J. Examine contacts on RF oscillator switches S5 and S6.
   K. Replace coil L18 of discriminator circuit.
IV. Raster and Sound but no Picture


B. Check tube V12 (6AC7) by substitution.

C. Check video detector circuit components L30, L48, R54, and crystal X1 (IN34).
   NOTE: Check crystal X1 front to back ratio with ohmmeter.
   Front - 50 to 125 ohms
   Back - 300K to 5 meg
   (Be sure crystal is disconnected from circuit.)

D. Check operation of RF oscillator by measuring voltage (-5 to -9 volts) across C26 in the mixer grid bias circuit.

E. Turn receiver off and check for continuity in the RF and IF circuits.

V. High Voltage but no Sound, no Raster

This indication immediately tells us the trouble is either in the low voltage supply or ahead of 2nd IF, V9.

A. Check all plus and minus voltages at tube sockets (before V9 circuits). See Voltage Chart pages 17 and 18 of Preliminary Service Manual.

B. Check RF and IF bias at terminals "S" and "Q" of IF-RF terminal strip:

   **APPROX. VALUES (VTV)**
   
   RF Bias = .2V  @ Max. Contrast
   IF Bias = 1.5V
   RF Bias = 25V  @ Min. Contrast
   IF Bias = 9V

C. Be sure RF oscillator is operating. See step 4, paragraph 4, of Preliminary Service Information.

D. Check for open screen by-pass capacitors on first four IF stages.

E. Be certain the aud output transformer is not oscillating. See 2nd paragraph of "IF Alignment," pages 7 and 8 of Preliminary Service Manual.

F. Be certain that one side of L9, oscillator (V2) plate choke coil, is not open.

   **NOTE:** When checking L9, disconnect from C22.

G. Check L10 and L11 in mixer (V3) grid circuit. Resonance should occur at 34.5 MC with a 13 mmf capacitor across each coil. Check by substitution if proper equipment is not available.

H. Check Fine tuning, C22, for shorts.

I. Check the following tubes: V1, V2, V3, V8, and V9.

   **CAUTION:** Do not remove tubes while power is on.

VI. No Vertical Sweep

A. Check Vertical Oscillator Discharge and Output tube V16.

B. Check all V16 voltages. Refer to Voltage Chart on pages 17 and 18 of Preliminary Service Manual.

C. Check continuity of T4, T5, and vertical yoke.

D. Check for open wiring at all potentiometers on front panel.

E. Check C94 and C95 by substitution.

F. Check R79 and R80 fo value.

G. Check knife disconnects on vertical yoke leads.

H. Check R83 connected to junction of T5 and C46A for value.

VII. Excessive Vertical Size

A. Check value of vertical oscillator circuit components R70, R71, R72, R75, R81, and R82.

B. Check all voltages of vertical sync circuit. See Voltage Chart pages 17 and 18 of Preliminary Service Manual.

C. Check tube V16. See step 1, paragraph V, of this section.

D. Check R81. See step 1, paragraph V, of this section.

VIII. Deficiency in Vertical Size

A. Make same examination as in preceding paragraph VII, "Excessive Vertical Size."

IX. Run in Video and Sound

A. Check to see if C143 or C144 is shorting to pin 94 of RF amplifier V1.

B. Check by substitution for filament to cathode leakage in all tubes. **CAUTION:** Do not remove tubes while power is on.

C. Check for open electrolytic capacitors.

D. Examine RF and IF bias circuit for short to filament wiring or components.

E. Examine for open capacitor C112.

X. Smear

A. Check crystal X1 front to back ratio with ohmmeter. See step 3, paragraph IV, of this section.

B. Check continuity of RF and Oscillator circuit components L7, L8, L11, L12, and L13.
C. Check by substitution C47 connected to pin #1 of tube V8.
D. Check RF and IF alignment. See pages 7 to 10 of Preliminary Service Manual.
E. Check tube V12 (6AC7) by substitution.
F. Check value of R59 connected to terminal "L" of IF-RF terminal board.

XI. Lace and Guts (Crosshatch and 4.5 MC beat)
A. Realign RF and IF circuits. See page 7 to 10 of Preliminary Service Manual.

XII. Noise in Picture
A. High Voltage breakdown.
   1. Check for arcing and corona in high voltage compartment and also in the neck of picture tube (V13).
   2. Check by substitution C107.
      CAUTION: Discharge capacitor - HIGH VOLTAGE.
B. Check for intermittent tubes.
   CAUTION: Do not remove tubes while power is on.
C. Examine antenna plug to check for looseness.

XIII. Weak Video
A. Realign RF and IF circuits. See pages 7 to 10 of Preliminary Service Manual
B. Check crystal X1 front to back ratio. See step 3, paragraph IV, of this section.
C. Check tube V12 (6AC7) by substitution.
D. Check RF amplifier V1 and all IF tubes.
   CAUTION: Do not remove tubes while power is on.
E. Check all coupling capacitors in the IF circuit.

XIV. Negative Picture
A. Check tube V12 (6AC7) by substitution.
B. Examine crystal X1 to determine if it is reversed.

Practical Trouble Shooting Hints
1. If R16 and R17, plate circuit of mixer tube V2, are burned, check RF oscillator (see step 5 of paragraph IV of "Trouble Shooting Procedures." for proper operation before replacing these resistors.
2. If response is peaked on high frequency side, as viewed with an oscilloscope, check coils L10 and L11 (see step 6 of paragraph V of "Trouble Shooting Procedures." page 8).
3. If container of electrolytic capacitor C46 shows disfigurement, look for B+ (-200 volts) to be shorted at some point to the chassis before attempting to replace this capacitor.
4. If picture indicates a non-linear vertical sweep, examine the lug on electrolytic capacitor C69 to be sure of good contact.
5. If IF tubes keep burning out, check IF bias with VTVM to determine if its potential is not more positive than -10.5 volts. If bias is more positive, examine all bias circuit components and IF coupling capacitors. Check also voltage from chassis ground to B- to determine if it is less negative than -115 volts, which would cause the IF bias to be more positive.
6. If the center tap of the volume control is shorted to chassis, the sound and picture will be distorted and the picture may, possibly be eliminated when the volume control is rotated.
7. If the sound is weak and distorted, check VI cathode by-pass electrolytic capacitor C45.
8. If there is evidence of speaker rattle, the cause may be the shielded audio lead touching speaker cone.
9. Hum in picture and sound may be caused by the lead of coil L39 (filament choke) shorting to pin #6, tube V6 (RF bias).
10. Insufficient vertical size could be caused by C83, plate circuit of V16B, increasing in value.
11. Lack of vertical sweep could be caused by:
   a. Loose or broken knife disconnects in vertical yoke leads.
   b. Defective V16 tube (6SN7GT).
   c. Defective transformer T4 or T5.
   d. Defective vertical yoke winding.
   e. Open wiring to potentiometers located on front panel.
12. No Raster: Examine tube V20 (1B3). If the filament is lit, then it is safe to assume the horizontal sweep circuits are functioning and the trouble can be in the picture tube, picture tube circuits, video amplifier, or AGC circuit. Examine the above circuits as outlined in "Trouble Shooting Procedures."
13. If capacitor C112, connected to junction of terminal 1 of high voltage transformer and L46, becomes open then resistor R116, connected to pin #3 of V21, will slowly burn.
14. A picture tube (V13) that draws too much 2nd anode current will cause a reduction of the high voltage (10KV). The voltage difference between cathode, pin #11 of V13, and grid, pin #2 of V13, should not be less than 15 volts.
when Brilliance control is set at maximum, or there will be a reduction in the high voltage.

15. If the raster fails to disappear when the Brilliance control is in the minimum (counterclockwise) position, check:
   a. The voltage between grid, pin #2, and cathode, pin #11, of V13 should be approximately 70 volts. If the reading is low, then examine the associated circuit and B- (-150 volts).
   b. If B- and B+ voltages appear normal, then shorting out resistor R112 connected to Brilliance potentiometer may correct the voltage condition between grid and cathode of V13.
   c. If the grid to cathode voltage is above 70 volts, the picture tube should be replaced.

16. If C108C (horizontal drive trimmer) is turned so far clockwise that it is extremely tight (maximum capacity point) and left in this position, the horizontal output tube or tubes and associated plate circuits will slowly burn.

17. If unstable sync is noted:
   a. Turn C108A and C108B (horizontal frequency and lock range trimmers) counterclockwise one half turn to a full turn.
   b. Use substitution method to check for leakage in capacitor C110 connected between terminals 4 and 9 of the high voltage transformer.

18. The following are the voltages that can be expected at the various test points listed.

   Note: All voltage readings are taken at minimum contrast which occurs at full counterclockwise position of control.

<table>
<thead>
<tr>
<th>TEST POINT</th>
<th>VOLTAGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boosted Be</td>
<td>pin #3, V21</td>
<td>+ 275 to + 325 V</td>
</tr>
<tr>
<td></td>
<td>pin #3, V23</td>
<td>+ 230 to + 290 V</td>
</tr>
<tr>
<td>+ 165V Bus</td>
<td>lug 3, R67</td>
<td>+ 140 to + 190 V</td>
</tr>
<tr>
<td></td>
<td>Hor. Center</td>
<td>terminal &quot;E&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>terminal &quot;S&quot;</td>
</tr>
<tr>
<td>B-</td>
<td>IF Bias</td>
<td>terminal &quot;G&quot;</td>
</tr>
<tr>
<td>RF Bias</td>
<td>Hor. Drive</td>
<td>pin #5, V19 (BE66) or pin #6 of V18 or V19 (7A5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of V18 or V19 (7A5)</td>
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<tr>
<td></td>
<td>Vert. Drive</td>
<td>junction C94 &amp; C95</td>
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19. If sound cuts on and off or takes 3 to 15 minutes to reach proper level, replace coil L16 connected to terminal 5 of discriminator transformer T1.

20. If receiver blows fuses, check for arcing in tubes V22 and V23. A short in the filament circuits can also cause the fuse to blow.

**IF ALIGNMENT PROCEDURE FOR CODE WC AND MD CHASSIS**

Briefly, the detailed procedure may be analyzed as follows: Connect the high side of the signal generator to IF Test Input (see Fig. 5) and the grounded side of the generator is connected directly to receiver chassis ground. The first adjustment is made at 34.5 megacycles, adjusting L29 for maximum output with the vacuum tube voltmeter connected between terminals "G" and "E" on the terminal strip of the IF sub-chassis assembly. The input signal should be adjusted to produce a 1-1/2 to 2-1/2 volt reading on the VTV. The signal generator is then adjusted to 32.9 MC and L14, and L23 adjusted to produce the maximum output voltage.

The signal generator is then adjusted to 31.625 MC and L26 adjusted to produce a maximum voltage at "G" and "E". If L54 is adjusted near the minimum point, it may be very difficult to obtain a satisfactory reading between "G" and "E" when adjusting L26. This again is not important, for L26 will be rechecked and adjusted when the voltmeter is connected to the output of the sound discriminator. With L26 peaked roughly to 31.625 MC, adjust L54 to produce a minimum voltage between terminals "G" and "E". Then connect the VTV from terminal "A" to chassis and peak L26, L54, L28, L27 and L16 to 31.625 MC. The signal input level should be adjusted to maintain a maximum of 4 volts from "A" to chassis at all times, to prevent limiting. These adjustments should be repeated several times to be sure that all coils are peaked at exactly the same frequency. If they are badly out of adjustment, it is advisable to return the VTV to terminals "G" and "E" and check L54 to be sure that it is adjusted to produce a minimum voltage at exactly this same frequency.

Oscillation within the receiver circuits may be detected by an excessive and unstable output voltage at terminals "G" and "E" exceeding 5 or 6 volts as a minimum and very often exceeding 10 volts. To be sure the set is not oscillating and adjustments made to produce this oscillation rather than eliminate it, vary the signal generator input and notice if the voltage output varies correspondingly with the signal input. If it does not, some circuit must be oscillating.

After L29, L14, L23, L26, L54, L27, L28, and L16 have all been adjusted as outlined above, change the VTV to terminal "B" and chassis and turn signal generator completely off. Note reading on VTV. (Antenna input should be shorted to prevent any signal pickup through the RF stage.) Turn signal generator on and adjust L17 to produce the same voltage on the VTV noted when no signal was applied. This point should occur approximately in the center (zero voltage) of the voltmeter reading, as it passes sharply from a positive to a negative voltage. Adjustment of L17 to this zero voltage should also produce a minimum of background noise and best tone quality from an FM signal of 31.625 MC center frequency.

The VTV should be connected from "A" to ground when making the final adjustment on L26, since L54 has been adjusted to minimum response with the VTV connected from "G" to "E". If L26 requires considerable adjustment in order to peak it, check L54 again with the VTV connected between "G" and "E". This should be a minimum after L26 is peaked to a maximum. Now adjust the signal generator to 35.9 MC, and adjust L24 for maximum output with the VTV connected from "G" to "E".
Change the signal generator frequency to 37.625 MC and adjust L19 for maximum voltage between "G" and "E". If L22 is correctly adjusted for minimum response, it may be impossible to obtain a satisfactory reading at "G" and "E" for adjustment of L19. Therefore, L22 should be detuned slightly, but be very careful not to detune it any great amount, for it must be tuned finally to an absolute minimum, and if its adjustment is changed greatly after L19 is peaked, the initial adjustment of L19 will be altered. In other words, adjust L19 for maximum output with L22 adjusted to as near a minimum output as is possible to obtain a satisfactory reading between "G" and "E".

L19 should be rechecked to be sure that it is at maximum response and L22 at minimum.

Alignment of the mixer output stage L14 may be accomplished roughly by applying the signal to the mixer tube V3. But since access to this tube is rather difficult with the picture tube in place, it is suggested that the signal be applied to the antenna input directly. However, if any difficulty is encountered in adjustments, indicating that it is badly out of adjustment or that oscillation is taking place in the RF stage, then go back to V3 and apply the signal generator output to the tube shield of this tube in a similar manner as was done throughout the previous IF alignment. Erratic meter readings may be caused by the signal generator not being firmly grounded to the TV chassis especially when the generator is connected to the antenna input terminals. A good ground connection must be maintained between the signal generator and the TV chassis at all times. With the signal generator applied to the antenna output, adjust its frequency to 32.9 MC and adjust L14 and recheck L23 for maximum voltage output on VTVS connected from "G" to "E". Return the signal generator setting to 35.9 MC and recheck L24 and L26 for maximum output. Normally no difficulty should be encountered in finding an IF signal through from the antenna terminals into the IF, but in case the antenna wavetaps (C144, C145, L50 and L53) are turned to the particular frequency one is attempting to apply to the IF, a very strong signal may be necessary unless the antenna plug is pulled out of the RF chassis and the signal generator input applied directly to the chassis. Even though the signal generator output is unbalanced to ground, this will make no difference as far as IF alignment is concerned, but it should be balanced when making RF adjustments.

**FM ANTENNA**

The FM antenna used in Models 235M1, 235B1, and 325MB will not be found in the Replacement Parts List since the service man, by following the specifications in the drawing, Fig. 3, can very easily and inexpensively make the antenna himself.