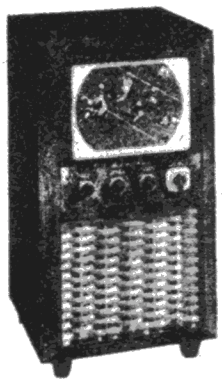
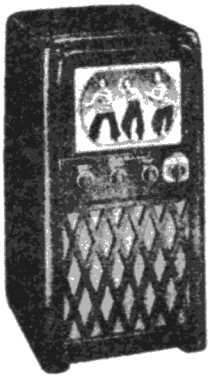
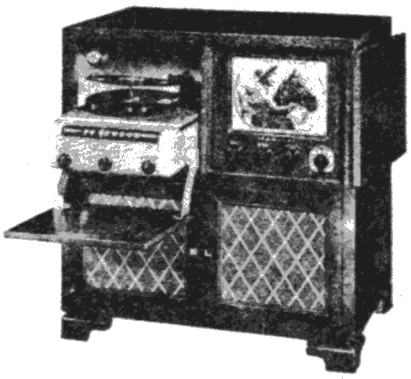


20X145, 20X146, 20X147

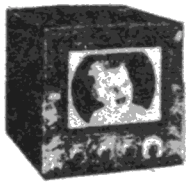


20X122



24X15, 24X16, 24X15S, 24X16S, 24X17S

20X11, 20X12



20X136

Note: Model 24A125AN not shown above.

IMPORTANT

Final production 20Y1 chassis were stamped with run number 12. Final production 20X1 chassis were stamped with run number 13.

For complete discussion of production changes and trouble shooting, see pages 52 through 56

When installing a set, be sure to see pages 40 through 43, and especially "Individual Channel Oscillator Adjustment Using Television Signal" on page 41

The models covered by this manual are indicated in the chart on page 39

Combination models used either a model RC221 or RC321 3-speed Record Changer. Refer to the RC221, RC222 Record Changer Service Manual (Form No. S256) and its Supplement (Form No. S256A).

INDEX

MODELS 20X11, 20X12, 20X122, 24A125AN, Ch. 20X1;
20X136, 20X145, 20X146, 20X147, Ch. 20Y1;
24X15, 24X16, 24X15S, 24X16S, 24X17S, Ch. 20X1,
Radio Ch. 4L1

SPECIFICATIONS

Picture Presentation

Direct View Electromagnetic Cathode Ray Tube
Picture Area:

10 inch tube: 62 square inches.
12 inch tube: 82 square inches.

Operating Voltage

110-120 volts. 60 cycles.

Wattage

190 watts for "television only" models.
250 watts for combination models.

Input Impedance

300-ohm Balanced.

Note that 75 ohm coaxial cable may be used by connecting the outer conductor to the chassis and the inner conductor to either antenna terminal.

Antenna

All models equipped with Built-In "Roto-Scope" antenna. See "Installation Instructions" before installing other types of antennas.

Intermediate Frequencies

Video 25.75 MC. Sound 21.25 MC.
Intercarrier Sound IF 4.5 MC.

Tube Complement

See "Voltage Data" on page 44 for TV chassis tube complement and functions.

RUN NUMBERS

A system of run numbers is used with these television chassis. The run number is rubber stamped on the rear of the chassis. Whenever a production change is made in the television chassis, the run number changes to the next higher number. Final production 20Y1 chassis were stamped with run number "12", and final production 20X1 chassis were stamped with run number "13".

20X1, 20Y1 TELEVISION CHASSIS

The 20X1 uses a 10 inch picture tube; the 20Y1 chassis uses a 12 inch picture tube. The picture tube and focus coil mounting bracket, and the webbing strap are different for 10 inch and 12 inch picture tube mountings. See parts list. Also note that the vertical oscillator receives its plate voltage from the "Boot Strap" circuit in the 20Y1 chassis. This plate voltage is obtained from direct connection to B plus in the 20X1 chassis (except for some early 20X1 chassis which were wired like the 20Y1 chassis).

In early production sets, the focus coil adjustment is made by adjusting the focus coil mounting screws.

In late production sets the focus coil adjustment is made by means of the "picture positioning lever" which extends from the rear of the set through the cabinet back. For details on adjusting either type, see "Picture Centering (Focus Coil Adjustment)" on page 9.

SPEAKER DIFFERENCE IN COMBINATIONS AND "TELEVISION ONLY" MODELS

"Television only" models use an electrodynamic speaker (part #78B50-1 or 78B51-1). Combination models use a permanent magnet dynamic (PM) speaker (part #78B52-1) and a separate filter choke L501 located in the chassis; see note on schematic. Therefore, when making repairs in the shop, it is important that the correct type speaker or speaker substitute be used. For identification, the back of the chassis used in combination models are stamped with a large (about 1½") letter "C".

HIGH VOLTAGE WARNING

Operating or servicing this television receiver with cabinet removed involves shock hazard. Exercise normal High Voltage precautions while working with this set.

High voltages are present throughout the horizontal output and second anode supply circuits. No attempt should be made to make measurements from these points with ordinary test equipment.

Very carefully follow instructions given in this manual regarding location of test points for alignment, for taking voltage measurements, or in making oscilloscope waveform analysis. Do not connect test equipment across other points in the receiver unless you are thoroughly familiar with the circuit wiring and points at which high voltages are present.

CAUTION — PICTURE TUBE HANDLING

Due to the high vacuum and large surface area of the picture tubes, great care must be exercised when handling these tubes. The picture tube must not be scratched or subjected to excessive pressure as fracture of the glass will result in an explosion of considerable violence which may cause personal injury or property damage.

WRITING TO FACTORY OR DISTRIBUTOR

When reporting about any Admiral product, be sure to include the following information:

1. Model number and anything stamped on model label.
2. Fill out and send the Inspection Tag, if a tag is attached to chassis.
3. If Inspection Tag is not sent in, give all letters and numbers stamped on back of chassis.
4. Detailed explanation to speed investigation.
5. If reporting parts failure, give schematic symbol number, part number and any brand name on part.
6. For record changers, give model and anything stamped on model label on bottom of changer pan.

MODEL IDENTIFICATION CHART

Model Numbers	TV Chassis	TV Tuner	Record Changer	AM Radio Tuner	Power Supply
20X11, 20X12, 20X122, 24A125AN	20X1	94C21-1 or -2	.....	.....	.....
20X136, 20X145, 20X146, 20X147	20Y1	94C21-1 or -2	.....	.....	.....
24X15, 24X16, 24X15S, 24X16S, 24X17S	20X1	94C21-1 or -2	RC221 or RC321	4L1	1PA1

Note: Above model numbers may have suffix letter "N". For cabinet description see "Cabinet Parts" list.

TELEVISION FREQUENCY RANGES

Channel Number	Channel Freq., MC	Wave Length Meters	Picture Carrier, MC	Sound Carrier, MC	Het. Osc. Freq., MC	Dipole Length	Folded Dipole Length	Reflector Length	Director Length	Half Wave Shorted Channel Trap*
2	54- 60	5.55-5.0	55.25	59.75	81	98″	96″	103″	95″	84″
3	60- 66	5.0 -4.55	61.25	65.75	87	90″	88″	94″	86″	78″
4	66- 72	4.55-4.17	67.25	71.75	93	82″	80″	86″	78″	70″
5	76- 82	3.95-3.66	77.25	81.75	103	71″	69″	74″	68″	61″
6	82- 88	3.66-3.41	83.25	87.75	109	66″	64″	69″	64″	53″
7	174-180	1.72-1.66	175.25	179.75	201	32″	30″	33″	30″	25″
8	180-186	1.66-1.61	181.25	185.75	207	31″	29″	32″	29½″	24″
9	186-192	1.61-1.56	187.25	191.75	213	30″	28″	31″	29″	24″
10	192-198	1.56-1.51	193.25	197.75	219	29″	27″	30″	28″	23″
11	198-204	1.51-1.47	199.25	203.75	225	28″	26″	29″	27″	22″
12	204-210	1.47-1.43	205.25	209.75	231	27″	25″	28″	26″	22″
13	210-216	1.43-1.39	211.25	215.75	237	26″	24″	27″	25″	21″

* CONSTRUCTING A CHANNEL TRAP

* Constructed of a piece of 300 ohm transmission line, shorted on one end to serve as a ½ wave length shorting stub. Cut a piece of line slightly longer than given under the "Half-wave Shorted Channel Trap" column and connect the two leads of one end across the receiver antenna terminals.

Using diagonal cutters or razor blade, "short" across the transmission line at a place slightly longer than the calculated length. *Care should be taken when "shorting" the line to cut through the plastic covering only; do not cut the conductors.* If the interference is not "trapped out", short the line in ⅛″ intervals (working toward the terminals) until the critical point is reached. Cut the transmission line and place a carbon resistor across the line. The resistor should be approximately 60 ohms. For strong interference, it may be necessary to drop the resistance to 20 ohms, and for weak interference it may be possible to use 150 ohms. Do not use a lower value resistor than necessary to minimize the interference.

If the interference frequency is not that of a television station, the line may be cut and the leads shorted together without using the resistor. Generally, this will completely eliminate the interference frequency.

If the interference frequency being eliminated or "trapped-out" is that of some other television station operating in the vicinity, the interfering frequency will also be attenuated on its own channel. If the interference frequency is so strong that it can not be attenuated enough using a resistor across the line, it will be necessary to install a double-pole, single-throw switch to open the trap leads when the receiver is switched to this channel. Recheck trap length after installing switch.

If the interference frequency is known, the transmission line can be cut by using the following formula.

$$\text{Half wave shorting stub in inches} = \frac{4841}{\text{Freq. (MC)}}$$

OPERATING THE RECORD CHANGER

For instructions on the operation of the record changer used in these sets, see the "RC221, RC222 Record Changer Service Manual" (Form number S256), or the RC221, RC222 customer instruction booklet (Form number 41A17-44).

OPERATING THE RADIO RECEIVER

Operation of the AM radio receiver is conventional. Note that the television receiver and the radio receiver operate independently of each other. However, since there is a possibility of interference from the horizontal oscillator, the radio and television should not be operated at the same time.

OPERATING THE TELEVISION RECEIVER

Follow steps 1 through 4 in order. Also see notes below the Horizontal-Vertical and Channel-Sharp Tuning controls.

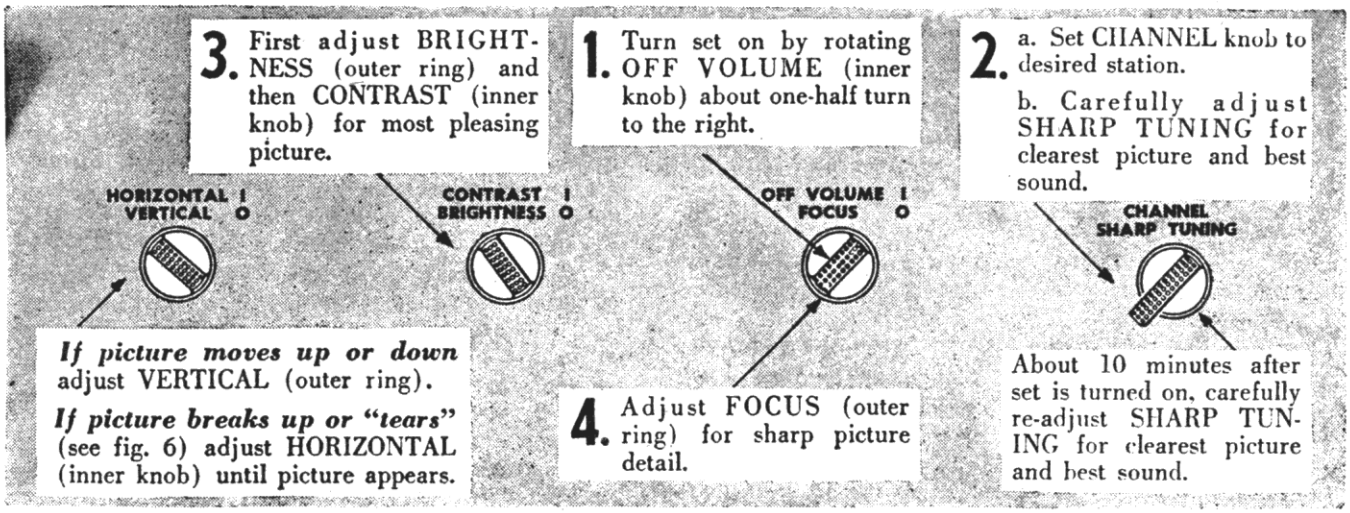


Figure 1. Tuning Procedure

IMPROVING PICTURE QUALITY

After you have tuned in the picture as described above, it is sometimes possible to improve picture quality.

a. Be sure the SHARP TUNING control has been carefully set by tuning for clearest picture and best sound. Do not try to tune for brightest picture. Clearest picture and best sound is generally obtained by watching the picture and adjusting the SHARP TUNING control so that the picture detail appears bright and clear. At this point, the sound should also be best. However, if the sound is slightly distorted, a compromise adjustment should be made.

Be sure that the picture is properly focused before adjusting the SHARP TUNING. See figure 8.

b. Try readjusting the FOCUS to improve picture detail.

c. Better pictures may sometimes be obtained by changing the settings of the BRIGHTNESS and CONTRAST controls. See Figures 4, 5 and 7. Set the BRIGHTNESS control at a slightly different position and then adjust the CONTRAST control for best reception. Try several such control settings to determine the ones giving the most satisfactory picture.

SELECTING A DIFFERENT STATION

When correctly adjusted, the receiver may be tuned from station to station by merely setting the CHANNEL control to the desired station and carefully "touching-up" the SHARP TUNING control for clearest picture and best sound.

If picture breaks up or tears (as shown in Figure 6) when switching to a different channel, adjust HORIZONTAL control to the position where there is no tearing when switching from channel to channel. (If picture cannot be locked in, see "Horizontal Oscillator Check And Alignment", page 20.)

CENTERING THE PICTURE IN LATE SETS

For more details on picture centering in early and late sets, see "Picture Centering (Focus Coil Adjustment)" on page 9.

If the picture is not centered in the picture window, or rounded shadows appear on one corner, it will be necessary to adjust the focus coil by means of the "picture positioning lever" which extends from the rear of the set. See Figure 11. The "picture positioning lever" can be moved up or down and to each side so that the picture may be properly centered. For example, the off-centered picture (illustrated in Figure 10), can be corrected by moving the picture positioning lever straight up. (For convenience in making this adjustment, a mirror may be placed in front of the set to reflect the picture.) Moving the lever arm down will move the picture toward the upper right hand corner; moving it up will move the picture toward the lower left hand corner. Moving the lever to the left will move the picture toward the upper left hand corner; and moving it to the right will move the picture toward the lower right hand corner.

After moving the "picture positioning lever", readjust the "FOCUS" control knob at front of set.

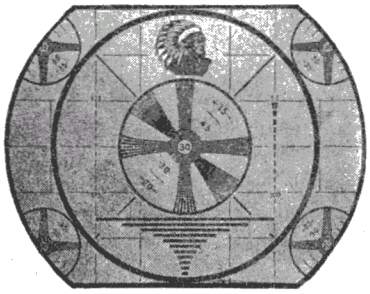


Figure 2. Correct Picture.

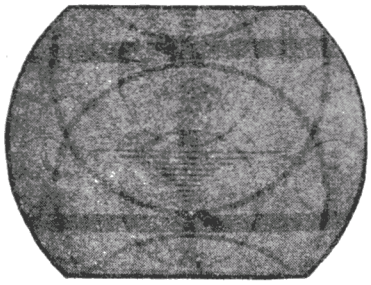


Figure 3.
Adjust VERTICAL.

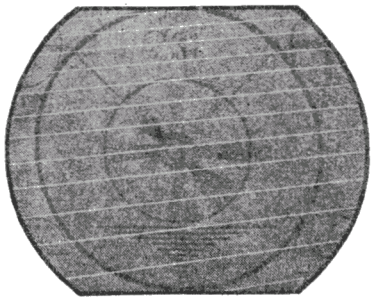


Figure 4. Adjust CONTRAST or BRIGHTNESS.

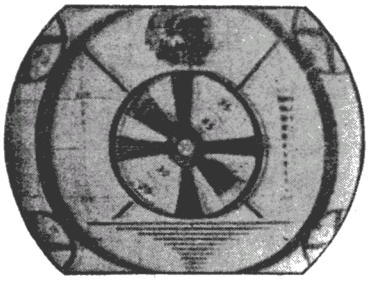


Figure 5. Too much contrast; turn CONTRAST to left.

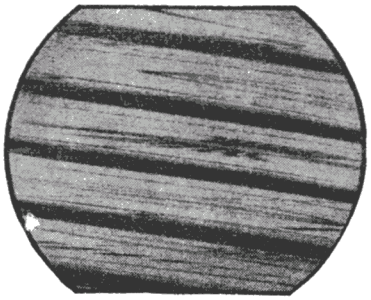


Figure 6. Picture breaks up or "tears"; adjust HORIZONTAL.

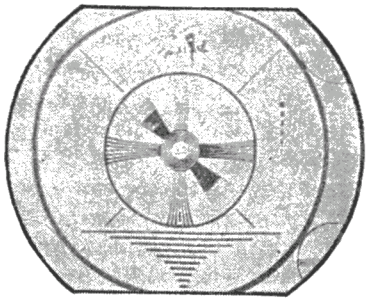


Figure 7. Excessive brightness; turn BRIGHTNESS to the left.

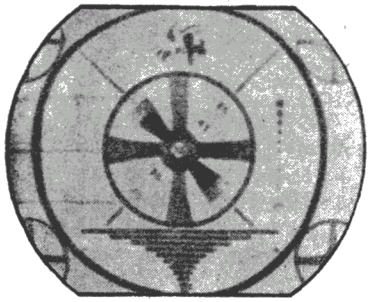


Figure 8. Improper focus; adjust FOCUS.

Figure 9. Sound bars; adjust SHARP TUNING.

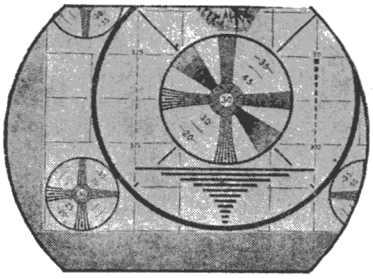


Figure 10. Picture not centered; adjust focus coil.

BUILT-IN "ROTO-SCOPE" TV ANTENNA

These sets are equipped with the new Admiral Built-In "Roto-Scope" Antenna which may eliminate the need for either an indoor or outdoor antenna if the set is in a "normal signal strength" area.

Operating The "Roto-Scope" Antenna: The Roto-Scope antenna is operated by the antenna control lever which extends from the back of the cabinet near the top. See figure 11. The antenna control lever can be set to any of three different positions which, in effect, allow the Roto-Scope to be oriented (rotated) for best possible reception on all channels operating in your area.

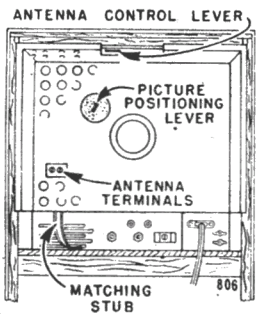


Figure 11. Rear of Cabinet.

To determine the best position of the antenna control lever, first tune the set for clearest picture and best sound. Then move the antenna control lever to each of its three positions (extreme left, center and extreme right) carefully watching for the position giving clearest picture.

A good picture should have good contrast, sharp detail, and freedom from "ghosts", "snow" effect, and other interference.

The antenna control lever should be left in the position which gives the most satisfactory picture on all channels. **Note:** Sometimes, rotating the set slightly or moving the set to another location in the room, will make an appreciable difference in the picture. However, if it is not possible to find a setting which gives satisfactory reception on ALL channels, it may be desirable for the owner to reposition the antenna control lever for each station being tuned in.

Weak Signal Areas: In some areas the signal is so weak, or some particular locations are so unfavorable, that it is not possible to get satisfactory pictures with a built-in antenna.

Before connecting an indoor or outdoor antenna, be sure to disconnect the built-in Roto-Scope antenna from the antenna terminals. Do not reconnect the Roto-Scope leads. When disconnected, it is advisable to cover the Roto-Scope antenna lead clips with tape, and to tape the matching stub to the side of the cabinet.

INSTALLATION

Do not consider an installation completed until you have read the discussion under "Elimination of Audio Buzz" (page 41) and "Individual Channel Oscillator Adjustment Using Television Signal" (page 41).

When installing any set, the operation of the set should be checked for picture centering, picture tilt, shaded corners, proper size, linearity, etc. Any service adjustments required should be made as described under "Service Adjustments" on page 41

Notice especially that some sets have a "picture positioning lever" at the rear of the set for adjusting the focus coil. See "Service Adjustments" on page 42 for details.

RECEIVER LOCATION

The receiver should be placed so that sunlight or light from lamps will not fall directly upon the face of the picture tube and cause glare or reflections. Location should be made for best seating arrangement, comfortable viewing and maximum visibility.

It is also important that an electrical outlet and the antenna lead-in be easily accessible. If the built-in Roto-Scope antenna or other indoor antenna is used, check various locations for best signal strength with minimum of "snow", "ghosts" or other interferences.

Important: Allow for good ventilation of the receiver by placing it approximately six inches away from the wall. Do not locate receiver close to sources of heat, such as radiators or heating vents. Do not cover ventilating holes or slots in the cabinet or cabinet back.

ANTENNAS

Built-In "Roto-Scope" Antenna. These sets are equipped with a built-in "Roto-Scope" antenna which may eliminate the need for either an indoor or outdoor antenna if the set is in a "normal signal strength" area. This built-in antenna can be electrically oriented for best possible reception on all channels. However, the set may be installed in a weak signal area or where it is impossible to get satisfactory reception with a built-in antenna. Under these conditions, in some locations an indoor antenna may improve reception. In most locations, an outdoor antenna will improve reception. Before definitely deciding that an indoor or outdoor antenna is required, be sure to read the discussion under "Built-In Roto-Scope Antenna" on Page 5.

If an outdoor or indoor antenna must be used, be sure to disconnect the "Roto-Scope" leads from the antenna terminals and tape or staple the matching stub to the side of the cabinet. Also, read the data given below regarding "Outdoor Antenna".

Outdoor Antenna. Fundamentally, a satisfactory outdoor television antenna installation requires the use of a proper type antenna, transmission line and mast mounting accessories. Aside from properly securing the antenna and transmission line to withstand all weather conditions, the antenna must be mounted high enough to be unobstructed and within line of sight of the transmitting stations to be received. Location of the antenna and transmission line should be such as to be free from reflected signals (ghosts) and electrical interferences.

Data on electrical characteristics and installation instructions are generally supplied or packed with each antenna. Technical books are available to the serviceman on problems of direction, impedance, terrain, selectivity, interference, ghosts, signal strength, etc. The subject of antennas for television is beyond the scope of this manual. However, it will be well to review the following information under "General" for all types of antennas and installations.

General. Television signals are transmitted on very high frequencies and unlike ordinary broadcast transmissions, the range of television transmission is restricted to line of sight.

Also the high frequencies used in television are subject to reflection from solid objects, thus a signal may be received over two or more paths: the signal direct from the transmitting antenna and one or more signals which have been reflected by objects such as buildings. Since there is a time difference in the arrival of the direct and reflected signals, multiple pictures or ghosts may appear on the cathode ray tube.

In order to prevent or lessen multi-path reception, special antennas are necessary, the most common type being a half-wave dipole consisting of two rods each a quarter wavelength long. Such an antenna will receive from two directions only. By fitting a reflector to the dipole, it can be made uni-directional. If multi-path reception or "ghosts" are still apparent, it will be necessary to sharpen the directivity of the antenna still further.

It is most important that the antenna be correctly oriented for a minimum of ghost signals.

The orientation or positioning of the antenna should be carried out by two persons equipped with telephones. One person should be stationed on the roof of the building to slowly orient the antenna, while the second person stationed alongside the television receiver can advise him when the most satisfactory picture is obtained.

The following points should be closely observed with any type of antenna if clear pictures are to be obtained.

a. The antenna should be placed as high as possible and in line of sight of the transmitting station.
b. The antenna should be orientated for best picture with a minimum of ghost signals.
c. On weak signals, the antenna should be cut accurately for the required frequency.

TRANSMISSION LINES

The Admiral television receiver is intended for use with 300-ohm transmission line. This line must be held away from any walls, metal, or the antenna mast by

means of approved stand-off insulators. The line should be twisted about one turn each foot throughout its length to cancel out direct signal and/or noise pick-up by the transmission line. The transmission line should be firmly anchored to prevent a change in position during windy weather.

Also, 75-ohm coaxial cable may be used by connecting the outer conductor to the chassis and the inner conductor to either antenna terminal.

CHANNEL TRAP

Objectionable interference from another television station or from an unknown source may sometimes be apparent in the picture. To eliminate this type of interference, a channel trap can be constructed using a piece of 300 ohm transmission line. For details see "Constructing A Channel Trap" on page 3.

INTERFERENCE

The operation of certain types of electrical equipment will often interfere with television reception. Some common "interference" patterns are shown in figures 12 to 15. Interference conditions should be considered when the television receiver is first installed and the proper antenna system installed to minimize interference effects. Sometimes a new source of interference will give trouble after an installation has been made and operating satisfactorily for some time.

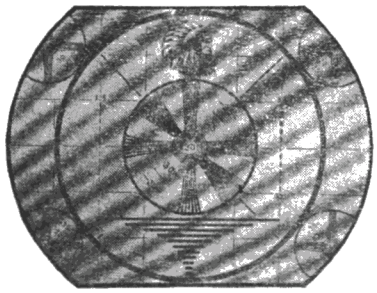
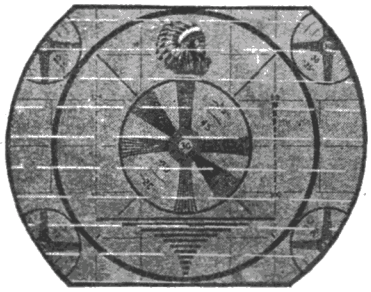


Figure 12. RF interference.



Figures 13. Ignition interference.

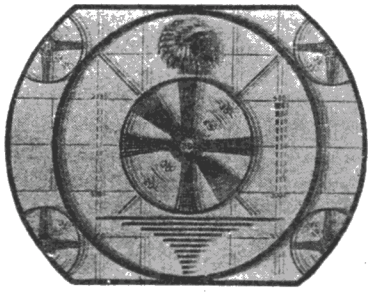


Figure 14. "Ghosts".

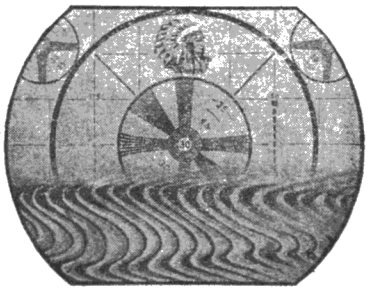


Figure 15. Interference from electronic medical equipment.

ELIMINATION OF AUDIO BUZZ

As is characteristic with all receivers using "Inter-Carrier Sound System", a 60 cycle station buzz may be heard in the sound. This will occur under certain conditions of non-standard picture transmission (over modulation or phase shift), misalignment, or improper tuning of receiver controls. Buzz in sound is the result of amplitude modulation (picture content) contained in 4.5 MC beat FM IF carrier to such high level that it is passed through FM ratio detector without being completely eliminated.

Station buzz is most commonly due to improper tuning of the receiver controls. The Sharp Tuning control may be misadjusted or the Contrast control may be turned too far (clockwise) thus overloading the video amplifier. The Sharp Tuning control should be tuned for the most clearly defined picture with best sound. ***If no definite sound peak is obtainable with rotation of the Sharp Tuning control, it may be necessary to make the individual channel oscillator adjustment given on page 8.*** Overloading caused by improper setting of the Contrast control should normally disappear when this control is rotated slightly in a counter-clockwise direction.

Other conditions in the receiver which may cause buzzing sound are given below. These adjustments can easily be made ***in the customers home*** without removing the chassis from the cabinet.

Misalignment of oscillator adjustments (overall or individual channel) may cause buzz. See "Individual Channel Oscillator Adjustment Using Television Signal". If buzz still remains after checking oscillator alignment, remaining buzz may be due to misalignment of the ratio detector secondary tuning slug. See "Alignment of Ratio Detector Secondary Using Television Signal" on the next page. Note: It may be necessary to repeat oscillator alignment and conclude with retouching the ratio detector secondary slug adjustment. If oscillator adjustment is required for other channels it will not be necessary to readjust the FM ratio detector secondary slug adjustment after having correctly made this adjustment on one channel.

Buzz is also caused by overloading of the video stages due to a very strong television signal. Insertion of an attenuation pad between the transmission line and the receiver should decrease the incoming signal strength to normal level. Other faults in the receiver which may cause buzz are misalignment of the video IF stages and changes in component values such as resistors and electrolytic condensers.

Important: Presence of station buzz may not always be an indication of fault in the receiver. The cause is

often due to transmission of a non-standard picture signal (over modulation or phase shift) by the station. This condition is usually momentary and may be especially noticed when maximum white is transmitted. If more than one station is in operation at the time, tuning in another station will indicate where the fault lies. If only one channel is in operation make the check with another receiver known to be operating properly.

SERVICE ADJUSTMENTS

INDIVIDUAL CHANNEL OSCILLATOR ADJUSTMENT (A12) USING TELEVISION SIGNAL

The individual channel oscillator slugs of every TV set should be adjusted upon installation. If this adjustment is properly made, the Automatic Gain Control (AGC) action makes the selection of stations on the receiver practically a single control operation. Only slight readjustment of the Sharp Tuning control may be needed when switching from one channel to another.

This adjustment can be made without removing the chassis from the cabinet as follows:

a. Turn the set on and allow 15 minutes to warm up.

b. Set the Channel Selector knob for a station and adjust controls for normal picture and sound.

c. Remove the Channel and Sharp Tuning knobs.

d. Slide the channel indicating escutcheon to the left as far as it will go. Generally, this should allow access to the adjustment opening in the cabinet. However, if necessary, the escutcheon can be removed by sliding the escutcheon and the escutcheon retaining spring completely to the left and then lift the right side away from the cabinet.

e. Set Sharp Tuning control at electrical center by rotating approximately 150° or half rotation as shown in figure 32. Note position of dielectric rotor.

f. Carefully insert a ⅛″ blade, NON-METALLIC, alignment screwdriver in the ¼″ hole in the television panel. Engage the slot in the oscillator slug (A12); carefully adjust for best picture and sound. Only slight movement of the slug is required; turning the slug in too far will cause the slug to fall into the coil. If this happens, see "Oscillator Slugs In Too Far" on page 48.

g. Check the setting of the Sharp Tuning control per step "e" and repeat step "f" for each channel.

h. If objectionable station buzz is heard in the sound after adjusting oscillator slugs, see "Elimination of Audio Buzz" on page 7.

OVERALL OSCILLATOR ADJUSTMENT (A11) USING TELEVISION SIGNAL

(May only be required when V102 (6J6) is replaced.)

a. Follow steps "a", "b" and "e" above.

b. Carefully adjust trimmer "A11" (figure 30) for best picture and sound.

c. Check and, if necessary, make individual channel adjustments as indicated above.

TOUCH-UP OF RATIO DETECTOR SECONDARY USING TELEVISION SIGNAL (A7, BOTTOM SLUG OF T201)

This adjustment is accessible through the ¼″ hole in bottom of the cabinet or the chassis mounting shelf, located toward the left side facing the rear of the set. Removal of the chassis is therefore not required. **Adjustment need be made on one channel only.** Proceed as follows:

a. Turn set on and allow about 15 minutes for warm up.

b. Tune set for normal picture and sound. Slightly advance contrast and volume control until audio buzz is heard. Caution: Do not turn contrast full on, as video detector may produce a similar buzz due to overloading.

c. Carefully insert a non-metallic alignment screwdriver (with ⅛″ blade) through the opening in cabinet bottom. When the blade of the alignment screwdriver engages the slot in the tuning slug, adjust the slug for best sound with minimum buzz level. Do this carefully as only slight rotation in either direction will generally be required. Correct adjustment point is located between the two maximum buzz peaks that will be noticed when turning the slug back and forth about ¼ to ½ turn.

d. If necessary, repeat individual channel oscillator adjustment and conclude with retouching the ratio detector secondary. Note: If oscillator adjustment is required for other channels, it will ***not*** be necessary to repeat the ratio detector secondary adjustment after **once** correctly adjusting it.

ION TRAP ADJUSTMENT

The ion trap should be located with the black (sleeve) magnet toward the tube base.

The ion trap should be positioned so that rear end of the ion trap magnet is opposite the metal flags located in the neck of the picture tube. Starting from this point, very carefully move the ion trap forward or backward and at the same time rotate it slightly in either direction; adjust for the brightest raster possible with the lowest setting of the brightness control on which good line focus can be maintained.

Important: Be sure to tighten ion trap mounting screws since shifting of the ion trap will cause poor brilliance, or rounding off (shading) of corners of the raster pattern. Should the corners of the raster become rounded off or shadowed after adjusting the ion trap, correct this condition by moving the deflection yoke (coil) as far forward as possible and then adjusting the focus coil.

PICTURE CENTERING (FOCUS COIL ADJUSTMENT)

Centering the picture on the screen of the picture tube is made by adjusting the mechanical position (tilt) of the focus coil. Figure 16 shows need for picture centering (focus coil adjustment).

In early 20X1 sets, picture centering (focus coil adjustment) is made by adjusting the focus coil mounting screws. These are the four spring loaded screws located at either corner of the focus coil mounting plate, see Figure 19.

In later 20X1 sets, picture centering (focus coil adjustment) can be made without removing the cabinet back. This adjustment is made by moving the picture centering lever up or down and to the left or to the right. See Figure 18.

In these later sets, the focus coil is mounted on brackets which form a universal joint support, thus allowing the focus coil to be tilted through a limited degree of tilt. The picture centering lever is an adjustable length lever attached (welded) to the upper left hand side of the focus coil.

Tilt of the focus coil is limited by the clearance to the neck of the picture tube. In order for proper picture centering, it is important that the deflection yoke mounting bracket be moved forward until the rubber collar firmly supports the flare of the picture tube. It is also important that the deflection yoke bracket be orientated so that the focus coil will have equal tilt up, down, left or right. The deflection coil must be moved forward as far as possible. Caution: Do not force the picture centering lever beyond its limit of tilt, as this may break the neck of the picture tube. Also should the section of the picture centering lever which is welded to the focus coil become bent or distorted, difficulty will be experienced in centering the picture due to the limited tilt in one direction through the hole in the cabinet back. To remedy this trouble, remove the cabinet back and holding the focus coil securely, bend the bracket back to its original shape.

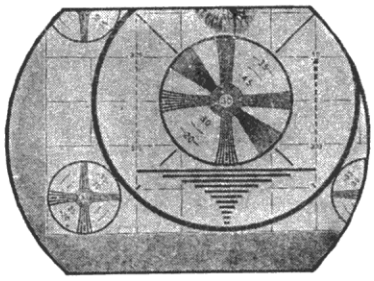


Figure 16. Picture Not Centered; Adjust Focus Coil.

DEFLECTION YOKE ADJUSTMENT

If picture appears tilted (Figure 17), loosen the wing nut on top of deflection yoke and rotate the yoke until picture is straight. Before tightening the wing nut, make sure that the deflection yoke is moved as far forward as possible, otherwise corners of the raster may become shadowed.

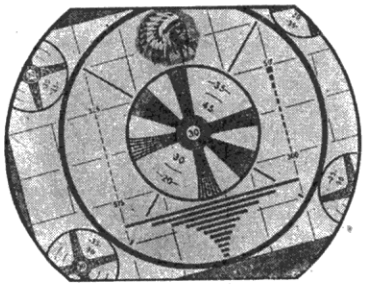


Figure 17. Picture Tilted; Adjust Yoke.

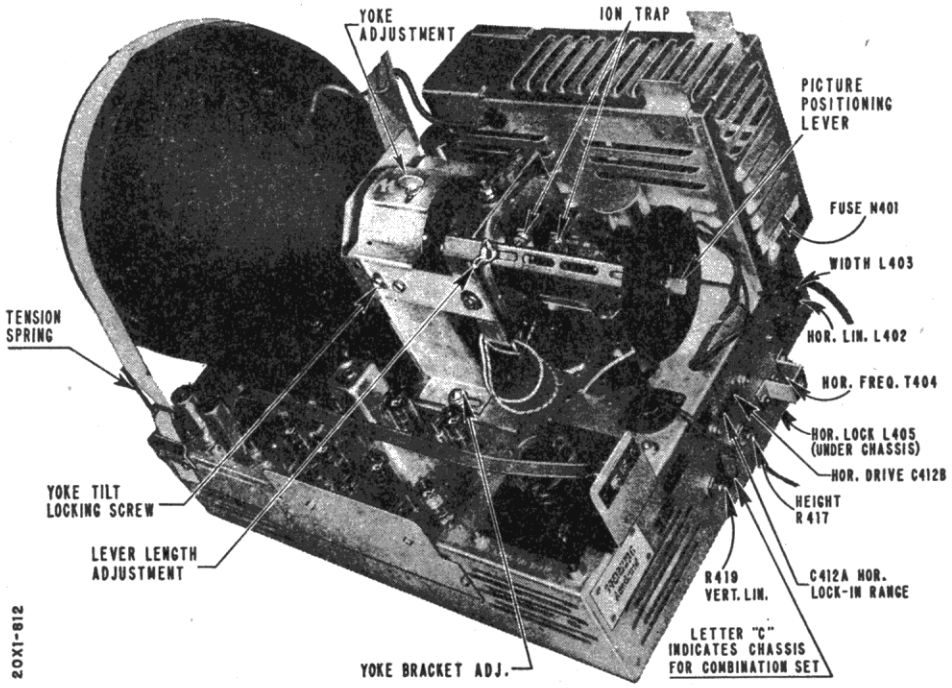


Figure 18. Top View of Chassis. (Picture Positioning Lever shown here used in late sets only.)

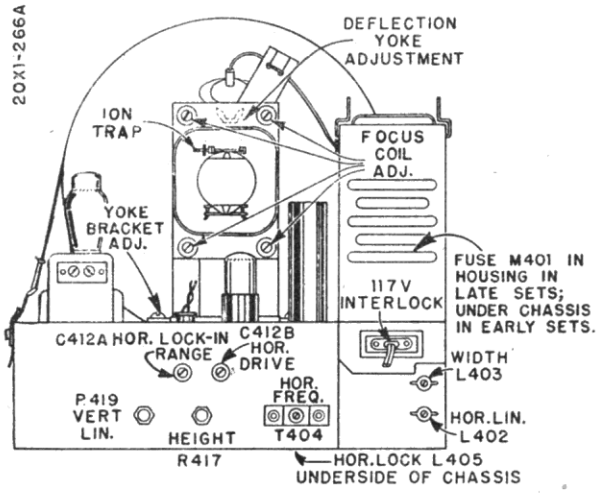


Figure 19. Rear View of Chassis. (Screw-type focus coil adjustment shown here used in early sets only.)

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS

When making height and vertical linearity adjustments it is important to note that the upper portion of the picture (C tc A in Figure 22) is affected most by the vertical linearity control (R419). The lower portion (C to E in Figure 22) is most affected by the height control (R417). For locations of these controls, see Figure 19.

Extreme cases of height and vertical linearity misadjustments are shown in Figures 20 and 21. To correct for such extreme conditions, alternately adjust the vertical linearity control and then the height control until distances AB and DE are equal, as shown in Figure 22. BC should also equal CD. In less extreme cases, the picture (test pattern) should be examined carefully and if only the upper or lower portions are affected, adjust only the appropriate control.

WIDTH, HORIZONTAL DRIVE AND HORIZONTAL LINEARITY ADJUSTMENT

a. Adjust Horizontal Drive trimmer C412B by first turning screw in fully and then slowly backing it out until best linearity consistent with good line focus is obtained. Distance FG should then equal HK; GC should equal CH (Figure 22). Horizontal Drive trimmer C412B should be as far clockwise as possible, consistent with good linearity and line focus. Caution: Trimmer screw will fall out if turned out completely.

b. If horizontal non-linearity (Figure 24) cannot be corrected by Horizontal Drive trimmer adjustment, further adjustment can be obtained by means of Horizontal Linearity control L402 (Figure 19). (L402 has the greatest effect on the center of the pattern.) Alternate readjustment of these controls may be necessary to obtain best horizontal linearity.

c. Adjust width (Figures 25 and 26) control L403 (Figure 19) until the test pattern just fills the picture tube mask.

With correct horizontal and vertical linearity and correct size adjustment, the circles in the test pattern should appear round. The test patterns used by different stations vary. For example, the outer circle may be cut off at A and E while points F and K are at the edges of the picture tube mask (Figure 22). The large circle in the test pattern should be concentric with the circular contour at the ends of the picture window.

Note: If a white vertical line appears on the left side of the picture, it can generally be eliminated by adjustment of the horizontal drive. If the line still appears, try replacing the horizontal output tube V404 (6BG6G). If this does not help, a compromise adjustment for linearity must be made.

If more than one station is on the air when making linearity, size and centering adjustments, check receiver adjustment on all stations. This is necessary since all TV stations do not send perfectly linear patterns at all times.

HORIZONTAL OSCILLATOR

The horizontal oscillator may require adjustment when installing the television receiver. Before making horizontal oscillator service adjustments, be sure to read the discussion under the heading "Horizontal Oscillator Check and Alignment" on page 20. Note that the "HOR. LOCK" adjustment is on the underside of the chassis and should not be adjusted without the use of an oscilloscope.

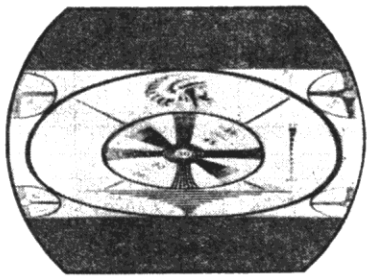


Figure 20. Lack of Height; Adjust Height Control.

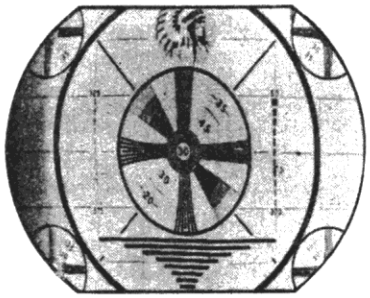


Figure 21. Too Much Height; Adjust Height and Vertical Linearity Controls.

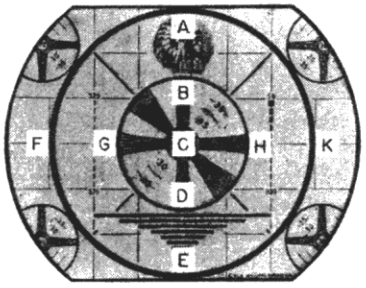


Figure 22. Correct Width, Height, Horizontal and Vertical Linearity.

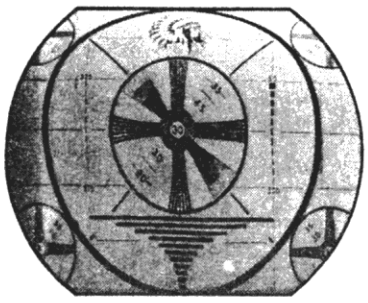


Figure 23. Non-Linear Vertically; Adjust Vertical Linearity and Height.

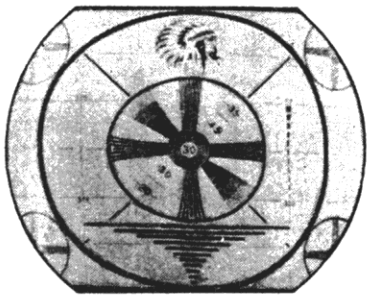


Figure 24. Non-Linear Horizontally; Adjust Horizontal Drive and Horizontal Linearity.

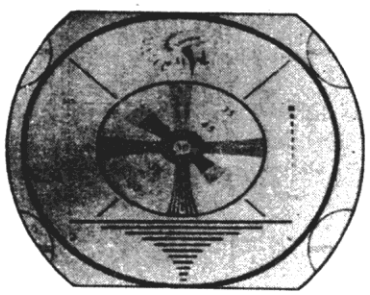


Figure 25. Too Much Width.

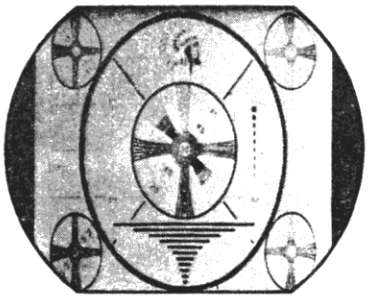


Figure 26. Insufficient Width.

CLEANING PLASTIC PICTURE TUBE WINDOW

The picture tube window should be cleaned only with a dampened chamois or a soft line-free cloth, with as little rubbing as possible. If necessary, use Dust-Ded (part No. 98A11-2; ½ oz. bottle) as a plastic cleaner and dust repellent. Caution: Do not use other cleaners or solvents. Cleaners and solvents such as kerosene, carbon tetrachloride and most of the kitchen-type cleaners may be injurious.

PICTURE TUBE REPLACEMENT

IMPORTANT: When replacing picture tubes, be sure to keep in mind the information regarding Ion Trap, Focus Coil (Picture Centering) and Deflection Yoke (Picture Tilt) adjustments on pages 8 and 9.

REPLACING 10" or 12" PICTURE TUBE

WARNING: Before handling a 10" or 12" picture tube, remove the static charge on the second anode as follows: Connect an insulated test lead to the receiver chassis and insert the free end into the well connector of the picture tube.

Remove the defective picture tube in the following manner:

a. Remove the 2nd anode lead from the connector on the top of the picture tube. See warning above.
b. Remove the socket from base of picture tube.
c. Remove the ion trap.
d. Remove webbing band tension spring if used.
e. Loosen webbing band clamping plate at side of chassis.
f. Remove picture tube bumper plate in front of chassis.
g. For sets having a picture centering lever, loosen the deflection yoke tilt locking screw, see figure 18.
h. Withdraw the picture tube through the deflection yoke and focus coil towards the front of the chassis.

To install a new picture tube, the above procedure should be reversed, making sure that the flare of the picture tube is fitted closely against the rubber collar (cushion) on the deflection yoke housing and that the 2nd anode connector is on top of the picture tube.

CIRCUIT DESCRIPTION

General Note: This chassis uses an "Inter-Carrier Sound System." When analyzing trouble or making service adjustments, it is well to remember the following important characteristics of this type of set:

The video and sound intermediate frequencies are amplified simultaneously by the IF amplifiers.

The sound IF carrier (21.25 MC) and the video IF carrier (25.75 MC) mix at the video detector, so that a resultant beat frequency of 4.5 MC (inter-carrier sound) is produced. This 4.5 MC beat frequency contains the FM sound modulation. The 4.5 MC beat is amplified by the video amplifier, 4.5 MC sound IF amplifier and then, detected by the ratio detector. Since the FM modulated 4.5 MC inter-carrier sound signal results from beating the sound and video IF carriers together, any difficulty in the IF amplifiers or loss of one of the carriers, will result in no sound.

The IF amplifiers are designed so that when they are properly aligned, the 21.25 MC sound IF carrier is at least 26 DB (95%) below the 25.75 MC video IF carrier. See "Overall IF Response Curve", Figure 28. Misalignment of the IF amplifiers may cause excessive amplitude modulation of the FM sound signal, which might result in an audio "buzz". See discussion under the heading "Elimination of Audio Buzz".

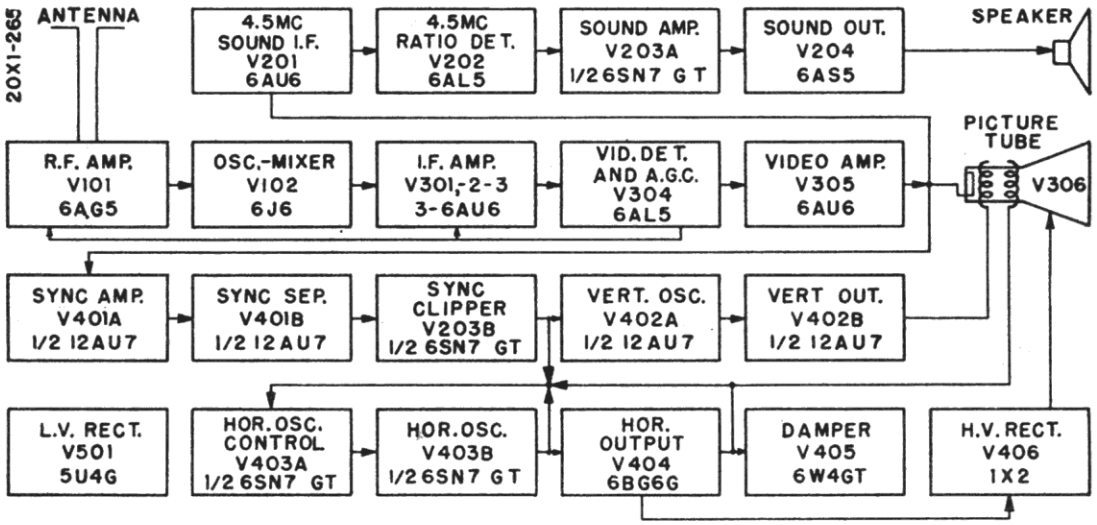


Figure 27. Functional Block Diagram.

RF SECTION

RF Amplifier (V101, 6AG5). Center-tapped primary winding L101A provides for a balanced 300 ohm and unbalanced 75 ohm input to the receiver. Loading resistor R101 is connected across secondary L101B to obtain the required bandpass. L101B is tuned by V101 input capacity in series with the parallel combination of C101 and C102. Trimmer C102 is used for alignment.

Primary coil L102A is the plate load of RF amplifier V101. R103 is used to broaden the response of the circuit. The parallel combination of C104 and tube output capacity acts in series with C105 to tune L102A. Trimmer C104 is used for alignment.

A different set of coils (L101 and L102), is switched into the circuit for each television channel by means of a turret assembly.

Mixer (½ V102, 6J6). Secondary coil L102B feeds the RF and oscillator injection voltages to the grid of the mixer, one triode section of V102. C106, R105 and R106 develop grid-leak bias for the mixer. Two resistors are used in this circuit to permit bringing out the junction as an alignment test point. A test scope can be connected to this point ("W") without materially affecting the operation of the circuit. C107 is used for alignment of the mixer.

Plate load resistor R109 is by-passed by C114 in order to limit regenerative feedback in the mixer. L105 and C115 are the principle components of the resonant coupling network between the mixer and the first video and sound IF amplifier (V301).

H.F. Oscillator (½ V102, 6J6). Oscillator coil L102C is inductively coupled to the mixer grid for oscillator injection. Condenser C109 is in series with the parallel combination of C110 and C111 to form the split condenser of a Colpitts Oscillator. C110 permits oscillator alignment. C111 is a variable dielectric type of condenser used as a Sharp Tuning Control.

R107 and C108 develop grid-leak bias for the oscillator tube, half of a 6J6. (The functions of an oscillator and a mixer are combined in a single type 6J6 dual triode tube.) R108 is used to shunt-feed the Colpitts oscillator plate.

VIDEO SECTION

IF Amplifiers V301, V302 and V303 (6AU6). The IF amplifiers, video detector, video amplifier, 4.5 MC sound IF and ratio detector circuits are all mounted on a sub-chassis. Bifilar-wound slug-tuned transformers are used for interstage coupling in the stagger-tuned IF amplifier system. Only three stages are required for the necessary gain and band width using this type of IF amplifier design. The skirt steepness of this IF bandpass is sufficient to make adjacent-channel trapping unnecessary. Because of this steepness the 4.5 MC beat frequency is not of sufficient amplitude to warrant a 4.5 MC trap in the video amplifier plate circuit.

Since AGC bias is applied to IF amplifiers V301 and V302 (6AU6) as well as RF amplifier V101 (6AG5) cathode resistors R304 and R307 are unbypassed to provide a stabilizing degenerative feedback.

Video Detector and AGC V304 (6AL5). One-half of V304 serves as a video detector and is connected so that it delivers a positive picture phase signal to the video amplifier grid.

This is the proper phase, since the signal applied to the cathode of the picture tube must have a negative picture phase. The load consisting of L301, L302, R325, and R316 is by-passed by C311 to remove the IF carrier component from the video signal. The video detector is operated at a potential of approximately 140 volts since the video amplifier V305 is also operated at approximately 140 volts above ground.

Although the IF amplifier gain is quite low at 21.25 MC, both the audio and video IF carriers appear at the video detector. The resulting 4.5 MC inter-carrier beat signal contains the FM sound modulation. The small amount of AM video modulation is removed by ratio detector limiter action. The video detector thus serves as a second mixer. The 4.5 MC sound IF and the de-

tected video signal are both amplified by video amplifier V305.

The second section of the 6AL5 twin diode is used as an AGC rectifier. Approximately 1.5 volts of delay bias is developed across the cathode resistor R310 so that the AGC is inoperative until the video signal reaches an amplitude greater than 1.5 volts. This rectified voltage is filtered and applied to the RF amplifier and the first and second video IF stages. Condenser C310 by-passes the video and sound carriers to ground.

Video Amplifier (V305, 6AU6). The circuit is a conventional video amplifier, with a plate load consisting of a series peaking coil (L303) which is damped by R322, shunt peaking coil (L304) which is damped by R321, and load resistor R319. This network offers a constant impedance (constant K) output over a wide frequency range. The video signal is coupled to cathode of picture tube V306 by coupling condenser C317. R323 is used to insure proper bias on V306.

The video signal from the video detector V304 is capacitively coupled to the grid of video amplifier V305 by coupling condenser C321. Grid leak bias is developed for the video amplifier by C321 and R328. Contrast control R317A varies the contrast by varying the gain of the video amplifier V305. Since R317A is connected in series with the video amplifier plate resistance, plate voltage will be proportional to the contrast control setting. Note: The cathode and control grid of V305 operate approximately 140 volts above chassis ground.

SOUND SECTION

Sound IF Amplifier (V201, 6AU6). Coupling between the video amplifier plate and the grid circuit of sound IF amplifier V201 is provided by C313, L201, and C201. This resonant coupling network also serves as a trap to take the 4.5 MC inter-carrier beat out of the video amplifier (and the picture). The sound IF amplifier is a conventional grid-leak biased circuit and feeds the primary of ratio detector transformer T201.

Ratio Detector (V202, 6AL5). A ratio detector is used for FM sound detection. The network between point "Z" and ground (de-emphasis filter and volume control circuit) is the AF output load circuit. Condenser C205 is an IF bypass.

Ratio detector limiter action is provided by the filtering action of C204. Condenser C204 is effectively connected across the tuned secondary of T201 through the two diode sections of V201. This tends to hold the IF signal amplitude at its average value and results in limiter action.

Since C204 charges to a value proportional to average IF signal amplitude and then limits at that level, the circuit will adjust itself to any signal level. As a result, limiter action is effective on weak as well as strong signals.

Sound Amplifier (V203A, ½ 6SN7GT). Normal operating bias for sound amplifier V203A is developed by a grid-leak bias resistor R208 and condenser C207. Static (no signal) plate current is limited by plate load resistor R209 and the negative contact potential developed across R208. The RC coupled plate circuit of this stage is conventional.

Sound Output (V204, 6AL5). Sound output V204, as well as video amplifier V305, has a modified plate supply circuit in order to make the most efficient use of plate supply power. The AC power requirements and the size of the power transformer are kept at a minimum by the use of this type of plate supply distribution system. (See "Power Supply Section" circuit description).

The plate circuit of V204 is a conventional transformer-coupled circuit. The plate and screen circuits are decoupled from the plate supply by the filtering action of R212, C213A, C213B, and C209B. Cathode condenser C209A is exceptionally large in order to prevent circuit inter-action since several stages in the receiver obtain their plate supply from this circuit. Since the cathode of V204 is approximately 150 volts positive with respect to chassis ground, the grid must also be kept at a rather high positive potential. This is the function of the divider made up of R210 and R211. Resistor R210 also serves as the grid return of this stage.

SWEEP SECTION

Sync Amplifier (V401A, ½ 12AU7). Grid-leak bias is used on the RC-coupled sync amplifier stage. The input coupling network, consisting of R326, R327, C316 and C315, effectively increases the source impedance and results in sync clipping at the grid of V410A. It also eliminates loading effects on the video amplifier plate circuit. Since sync limiting is not used in video amplifier V305, clipper action in the sync amplifier is necessary in order to obtain the desired noise immunity in the sync circuits.

Sync Separator (V401B, ½ 12AU7). Since the sync pulse input to this stage is of negative polarity, a grounded-grid type of circuit is necessary in order to obtain separator action. (The signal is applied to the cathode rather than to the grid). A divider network consisting of R404 and R405 is used as a plate load in order to reduce the plate voltage to a value that results in normal separator action.

Sync Clipper (V203B, ½ 6SN7GT). Since no phase inversion takes place in a grounded-grid stage, the input pulses applied to the grid of V203B are negative. Pulse clipping takes place due to plate current cut-off. Voltage divider R407 and R408 is used to reduce the plate voltage of the stage to a suitable value for normal operation.

Vertical Oscillator (V402A, ½ 12AU7). The output of sync clipper V203B is fed to an integrator filter consisting of R409, R410, R411, C404, C405 and C406. The integrated vertical pulse is fed to the grid of vertical oscillator V402A through coupling condenser C427 and the grid winding of blocking-oscillator transformer T401. Vertical hold control R432B adjusts the time constant of the blocking oscillator grid circuit, providing an adjustment for proper synchronization. Height control R417 is a variable resistor in the plate circuit of the vertical oscillator. Since vertical oscillator V402A also functions as a discharge tube, R417 provides height control by adjusting the charging current to C408.

Vertical Output (V402B, ½ 12AU7). The vertical output stage is a conventional triode sweep amplifier circuit. Vertical linearity control R420 provides linearity adjustment by varying the cathode bias on V402B. The plate circuit is transformer-coupled to vertical deflection coil T403A and damping resistors R421 and R422. Due to the waveshaping by condenser C408 and resistor R447, the output waveform is of the correct waveshape to produce a saw-tooth current in the deflection yoke.

Horizontal Oscillator Control Tube (V403A, ½ 6SN7GT). The horizontal oscillator control tube (V403A) controls the horizontal oscillator frequency by a method called "pulse width modulation". This circuit functions as follows:

A positive saw-tooth voltage from the output of the horizontal oscillator is developed across resistor R434 and condenser C412A to ground. The voltage waveform appearing across C412A is partially integrated. Another voltage, from the deflection yoke, is developed across R443, C427, and condenser C412A. This waveform also appears across C412A partially integrated. These two waveforms add together on the grid of V403A as a saw-tooth with an upward sloping positive peak.

The positive sync pulse from the sync clipper, is also developed across C412A, and if properly phased, will add on top of the positive peak of the self-generated waveshape from the horizontal oscillator output and the deflection yoke.

Resistors R428 and R424, connected from the control grid of the horizontal oscillator to the cathode of the horizontal oscillator control tube (V403A), form a voltage divider network to develop a negative potential at the horizontal oscillator control tube grid. This voltage biases the horizontal oscillator control tube sufficiently negative so that only the positive peak of the waveshape will allow the tube to draw plate current. Consequently, only this positive pulse, which consists primarily of the horizontal sync pulse, appears across cathode resistors R425 and R426. This pulse, across the cathode resistors, is filtered by condenser C414, C415 and R423 so that a DC voltage proportional to the average level of this pulse will be developed across R425 and R426.

Since the positive sync pulses must be in the correct phase relation when added to the top of the self-generated waveshape. Any shifting of phase due to oscillator drift will tend to make the sync pulse add either ahead or behind the peak of the self-generated pulse. This will tend to make the positive peaks of the waveform at the horizontal oscillator control tube grid narrower if the horizontal oscillator frequency increases and wider if the oscillator frequency decreases.

These variations will determine the amount of time that tube V403A will draw plate current and consequently, the DC voltage developed across resistor R425. This voltage is injected into the grid of the horizontal oscillator through resistor R427, and thus controls the oscillator frequency.

A vernier control for this system is provided for by the Horizontal Hold control (R432A). The setting of this control, determines the plate voltage on the horizontal oscillator control tube, and thus the voltage across cathode resistor R425.

For "Service Hints For Horizontal Sync", see page 35.

Horizontal Oscillator (V403B, ½ 6SN7GT). Horizontal oscillator V403B uses a blocking oscillator circuit. Transformer T404 employs auto-transformer action to produce feedback at the control grid. In addition to the time constant of the grid circuit, the oscillator frequency is determined by the DC voltage developed across cathode resistor R425. This voltage depends upon the plate current of the horizontal oscillator control tube V403A. See previous paragraphs on horizontal oscillator control tube. V403B also functions as a discharge tube for the waveshaping condensers C419, C420, and C412B.

A parallel LC circuit consisting of L405 and C418 is placed in the plate circuit of the horizontal oscillator and is resonated at approximately 17 KC. This LC circuit is shock excited and then damped by resistor R431, so that a sine wave is produced. This sine wave adds with the instantaneous potentials on both the plate and grid of the oscillator, so that a steeper slope results on the portion of the sawtooth just before conduction of the oscillator tube. This results in improved oscillator stability. This LC circuit is called the Horizontal Lock and is located underneath the chassis.

Horizontal Output (V404, 6BG6G). Horizontal drive adjustment C421 adjusts the sweep voltage applied to the grid of horizontal output tube V404. A cathode-biased beam tetrode amplifier is used to develop the power required to drive the horizontal deflection coils of the magnetic deflection yoke and to provide the source for the kick-back type second anode supply. The output of V404 is transformer-coupled to horizontal deflection coils T403B. Width control L403 shunts a portion of the output transformer secondary, making the inductance variable for width control. DC blocking condenser C428 prevents DC flow through the horizontal deflection coils.

Damper (V406, 6W4GT). Aside from its function of damping transients in the horizontal output circuit, Damper V406 is connected in such a way as to give an effective increase in plate supply voltage for horizontal output amplifier V404 (and various other stages in the receiver). The plate current of V404 flows through V406 for the major portion of the trace. Condensers C424 and C425 are fully charged during this period and supply V404 plate current during the time that V406 is not conducting. An average voltage is developed across the network consisting of C424, C425 and L402. This voltage is approximately 60 volts greater than the normal plate voltage source.

Since L402 is variable, the network consisting of C424, C425 and L402 provides linearity control by adjusting the cathode waveform (bias) of damper tube V405.

POWER SUPPLY SECTION

H.V. Rectifier (V405, 1X2). An auto-transformer type primary winding on horizontal output transformer T405 provides a pulsed high voltage source for the second anode rectifier system. Filament current for half-wave rectifier tube V405 (1X2) is supplied by a separate

winding on T405 and fed through current limiting resistor R442. Due to the high frequency power source and the small load current, adequate filtering is provided by R444, C426 and the capacity between the inner and outer dag coatings of picture tube V306.

L.V. Rectifier (V501, 5U4G). A single 5U4G rectifier and pi-type filter provides all the plate and screen voltages required by the various stages of the receiver. The speaker field is used as a filter choke in "television only" models. Chassis used in combination models have a filter choke mounted to the underside of the chassis because the radio and sound output use a single PM speaker. Approximately 50 milliamperes of the plate supply load is drawn from the arm of focus control R207B. The amount of this load that passes through the focus coil is adjustable and provides the required focus control range. The remainder of the plate supply load flows through the focus control at all times.

Since several stages of the receiver require no more than half of the power supply output voltage for normal operation, these stages are connected in a series-parallel combination to eliminates dropping resistors and make the most efficient use of the power supply output. See "B+ Voltage Distribution", figure 43. Considering only the power supply connections, video amplifier V305 and audio output V204 are connected in parallel. RF amplifier V101, oscillator-mixer V102, video IF amplifiers V301-2-3, sync amplifier V401A, sync separator V401B and sync clipper V203B are all in parallel and get their plate supply feed from the cathodes of V305 and V204.

The boot-strap circuit, from the cathode of damper V406, feeds horizontal oscillator control V403A, vertical output V402B, first anode of picture tube V306 and the plate of horizontal output V404. Audio amplifier V203A, horizontal oscillator V403B, the screen of horizontal output V404 and the brightness control network are fed directly from the power supply.

The vertical oscillator acquires its plate voltage from the "Boot Strap" circuit in the 20Y1 chassis. This plate voltage is obtained from direct connection to B plus in the 20X1 chassis, except for some early 20X1 chassis which were wired like the 20Y1 chassis. Refer to the schematic, Figure 77.

TELEVISION ALIGNMENT PROCEDURE

GENERAL

Complete alignment consists of the following individual procedures. Alignment should be performed in this sequence.

a. IF Amplifier Alignment.

b. 4.5 MC Sound IF Alignment.

c. RF and Mixer Alignment.

d. Overall RF and IF Response Curve Check and High Frequency Oscillator Alignment.

e. Horizontal Oscillator Check and Alignment.

Do not attempt alignment until all possible causes of trouble have first been investigated. Do not attempt alignment unless suitable test equipment is available.

Speaker must be connected to television chassis during alignment.

HIGH VOLTAGE WARNING

Operating or servicing television receivers with cabinet removed involves shock hazard. Exercise all normal High Voltage precautions.

Very carefully follow instructions given in this manual regarding location of test points for alignment, for taking voltage measurements, or in making oscilloscope waveform analysis. Do not connect test equipment across other points in the receiver unless you are thoroughly familiar with the circuit wiring and points at which high voltages are present.

ALIGNMENT TOOL KIT (#98A30-3)

An Alignment Tool Kit consisting of 2 screwdrivers is available. Order part #98A30-3 from Admiral Distributor.

TEST EQUIPMENT

To properly service this receiver, it is recommended that the following test equipment be available.

RF Sweep Generator

18 to 30 MC range: 10 MC sweep width.
50 to 90 MC range: 10 MC sweep width.
170 to 225 MC range: 10 MC sweep width.
Output: adjustable; at least one-tenth volt maximum.
Output impedance: 300 ohms balanced to ground for RF ranges.

Marker Generator

18 to 30 MC frequency range.
50 to 90 MC frequency range.
170 to 225 MC frequency range.
Must be extremely accurate or have built-in crystal calibrator for checking accuracy of calibration.

Crystal Calibrator

Check points at 4.5 MC and from 18 to 225 MC. Not required for 18 to 225 MC if marker or sweep generators have built-in calibration crystals.

Signal Generator

Accurate signal generator, 4.5 MC range and of 18 to 225 MC, with low impedance output and calibrated attenuator.

Oscilloscope

Standard oscilloscope, preferably with a wide band vertical deflection, vertical sensitivity at least .5 volt peak-to-peak per inch, and input calibrator.

Vacuum-Tube Voltmeter

Preferably VTVM with low range (3 volt) DC zero center scale.

Adj.	Symbol	Frequency	Function
A1	T303	25.3 MC	3rd IF Transformer
A2	T301	25.3 MC	1st IF Transformer
A3	T302	23.1 MC	2nd IF Transformer
A4	L105	23.1 MC	Mixer Plate Coil
A5	T201	4.5 MC	Primary of Ratio Detector Transformer
A6	L201	4.5 MC	1st Sound IF Transformer
A7	T201	4.5 MC	Secondary of Ratio Detector Transformer
A8	C102		Trimmer (RF Amplifier)
A9	C104		Trimmer (RF Amplifier)
A10	C107		Trimmer (Mixer)
A11	C109		Trimmer (HF Oscillator)
A12	L102		Slug, HF Oscillator Coils

IF AMPLIFIER ALIGNMENT

IMPORTANT: Before starting alignment, assemble the IF inspection plate (cover shield) to the chassis. In some early sets, the shield was spot soldered to the chassis and, if removed, it must be re-soldered.

- Allow about 15 minutes for receiver and test equipment to warm up.
- Disconnect antenna from receiver.
- Set Channel Selector to channel 13 or other unassigned high channel.
- Connect a wire jumper across antenna terminals (to prevent signal interference during IF alignment).
- Connect signal generator high side to tube shield of 6J6 oscillator-mixer tube. Be sure to insulate tube shield from chassis. Connect generator low side to chassis close to 6J6 tube base.
- Set Contrast control fully clockwise. Retain setting for all IF adjustments.
- Alignment adjustment and connection point locations are shown in Figures 30 and 29.
- Speaker must be connected to chassis.

Step	Signal Gen. Frequency	Connect VTVM to	Instructions	Adjust
1	25.3 MC	High side to point "T"; common to chassis.	Use VTVM 3 volt DC scale. When peaking, keep reducing generator output for VTVM reading of approx. 1 volt or less.	A1 and A2 for maximum.
2	23.1 MC	"	"	A3 and A4 for maximum.
3	To insure proper alignment, make the "Over-all IF Response Curve Check" given below.			

OVERALL IF RESPONSE CURVE CHECK

(Using sweep generator and oscilloscope with sweep input to RF mixer).

Differences in component values affect IF response. These differences are not apparent in alignment of IFs using a signal generator and VTVM (single frequency alignment); hence it is preferable that an IF response curve check be made after completion of the IF amplifier alignment.

Since feeding the sweep signal through the entire RF and IF system provides a better overall response, this check should be made after RF and HF Oscillator alignments as indicated in step 1 of the alignment chart on page 19. However, the procedure is given below if it is desired to take video IF response curve as a check.

If the procedure given below is followed and the response curve obtained differs greatly from the curve shown in figure 28, repeat all IF amplifier alignment steps, making sure generator frequencies are precise and adjustments are accurately made.

a. Make all control settings and connections as given in the IF amplifier alignment chart.

b. Connect oscilloscope* between point "V" and chassis ground through a decoupling filter; see fig. 29. Keep leads away from receiver. Caution: Voltage at point "V" is approximately 130 volts DC.

c. Connect sweep generator high side to tube shield of 6J6 osc-mixer tube. Be sure to insulate tube shield from chassis. Connect sweep generator low side to chassis close to 6J6 tube base. Set sweep generator to sweep the IF pass band (19 to 29 MC).

d. Loosely couple marker generator high side to the sweep generator lead connected to tube shield on tuner; low side to chassis ground.

To avoid distortion of the response curve, keep the sweep generator and marker generator outputs at a very minimum. Marker pips should be just kept barely visible. Setting sweep generator output for VTVM reading from .5 to 1 volt DC, measured between AGC buss (point "T") and chassis, will avoid distortion of response curve. Connecting a 1½ volt battery (negative to point "T", positive to chassis) will allow greater signal input without distorting the response curve.

e. Check curve obtained against the ideal overall IF amplifier response curve shown in figure 28. Since it is not always possible to get ideal curves, it should be noted that the height of opposite peaks should be within 3db or 30% of each other. The dip or valley in the center of the curve should not be greater than 3db or 30% down the highest peak of the curve. Check video and sound IF carrier points by means of marker generator. It is important that marker pips be in the proper location on the response curve. The 25.75 MC marker, should be 6db below the highest peak (50% point on the high frequency side of the curve). The 22 MC marker should be at the opposite side of the response curve, located approximately 18db (85%) below the highest peak. The 21.25 MC marker should be located at least 26db (95%) below the highest peak, and may or may not be visible.

Consistent with proper band width and correct location of markers, the response curve should preferably have maximum amplitude, symmetry, and flat top appearance. If correct response is not obtained, repeat the "IF Amplifier Alignment."

f. Remove wire jumper from across antenna terminals.

*** In dealing with RF and IF response curves, it is well to remember that an inverted or mirror image may result, depending on the sweep generator and oscilloscope used. The general waveform should still be identical. When using a wide band oscilloscope for alignment, marker pips will be more distinct if condenser from 100 to 1,000 mmfd. is connected across the oscilloscope input. Caution: Use the lowest capacity condenser possible, since too high a capacity will affect the shape of the response curve.**

ALIGNMENT HINT

After becoming familiar with alignment procedure, some servicemen simplify subsequent alignment of sets by using merely the essential alignment data given in figures 29 and 30.

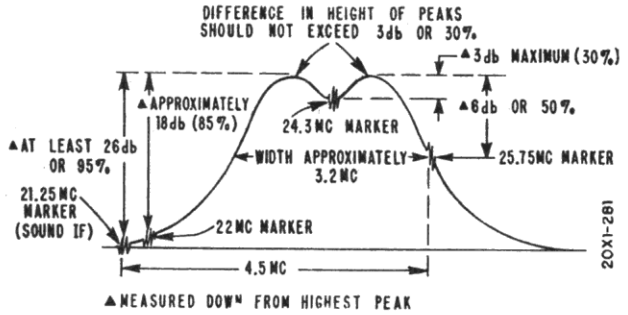


Figure 28. Overall IF Response Curve.

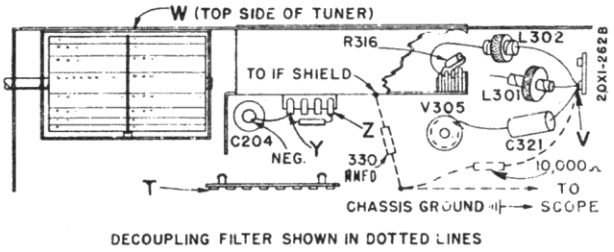


Figure 29. Bottom View of Chassis Showing Alignment Connection Points.

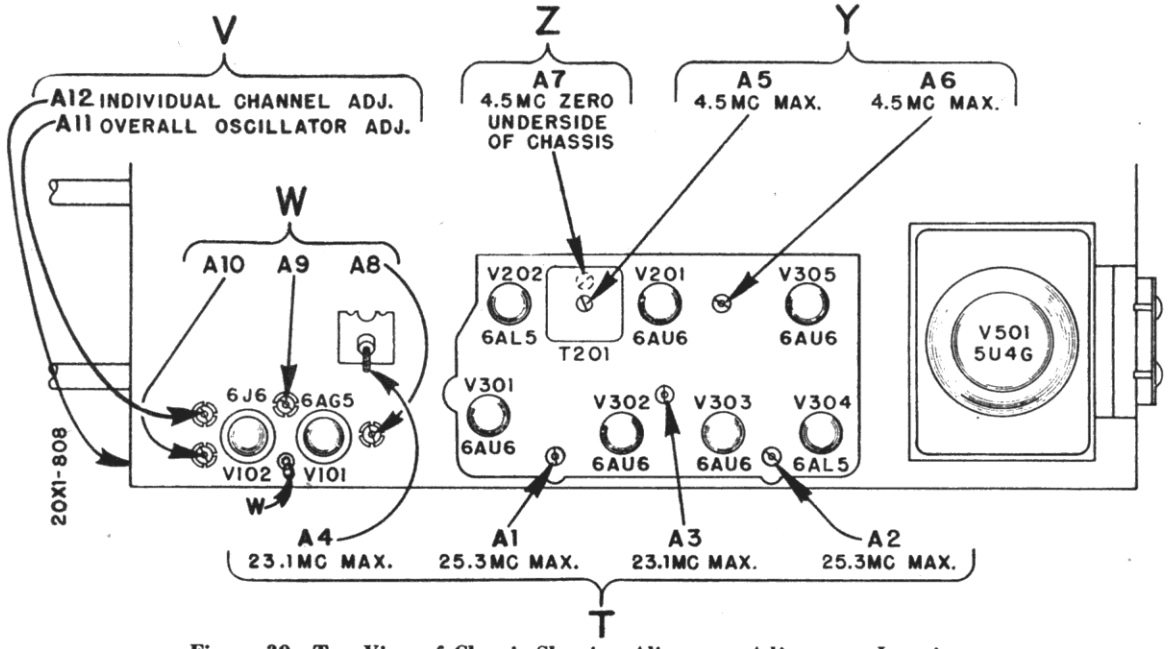


Figure 30. Top View of Chassis Showing Alignment Adjustment Locations.

4.5 MC SOUND IF ALIGNMENT

- Disconnect antenna from receiver.
- Set contrast control fully clockwise.
- Connect signal generator high side to point "V" through a .01 mfd. condenser.
- Before starting alignment, allow 15 minutes for receiver and test equipment to warm up.
- Speaker must be connected to chassis.
- Alignment adjustment and connection point are shown in figures 29 and 30.

Step	Signal Gen. Frequency	Connect VTVM to	Instructions	Adjust
	IMPORTANT: Before proceeding, be sure to check the signal generator used in alignment against a crystal calibrator or other frequency standard for absolute frequency calibration at the 4.5 MC alignment point required for this operation. Accuracy required within one kilocycle. If a frequency standard is not available for a 4.5 MC frequency check, it is recommended that touch-up of zero setting adjustment A7 in step 2 be made using a television signal rather than the 4.5 MC signal from a signal generator. This "touch-up" adjustment procedure is given on page 8 and should be made after checking (and aligning where necessary) the IF Amplifier, Tuner RF and Mixer, and HF oscillator.			
1	†4.5 MC	VTVM (3 volt DC scale) to point "Y".	Use 3 volt scale on VTVM. Keep VTVM leads well separated from signal generator and chassis wiring. A non-metallic screwdriver will be required for aligning slug adjustment A5.	A5 and A6 for maximum (keep reducing generator output to keep VTVM at approx. 1 volt).
2	†4.5 MC	VTVM to point "Z".	Use 3 volt zero center scale on VTVM, if available. Keep VTVM leads well separated from signal generator and chassis wiring. A non-metallic screwdriver will be required for aligning slug adjustment A7.	**A7 for zero on VTVM (the correct zero point is located between a positive and a negative maximum).

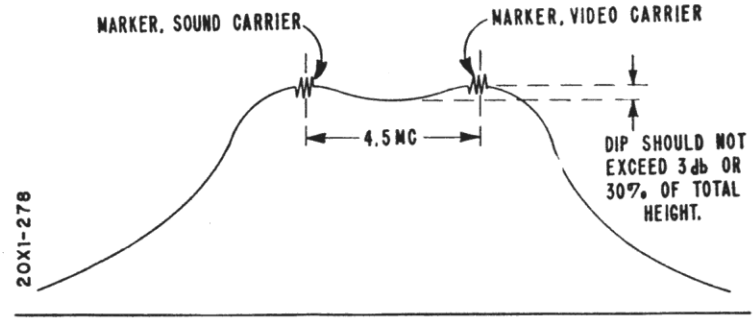
† Signal may be unmodulated or 400 cycle AM modulated.

** If A7 was far off, readjust A5 and repeat A7.

RF AND MIXER ALIGNMENT

- Disconnect antenna from receiver.
- Set contrast control full on (clockwise).
- Before starting alignment, allow 15 minutes for receiver and test equipment to warm up.
- Speaker must be connected to chassis.
- Connect sweep generator to antenna terminals.
- Loosely couple marker generator to antenna terminal (to obtain marker pips of video and sound RF carriers). To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible.
- Connect oscilloscope through 10,000 ohm resistor to point "W" on tuner. Keep oscilloscope leads away from chassis.
- Connecting a 1½ volt bias battery (negative to AGC buss, point "T"; positive to chassis) will allow greater signal input without distorting response curve.
- Alignment adjustments, connection points, and response curve are shown in Figures 29, 30, 31.

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Adjust
1	*205.25 **209.75	Sweeping Channel 12	Check for curve resembling RF response curve shown in figure 31. If necessary, adjust A8, A9 and A10 (Figure 30) as required. Consistent with proper band width and correct marker location, response curve should have maximum amplitude and flat top appearance.
2	211.25 215.75	13	Check each channel for curve resembling RF response curve shown in figure 31. In general, the adjustment performed in step 1 is sufficient to give satisfactory response curves on all channels. However, if reasonable alignment is not obtained on a particular channel, (a) check to see that coils have not been intermixed, or (b) try replacing the pair of coils for that particular channel, or (c) repeat step 1 for the weak channel as a compromise adjustment to favor this particular channel. If a compromise adjustment is made, other channels should be checked to make certain that they have not been appreciably affected.
3	199.25 203.75	11	
4	193.25 197.75	10	
5	187.25 191.75	9	
6	181.25 185.75	8	
7	175.25 179.75	7	
8	83.25 87.75	6	
9	77.25 81.75	5	
10	67.25 71.75	4	
11	61.25 65.75	3	
12	55.25 59.75	2	



Full skirt of curve will not be visible unless generator sweep width extends beyond 10 MC.

Figure 31. RF Response Curve (see NOTE below).

* Video Carrier Frequency (MC). ** Sound Carrier Frequency (MC).

OSCILLOSCOPE NOTE

In dealing with RF and IF response curves, it is well to remember that an inverted or mirror image may result, depending on the sweep generator and oscilloscope used. The general waveform should still be identical.

When using a wide band oscilloscope for alignment, marker pips will be more distinct if condenser from 100 to 1,000 mmfd. is connected across the oscilloscope input. Caution: Use the lowest capacity condenser possible, since too high a capacity will affect the shape of the response curve.

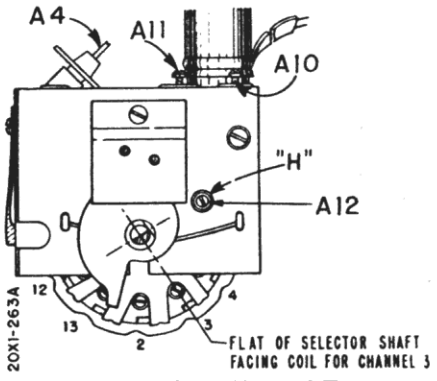


Figure 32. Front View of Tuner.

OVERALL RF and IF RESPONSE CURVE CHECK (Step 1) and HF OSCILLATOR ALIGNMENT

(Using sweep generator and oscilloscope. See page 8 for HF Oscillator Adjustment using television signal.)

- Disconnect antenna from receiver.
- Disconnect signal generator and VTVM (if used in previous alignment).
- Before starting alignment, allow 15 minutes for receiver and test equipment to warm up.
- Set Contrast and Focus controls full on (clockwise).
- Alignment adjustments, connection points, and response curve shown in figs. 29, 32, 33.
- Connect sweep generator to antenna terminals.
- Loosely couple marker generator to antenna terminals (to obtain marker pips of video and sound RF carriers). To avoid distorting response curve (overloading the video detector), keep the sweep generator output and the marker generator output at a very minimum. The marker pips should just be barely visible. Connecting a 3 volt bias battery (negative to AGC buss, point "T"; positive to chassis) will allow greater signal input without distorting response curve.
- Connect oscilloscope between point "V" and chassis ground through a decoupling filter (see figure 29). Keep oscilloscope leads away from chassis. Caution: Voltage at point "V" is approximately 130 volts DC.
- Set Sharp Tuning control at half rotation by rotating it approximately 150° as shown in figure 32.
- Speaker must be connected to chassis.
- Use a NON-METALLIC alignment screwdriver with a ⅛ inch blade for adjustment of A12.
- If HF oscillator slugs "fall into" coil form, remove the channel coil, move the slug retaining spring aside, and tap the coil assembly until the slug slips forward. Set the coil retaining spring into position; it should rest firmly against the slug.

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Instruction
1			**While sweeping the RF pass band (channel 13 or other unassigned high channel), check the overall response curve obtained against the ideal curve shown in Figure 33. If shape of curve is not within limits shown, it will be necessary to repeat the IF Amplifier Alignment given on page 16. The IF's must be accurately aligned before correct oscillator adjustment can be made.**
2	*211.25 **215.75	Sweeping Channel 13	**With correct oscillator alignment, the video carrier marker should be located 6db down (50% point) on the response curve (figure 33) when the Sharp Tuning Control is set at the center of its range (half rotation). See figure 32. When checking curve, see "NOTE" on previous page. If adjustment is needed, check to see whether mis-alignment is apparent on channel 13 *only* or also exists on other channels. If *overall* adjustment is required, adjust A11. Otherwise make individual HF oscillator adjustments (A12) as instructed in beginning of this paragraph.**
3	205.25 209.75	12	
4	199.25 203.75	11	
5	193.25 197.75	10	
6	187.25 191.75	9	**Check all channels individually for proper marker location. If overall adjustment has been made, it may not be necessary to make any further adjustments. If necessary, however, make individual HF oscillator adjustment A12. Note that A11 and A12 can be adjusted without removing chassis from cabinet. For details, see Oscillator Adjustment using television signal on page 8.**
7	181.25 185.75	8	
8	175.25 179.75	7	
9	83.25 87.75	6	
10	77.25 81.75	5	
11	67.25 71.75	4	
12	61.25 65.75	3	
13	55.25 59.75	2	

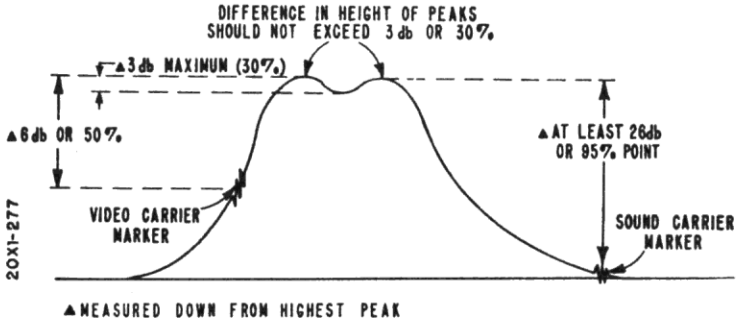


Figure 33. Overall RF and IF Amplifier Response Curve.

* **Picture Carrier Frequency (MC).** ** **Sound Carrier Frequency (MC).**

HORIZONTAL OSCILLATOR CHECK AND ALIGNMENT

CHECKING NEED FOR HORIZONTAL OSCILLATOR ADJUSTMENT

Horizontal sweep rear panel controls (Horizontal Frequency T404, Horizontal Lock L405, Horizontal Lock-In Range C412A and Horizontal Drive C412B) should seldom require readjustment unless the original factory adjustments have been disturbed or if tubes or other components in these circuits have been replaced. **However, the horizontal oscillator check given below should be made in the customers home at the time of installation.**

Check the need for horizontal oscillator adjustment as follows:

a. With television signal properly tuned in (preferably to a test pattern), allow the receiver to warm up for a few minutes.

b. Rotate the Horizontal Hold control (on front panel) fully counter-clockwise. The picture should remain in horizontal sync.

c. Interrupt the television signal by switching the channel selector switch off and on channel. The picture will normally fall out of sync.

d. Slowly rotate the Horizontal Hold control in a clockwise direction. The number of diagonal blanking bars will gradually decrease until about 3 diagonal blanking bars can be seen; at this point slight additional rotation will pull the picture into sync. The point where the picture pulls into sync should occur when the Horizontal Hold control is approximately 90 degree clockwise rotation from fully counter-clockwise position. The picture should then remain in sync (hold in) for at least 90 degrees of additional clockwise rotation. At full clockwise rotation, the picture should normally fall out of sync and a vertical or diagonal blanking bar will be visible on the raster.

If the horizontal sweep functions as described in steps b, c, and d, for each channel operating in the service area, the horizontal oscillator is in proper adjustment; do not touch any of the rear panel, horizontal sweep adjustments other than width (L403), Horizontal Drive (C412B) Horizontal Linearity (L402).

If horizontal oscillator adjustment is required, make the "Horizontal Frequency and Horizontal Lock-In Range Adjustment" as given in the following paragraphs.

HORIZONTAL FREQUENCY AND HORIZONTAL LOCK-IN RANGE ADJUSTMENT

NOTE: These adjustments can be made in the customers home, without removal of the chassis from the cabinet. Caution: Before proceeding, be sure that the picture will sync vertically, as lack of both vertical and horizontal sync indicates sync circuit trouble and not horizontal oscillator trouble.

a. With television signal properly tuned in (preferably to a test pattern), allow the receiver to warm up for a few minutes. Be sure CONTRAST control is set for normal picture.

b. Rotate the Horizontal Hold control (on front panel) fully clockwise.

c. Adjust Horizontal Frequency control slug T404 (on back of chassis) until the picture just falls in and then just out of sync. Then slowly rotate the control until a vertical or diagonal horizontal blanking bar is visible on the raster.

d. Rotate the Horizontal Hold control (on front panel) fully counter-clockwise. The picture will normally fall out of horizontal sync. If it does not, interrupt the television signal by switching the channel selector off and on channel.

e. Carefully adjust the Horizontal Lock-In Range trimmer C412A until 2, 3 or 4 diagonal blanking bars are seen; at this point, slight clockwise rotation of the Horizontal Hold control should pull the picture into sync.

Check the results of these adjustments as described under "Checking Need For Horizontal Oscillator Adjustment".

If the above adjustments have been carefully made, but the horizontal sweep still does not sync properly, try replacing the horizontal oscillator tube (V403); then repeat the above steps.

If trouble is not eliminated, check for a gassy tube in the horizontal sweep circuit (V406, V407, V408). These tubes may cause horizontal sync trouble since an integrated voltage from the deflection yoke is applied to the horizontal oscillator control tube grid (pin 1 of V403A).

If horizontal sync difficulty still persists after carefully making these checks, remove the chassis from the cabinet and then check the following components:

(1) If R425 is 150,000 ohms, replace it with a 220,000 ohm, ½ watt resistor (part number 60B8-224).

(2) Check condenser C416 by substituting identical condenser (180 mmfd, ±5%) part number 65B6-59.

(3) Check C414 for either open or short.

(4) Check condenser C417 for short.

(5) Check resistance of R427. It should be 100,000 ohms.

If, after checking these components, the horizontal oscillator still will not sync, it will be necessary to proceed with "Complete Alignment of the Horizontal Oscillator" given below.

COMPLETE ALIGNMENT OF HORIZONTAL OSCILLATOR

NOTE: This adjustment requires the use of an oscilloscope. Making this adjustment without an oscilloscope may result in poor horizontal sweep stabilization.

a. With television signal properly tuned in (preferably to a test pattern) allow the receiver to warm up for a few minutes.

b. Turn out fully Horizontal Lock L405 slug (underside of chassis). Turn out trimmer adjustment screws for Horizontal Lock-In Range C412A and Horizontal Drive C412B about ½ turn counter-clockwise from "full in" position.

c. Set Contrast control for normal picture and Horizontal Hold control (front panel) to the extreme counter-clockwise position. Adjust Horizontal Frequency slug T404 (rear of chassis) until picture falls into horizontal sync. **NOTE:** If it is impossible to sync the picture, sync can sometimes be obtained by re-setting the Horizontal Lock-In Range C412A to approximately one-quarter turn counter-clockwise from its tight position.

d. Connect oscilloscope between terminal "C" on T404 to chassis ground. Set oscilloscope sweep to horizontal frequency (15.75 KC) or a sub multiple of it. Oscilloscope leads must be of low capacity (unshielded) or the Horizontal Oscillator may not sync. It may be necessary to add a small capacitance in series with one lead. While holding picture in sync with Horizontal Hold control on front panel, adjust Horizontal Lock slug L405 (inside chassis) for oscilloscope waveform pattern illustrated. Note that slug L405 should be adjusted until the rounded peak of this waveform is equal in height to the pointed peak.

e. Disconnect oscilloscope from receiver. With the Horizontal Hold control (front panel) set fully clockwise, adjust the Horizontal Frequency slug T404 until the complete raster just starts to move across the screen appearing as a split-framed picture. The horizontal blanking should appear as a diagonal or vertical bar.

f. Rotate the Horizontal Hold control (front panel) fully counter-clockwise. The picture will normally fall out of horizontal sync, or if not, interrupt the television signal by switching the channel selector switch off and on channel. Carefully adjust the Horizontal Lock-In Range trimmer C412A so that three or four diagonal bars are seen just before the picture falls into horizontal sync as the Horizontal Hold control (front panel) is rotated in the clockwise direction.

g. Adjust Horizontal Drive trimmer C412B, Linearity control L402 and Width control L403 for best picture; see "Width, Horizontal Drive, and Horizontal Linearity Adjustment" on page 10.

h. Set the Horizontal Hold control (front panel) to fully clockwise position. Carefully readjust the Horizontal Frequency slug T404 until a vertical or diagonal bar is seen, upon which very slight additional rotation of slug T404 will bring the picture fully into horizontal sync.

i. Make check "Checking Need For Horizontal Oscillator Adjustment". If satisfactory alignment cannot be obtained, refer to "Service Hints For Horizontal Sync Trouble" on page 35.

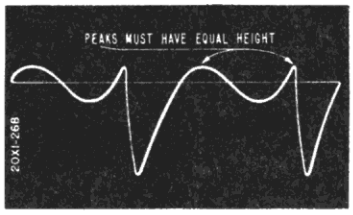


Figure 34. Horizontal Oscillator Waveform.

REMOVING RADIO OR CHANGER FOR SERVICE

REMOVING COMPLETE RADIO AND RECORD CHANGER ASSEMBLY

The complete Radio-Phono unit does not need to be removed unless the "Tilt-Out mechanism requires repair. The radio tuner can be removed separately as explained under "Removing Radio Chassis Only for Servicing". The record changer can be removed separately by unscrewing the three screws on the top of the changer, unplugging the cable connectors, and then lifting the changer out.

If it is necessary to remove the complete Radio and Record Changer assembly, disconnect the power cable and unsolder the radio speaker leads. Disconnect one side of the tie-bar spring and one side of the tie-rod from a titlt-out bracket. Hold the radio-phono unit with one hand while springing each of the four tilt-out hinge arms away from the sides. As this is done, the four pivot studs will come out of their sockets and free the unit from the cabinet.

To reinstall, place the radio-phono unit back in the cabinet; spring the tilt-out arms out so that the unit will drop down between them; guide the studs back into their sockets; then reassemble the tie-bar spring and tie-rod to the tilt-out brackets. Reconnect the power cable and re-solder the speaker leads.

REMOVING RADIO CHASSIS ONLY FOR SERVICING

Oscillator trimmer "E" and antenna trimmer "F" are accessible from the outside of the radio-phono housing, see figure 35.

The radio tubes can be serviced from top of the chassis by merely unscrewing the three screws "P" (figure 35) and lifting away the record changer assembly.

To remove the radio chassis for complete alignment or for servicing the underside of the chassis, follow steps "a" through "g" below.

a. Loosen the power supply cable clamp on the underside of the radio-phono housing and on the cabinet or power supply. Disconnect the power supply cable plug from the power supply.

b. Remove one of the loop antenna mounting screws, move that side of the loop up so the black and white leads to the loop antenna can be unsoldered. Also unsolder the black and white leads connecting to the speaker voice coil terminals.

c. Remove the radio front housing mounting screws "S" (Figure 35) at the sides and at the seams on the underside of the housing.

d. Carefully pull the radio chassis down and forward until you can reach in and unplug the phono pickup

and phono motor connector plugs. Then, pull the radio tuner completely forward.

e. Remove the tuning knobs. Position the dial drum as shown in figure 36; unhook spring at "A"; and keeping tension on dial cord, hook it to tab "B".

f. Remove the six hex-head screws "C" which hold chassis cover and dial scale to chassis.

g. After removing the pilot light brackets and hex nut "D" and "E", the chassis front can be pulled away from the chassis. All trimmers and parts are now accessible for adjustment or service.

h. Reassemble in the same manner.

EXTERNAL RADIO ANTENNA

The radio is provided with a built-in Aero-scope antenna. This antenna eliminates the need for external antenna or ground wires in most locations.

The built-in radio (loop) antenna is directional in that better reception of weak or distant stations may be had by slightly rotating the set. In extra noisy locations, the set may be rotated to the position that gives a minimum of noise or other interference.

If an external antenna is desired, connect the external antenna lead-in wire (preferably by soldering) to the terminal lug on the back of the internal loop antenna. The internal loop antenna is mounted on a fibre board which is attached to the back of the radio-phono chassis.

The lead-in should be stapled or tacked to the cabinet rail, being sure to allow enough slack so the lead is not pulled tight when the "Tilt-Out" cabinet door is opened.

After connecting the external antenna to the set, reception of weak or distant stations may further be improved by readjusting the antenna trimmer located on the loop antenna. Adjust the antenna trimmer for maximum signal while tuned to a weak station, preferably at 1400 or 1500 KC.

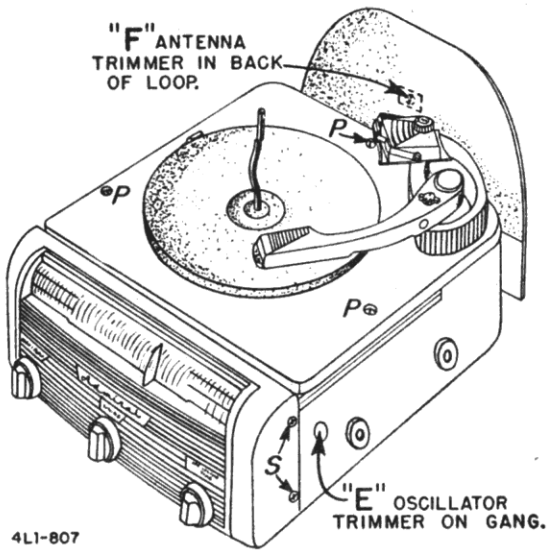


Figure 35. Radio-Phono Unit.

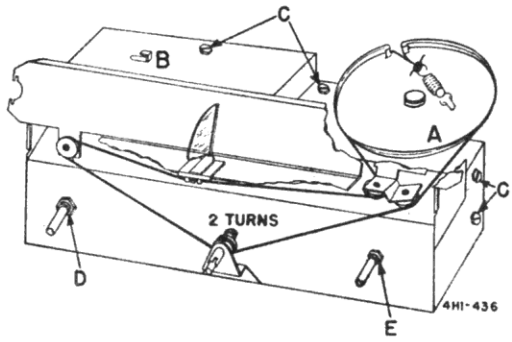


Figure 36. Radio Tuner Showing Chassis Cover and Dial Assembly.

ALIGNMENT PROCEDURE FOR 4L1 RADIO

Oscillator and antenna trimmer are accessible without disassembly of chassis housing and dial scale. See Figure 35. For IF slug adjustments, it will be necessary to remove and disassemble the radio chassis as instructed under "Removing Radio Chassis Only For Servicing". See Figure 39 for trimmer locations.

- Connect output meter across speaker voice coil.
- Turn receiver Volume control fully on: Tone control fully clockwise.
- "Radio-Phono" switch in Radio Position.
- AM loop antenna must be connected and placed in the same relative position to the chassis as when in the cabinet.
- Use lowest output setting of signal generator that gives a satisfactory reading on meter.
- Use a non-metallic alignment tool for IF adjustments.
- Repeat adjustments to insure good results.

Step	Connect Signal Generator	Dummy Antenna Between Radio and Signal General	Signal Generator Frequency	Receiver Dial Setting	Adj. Trimmers in Following Order to Max.
1	Gang condenser antenna stator	.1 MFD	455 KC	Tuning gang wide open	*A-B (2nd IF) *C-D (1st IF)
2	Gang condenser antenna stator	.1 MFD	1620 KC	Tuning gang wide open	E (oscillator)
3	Place generator lead close to loop of set to obtain adequate signal. No actual connection (signal by radiation).		1400 KC	Tune in signal	§F (antenna)

*** Trimmer adjustments A and C made from underside of chassis.**

§ AM antenna trimmer adjustment "F" in step 3 should be repeated after set and antenna have been installed in cabinet. Important: AM antenna trimmer may not peak if antenna leads are not routed or separated as originally made.

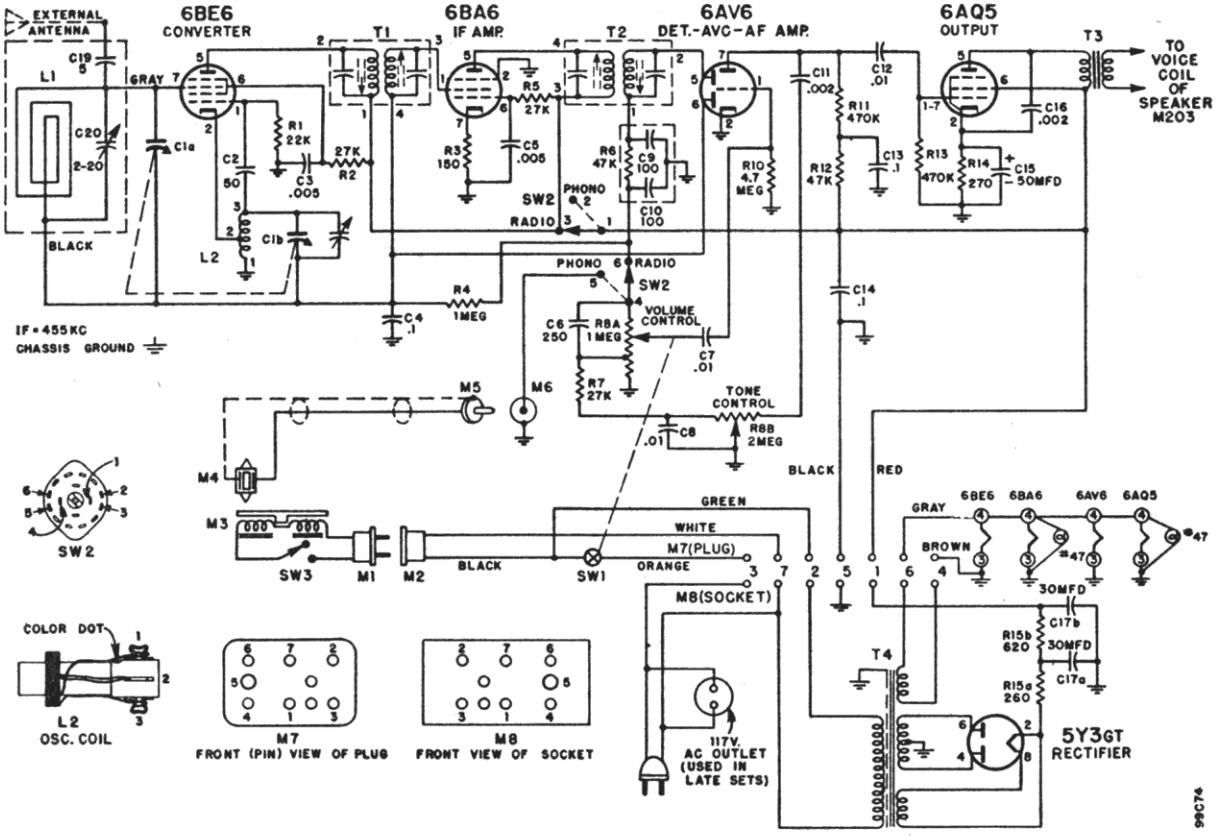


Figure 37. Schematic of 4L1 Radio.

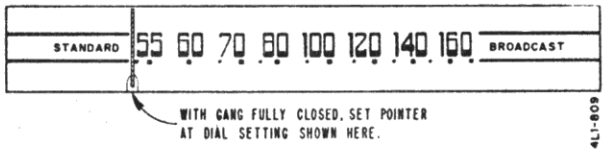


Figure 38. Pointer Setting.

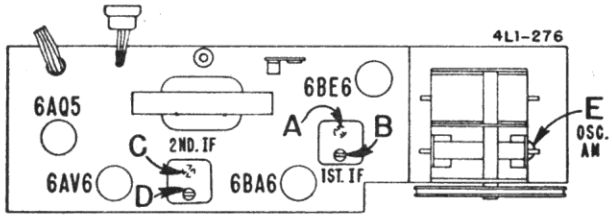


Figure 39. Radio Trimmer Locations.

RECORD CHANGERS: See Admiral Models RC-221, RC-222, Vol.20 Pages RCD.CH.20-1 through RCD.CH.20-8.

4L1 VOLTAGE DATA

- Readings taken from tube socket terminals to chassis.
- Switch in Radio position. Voltages marked with ▲ taken on Phono position.
- Measured on 117 volt AC line.
- Volume control minimum; gang closed.
- Voltages measured with vacuum tube voltmeter.

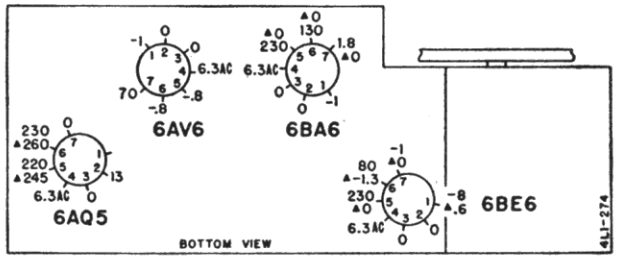


Figure 40. Voltage Chart for 4L1 Radio.

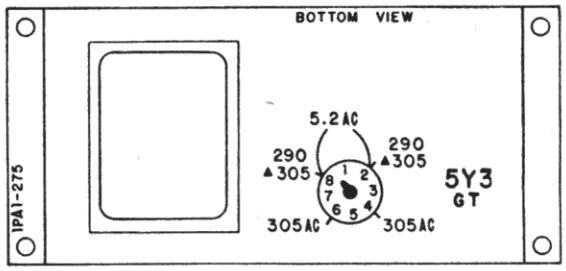


Figure 41. Voltage Chart for Radio Power Supply.

PARTS LIST

Electrical components have symbols according to "section" location on the schematics. For example: C204 is in the Audio Section, V303 is in the Video Section, T402 is in the Sweep Section. Order parts by part number and description from the nearest Admiral distributor.

20X1, 20Y1, 4L1 CHASSIS PARTS

RESISTORS

Sym.	Description	Part No.
R1	22,000 ohms, ½ watt	60B 8-223
R2	27,000 ohms, 1 watt	60B 14-273
R3	150 ohms, ½ watt	60B 8-151
R4	1 Megohm, ½ watt	60B 8-105
R5	27,000 ohms, 1 watt	60B 14-273
†R6	47,000 ohms, ½ watt	
R7	27,000 ohms, ½ watt	60B 8-273
R8A	1 Megohm, Volume } Dual Control	75B 11-11
R8B	2 Megohm, Tone } Dual Control	75B 11-11
R10	4.7 Megohm, ½ watt	60B 8-475
R11	470,000 ohms, ½ watt	60B 8-474
R12	47,000 ohms, ½ watt	60B 8-473
R13	470,000 ohms, ½ watt	60B 8-474
R14	270 ohms, 2 watt	60B 20-271
R15A	260 ohms } 5 watt, Tapped Candohm	61A 5-5
R15B	620 ohms } 5 watt, Tapped Candohm	61A 5-5
*R101	3,900 ohms, ½ watt	98A 45-16
R102	47,000 ohms, ½ watt	98A 45-17
R103	10,000 ohms, ½ watt	98A 45-18
R104	2,200 ohms, ½ watt	98A 45-19
R105	4,700 ohms, ½ watt	98A 45-20
R106	220,000 ohms, ½ watt	98A 45-21
R107	10,000 ohms, ½ watt	98A 45-18
*R108	4,700 ohms, ½ watt	98A 45-20
R109	15,000 ohms, ½ watt	98A 45-67
R201	1 megohm, ½ watt	60B 8-105
R202	1,000 ohms, ½ watt	60B 8-102
R203	390 ohms, ½ watt	60B 8-391
R204	10,000 ohms, ½ watt, 5%	60B 7-103
R205	10,000 ohms, ½ watt, 5%	60B 7-103
R206	33,000 ohms, ½ watt	60B 8-333
R207A	250,000 ohms (Volume) } Dual Pot.	75B 12-5
R207B	1350 ohms (Focus) } Dual Pot.	75B 12-5
	Before replacing, see Run 10, 11 under "Production Changes".	
R208	4.7 megohms, ½ watt	60B 8-475
R209	470,000 ohms, ½ watt	60B 8-474
R210	680,000 ohms, 5%, ½ watt	60B 7-684
R211	820,000 ohms, 5%, ½ watt	60B 7-824
	See Run 2 under "Production Changes".	
R212	820 ohms, 2 watt	60B 20-821
R301	100,000 ohms, ½ watt	60B 8-104
R302	1,000 ohms, ½ watt	60B 8-102
R303	10,000 ohms, 5%, ½ watt	60B 7-103
R304	82 ohms, ½ w. (carbon res. only)	60B 28-31
R305	1,000 ohms, ½ watt	60B 8-102
R306	18,000 ohms, ½ watt	60B 8-183
R307	82 ohms, ½ w. (carbon res. only)	60B 28-31
R308	10,000 ohms, 5%, ½ watt	60B 7-103
R309	1,000 ohms, ½ watt	60B 8-102
R310	150 ohms, ½ watt	60B 8-151
R312	560,000 ohms, ½ watt	60B 8-564
R315	47,000 ohms, ½ watt	60B 8-473
R316	4,700 ohms, 5%, ½ watt	60B 7-472
R317A	2,000 ohms (Contrast) } Dual Pot.	75B 11-10
R317B	100,000 ohms (Bright.) } Dual Pot.	75B 11-10
	See Run 3 under "Production Changes."	
R319	5,600 ohms, 1 watt	60B 14-562
R320	100,000 ohms, ½ watt	60B 8-104
R321	10,000 ohms	Part of L305
R322	22,000 ohms	Part of L303
R323	470,000 ohms, ½ watt	60B 8-474

Continued from preceding column

Sym.	Description	Part No.
R324	470,000 ohms, ½ watt	60B 8-474
R325	33,000 ohms	Part of L301
R326	10,000 ohms, 5%, ½ watt	60B 7-103
R327	270,000 ohms, ½ watt	60B 8-274
R328	1.2 megohms, ½ watt	60B 8-125
R329	1,000 ohms, ½ watt	60B 8-102
R401	2.2 megohms, ½ watt	60B 8-225
R402	47,000 ohms, ½ watt	60B 8-473
R403	270,000 ohms, ½ watt	60B 8-274
R404	15,000 ohms, ½ watt	60B 8-153
R405	270,000 ohms, ½ watt	60B 8-274
R406	1 megohm, ½ watt	60B 8-105
R407	22,000 ohms, 1 watt	60B 14-223
R408	15,000 ohms, ½ watt	60B 8-153
R409	22,000 ohms, ½ watt	60B 8-223
R410	8,200 ohms, ½ watt	60B 8-822
R411	8,200 ohms, ½ watt	60B 8-822
R412	1.2 megohms, ½ watt	60B 8-125
R416	2.2 megohms, ½ watt	60B 8-225
R417	2.5 megohms, Pot. (Height)	75A 13-3
	Before replacing, see Run 7 under "Production Changes".	
R418	2.2 megohms, ½ watt	60B 8-225
R419	3,000 ohms Pot. (Vert. Lin. Cont.)	75A 13-7
R420	470 ohms, ½ watt	60B 8-471
R421	560 ohms, ½ watt	60B 8-561
R422	560 ohms, ½ watt	60B 8-561
R423	8,200 ohms, ½ watt	60B 8-822
R424	820,000 ohms, ½ watt	60B 8-824
R425	220,000 ohms, ½ watt	60B 8-224
	See Run 4 under "Production Changes".	
R426	150,000 ohms, ½ watt	60B 8-154
R427	100,000 ohms, ½ watt	60B 8-104
R428	2.7 megohms, ½ watt	60B 8-275
R429	8,200 ohms, ½ watt	60B 8-822
R430	68,000 ohms, ½ watt	60B 8-683
R431	22,000 ohms, ½ watt	60B 8-223
R432A	50,000 ohms (Hor. Hold) } Dual Pot.	75B 11-9
R432B	1.5 megohms (Vert. Hold) } Dual Pot.	75B 11-9
	Before replacing, see Run 6 under Production Changes".	
R433	75,000 ohms, 5%, ½ watt	60B 7-753
R434	120,000 ohms, ½ watt	60B 8-124
R435	120,000 ohms, 1 watt	60B 14-124
R436	470,000 ohms, ½ watt	60B 8-474
R437	47 ohms, ½ watt	60B 8-470
R438	82 ohms, 2 watt	60B 20-820
R439	100 ohms, ½ watt	60B 8-101
R440	8,200 ohms, 2 watt	60B 20-822
R441	1,500 ohms, 1 watt	60B 14-152
R442	3.3 ohms, ½ watt	60B 28-10
R443	560,000 ohms, ½ watt	60B 8-564
R444	470,000 ohms, ½ watt	60B 8-474
R446	750 ohms, 7.5 w. (Wire wound)	61A 1-17
	Before replacing, see Run 10, 11 under "Production Changes".	
R447	3,900 ohms, ½ watt	60B 8-392
R448	150 ohms, 1 watt	60B 14-151
R449	750 ohms, 7.5 watt	61A 1-17
R450	Focus Control (See R207B)	
	Before replacing, see Run 10, 11 under "Production Changes".	

† Part of encased Diode Filter Unit 63A3-1. This unit consists of R6, C9, C10 (see schematic).

* To secure proper high frequency characteristics, order exact part from Admiral distributor or use IRC metalized resistor only.

CHASSIS PARTS (Cont'd)

CONDENSERS

Sym.	Description	Part No.
C1A C1B	0-420 mmfd. 0-108 mmfd. Gang (Note: Dial drum spot-welded to gang.)	68B 32
C2	50 mmfd, Ceramic	65B 6-4
C3	.005 mfd. min, Ceramic	65A 10-1
C4	.1 mfd, 200 volt, Paper	64B 5-30
C5	.005 mfd. min, Ceramic	65A 10-1
C6	250 mmfd, Ceramic	65B 6-5
C7	.01 mfd, 400 volt Paper	64B 5-25
C8	.01 mfd, 400 volt Paper	64B 5-25
†C9	100 mmfd, Ceramic	
†C10	100 mmfd, Ceramic	
C11	.002 mfd, 600 volt, Paper	64B 5-9
C12	.01 mfd, 400 volt, Paper	64B 5-25
C13	.1 mfd, 400 volt, Paper	64B 5-20
C14	.1 mfd, 400 volt, Paper	64B 5-20
C15	50 mfd, 25 volt, Electrolytic	67A 4-7
C16	.002 mfd, 600 volt, Paper	64B 5-14
C17A C17B	30 mfd, 350 volt 30 mfd. 350 volt Electrolytic	67C 6-22
C19	5 mmfd., Mica	65B 1-62
C20	2-20 mmfd., Trimmer	66B 8-5
C101	5 mmfd., ±.5 mmfd, Zero Temp. Coeff.	98A 45-22
C102	.5 to 3 mmfd, Ceramic Trimmer	98A 45-87
C103	.001 mfd. min., Ceramic	98A 45-24
C104	.5 to 3 mmfd, Ceramic Trimmer	98A 45-23
C105	120 mmfd, 5%, Ceramic, —750 Temp. Coeff.	98A 45-25
C106	100 mmfd, Cer, —750 Temp. Coeff.	98A 45-26
C107	.5 to 3 mmfd, Ceramic Trimmer	98A 45-23
C108	20 mmfd, Cer, Zero Temp. Coeff.	98A 45-27
C109	10 mmfd, 5%, Cer, —750 Temp. Coeff.	98A 45-79
C110	.5 to 3 mmfd, Ceramic Trimmer	98A 45-23
C111	3 to 5 mmfd, Sharp Tuning	Part of M104
C112	.001 mfd. min., Ceramic	98A 45-24
C113	.001 mfd. min., Ceramic	98A 45-24
C114	10 mmfd, 5%, Cer, Zero Temp. Coeff.	98A 45-64
C115	120 mmfd, 10%, Silver Mica	98A 45-78
C201	75 mmfd. —150 Temp. Coeff, Silver Ceramic	98A 47-1
C202	120 mmfd, 500 V, Ceramic	65B 6-66
C203	180 mmfd, ±5%, ±.00003 Temp. Coeff., Ceramic	65B 6-59
C204	4 mfd, 50 V, Electrolytic	67A 4-4
C205	500 mmfd, 500 V, Ceramic	65B 6-6
C206	.002 mfd, 600 V, Paper See "Service Hints" on page 35.	64B 5-14
C207	.005 mfd, 600 V, Paper	64B 5-12
C208	.01 mfd, 400 V, Paper	64B 5-25
C209A C209C C209D	60 mfd, 250 V. 20 mfd, 450 V. 100 mfd, 25 V. 3 section Electrolytic	67C 15-11
C209A C209B C209C C209D	60 mfd, 150 V. 20 mfd, 450 V. 20 mfd, 450 V. 100 mfd, 25 V. 4 section Electrolytic	67C 15-9
C211	40 mfd, 250 V., Electrolytic	67A 19-1
C212	.005 mfd. min., 450 V., Ceramic	65A 10-1
C213A C213B	40 mfd, 250 V. 40 mfd, 250 V. Dual Electrolytic Before replacing, see Run 5 under "Production Changes".	67C 15-52
C214	.05 mfd, 400 V., Paper See Run 8 under "Production Changes".	64B 5-22
C215	.005 mfd. min., 450 V, Ceramic	65A 10-1
C302	.001 mfd, min., 500 V, Ceramic	65B 6-41
C303	.001 mfd. min., 500 V, Ceramic	65B 6-41
C304	.001 mfd. min., 500 V, Ceramic	65B 6-41
C305	.001 mfd. min., 500 V, Ceramic	65B 6-41
C306	.005 mfd. 600 V, Paper	64B 5-12
C307	.005 mfd. min., 450 V, Ceramic	65A 10-1
C308	.25 mfd, 200 V, Paper	64B 5-28
C310	5 mmfd, 500 V, Ceramic	65B 6-61
C311	5 mmfd, 500 V, Ceramic	65B 6-61
C312	.005 mfd. min., 450 V, Ceramic	65A 10-1
C313	2 mmfd, 500 V, Ceramic, ±.5 mmfd, Zero Temp. Coeff.	65B 6-58
C314	.01 mfd, 600 V, Paper See Run 12, 13 under "Production Changes".	64B 5-10
C315	.01 mfd, 600 V, Paper	64B 5-10
C316	250 mmfd, Ceramic See Run 12, 13 under "Production Changes".	65B 6-5
C317	.1 mfd, 400 V, Paper	64B 5-20
C318	.001 mfd. min., 500 V, Ceramic	65B 6-41
C319	.005 mfd. min., 450 V, Ceramic	65A 10-1
C320	.05 mfd, 400 V, Paper	64B 5-22
C321	.1 mfd, 200 V, Paper See Run 3 under "Production Changes".	64B 5-30
C401	.05 mfd, 600 V, Paper	64B 5-7
C402	.01 mfd, 600 V, Paper	65A 13-3
C403	180 mmfd, ±5%, ±.00003 Temp. Coeff., Ceramic	65B 6-59
C404	.002 mfd, 600 V, Paper	64B 5-14
C405	.002 mfd, 600 V, Paper	64B 5-14
C406	4,700 mmfd, 300 V, Mica	65B 21-472
C407	.006 mfd. 300 V., Mica Before replacing, see Run 6 under "Production Changes".	65B 21-602
C408	.05 mfd, 600 V, Paper	64B 5-7
C409	.1 mfd, 400 V, Paper	64B 5-20
C410	100 mfd, 25 V, Elect.	See C209D
C411	20 mfd, 450 V, Elect.	See C209C
C412A C412B	10-160 mmfd. 40-370 mmfd. Dual Trimmer	66A 32-1
C413	.002 mfd, 600 V, Paper	65A 13-4
C414	.02 mfd, 400 V, Paper	64B 5-24
C415	.2 mfd, 200 V, Paper	64B 5-29
C416	180 mmfd, 5%, Cer, —300 Temp. Coeff.	65B 6-59
C417	.05 mfd, 400 V, Paper	64B 5-22
C418	.01 mfd, 400 V, 10%, Paper	64B 5-25
C419	.002 mfd, 600 V, 10%, Paper	64B 5-14
C420	470 mmfd, Mica	65B 21-471
C422	.2 mfd, 200 V, Paper	64B 5-29
C423	.05 mfd, 600 V., Paper Before replacing, see Run 7 under "Production Changes".	64B 5-7
C424	.035 mfd, 600 V, Paper	64A 2-5
C425	.05 mfd, 400 V, Paper	64B 5-22
C426	500 mmfd, 10,000 V, Ceramic	65A 11-2
C427	7.5 mmfd, 1,500 V, Ceramic	65A 23-3
C428	.5 mfd, 200 V, Paper	64B 6-27
C429	56 mmfd, Mica (used with 94B24-1 or 94B2-1 Deflection Yoke) 39 mmfd, Mica (used with 94B24-2 or 94B2-2 Deflection Yoke)	65B 1-54 65B 1-55
C431	Electrolytic	See C501C
C501A C501B C501C	80 mfd, 450 V. 40 mfd, 450 V. 20 mfd, 450 V. Electrolytic	67C 15-10

PICTURE TUBES

V306	10" Picture Tube (20X1)	10BP4
	12" Picture Tube (20Y1)	12LP4

MISCELLANEOUS PARTS for TELEVISION CHASSIS

M201	Socket, Speaker	87A 6-3
M202	Plug, Speaker	88B 22-1
	Cover and Insulator (for M202)	88B 22-3
M203	Speaker and Output Transformer	
	5" Electrodynamic for 20X11, 20X12, 20X135, 20X136, 20X137	78B 50-1
	6" Electrodynamic for 20X121, 20X122	78B 51-1
	6" Electrodynamic for 20X145, 20X146, 20X147	78B 51-1
	6" Electrodynamic for 24A125AN	78B 51-1
	10" PM for 24X15, 24X15S, 24X16, 24X16S, 24X17S	78B 52-1

† Part of encased Diode Filter Unit 63A3-1. This unit consists of R6, C9, C10 (see schematic).

Spring
- Cone (keeps pressure on fibre disc) 19A 10-4
- Grounding (Picture tube to chassis) 19A 23

Washer, Spring (⅝" OD x ¼" ID) 4A 5-16-0

Webbing, Picture Tube Mtg. Strap
- 30" length (for 10" sets) 50A 3-1
- 36" length (for 12" sets) 50A 3-3

COILS

L1	Antenna, AM Loop (includes C19, C20)	69C 100-1
L2	Coil, Oscillator	69A 52-1

Individual Channel Coils For TV Tuner 94C21-1

Coils used in the 94C21-1 Tuner are stamped 2, 3, 4, etc.

**L101	Antenna Coil		For 94C21-1 tuner only
	for Channel #2	98A 58-2	
	for Channel #3	98A 58-3	
	for Channel #4	98A 58-4	
	for Channel #5	98A 58-5	
	for Channel #6	98A 58-6	
	for Channel #7	98A 58-7	
	for Channel #8	98A 58-8	
	for Channel #9	98A 58-9	
	for Channel #10	98A 58-10	
	for Channel #11	98A 58-11	
	for Channel #12	98A 58-12	
	for Channel #13	98A 58-13	
**L102	Mixer—Oscillator Coil		
	for Channel #2	98A 59-2	
	for Channel #3	98A 59-3	
	for Channel #4	98A 59-4	
	for Channel #5	98A 59-5	
	for Channel #6	98A 59-6	
	for Channel #7	98A 59-7	
	for Channel #8	98A 59-8	
	for Channel #9	98A 59-9	
	for Channel #10	98A 59-10	
	for Channel #11	98A 59-11	
	for Channel #12	98A 59-12	
	for Channel #13	98A 59-13	

Individual Channel Coils For TV Tuner 94C21-2

Coils used in the 94C21-2 Tuner are stamped 2F, 3F, 4F, etc.

**L101	Antenna Coil		For 94C21-2 tuner only
	for Channel #2	98A 62-2	
	for Channel #3	98A 62-3	
	for Channel #4	98A 62-4	
	for Channel #5	98A 62-5	
	for Channel #6	98A 62-6	
	for Channel #7	98A 62-7	
	for Channel #8	98A 62-8	
	for Channel #9	98A 62-9	
	for Channel #10	98A 62-10	
	for Channel #11	98A 62-11	
	for Channel #12	98A 62-12	
	for Channel #13	98A 62-13	
**L102	Mixer—Oscillator Coil		
	for Channel #2	98A 63-2	
	for Channel #3	98A 63-3	
	for Channel #4	98A 63-4	
	for Channel #5	98A 63-5	
	for Channel #6	98A 63-6	
	for Channel #7	98A 63-7	
	for Channel #8	98A 63-8	
	for Channel #9	98A 63-9	
	for Channel #10	98A 63-10	
	for Channel #11	98A 63-11	
	for Channel #12	98A 63-12	
	for Channel #13	98A 63-13	

** Before inserting replacement coil L101 or L102 in turret, check to see that teeth at inner end of coils fit together when fitted in detent plate at center of turret. If necessary, file teeth slightly.

COILS, TRANSFORMERS, ETC.

Sym.	Description	Part No.
L103	Choke, Filament RF	98A 45-13
L104	Choke, Filament Oscillator	98A 45-14
L105	Coil, Mixer Plate	98A 45-77
L201	Coil, Sound IF	72A 60-1
L301	Video Series Peaking Coil (Wound on R325)	73A 5-6
L302	Video Shunt Peaking Coil	73A 5-7
L303	Video Series Peaking Coil (Wound on R322)	73A 5-8
L304	Video Shunt Peaking Coil (Wound on R321)	73A 5-9
L305	Choke, Filament	73A 2-5
L306	Choke, Filament	73A 2-5
L402	Horizontal Linearity Control	94A 3
L403	Width Control	94A 4-1
L404	Coil, Focus	
	for sets without picture positioning lever	69B 35-2
	for sets with picture positioning lever	69B 114-2
L405	Coil, Horizontal Lock	Part of T404
L501	In Television only models Speaker Field Coil	Part of M203
	In combination only models Choke, Filter	74A 12
T1	Transformer, 1st IF	72B 28-7
T2	Transformer, 2nd IF	72B 28-17
T3	Transformer, Speaker Output	79A 22
T4	Transformer, Power	80B 1
T201	Transformer, Ratio Detector	72B 68
T202	Transformer, Speaker Output	79A 27
T301	Coil, Video IF	72A 83-3
T302	Coil, Video IF	72A 83-3
T303	Coil, Video IF	72A 83-3
T401	Transformer, Vert. Blocking Osc.	79A 18-1
T402	Transformer, Vertical Output	79B 24-1
T403A T403B	Horiz.-Vertical Deflection Yoke	94B 24-2
	See "Production Changes" on page 33.	
T404	Transformer, Horiz. Blocking Oscillator (includes L405)	69B 110
T405	Horizontal Output Transformer	79C 28-1
	See "Production Changes" on page 33.	
T501	Transformer, Power (includes rectifier tube socket)	80B 19

Picture Tube Mounting Parts For Sets WITHOUT Picture Positioning Lever

L404	Coil, Focus	69B 35-2
T403	Coil, Deflection Yoke	94B 24-2
Bracket		
	for mounting yoke	15A 252
	yoke and focus coil support base	
	for 10" sets	15A 240-1
	for 12" sets	15C 403-1
Clamp, Wire (webbing tension takeup)		19A 61
Clamp, Metal (clamps webbing to chassis)		15A 526
Insulator Strip, Fibre		
	support for 2nd anode lead	32A 74
	Cover for deflection yoke	32A 75
Ion Trap		94B 6
Plate, Picture tube front bumper		15A 540
Rubber Collar (used inside focus coil)		12A 14
Rubber Insert, 1" Diameter (front bottom support for picture tube in late sets)		12A 16-1
Rubber Ring, 3½" OD (for front of yoke)		12B 34
Rubber Strip, Adhesive		
	Size (3/16"x⅜"x2") for bumper plate	12A 5-6
	Size (⅜"x1"x1½") front bottom support for picture tube in early sets	12A 5-11

CHASSIS PARTS (Cont'd)

Screw, Focus Coil Adjustment (10/32x1½") ... 100-1500-C2-71
Screw, Wing (deflection yoke adjustment) 1A 101-1-71
Spring
  Focus Coil Mounting 19A 22
  Grounding (Picture tube to chassis) 19A 23
Washer, Cup (⅝" OD x $\frac{3}{16}$" ID) 4A 7-6-71
Webbing, Picture Tube Mtg. Strap
  30" length (for 10" sets) 50A 3-1
  36" length (for 12" sets) 50A 3-3

MISCELLANEOUS PARTS FOR TV TUNER 94C21-1

Order only 94C21-1 parts from this list. To identify a 94C21-1 or 94C21-2 tuner, see figures 78 and 80.

M100 Tuner, Television (complete) 94C 21-1
M101 Roller, Detent (⅜" diameter) 98A 45-50
M102 Spring, Detent ($1\frac{1}{16}$" long) 98A 45-45
M103 Contact Plate and Bracket Assy. 98A 45-30
M104 Shaft Shell & Rotor Assembly (Sharp Tuning) (with 1⅞" long brass shaft shell) 98A 45-76
M105 Spring, Sharp Tuning Rotor Contact (Flat bronze ⅞"x½") 98A 45-60
M106 Spring, Front and Rear Turret Shaft (Wire 2¾" long) 98A 45-44
M107 Bracket, Sharp Tuning Rotor Retaining .. 98A 45-61
M108 Spring, Detent Plate Grounding 98A 45-74
M109 Shield, Tube (Slotted; for 6J6) 98A 45-73
M110 Shield, Tube (Plain; for 6AG5) 87A 7-7
M111 Turret and Shaft Assembly (less coils) (3¼" shaft and ⅛" detent depression) . 98A 45-75
M112 Spring, Slug Retaining (Osc. coil) 98A 45-52
M113 Washer, Fibre Spacer (¼" IDx½" OD) .. 98A 45-63
M114 Nut, Locking Spring (for trimmers) 98A 45-31
M115 Screw, Trimmer (4-36x⅝") 98A 45-33
Screw, Bracket Mtg. (6-32x¼") 98A 45-62
M205 Antenna, Built-In TV (Roto-Scope)
  for 20X135, 20X136, 20X137 ..... A3029
  for 20X11, 20X12, 20X121, 20X122, 24X15, 24X15S, 24X16, 24X16S, 24X17S A3060
  for 20X145, 20X146, 20X147 ..... A3072
  for 24A125AN A3029
M401 Fuse, Pigtail (¼ amp.—250 V.) 84A 7-1
M501 Line Cord (includes plug and interlock socket, less mtg. rivets) 89A 22-1
Rivet, Shoulder (for mounting line cord) . 6A 4-6-0
M502 Interlock Plug 89A 22-2
Bracket
  Coil Protector (for T404) 15A 549
  Coil Support (for L403 & L402) 15A 550
  (not used in early production)
Connector, Male (for 2nd anode) 88A 16-4
Corona Ring 19A 62
Plate, Channel Selector Shaft Bearing (Bakelite) 32A 111-1
Used in early sets. Before replacing, see "Sharp Tuning Control Difficult to Turn" on page 35.
Plate, IF and Video Inspection 15B 542
Plate, Tuner Inspection 32A 117
Screen, Metal (Chassis bottom) 16D 15
Shield, Tube (Miniature) 87A 7-7
Shield Base, Tube (for 87A7-7) 87A 7-6
Socket, Tube
  Miniature (7 pin) 87A 3-7
  Miniature (9 pin) plain 87A 25-1
  Miniature (9 pin) Mica filled for 1X2 ..... 87A 25-5
  Octal, Plain 87A 5-7
  Octal, Shock Mounted 87A 34-1
  Picture Tube 87A 31-4
Spacer, Brass (for mounting C426) 29A 1-34
Spring, Grounding (Picture tube to chassis) 19A 23
Terminal Board, Antenna 10A 6-2
Tuner, Complete TV 94C 21-2

Picture Tube Mounting Parts For Sets WITH Picture Positioning Lever

L404 Coil, Focus 69B 114-2
T403 Coil, Deflection Yoke 94B 24-2
Bracket
  for mounting yoke and picture tube A3079
  for mounting focus coil 15A 558
  yoke and focus coil support base
    for 10" sets 15C 561
    for 12" sets 15C 562
Clamp, Wire (webbing tension takeup) 19A 61
Clamp, Metal (clamps webbing to chassis) 15A 526
Disc, Fibre (3¼" diameter) 32A 125
Insulator Strip, Fibre (support for 2nd anode lead) 32A 74
Ion Trap 94B 6
Lever, Adjustable Picture Centering 15A 563
Nut, 8/32 Hex 2A 1-15-71
Plate
  Picture tube front bumper 15A 540
  focus coil mounting (3⅝"x⅝") 15A 557
Rubber Collar (used inside focus coil) 12A 14
Rubber Insert (front bottom support for picture tube)
  for 10" picture tube (1½" in diameter) 12A 16
  for 12" picture tube (1" in diameter) 12A 16-1
Rubber Ring, 3½" OD (for front of yoke) 12B 34
Rubber Strip, Adhesive ($\frac{3}{16}$"x⅜"x2") 12A 5-6
Screw (10/32x⅜ hex head MS) 1A 109-29-71
Spacer Sleeve 29A 2-13

MISCELLANEOUS PARTS FOR TV TUNER 94C21-2

Sym.	Description	Part No.

Order only 94C21-2 parts from this list. To identify a 94C21-1 or 94C21-2 tuner, see figures 78 and 80.

M104 Shaft Shell & Rotor, Sharp Tuning (with 1⅞" long brass shaft shell) 98A 45-76
M107 Bracket, Sharp Tuning Rotor Retaining .. 98A 45-61
M108 Spring, Detent Plate Grounding 98A 45-74
M109 Shield, Tube (Slotted; for 6J6) 98A 45-73
M110 Shield, Tube (Plain; for 6AG5) 87A 7-7
M112 Spring, Slug Retaining (Osc. coil) 98A 45-52
M113 Washer, Fibre Spacer (¼" IDx½" OD) . 98A 45-63
M114 Nut, Locking Spring (for trimmers) 98A 45-31
M115 Screw, Trimmer (4-36x⅝") 98A 45-33
M116 Screw, Bracket Mounting (6-32x¼") 98A 45-62
M117 Slug, Brass Tuning 98A 45-88
M118 Stator Plate (ungrounded); Silver with Ceramic Insulator (includes mounting bracket) for Sharp Tuning C111.
M120 Tuner, Television (complete) 94C 21-2
M121 Roller, Detent (⅜" dia., $\frac{3}{32}$" dia. bearing) 98A 45-82
M122 Spring, Detent ($2\frac{5}{16}$" long) 98A 45-81
M123 Contact Plate and Bracket Assembly (with wiping contacts) 98A 45-84
M124 Spring, Sharp Tuning Rotor Contact (Flat bronze $1\frac{1}{16}$"x½") 98A 45-83
M125 Spring, Front and Rear Turret Shaft (Wire 2¾" long, $\frac{3}{64}$" dia.) 98A 45-85
M126 Turret and Shaft Assembly (less coils) (3¼" shaft and $\frac{3}{16}$" rounded detent depression) 98A 45-89

MISCELLANEOUS PARTS FOR 4L1 RADIO CHASSIS AND POWER SUPPLY

SW1 Switch, On-Off ..... Part of R8A
SW2 Switch, Radio-Phono 77A 31

M2 Socket, Phono Motor 89A 6-1
M6 Socket, Phono Input 88A 1
M7 Plug, Cable Connector (9 pin rect.) 88A 20-11
Cover and Insulator (for 88A 20-11 plug) .. 88A 20-6
Cable, (7 wire) including 88A 20-11 plug and 88A 20-6 cover) AB204
M8 Socket, Power Supply Cable (14 contact) .. 88A 20-2
Bracket, Mounting
  for Off-Volume and Tone control 15A 385
  for Radio-Phono Switch 15A 409
  for Tuning Sleeve 15A 394
Clip, IF Transformer Mtg. 72B 28-10
Cover Assembly, Chassis A1880
Dial Back and Bracket Assembly A1881
Dial Cord (40" approximately) 50A 1-3
Dial Scale 22B 21

Escutcheon, Radio 23D 39-4
Grommet, Gang Mounting 12A 1-2
Hex Nut, Switch Retaining 2A 2-9-71
Line Cord 89A 1-1
Lockwasher, Oscillator Coil & Gang (#6 I.T.) .. 3B 1-25-71
Pilot Light, #47 Mazda 81A 1-8
Pointer, Dial 25A 33
Shaft, Tuning 28A 48
Snap Button (for mtg. dial scale) 13A 1-1-71
Socket Tube
  7 pin (for 6BA6, 6AU6, 6AQ5) 87A 3-7
  7 pin (for 6BE6) 87A 24-3
  8 pin (for 5Y3GT) 87A 5-1
Socket, Pilot Light (includes 12" lead) 82A 8-6
Socket, Power Cable (14 contact) 88A 20-8
Socket, AC Power Outlet 87A 21-1
  (Used in late sets.)
Spacer Sleeve (for gang mounting) 29A 2-1-71
Spacer Sleeve (3¼" long, for mounting
  phono-radio switch) 29A 3-15
Spring, Dial Cord Tension 19B 1-3
Spring, Tube Retainer (for 6AQ5) 19A 56-2
Washer, Vellutex (Oscillator coil mtg.) 5A 1-21

PHONOGRAPH PARTS

Check the changer model label and see Record Changer Service Manual for complete Record Changer parts list. See title page for model numbers of Record Changers used.

M1 Plug, AC Phono Motor 88A 8-1
M2 Socket, Phono Motor 89A 6-1
M3 Motor, 3 Speed 407B 17
M4 Cartridge, Dual (includes needles) 409A 11
  Needle, Long Play 98A 15-6
  Needle, 78 RPM 98A 15-7
M5 Cable, Shielded (includes plug) 413A 11-1
M6 Socket, Phono Input 88A 1
Belt, Rubber Drive 406A 20
Centerpost, Record
  for 10" and 12" records G400B 311
  for 7" 33 RPM records G400B 310
  for 7" 45 RPM records G400B 329
Centerpost Mounting Assembly (for holding
  extra centerposts) A2002
Idler Wheel Assembly (includes tire) G400A 279
Needle Retaining Nut 98A 54-2
Shoulder Eye Bolt (for adjusting phono
  tilt-out spring) 1A 87-1
Tilt-Out Hinge Assembly
  for Left side (facing front) AC183-1
  for Right side (facing front) AC183-2
Tilt-Out Spring (2⅛" long) 19A 15-1
Tilt-Out Tie Bar Spring (8½" long) 19A 59
Tilt-Out Tie Rod (13⅞" long) 28A 22-1
Touch-Up Paint (Coppertone Hammer) 98A 54-3

CABINET PARTS

CABINET PARTS for 20X11, 20X12, 20X121, 20X122

(The above models may have suffix letter "N".)

Antenna, Built-in TV
  for 20X11, 20X12 ..... A3060
  for 20X121, 20X122 ..... A3029
Back, Cabinet (perforated)
  for 20X11, 20X12 ..... 16C 21
  for 20X121, 20X122 ..... 16D 14
Baffle Board and Speaker Mtg.
  for 20X11, 20X12 ..... A3015
  for 20X121, 20X122 ..... A2032
Cabinet, Plastic
  for 20X11 (Ebony) 34E 30-1
  for 20X12 (Mahogany) 34E 30-2
  for 20X121 (Ebony) 34E 24-1
  for 20X122 (Mahogany) 34E 24-2
Bumper, Rubber (20X11, 20X12)
  Black Rubber (used in early sets) 12B 3-8
  Red Rubber, with Spacer (used in late sets) .. 12B 3-9
Carton and Fillers
  for 20X11, 20X12 ..... 44B 152
  for 20X121, 20X122 ..... 44B 143
Escutcheon, Channel (less spring) 23B 43-2
Gasket, Sponge Rubber
  with cardboard backing for picture
    window 23D50 or 23D50-1 ..... 98A 61-1
  §for mounting to plastic picture frame
    23D50-6 or 23D50-1 ..... 12A 32-3
Grille Cloth
  for 20X11, 20X12 ..... 36B 3-20
  for 20X121 ..... 36B 3-14
  for 20X122 ..... 36B 3-15
Grommet, Speaker Mounting 12A 2-6
§Frame, Plastic Picture (used only with
  23D50-5 Plexiglas picture window)
    Green, for 20X11, 20X12 ..... 23D 50-6
    Gold, for 20X121, 20X122 ..... 23D 50-7
Knobs, Television Tuning
  for Ebony (20X11 or 20X121)
    'Channel' (Ebony inner knob) 33C 28-29
    'Horizontal, Contrast, Off-Volume'
      (Ebony inner knob) 33C 28-30
    'Sharp Tuning' (Brass outer knob) 33C 28-35
    'Vertical, Brightness, Focus'
      (Brass outer knob) 33C 28-36
  for Mahogany (20X12 or 20X122)
    'Channel' Maroon inner knob) 33C 28-19
    'Horizontal, Contrast and Off-Volume'
      (Maroon inner knob) 33C 28-20
    'Sharp Tuning' (Brass outer knob) 33C 28-35
    'Vertical, Brightness, Focus'
      (Brass outer knob) 33C 28-36
Lockwasher, Escutcheon Mtg. (#6 E.T.) 3B 1-3-71
Lockwasher, Speaker Mtg. (#8 I.T.) 3B 1-26-71
Ring, Channel Knob Compression 18A 5-3
Screw, Chassis Mtg. (¼-20x1" Hex Hd.) 1A 67-43-71
Screw, Picture Window Mtg. (6-32x⅜" Bd. Hd.
  M.S.) 65-375-C2-71
Spacer, Speaker Grommet (Metal) 29A 2-5-71
Speaker and Output Transformer
  5" Electro-dynamic (for 20X11, 20X12) 78B 50-1
  6" Electro-dynamic (for 20X121, 20X122) 78B 51-1
Speed Nut, Baffle Board Mounting
  (for 20X121, 20X122) 2B 10-26-59
Spring, Tuning Knob
  for 'Channel, Horizontal, Contrast,
    On-Off Volume' (inner knobs) 98A 44-1
  for 'Sharp Tuning' (outer knob) 98A 44-2
Spring, Channel Escutcheon Retaining 19A 48
Strip, Shelf Support (Metal 1/16"x14¾") 15B 457
Washer, Felt
  for 'Horizontal—Vertical, Contrast—
    Brightness, Off-Volume—Focus' knobs 5A 4-6
  for 'Channel—Sharp Tuning' knobs 5A 4-5
Washer, Fibre (used between Telev.
  tuning knobs) 5A 1-30
Window, Picture
  Plexiglas Sheet; used with separate
    picture frame 23D 50-5
  Molded Plastic, with picture frame
    molded to window
      with green frame for 20X11, 20X12 ..... 23D 50
      with gold frame for 20X121, 20X122 ..... 23D 50-1

CABINET PARTS FOR 20X135, 20X136, 20X137

Note: The above model numbers may contain the suffix letter "N".

Antenna, Built-In Roto-Scope A3029
Back, Cabinet (includes tube shield) A3027
Baffle Board Assembly (includes mtg. spring) .. A3015
‡Cabinet, Wood
  Walnut (20X135) 35E 109-1
  Mahogany (20X136) 35E 109-2
  Blond (20X137) 35E 109-3
Carton and Fillers 44B 157
Decal, Cabinet Lettering 98A 15-1

‡ Supplied only if old part cannot be repaired. When ordering, describe condition of old part in detail.
§ Use only rubber cement when mounting sponge rubber gasket.

CABINET PARTS (Cont'd)

Escutcheon, Television Channel (less mounting spring) 23B 43-2
Gasket, Sponge Rubber (includes chipboard back for picture window) 98A 61-2
Grille Cloth
for 20X135 and 20X136 (brown, 5½"x6½") .. 36B 3-22
for 20X137 (green, 5½"x6½") 36B 3-23
Hex Nut, Speaker to Baffle Mtg. (#8-32) 2A 2-14-71
Knob, Tuning
Channel (Maroon "I-shaped" knob) 33C 28-19
Horizontal, Contrast, Off-Volume (Maroon "I-shaped" knob) 33C 28-20
Sharp Tuning (Brass rim "O-shaped" knob) .. 33C 28-35
Vertical, Brightness, Focus (Brass rim "O-shaped" knob) 33C 28-36
Lockwasher, Chassis Mtg. (¼") 3B 1-29-71
Ring, Channel Knob Compression 18A 5-3
Screw, Chassis to Cabinet Mtg. 1A 67-44-71
Screw, Picture Tube Escutcheon to Cabinet Mtg. (#6 X ½" Rd. Hd. W.S.) 1A 7-24-71
Screw, Speaker to Baffle Board Mtg. (#8-¾) ... 1A 48-2-71
Sheet, Perforated Metal (11" x 8") 16A 2-1-71
Speaker, 5" Electro-dynamic (includes output transformer) 78B 50-1
Spring, Channel Escutcheon Retaining 19A 48
Spring Clip, Baffle Board Retaining 18A 12
Spring, Tuning Knob Tension
for Channel, Horizontal, Contrast, Off-Volume ("I-shaped" knob) 98A 44-1
for Sharp Tuning ("O-shaped" knob) 98A 44-2
Washer, Felt (Television)
for Horizontal-Vertical, Contrast-Brightness, Off-Volume-Focus knobs 5A 4-6
for Channel-Sharp Tuning knob 5A 4-5
Washer, Fibre (used between inner and outer television knobs) 5A 1-30
Window, Picture 23D 49

CABINET PARTS FOR 20X145, 20X146, 20X147

Note: The above model numbers may contain the suffix letter "N".
Antenna, Built-In Roto-Scope A3072
Back, Cabinet (includes tube shield) A3082
Backing, Picture Tube 43B 86
Bottom, Metal Cabinet 16A 21-1-70
‡Cabinet, Wood
Walnut (20X145) 35E 107-1
Mahogany (20X146) 35E 107-2
Blond (20X147) 35E 107-3
Carton and Fillers 44B 156
Decal, Cabinet Lettering 98A 15-1
Escutcheon, Bezel (fits between cabinet cutout and picture tube escutcheon) 23C 56
Escutcheon, Channel (less mtg. spring) 23B 43-2
Gasket, Sponge Rubber (includes chipboard backing for back of picture window) 98A 61-2
Grille, Plastic Woven
for 20X145, 20X146 ..... 35E 107-57
for 20X147 ..... 35E 107-58
Grommet, Speaker Mounting (use with spacer Grommet 29A2-5-71) 12A 2-6
Knobs, Tuning
Channel (Maroon "I-shaped" knob) 33C 28-19
Horizontal, Contrast, Off-Volume (Maroon "I-shaped" knob) 33C 28-20
Sharp Tuning (Brass rim "O-shaped" knob) .. 33C 28-35
Vertical, Brightness, Focus (Brass rim "O-shaped" knob) 33C 28-36
‡Leg, Cabinet (front)
for Walnut 35E 107-50
for Mahogany 35E 107-51
for Blond 35E 107-52
‡Leg, Cabinet (rear)
for Walnut 35E 107-53
for Mahogany 35E 107-54
for Blond 35E 107-55
Ring, Channel Knob Compression 18A 5-3
Spacer, Metal (for speaker mtg. grommet) 29A 2-5-71
Speaker, 6" Electro-dynamic (includes output transformer) 78B 51-1
Spring Clip, Channel Escutcheon 19A 48
Spring, Tuning Knob Tension
for Channel, Horizontal, Contrast, Off-Volume ("I-shaped" knob) 98A 44-1
for Sharp Tuning ("O-shaped" knob) 98A 44-2
Washer, Felt (Television)
for Horizontal-Vertical, Contrast-Brightness, Off-Volume-Focus knobs 5A 4-6
for Channel-Sharp Tuning knobs 5A 4-5
Washer, Fibre (used between inner and outer television knobs) 5A 1-30
Window, Picture 23D 49

CABINET PARTS for 24A125AN

Antenna, Built-In TV A3029
Back, Cabinet 16D 14
Bottom, Metal Cabinet 16A 2-1-70
Bracket, Plug Lock 15A 365
‡Cabinet, Walnut 35E 104-1
Carton and Fillers 44B 153
Clamp, Cable 11A 2-6
Decal, Cabinet Lettering 98A 15-1
Escutcheon, Channel (less spring) 23B 43-2
Gasket, Sponge Rubber (includes chipboard backing for back of picture window) 98A 61-1
Grille Cloth 36B 3-15
Grommet, Speaker Mounting 12A 2-6
Knobs, Tuning
'Sharp Tuning' (Brass rim outer knob) 33C 28-35
'Vertical,' 'Brightness,' 'Focus' (Brass rim outer knob) 33C 28-36
'Channel' (Maroon inner knob) 33C 28-19
'Horizontal,' 'Contrast,' 'On-Off-Volume' (Maroon inner knob) 33C 28-20
Medallion, Speaker Grille 37A 23-1
Ring, Channel Knob Compression 18A 5-3
Rubber Grommet (for shock mounting speaker, use with spacer sleeve 29A 2-5-71) 12A 2-6
Screw, Escutcheon Mtg. (#6x½ Phillips W.S.) .. 1A 7-24-47
Spacer, Fibre Cabinet Level (Kit of six) 98A 44-47
Spacer, Grommet (Metal) 29A 2-5-71
Speaker, 6" Electro-dynamic (includes output transformer) 78B 51-1
Spring Clip, Channel Escutcheon 19A 48
Spring, Tuning Knob
for 'Channel,' 'Horizontal,' 'Contrast,' 'On-Off-Volume' (inner knobs) 98A 44-1
for 'Sharp Tuning' (outer knob) 98A 44-2
Washer, Felt (Television)
for 'Horizontal—Vertical,' 'Contrast—Brightness,' 'Off-Volume Focus' knobs 5A 4-6
for 'Channel—Sharp Tuning' knobs 5A 4-5
Washer, Fibre (used between inner and outer television knobs) 5A 1-30
Window, Picture 23D 50

CABINET PARTS FOR 24X15, 24X16, 24X15S, 24X16S, 24X17S

Note: The above model numbers may contain the suffix letter "N".
Antenna, Built-In Roto-Scope A3060
Back, Cabinet
for Album Compartment 43C 85-1
for Radio-Phono Compartment 43B 64-3
for Television Compartment 16D 18
‡Cabinet, Wood
Walnut (24X15) 35E 108-1
Mahogany (24X16) 35E 108-2
Mahogany (24X16S) 35E 89-5
Walnut (24X15S) 35E 89-4
Blond (24X17S) 35E 89-6
Carton and Fillers 44B 158
Centerpost Mounting Assembly (for holding extra centerposts) A2002
Clamp, Cable 11A 2-6
Cushion Plate, Fibre (for mtg. 23B44-1 channel escutcheon) 32A 78

‡ Supplied only if old part cannot be repaired. When ordering, describe condition of old part in detail.
§ Use only rubber cement when mounting sponge rubber gasket.

Decal, Cabinet Lettering 98A 15-1
Door Bumper, Sponge Rubber
($\frac{1}{16}$" x $\frac{1}{4}$" x 1") 12A 5-5
Door Catch and Strike Plate, Bullet 98A 48-26
‡Door, Record Compartment Complete
for Walnut (24X15) 35E 108-56
for Mahogany (24X16) 35E 108-57
for Mahogany (24X16S) 98A 48-20
for Walnut (24X15S) 98A 48-19
for Blond (24X17S) 98A 48-21
‡Doors, Television and Radio-Phono Compartment
matched pair for Walnut (24X15) 35E 108-53
matched pair for Mahogany (24X16) 35E 108-54
matched pair for Mahogany (24X16S) 98A 48-17
matched pair for Walnut (24X15S) 98A 48-16
matched pair for Blond (24X17S) 98A 48-18
Escutcheon, Channel (less mounting spring)
for 24X15, 24X16 ..... 23B 43
Escutcheon, Channel (less mounting spring, speed nuts and fibre cushion plate)
for 24X16S, 24X15S, 24X17S 23B 44-1
Escutcheon, Radio (plastic) 23D 39-4
Escutcheon, Lower Monogram Panel
(for use with 23D48-1 picture window) 23D 48-2
§Frame, Picture Tube (used only with 23D50-5 picture window) 23D 50-6
Gasket, Sponge Rubber
for use with 23D50 picture tube window (includes cardboard backing) 98A 61-1
for use with 23D48-1 picture tube window (includes cardboard backing) 98A 61-3
§for use with 23D50-5 picture tube window and 23D50-6 picture tube frame 12A 32-3
Grille Cloth (2 pieces)
for Walnut 24X15 and Mahogany 24X16 ..... 36B 3-21
for Walnut (24X15S), Mahogany (24X16S) ... 98A 48-22
for Blond (24X17S) 98A 48-23
Hinge Assembly, Radio-Phono Tilt-Out
Left Side (facing front) AC183-1
Right Side (facing front) AC183-2
Hinge, Knife Door
Pair for Walnut (24X15) and Mah. (24X16) .. 98A 48-24
Knob, Door
record compartment 33A 52-2
telev. and radio phono compartment 33A 52-1
Knob, Radio Tuning
"Radio-Phono" (double knob) 33C 40-34
"Tuning" (double knob) 33C 40-33
"Tone" (O-shaped knob) 33C 40-35
"Volume On-Off" (I-shaped knob) 33C 40-36
Knob, Television Tuning
for 24X15, 24X16
Channel (mahogany "I-shaped" knob) 33C 28-38
Horizontal, Contrast, Off-Volume (mahogany "I-shaped" knob) 33C 28-41
Sharp Tuning (mahogany "O-shaped" knob) . 33C 28-40
Vertical, Brightness, Focus (mahogany "O-shaped" knob) 33C 28-39
for 24X16S, 24X15S, 24X17S
Channel (gold "I-shaped" knob) 33C 28-17
Horizontal, Contrast, Off-Volume (gold "I-shaped" knob) 33C 28-18
Sharp Tuning (maroon "O-shaped" knob) ... 33C 28-21
Vertical, Brightness, Focus (maroon "O-shaped" knob) 33C 28-22

‡Leg, Cabinet
Left Rear
for Walnut (24X15) 35E 108-59
for Mahogany (24X16) 35E 108-60
Right Rear
for Walnut (24X15) 35E 108-62
for Mahogany (24X16) 35E 108-63
Left Front
for Walnut (24X15) 35E 108-65
for Mahogany (24X16) 35E 108-66
Right Front
for Walnut (24X15) 35E 108-68
for Mahogany (24X16) 35E 108-69
Metal Sheet, 1$\frac{1}{8}$"x5$\frac{5}{8}$" (24X16S, 24X15S, 24X17S) 16A 2-6-70
Nut, Hex (#4-40 for tilt-out tie bar) 2A 1-6-71
Ring, Knob Compression (for "Channel" knob) .. 18A 5-3
Screen, Perforated (8" x 11") 16A 2-1-70
Screw, Telev. Chassis Mtg. (#$\frac{1}{4}$-20x1$\frac{1}{4}$") 1A 67-44-71
Screw, Escutcheon Mtg. (#6 x $\frac{3}{8}$" RH MS)
for 24X15, 24X16 ..... 1A 7-23-49
for 24X16S, 24X15S, 24X17S 1A 15-6-38
Screw, Tilt-out Tie Rod Mtg. (#6-32 x $\frac{1}{4}$" Bd H M S) 365-250-C2-58
Speaker, 10" PM (includes output transformer) .. 78B 52-1
Speed Nut (for Channel escutcheon 23B44-1) ... 2B 10-5-68
Speed Nut (radio escutcheon mounting) 2B 10-24-59
Speed Nut (#8-22 Speaker mounting) 2B 10-8-59
Spring, Channel Escutcheon Retaining
for 24X15, 24X16 ..... 19A 48
for 24X16S, 24X15S, 24X17S 18A 27
Spring, Tilt-Out Coil (2$\frac{3}{8}$" unstretched) 19A 15-1
Spring, Tilt-Out Arm Retaining (7$\frac{1}{4}$" unstretched) 19A 59
Spring, Tuning Knob Tension
for Channel, Horizontal, Contrast, Off-Volume ("I-shaped" knob) 98A 44-1
for Sharp Tuning ("O-shaped" knob) 98A 44-2
Tie Rod, Tilt-Out (13$\frac{7}{8}$" long) 28A 22-1
Tilt-Out Eye Bolt 1A 87-1
Washer, Escutcheon Mtg. (24X16S, 24X15S, 24X17S) 5A 1-21
Washer, Felt (radio knobs) 5A 4-11
Washer, Felt (television)
for Horizontal-Vertical, Contrast-Brightness, Off-Volume-Focus knobs 5A 4-6
for Channel-Sharp Tuning knobs 5A 4-5
Washer, Fibre (used between inner and outer knobs) 5A 1-30
Washer, Fibre (for loop mtg.) 5A 1-27
Window, Picture (with picture frame molded to window)
for 24X15, 24X16 ..... 23D 50
for 24X16S, 24X15S, 24X17S less lower monogram panel 23D48-2 ..... 23D 48-1
Window, Picture (Plexiglas sheet), used with separate picture tube frame for 24X15, 24X16 .. 23D 50-5

UNIVERSAL REPLACEMENT PARTS FOR ROTO-SCOPE ANTENNA

Antenna Lead (includes matching stub and spade lugs) A3030
Control Lever Arm (includes switch blades) A3024
Contact, Bronze Spring 18A 40

PRODUCTION CHANGES

At the start of production, chassis were not stamped with a run number. The first run number used was "2". Final production 20Y1 chassis were stamped "Run 12". Final production 20X1 chassis were stamped "Run 13".

Production changes are coded Run 2, Run 3, etc., as given in the headings below. All chassis stamped with any particular run number or any higher run number, have the change discussed under that particular run number heading as well as all preceding changes.

Note that numerical symbols (2), (3), (4) etc. on schematic are run numbers.

RUN 2

Tolerance of R211 changed to insure proper bias on 6AS5 sound output tube. Resistor R211 was changed from 820,000 ohms, 10%, ½ watt to 820,000 ohms 5%, ½ watt (part number 60B20-821). When replacing, use the late production part.

RUN 3

Modification of video amplifier to decrease audio "buzz". In early sets, the control grid of video amplifier V305 was connected to the junction of series peaking coil L301 and shunt peaking coil L302. Also, the cathode of V305 was returned to ground through a 15,000 ohm resistor.

In later sets, this resistor was removed, and coupling condenser C321 (.1 mfd, 200 volt, part number 64B5-30) was added to the circuit. Resistor R328 (1.2 megohms, ½ watt, part number 60B8-125) was added to provide grid leak bias to the tube.

RUN 4

R425 increased in value to improve horizontal stabilization. Resistor R425, which is common to both the horizontal oscillator V403B and horizontal oscillator control tube V403A, was 150,000 ohms. It was changed to a 220,000 ohm resistor, ½ watt (part #60B8-224). When replacing this resistor, use the late production part.

RUN 5

V204 filter network changed to decrease "hum". In some early sets, the de-coupling filter network connected to the sound output tube (V204) plate supply was connected as shown in Figure 42 below. This network consisted of two sections (C209A and C209B) of a four section electrolytic and a single electrolytic (C211).

Other early sets. used different combinations of filter condensers but they were wired as shown in the schematic, Figure 77.

In late sets. the four section electrolytic (C209) was replaced by a three section electrolytic (C209A, C209C, C209D) part number 67C15-11, and one section of a dual electrolytic (C213B), part number 67C15-52. The other half of the dual electrolytic was used to replace the single electrolytic (C211). See schematic. Figure 77 for late circuit.

Early Filter Circuit

C209A	60 mfd, 150 V		
C209B	20 mfd, 450 V	4 section	
C209C	20 mfd. 450 V	Electrolytic	67C 15-9
C209D	100 mfd, 25 V		
C211	40 mfd. 250 V, Electrolytic		67A 19-1

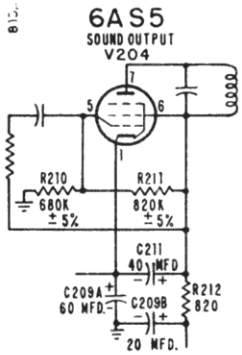


Figure 42. Early Filter Circuit.

RUN 6

Modification of vertical oscillator circuit V402A. In early sets, a 6.8 megohm resistor was connected from the plate (pin 1) of the vertical oscillator (V402A) to the control arm of the vertical hold control R432B. Also, a 100,000 ohm resistor was connected in series with R412 and R432B to ground. Both the 6.8 megohm resistor and the 100,000 ohm resistor were removed from the circuit. Removing these resistors made it necessary to change coupling condenser C407 from 4,700 mmfd. to .006 mfd. (part number 65B21-602).

RUN 7

Vertical oscillator plate voltage changed to improve height and linearity. "Boot Strap" voltage supplies the vertical oscillator with plate voltage in early production 20X1 chassis and all 20Y1 chassis. In late production 20X1 chassis, the vertical oscillator plate voltage is supplied directly through the focus coil L404 (approximately 340 volts). In some 20X1 chassis, load resistor R416 is 2.7 megohms. If vertical linearity or height is poor in these 20X1 chassis, try replacing R416 with the 2.2 megohm resistor (part number 60B8-225).

Voltage rating of C423 increased. Decoupling condenser C423 was changed from a .05 mfd, 400 volts, condenser to a .05 mfd. 600 volts condenser (part number 64B5-7. When replacing C423, be sure to use late production part.

RUN 8

Coupling condenser added to improve audio. A coupling condenser (C214, .05 mfd, 400 volts, part number 64B5-22) was added between the de-emphasis network (R206 and C206) and volume control R207A. This results in removing direct current from the volume control R207A.

Focus circuit modified. If replacing components in focus circuit, see "Run 10 in 20Y1—Run 11 in 20X1."

RUN 9 IN 20Y1 — RUN 10 IN 20X1

Location of fuse (M401) changed. In early sets, the second anode supply pig-tail fuse M401 (¼ amp., 250 volts, part number 84A7-1) is located at the underside of the chassis. In late sets, the fuse is mounted on a terminal board inside the second anode supply housing near the rear.

Focus circuit modified. If replacing components in focus circuit, see "Run 10 in 20Y1—Run 11 in 20X1."

RUN 10 IN 20Y1 — RUN 11 IN 20X1

Focus circuit modified. See schematic. In early sets, the focus control (R207B) was 1,500 ohms. In these sets, R448 and R449, shown in dotted lines on the schematic, were NOT used.

In later sets. resistors R448 (150 ohms, 1 watt, part number 60B14-151) and R449 (750 ohms, 7.5 watt, part number 61A1-17) were added as shown by dotted lines on the schematic. Note: In some of these sets, R449 (750 ohms) and R446 (750 ohms) were replaced by a 1,500 ohm resistor.

In latest sets, the focus control was changed from 1,500 ohms, 2 watt to 1,350 ohms, 4 watt, part number 75B12-5. When this focus control is used, R448 and R449 are NOT used.

If it is necessary to replace a focus control in any set, it is advisable to use the latest type focus control (part number 75B12-5) and the latest circuit (does not include R448 and R449).

RUN 11 IN 20Y1 — RUN 12 IN 20X1

Picture positioning lever added to simplify focus coil adjustment. In early sets, the focus coil is adjustable by means of its four mounting screws. Focus

When the horizontal oscillator is out of sync, it may be difficult to observe this waveform (Figure 45) on an oscilloscope due to the presence of out-of-phase sync pulses. In this case, remove the 12AU7 tube (V401). If the waveshape shown in Figure 45 is obtained, place the 12AU7 tube back into its socket. Then, remove the horizontal oscillator and control tube V403 (6SN7GT). Conventional, well-shaped sync pulses should appear at the control grid (pin 1) of V403 tube socket.

If there are no sync pulses, or the pulses are of low or varying amplitude, accompanied with noise, the sync circuits should be checked. However, if the sync pulses are well-shaped and of constant amplitude, the horizontal oscillator may be misaligned. Place V403 back into its socket and make the "Complete Alignment of Horizontal Oscillator" given on page 20.

If it is impossible to sync the picture, or obtain the correct waveform at terminal "C", check for a defective component in the following sequence:

a. Check tube V403 (6SN7GT) by substitution.
b. If R425 is 150,000 ohms, replace it with a 220,000 ohm resistor, ½ watt (part number 60B8-224).
c. Check C416 by substituting identical condenser (180 mmfd, 5% —.00003 temperature coefficient) part number 65B6-59.
d. Check C414 for either open or short.
e. Check condenser C417 for short.
f. Check resistance of R427. It should be 100,000 ohms.
g. Check the voltage dividing tubes V204 (6AS5) and V305 (6AU6) by substitution.
h. Lead dress is critical in the horizontal oscillator circuit. Check to see if lead dress has been disturbed while servicing.

GENERAL SERVICE HINTS

TV Tuner Service Hints. See page 48.

Audio "Buzz" When Station Is Tuned In. See page 7 for "Elimination of Audio Buzz".

Poor High Frequency Response In Sound. If the sound appears as though it has over-emphasized bass response, check value of C206. This condenser should be a .002 mfd, 600 volt, (part number 64B5-14).

Shadows Or Rounded Corners In Picture When Ion Trap Is Adjusted For Maximum Brightness. Always adjust the ion trap for maximum brightness. If shadows appear on the picture raster, adjust the deflection yoke until it is as far forward as possible. Then center the picture by carefully moving the focus coil forward or backward on the neck of the picture tube. If it is impossible to remove the shadows, try reversing the leads of the focus coil.

Vertical Line At Left Of Picture, Or Picture Will Only Focus At Extreme Setting Of Focus Control. If a white vertical line appears at the left side of the picture, or the picture will only focus at an extreme setting, it is probably due to misadjustment of the horizontal drive C421. Adjust the horizontal drive for best horizontal linearity. If then, the line still appears, or improper focus still results, try replacing the horizontal output tube (V404, 6BG6G). If this does not help, a compromise adjustment of the horizontal drive (C421) must be made.

Interference From Electric Range Switches. If the Admiral Flex-O-Heat electric range switch or other electric range switches creat an electrical disturbance in the television set, connect a .25 mfd, 1000 volt DC condenser across the line input terminals to the switch. If necessary, a similar condenser should be used from each terminal to the range body or neutral.

Interference From Cash Registers. Television interference which is caused by operation of a cash register can be eliminated by installing an inductive - capacitive line filter (such as Tobe Filterette #1394). The line filter should be installed inside the cash register as close to the motor as possible, and should be mounted on clean surface of the metal frame. The connecting leads should be as short as possible (see instructions supplied with filter).

TELEVISION TROUBLE SHOOTING CHART

This trouble shooting chart is arranged in sections ("DEAD SET", "PICTURE", "SOUND", etc.) for convenient reference.

DEAD SET

Symptoms	Check	Possible Cause and Remarks
Dead receiver.	a. Power line circuit (interlocking connector). b. Low voltage rectifier circuit (V501).	b. Speaker must be connected in order to develop plate voltage on "television only" models.

PICTURE

Symptoms	Check	Possible Cause and Remarks
Weak picture (insufficient contrast). Sound and raster OK.	a. Alignment, RF and IF. b. RF tuner circuit (V101, V102). c. IF amplifiers stages (V301, V302, V303). d. Video detector circuit (V304). e. Video amplifier circuit (V305).	Check waveforms at TP1, TP2 and TP3. b. Weak tubes. c. Weak tubes. d. Weak tube; peaking coils. e. Weak tube; peaking coils.

PICTURE (Cont'd)

Symptoms	Check	Possible Cause and Remarks
White vertical line on left side of picture.	a. Adjust horizontal drive C412B. b. Alignment of horizontal lock L405.	b. See alignment section.
Poor horizontal linearity. Insufficient width. Insufficient brightness.	a. Horizontal output tube V404. b. Setting of HOR. FREQ. T404.	
Picture jitter.	a. Contrast control advanced too far. b. Horizontal hold and/or lock adjustment. c. Change horizontal output (V404) if regular sections of the picture are displaced. d. For noisy tube(s) or poor connections in the RF, video and sweep section of the receiver.	d. Check Hor. output tube (V404) by substitution first.
Smeared effect in picture (poor low frequency response).	*a. Sharp tuning adjustment. b. Video IF stages. c. Video detector (V304). d. Video amplifier (V305).	Trouble may be at transmitter. Check on another station. b. Alignment. c. Tube; components. d. Tube; components.
Poor picture detail (poor definition).	*a. Sharp tuning adjustment. b. Alignment, RF and IF. c. Video detector circuit (V304). d. Video amplifier circuit (V305).	c. Check peaking coils. d. Check peaking coils.
Sound bars in picture.	*a. Sharp tuning adjustment. b. Alignment, RF and IF. c. Oscillation in the IF system. d. Condenser C209A, C209B, or C211. e. Microphonic tube in RF or video circuits.	c. May be caused by open by-pass condenser. d. Low capacity or open. e. Tube V102 probable cause.
"Snow" in picture background.	a. Antenna and transmission line. b. For weak signal input. c. Noisy tubes in RF tuner. d. 2nd anode power supply (V405) for corona discharge. e. Video amplifier for low gain.	a. Be sure transmission line is not loose or mismatched. b. Beyond normal service area of a station. c. V102 most likely cause.
Horizontal non-linearity.	a. Horizontal drive control setting (C412B). b. Horizontal Linearity control setting (L402). c. Horizontal output (V404). d. Damper (V406).	Check waveforms at TP15, TP16, and TP18.
Vertical non-linearity.	a. Vertical linearity control setting (R419). b. Vertical oscillator (V402A). c. Vertical output (V402B). d. Vertical output transformer (T402).	Check for leaky condenser C408. Check waveforms at TP9, TP10, TP11 and TP12. See Run 7 under "Production Changes".
Engraved effect in picture.	a. Video amplifier (V305). b. Video detector (V304). c. Peaking coils.	Output load and coupling circuit is common source of this difficulty.
Vertical bars on right side of picture.	a. Horizontal oscillator tube (V403B)	
Herringbone pattern super-imposed on picture.	a. FM, diathermy or other forms of RF interference. b. Oscillation in the IF system. c. Feed back through antenna if built-in antenna is used.	a. Can best be cured at source. Traps may also be used at the receiver. See page 3. b. Re-route transmission line from ant. terminals to tuner. c. See Run 12, 13 under "Production Changes".

* If on one channel only, individual channel oscillator slug may be misaligned. See page 8.

PICTURE (Cont'd)

Symptoms	Check	Possible Cause and Remarks
Brown or yellowish-brown spot on picture tube screen.	a. Picture tube by substitution.	Burned phosphor on picture tube screen. Replace tube if objectionable.
Light and dark vertical bars. Bad horizontal linearity.	a. Damper tube (V406).	Replace tube V406; if defective.
Two heavy black horizontal bars covering picture tube screen.	a. Voltage power supply for open filter. b. Short in B+ circuit.	a. Open or leaky filter capacitor. b. Shorted capacitor.

SOUND

Symptoms	Check	Possible Cause and Remarks
No sound. Picture OK.	a. Sound IF stage (V201). b. Ratio detector circuit (V202). c. Sound amplifier circuit (V203A). d. Sound output circuit (V204). e. Speaker.	b. Alignment. d. Picture and sync signals may be weak. e. Open voice coil.
*Weak sound. Picture OK.	a. Sound IF stage (V201). b. Ratio detector circuit (V202). c. Sound amplifier circuit (V203A). d. Sound output circuit (V204).	a. Alignment. b. Alignment. See Run 2 under "Production Changes".
Noisy sound. Picture OK.	a. Sound IF stage (V201). b. Ratio detector circuit (V202). c. Sound amplifier circuit (V203). d. Sound output circuit (V204). e. Speaker.	a. Tube. b. Tube, alignment. c. Tube, volume control See production change "H". d. Tube. e. Intermittent speaker voice coil. See Run 8 under "Production Changes".
No sound and no sync. Weak picture signal.	a. Sound amplifier (V204). b. Sound amplifier and sync clipper (V203).	a. Picture signal will be weak.
Horizontal bar in picture, sides of picture curved.	a. Low voltage power supply.	a. Defective filter condensers or short in B+ circuit.
Station buzz in sound.	a. See page 7. b. Shorted condensers C308, C302 or C310.	See Run 3 under "Production Changes". ‡b. AGC will read approx. 0 volts.
Intermittent sound. Picture OK.	a. Sound IF stage (V201). b. Ratio detector circuit (V202). c. Sound amplifier circuit (V203A). d. Sound output circuit (V204). e. Speaker.	Intermittent tube or components. e. Intermittent speaker voice coil.
Audio hum present when antenna is disconnected.	Open or shorted filter condenser.	See Run 5 under "Production Changes".

* If on one channel only, individual channel oscillator slug may be misaligned. See page 8.

‡ AGC voltage taken at the control grid (pin 1) of the 1st IF amplifier V301. Voltage should read from —1.5 to —3.5 volts depending on input signal. Since waveforms cannot be obtained from the video IF section without the use of a detector, it is generally helpful to locate the trouble by checking the AGC voltage.

SOUND AND PICTURE

Symptoms	Check	Possible Cause and Remarks
*No sound or picture. Raster OK.	a. RF tuner circuit (V101, V102). b. IF stages (V301, V302, V303). c. Video detector circuit (V304). d. Video amplifier circuit (V305). e. Audio output circuit (V204).	‡a. AGC voltage will read approximately —.3 volts. ‡b. AGC voltage will read approximately —.3 volts. ‡d. AGC will not be affected (—1.5 to —3.5 volts). See Run 5 under "Production Changes".
Intermittent picture and sound. Raster OK.	a. Antenna and transmission line. b. RF tuner circuit (V101, V102). c. IF amplifiers (V301, V302, V303). d. Video detector circuit (V304). e. Video amplifier circuit (V305).	b. Poor contact in turret assembly. See "Television Tuner Service" on page 46.
Weak or no picture; sound weak; raster OK.	*a. Oscillator or video IF alignment. b. Tubes V301, V302 and V303. c. T301, T302, T303 for open primary or secondary. d. Open peaking coil L304.	a. See alignment section. ‡b. AGC voltage may go positive. ‡c. AGC voltage will read approximately —.3 volts and video amp. plate voltage will be low. d. Plate voltage on video amplifier V305 will be low. See voltage chart.

SYNC

Symptoms	Check	Possible Cause and Remarks
No vertical sync. Horizontal will sync.	a. Coupling condenser C315 (shorted). b. Coupling condenser C401 (shorted). c. Integrator network condensers C404, C405, C406 (shorted). d. Open AGC filter condenser C308.	Check waveform at TP8.
No horizontal or vertical sync. Picture signal OK.	a. Tubes V401 and V203. b. Sync amplifier (V401A). c. Sync separator (V401B). d. Sync clipper (V203B).	Check waveforms at TP4 to TP7.
No horizontal sync; vertical sync OK.	a. V403 tube. b. "HOR. FREQ." adjustment. c. HOR. LOCK adjustment. d. Resistor R425. e. Feedback condenser C416.	See "Service Hints on Horizontal Sync Troubles", page 35. c. See alignment section if waveform shown in figure 34 cannot be obtained, check C418 for short. d. Replace with 220,000. See Run 4 under "Production Changes". e. If picture will not sync horizontally, replace C416 with 180 mmfd ± 5%.

RASTER

Symptoms	Check	Possible Cause and Remarks
No raster. Sound OK.	a. Tubes V306, V403, V404, V405, V406. b. Ion trap reversed or needs adjustment. c. Fuse M401. d. Horizontal Oscillator (V403). e. Horizontal output trans. (open). f. Horizontal output (V404). g. Damper (V406). h. Focus coil circuit (open). i. Leaky or shorted coupling condensers C413, C317, C320. j. Second anode power supply (V405, V406).	c. See Run 9, 10 under "Production Changes". 2nd anode voltage (rectified by 1X2 rectifier) is obtained by the auto transformer action of the primary circuit of the horizontal output-transformer. Failure of the horizontal oscillator (V403) or horizontal output tube (V404) will cause no voltage to be developed in the 2nd anode supply circuit, since no sweep voltage is introduced in the primary of the horizontal output transformer. Check waveforms at TP15 to TP20.

* If on one channel only, individual channel oscillator slug may be misaligned. See page 8.

‡ AGC voltage taken at the control grid (pin 1) of the 1st IF amplifier V301. Voltage should read from —1.5 to —3.5 volts depending on input signal. Since waveforms cannot be obtained from the video IF section without the use of a detector, it is generally helpful to locate the trouble by checking the AGC voltage.

RASTER (Cont'd)

Symptoms	Check	Possible Cause and Remarks
Intermittent raster. Sound OK.	a. Tubes V306, V403, V404, V405, V406. b. Second anode power supply (V405, V406). c. Horizontal oscillator (V403). d. Horizontal output (V404). e. Damper (V406). f. Focus coil circuit (intermittent open). g. Picture tube (V306) circuit.	Check for arc-over or corona discharge in the second anode power supply. Check waveforms at TP15 to TP20.
Raster "blooms" (gets larger) as contrast is increased.	a. 2nd anode filter resistor R444. b. Horizontal output tube V404.	
Insufficient raster brilliance.	a. Ion trap adjustment. b. Picture Tube (V306). c. 2nd anode power supply. d. Low AC line voltage. e. Low B+ voltage.	b. Check by substitution. Look for blue haze in picture tube.
Rounded corners on raster. Brilliance OK.	a. Deflection yoke (too far back on picture tube neck). b. Focus coil adjustment. c. Ion trap adjustment.	b. Made by external lever on late production sets. See Run 11, 12 under "Production Changes".
Rounded corners on raster. Insufficient brilliance.	a. Ion trap adjustment. b. Focus coil too far back on picture tube neck. c. Deflection yoke too far back on picture tube neck.	
Tilted raster.	a. Position adjustment of deflection yoke.	
Raster not centered.	a. Position adjustment of focus coil.	a. Adjust with external lever in late production. See Run 11, 12 under "Production Changes".
Excessive raster size (too large a picture for the picture tube mask).	a. Height and width adjustments (R417 and L403). b. Second anode power supply.	Low second anode potential increases the deflection sensitivity of the picture tube. Check 1X2 tube by substitution.
Trapezoidal or non-symmetrical raster.	a. Deflection yoke. b. Position adjustment of focus coil. c. Ion trap adjustment.	
Insufficient raster width. Sync OK.	a. Adjust horizontal drive C412A. b. Width adjustment (L405). c. Tubes V403 and V404. d. Horizontal oscillator (V403). e. Horizontal output (V404). f. Shorted or leaky condenser C403. g. Check resistor R433. If it is 100,000 ohms, replace it with a 75,000 ohm resistor.	b. See Run 12, 13 under "Production Changes".
Insufficient raster height.	a. Height adjustment (R417). b. Tube V402. c. Vertical oscillator (V402A). d. Vertical output (V402B). e. Leaky condenser C408.	c. Defective component. d. Defective T402 or L403.
Bright horizontal line. No vertical deflection, no raster.	a. Tube V402. b. Vertical oscillator (V402A). c. Vertical output (V402B). d. Leaky or shorted condensers C407, C408. e. Open deflection yoke.	Check waveforms at TP9 and TP12. e. See "Alternate Deflection Yoke T403" on page 33.

RASTER (Cont'd)

Symptoms	Check	Possible Cause and Remarks
Bright vertical line. No horizontal deflection, no raster.	a. Open deflection yoke (T403B).	
Raster too small (insufficient height and width).	a. Height and width adjustments (R417 and L403). b. Tubes V306 and V501. c. Low voltage power supply (V501)). d. AC line voltage (low). e. Low 2nd anode voltage.	Gas contents will decrease the deflection sensitivity of the picture tube (improper focus will also result). c. Open filter condenser.
Excessive raster brilliance. Brightness control has no effect.	a. Picture tube (V306). b. Picture tube circuit.	a. Check by substitution.
Bunching of several trace lines appearing as a white band across raster.	a. Vertical output tube (V402B). b. Leaky condenser C409.	Replace tube.
No raster, fuse M401 blows when set seems to be operating OK.	a. Damper tube V406.	
Vertical lines or "wrinkles" on left side of raster.	a. Spurious oscillations in horizontal output (V404). b. Deflection yoke. c. Horizontal drive (C412B) setting.	**If trouble is "a", replace tube V404.**
Improper focus (best at extreme control position).	a. Focus coil. b. Focus control circuit. c. Horizontal drive C412B adjustment. d. For circuit defect causing either excessive or low current drain from power supply.	b. See Run 10, 11 under "Production Changes". d. Defective tube or component.
Improper focus (control has no effect).	a. Focus coil. b. Focus control circuit. c. Picture tube. d. Horizontal drive C412B adjustment. e. For circuit defect causing either excessive or low current drain from power supply. f. Defective focus control R207B.	a. Check for open, shorted turns or incorrect position adjustment. c. Picture tube may be gassy. d. Defective tube or component. f. See Run 10, 11 under "Production Changes".

WAVEFORM ANALYSIS

SERVICING BY WAVEFORM ANALYSIS

After a circuit defect has been localized to the video or sweep sections of a television receiver (see trouble-shooting data), localization to a single stage can be accomplished by use of the waveforms shown. Voltage or resistance measurements can then be used to locate the defective part in a conventional manner.

The waveforms shown for test points TP1 through TP7, TP13A TP15 and TP17 are obtained only with a transmitted picture signal input to the receiver. Since the remainder of the waveforms shown are taken from the sweep circuits of the receiver, a transmitted picture signal input is not necessary. Note that TP13A and TP13B are taken from the same point. TP13A is taken with TV signal input, TP13B is taken without TV signal input.

Two separate waveforms are shown for the first seven test points. Two different oscilloscope sweep frequencies were used in order to show up the vertical and horizontal pulses at test points TP1 through TP7 (both cannot be locked in at the same sweep frequency due to the great difference in, and non-integral relationship of, the vertical and horizontal pulse frequencies). The oscilloscope sweep is adjusted for one half of the frequency of the vertical frequency (60 cycles) or the horizontal frequency (15.75 KC) in order that two pulses will appear on the screen.

The peak-to-peak voltages indicated for the various test points were measured by calibrating the oscilloscope used to observe the waveforms. Such peak-to-peak voltage measurements provide a check in the voltage gain per stage. For example: the peak-to-peak voltage readings at test points TP2 and TP3 are 4 and 36 volts, respectively. A voltage gain of 9 is indicated for the video amplifier stage V305 (6AU6).

Set the contrast control at approximate half rotation. Varying the contrast control will produce corresponding variations in peak-to-peak height of the test patterns TP1 through TP7.

A change in waveform may be noticed at test points TP1 through TP7 when the receiver is switched to a different television station. This is true since some variations in the transmitted waveform are tolerated at the television transmitter. All waveforms and peak-to-peak voltage readings are subject to some variations due to the response of the oscilloscope used for test. Due to parts and manufacturing tolerances, variations in peak-to-peak voltages between television receivers are a normal condition. Hence, when using waveforms and peak-to-peak voltage readings for quick trouble shooting, these variations should be kept in mind to avoid erroneous conclusions. Note that peak-to-peak voltages taken from sweep sections of 12″ sets (20Y1 chassis) may be about 10% higher than those taken from 10″ sets (20X1 chassis).

WARNING

Waveform analysis of high voltage sections of the receiver is not recommended; extreme care should be taken to avoid contact with these circuits. Care should be exercised when taking measurements on the horizontal output stage. No connections should be made to the plate cap of the V404 (6BG6G) or to any connections on the rectifier tube V405 (1X2) as the high voltages at these points are dangerous.

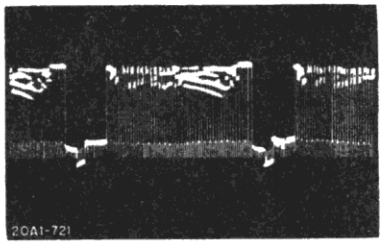


Fig. 46 Vertical Pulse
4 Volts PP

***TP1**
AGC Rectifier Cathode
Pin 2 of V304 (6AL5)

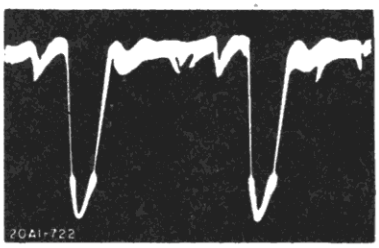


Fig. 47 Horizontal Pulse
4 Volts PP

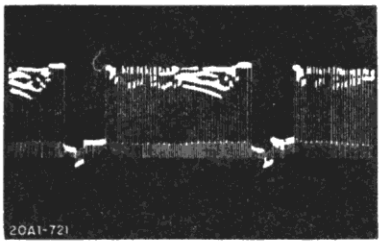


Fig. 48 Vertical Pulse
4 Volts PP

***TP2**
Input of Video Amplifier
Junction of L301 and L302

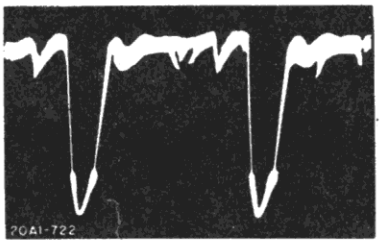


Fig. 49 Horizontal Pulse
4 Volts PP

*** Waveforms obtained only with transmitted picture signal input.**

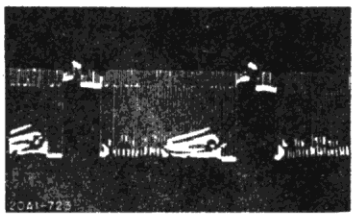


Fig. 50 Vertical Pulse
36 Volts PP

***TP3**
Output of Video Amplifier
Pin 5 of V305 (6AU6)

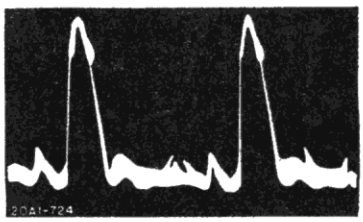


Fig. 51 Horizontal Pulse
36 Volts PP

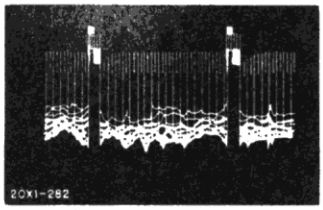


Fig. 52 Vertical Pulse
15 Volts PP

***TP4**
Input to Sync Amplifier
Pin 2 of V401 (12AU7)

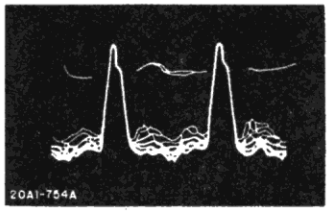


Fig. 53 Horizontal Pulse
15 Volts PP

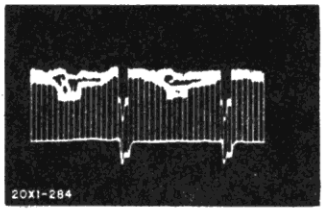


Fig. 54 Vertical Pulse
60 Volts PP

***TP5**
Output of Sync Amplifier
Pin 1 of V401 (12AU7)

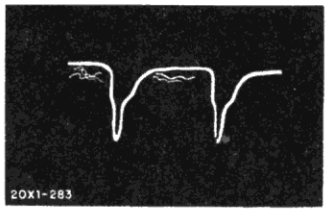


Fig. 55 Horizontal Pulse
60 Volts PP

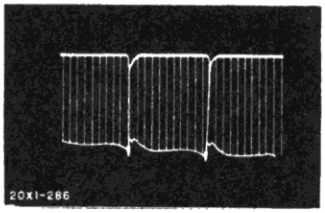


Fig. 56 Vertical Pulse
8 Volts PP

***TP6**
Output of Sync Separator
Pin 6 of V401 (12AU7)

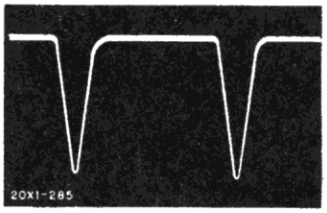


Fig. 57 Horizontal Pulse
8 Volts PP

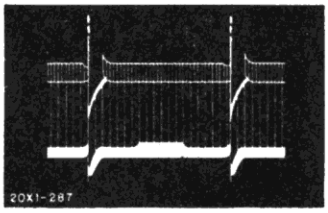


Fig. 58 Vertical Pulse
10 Volts PP

***TP7**
Output of Sync Clipper
Pin 2 of V203 (6SN7GT)

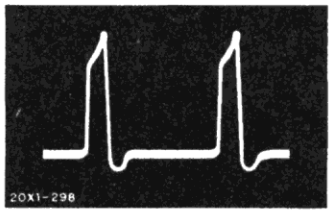


Fig. 59 Horizontal Pulse
10 Volts PP

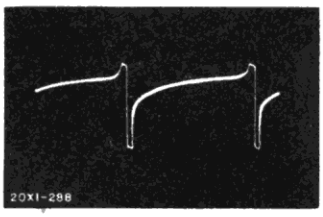


Fig. 60 160 Volts PP

TP8
Input to Vertical Osc.
Pin 2 of V402 (12AU7)

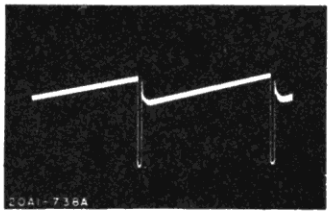


Fig. 61 60 Volts PP

TP9
Output of Vertical Osc.
Pin 1 of V402 (12AU7)

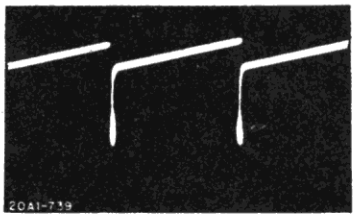


Fig. 62 30 Volts PP

TP10
Input to Vertical Output
Pin 7 of V402 (12AU7)

*** Waveforms obtained only with transmitted picture signal input.**

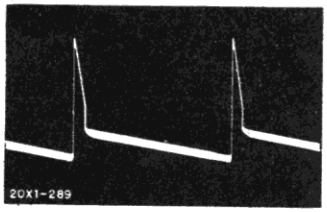


Fig. 63 550 Volts PP

TP11
Output of Vertical Output
Pin 6 of V402 (12AU7)

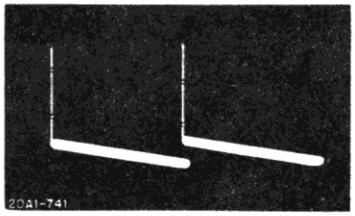


Fig. 64 60 Volts PP

TP12
Vertical Output
Junction of lead of T402
and lead of T403A

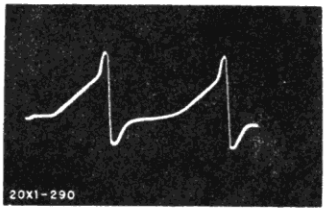


Fig. 65 17 Volts PP

***TP13A**
Input to Hor. Osc. Control
Junction of C412A an C413

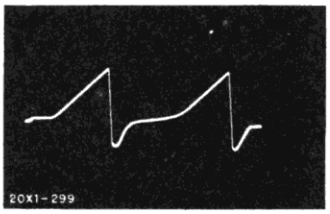


Fig. 66 15 Volts PP

TP13B
Input of Hor. Osc. Control
Junction of C412A and C413

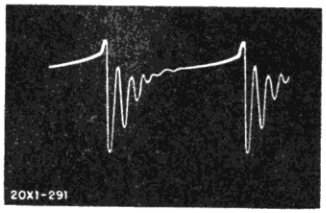


Fig. 67 180 Volts PP

TP14
Input to Hor. Osc.
Pin 4 of V403 (6SN7GT)

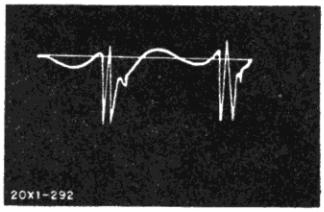


Fig. 68 90 Volts PP

TP15
Plate of Hor. Osc.
Pin 5 of V403 (6SN7GT)

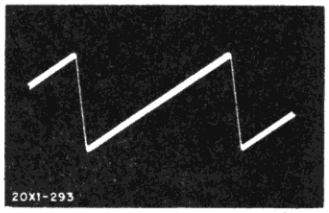


Fig. 69 50 Volts PP

TP16
Terminal D of Hor. Lock
L405 (part of T404)

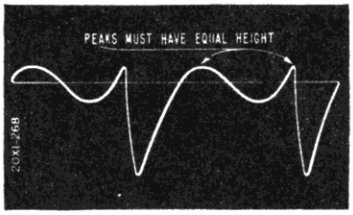


Fig. 70 55 Volts PP

***TP17**
Terminal C of Hor. Lock
L405 (part of T404)
See "Horizontal Oscillator Check
and Alignment", page 20.

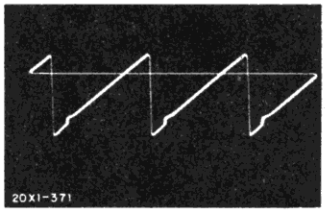


Fig. 71 30 Volts PP

TP18
Input to Hor. Output
Pin 5 of V404 (6BG6G)

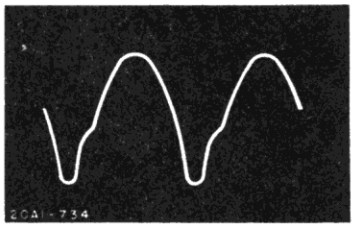


Fig. 72 45 Volts PP
Horizontal Pulse

TP19
Cathode of Damper Tube
Pin 3 of V408 (6W4GT)

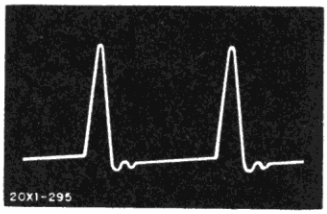


Fig. 73 35 Volts PP
Horizontal Pulse

TP20
Junction of terminal of
L403 and terminal
#6 of T405

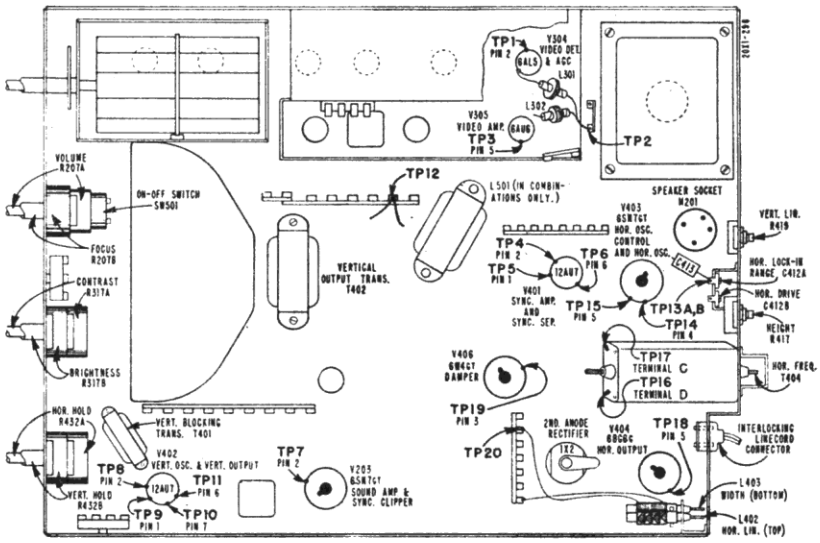


Figure 74. Bottom View Showing TP Locations.

*** Waveforms obtained only with transmitted picture signal input.**

VOLTAGE DATA

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Note that the cathodes of V204 (6AS5) and V305 (6AU6) are operated approximately 130 volts above chassis ground.
- Antenna disconnected from set with terminals shorted.
- Speaker must be connected while taking voltages.
- Contrast turned fully clockwise. Channel Selector set on an unused low channel. Other front controls set at approximately half rotation.
- Rear chassis controls should not be disturbed unless otherwise indicated.
- Some tube socket terminals (not connected to tube elements) are used as tie-points and a voltage reading may be present.

CAUTION

Pulsed high voltages are present on the cap of 6BG6G tube, and on the filament terminals and cap of the 1X2 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured at the high voltage cap of picture tube and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode is approximately 9 KV. Proper filament voltage check of 1X2 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

Sym.	Tube	Function		Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V101	6AG5	RF Amplifier		-.1	NC	6.3 AC	0	130	130	0		
V102	6J6	Osc. & Mixer		130	130	6.3 AC	0	0	0	0		
Voltages at V101 and V102 measured from top of chassis with tubes removed. Point "W" (Fig. 30) is -3 volts measured with tubes in sockets.												
V201	6AU6	Sound IF Amp.		-.6	0	0	6.3 AC	120	120	0		
V202	6AL5	Ratio Detector		.4	-.4	0	6.3 AC	-.2	0	0		
V203	6SN7GT	Sound Amp. & Sync Clip.		-1.2	40	0	-1	22	0	6.3 AC	0	
V204	6AS5	Sound Output		135	120	0	6.3 AC	120	270	260		
V301	6AU6	1st IF Amp.		-.5	0	0	6.3 AC	120	120	.9		
V302	6AU6	2nd IF Amp.		-.5	0	0	6.3 AC	120	120	.6		
V303	6AU6	3rd IF Amp.		0	0	0	6.3 AC	130	130	1.5		
V304	6AL5	Video Detector & AGC		135	0	6.3 AC	0	1.5	0	130		
V305	6AU6	Video Amplifier		115	130	6.3 AC	0	230	300	130		
V401	12AU7	Sync Amp. & Separator		60	-4	0	0	0	6	0	6	6.3 AC
V402	12AU7	Vert. Osc. & Output	20Y1	115	-36	0	0	0	390	-14	6	6.3 AC
			20X1	100	-34	0	0	0	390	-9	9	6.3 AC
Voltages measured at V402 (12AU7) taken with vertical linearity and height control turned fully clockwise.												
V403	6SN7GT	Hor. Osc. Cont. & Hor. Osc.		-22	165	-15‡	-85	200	0	6.3 AC	0	
V404	6BG6G	Horizontal Output		NC	0	8	NC	-9	NC	6.3 AC	270	
Voltage on tube cap: See "CAUTION" note above.												
V405	1X2	2nd Anode Rectifier		See "CAUTION" note above.								
V406	6W4GT	Damper		NC	0	450	NC	375	NC	6.3 AC	0	
V501	5U4G	Low Voltage Rectifier		NC	**400	NC	*400AC	NC	*400AC	NC	**400	
V306	10BP4 12LP4	Picture Tube		0	80	NC	NC	NC	NC	NC	NC	NC
Pin 10: 410V. Pin 11: 110V. Pin 12: 6.3AC 2nd Anode: See "CAUTION" above. Voltages taken at picture tube socket (socket removed from tube).												

* Measured from top of tube socket with 5U4 removed.
** Voltage taken from pin #1 of speaker connector socket M201. Filament 5.2 volts AC measured between pins 2 and 8 of 5U4G.
‡ Voltage will vary both positive and negative with setting of slug adjustment for Hor. Freq. T404.
NC—Indicates no connection to tube element.

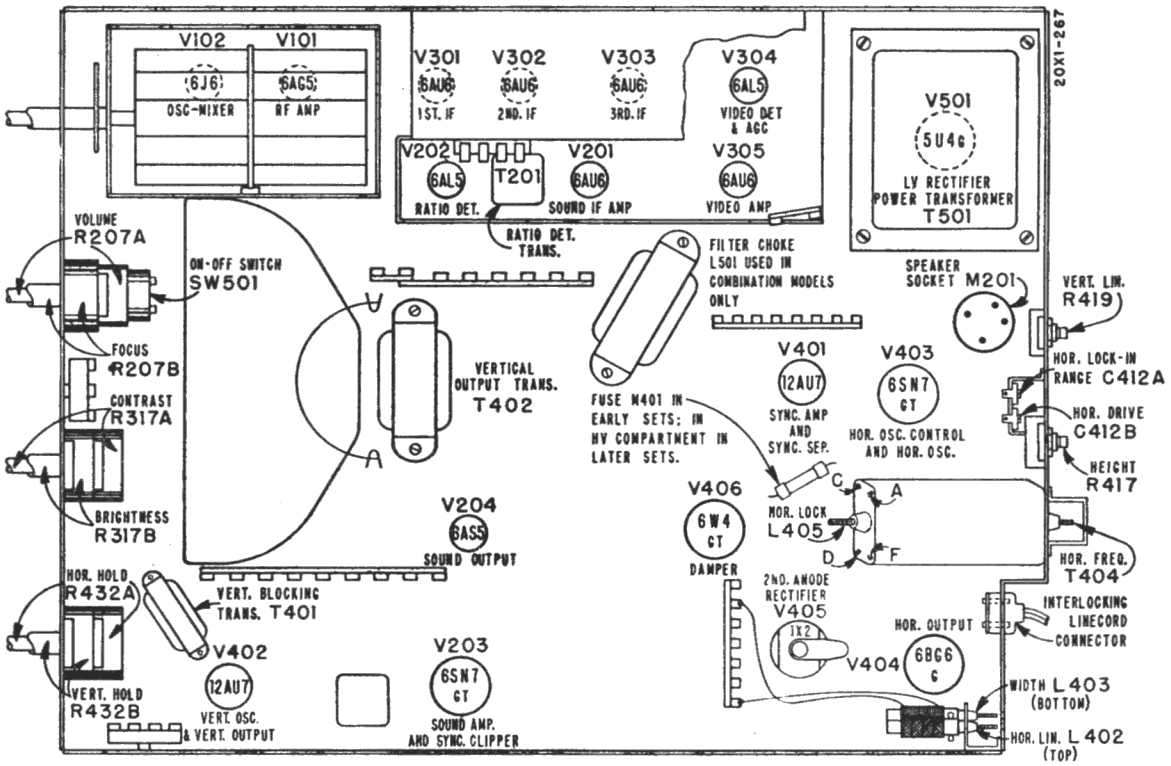


Figure 75. Bottom View of Television Chassis Showing Tube Locations.

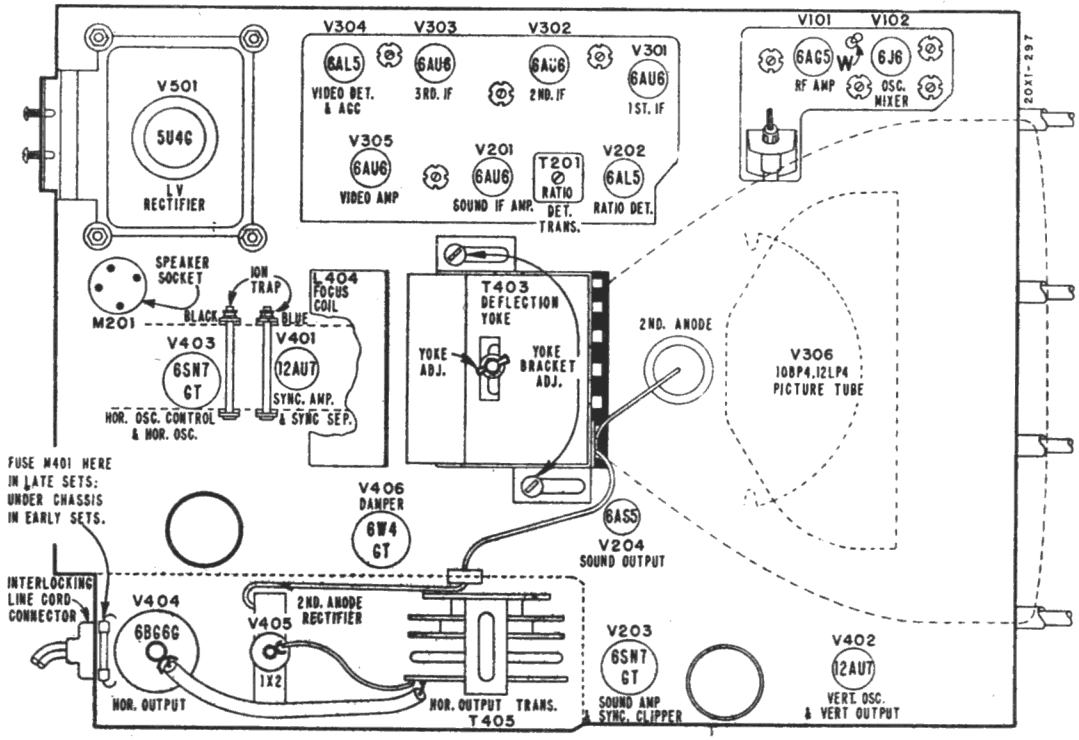


Figure 76. Top View of Television Chassis Showing Tube Locations.

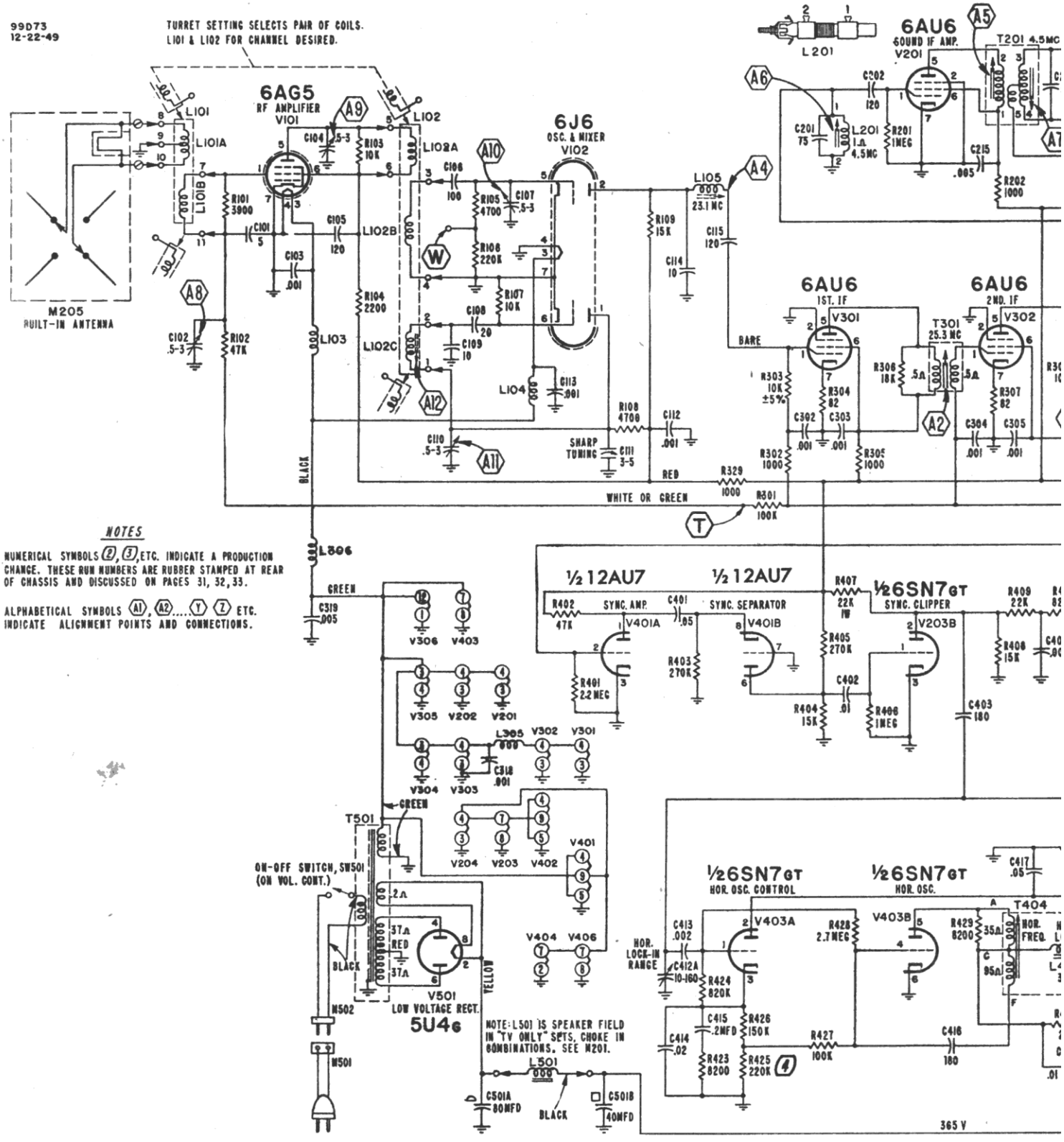
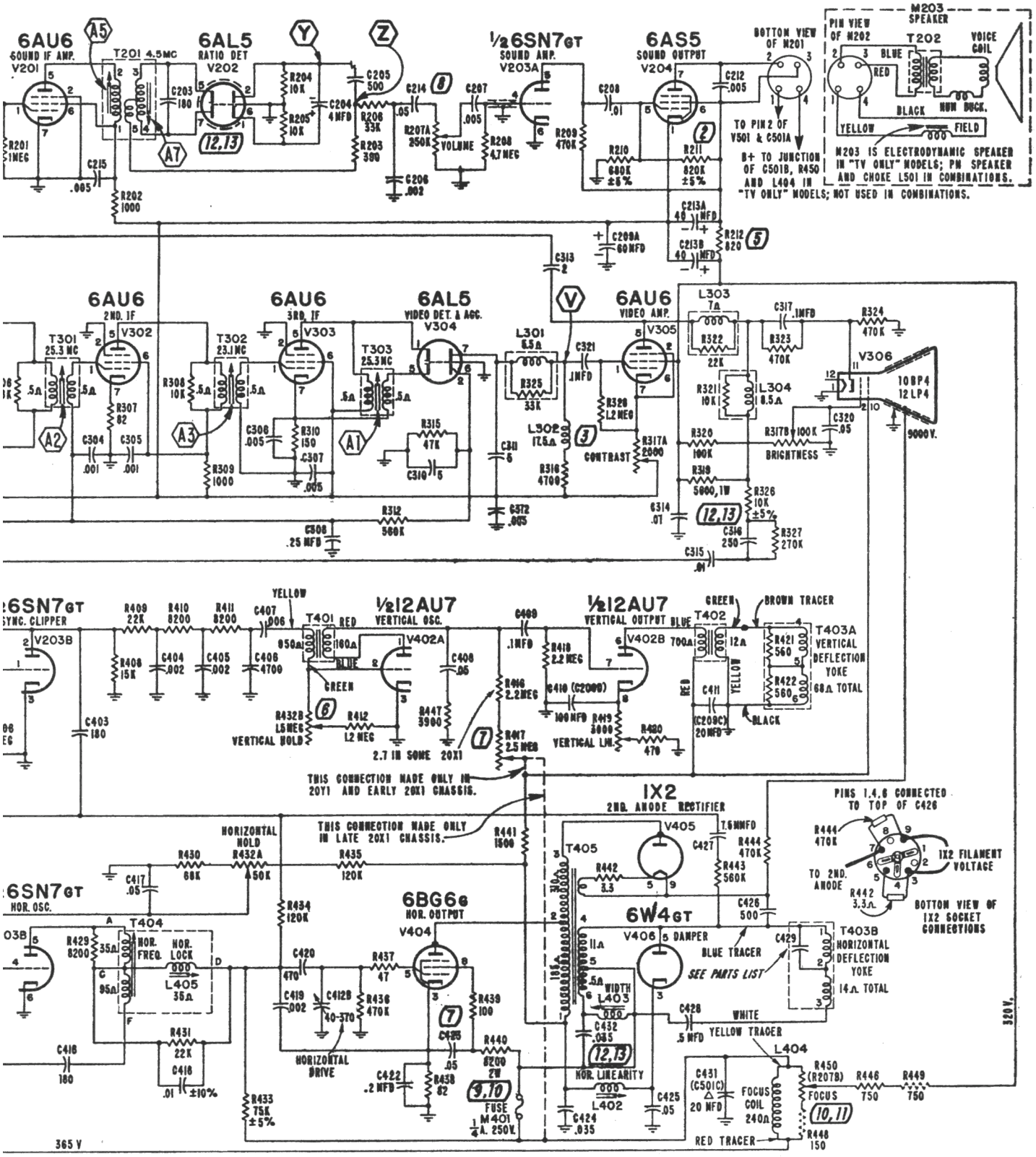


Figure 77. Schematic For 20X1, 20Y1



For 20X1, 20Y1 Television Chassis

94C21-1 and 94C21-2 TELEVISION TUNER SERVICE

IMPORTANT: ***It is very important to correctly identify a tuner to be serviced so that the proper service instructions and parts lists are used.***

TELEVISION TUNER IDENTIFICATION

The most noticeable identifying feature of the 94C21-2 Tuner is the individual channel coils. The coils on the 94C21-2 Tuner are stamped 2F, 3F, 4F, etc. and the coil contacts are mounted on a "raised" portion on the surface of the coil. See Figure 80.

The coils on the 94C21-1 Tuner are stamped 2, 3, 4, etc. (*without* letter "F") and the coil contacts are mounted on the flat surface of the coil. See Figure 78.

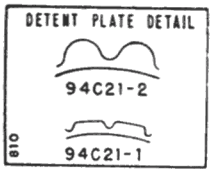


Figure 79. Detent Detail.

Another distinguishing feature is the difference in detent plates. See the adjoining illustration for detent plate detail.

Early production sets used the 94C21-1 TV Tuner. Later sets use the 94C21-2 TV Tuner. These tuners are similar in physical appearance and electrical operation but are only interchangeable as a complete unit. Many of the parts are neither electrically or mechanically interchangeable. Some of the parts appear to be identical physically but are not interchangeable. For example: The detent rollers in these tuners both have a $\frac{3}{8}$" diameter but the diameter of the bearings are different. The bearing diameter for the 94C21-1 Tuner is $\frac{1}{16}$"; the bearing diameter for the 94C21-2 Tuner is $\frac{3}{32}$". Consequently it is important that the tuner being serviced is identified properly and the correct parts list used.

Service procedure for the 94C21-2 Tuner is practically identical with service procedure for the 94C21-1 Tuner. Note that the only difference in servicing the 94C21-2 Tuner is that the contact plate assembly M123 can not be repositioned and the detent spring M122 can not be reset. Therefore, the paragraphs under heading "Repositioning Contact Plate Assembly M103" and "Resetting Detent Spring M102" apply only to the 94C21-1 Tuner.

GENERAL

The television tuner is a sub-chassis consisting of an RF Amplifier (6AG5) and a Mixer-Oscillator (6J6) dual triode.

Channel selection is accomplished by rotation of the

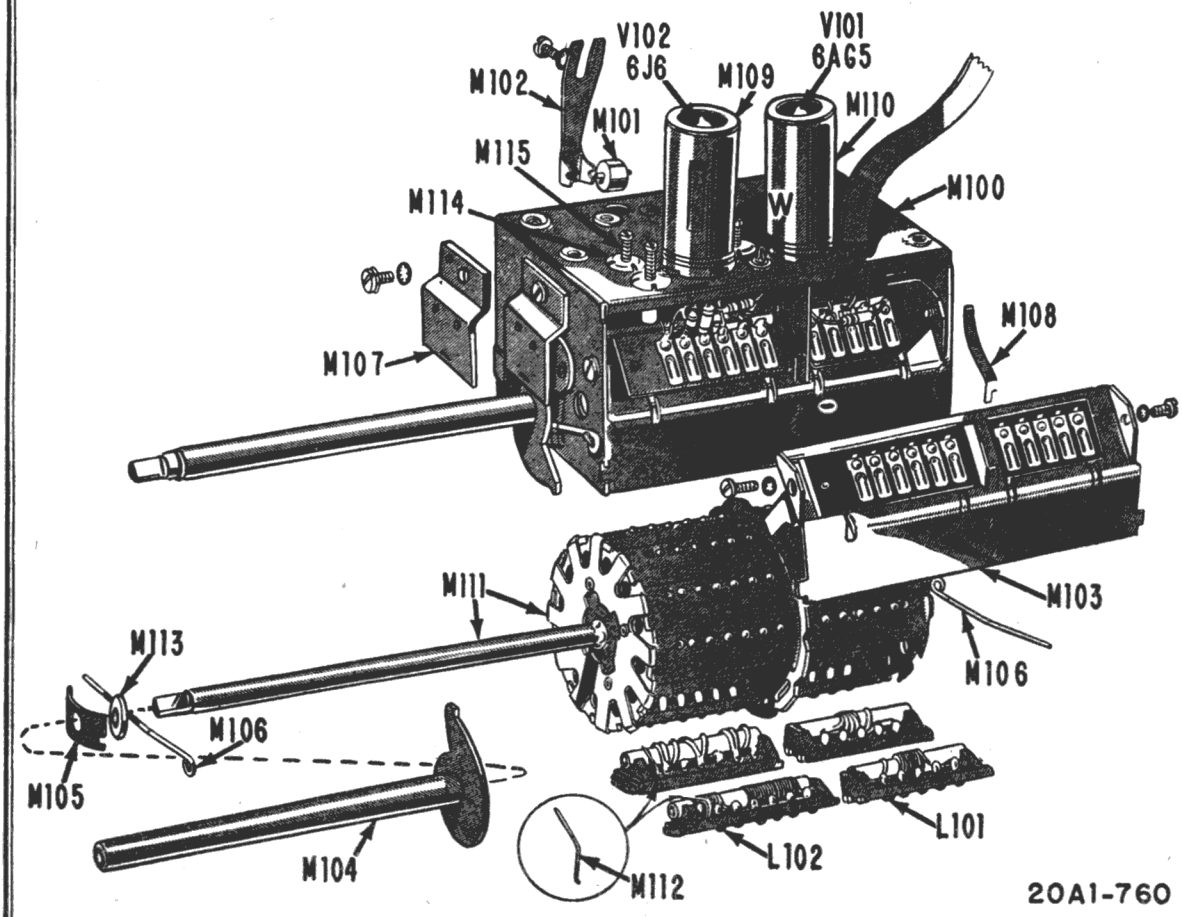


Figure 78. TV Tuner 94C21-1, Exploded View.

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tuner turret assembly, which has a separate set of two coils for each of the 12 television channels. Each set consists of an antenna coil in one assembly, and a mixer-oscillator coil in another. Coils are the snap-in type. Coils can be identified as to channel by the number stamped on the outside of the coil assembly. A Sharp Tuning control, having a tuning range of plus or minus 1.5 MC for low channels, and plus or minus 3 MC for high channels, permits fine adjustment of oscillator frequency.

The high frequencies used in television make it necessary that extreme care be exercised in handling or servicing tuners.

Location and lead dress of components and wiring are usually very critical. At high frequencies, wiring leads tend to act as small inductances or capacities and consequently may appreciably alter electrical characteristics of critical circuits.

Parts location and ground connections should be as originally made. When replacing components, *it is important that they be replaced with parts of identical electrical characteristics and physical size.* Refer to parts list for temperature coefficients, tolerances, and other essential description.

Note resemblance between some ceramic condensers and resistors. If in doubt, check Schematic and Parts List.

Also note that replacement of tubes (especially 6J6 oscillator-mixer tube) may cause some slight detuning of tuner circuits. This is due to the inherent differences of interelectrode capacitances. When replacing 6J6 tube, it is recommended that several tubes be tried in order to select a tube which will cause least oscillator frequency shift. This is easily checked by noting whether the Sharp Tuning control will tune in the television signal at, or reasonably close to, the middle of its range. See page 8 for Oscillator Adjustment using television signal.

Channel snap-in coils must be handled with care. Do not disturb coil windings. Also be sure the coils are properly paired for the indicated channel number, and that coils follow proper sequence when reassembled in the turret drum. For proper reference of tuner shaft in relation to coil position, refer to figure 32.

TUNER REPLACEMENT

Replacement of the complete tuner should generally never become necessary since electrical and mechanical parts are easily replaceable.

DIFFERENCES IN
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EARANCE AND
STAMPING

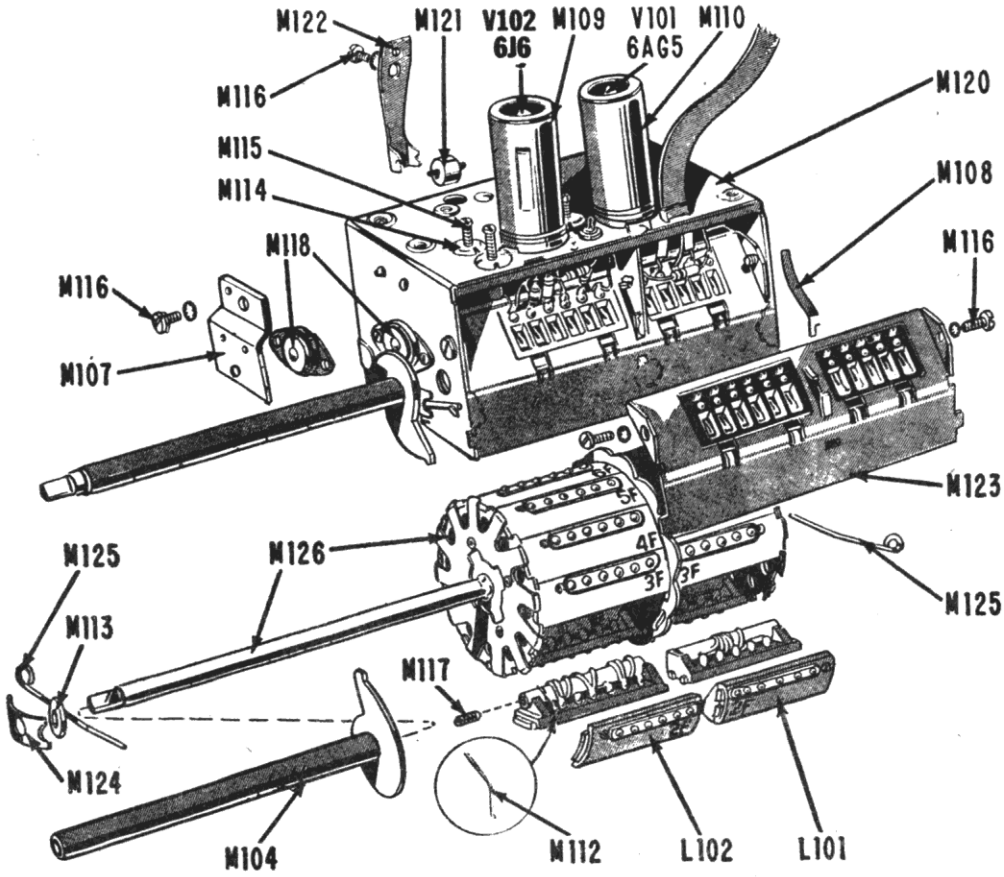

Figure 80. TV Tuner 94C21-2, Exploded View.

INTERMITTENT PICTURE AND SOUND

This trouble is most commonly due to an intermittent tube, loose tube socket contacts, dirty or loose coil contacts, loose or cold (rosin) soldered joints, or loose or vibrating components in the underside of the tuner chassis.

If a bad tube is the cause of trouble, replace with one known to be good, see tube note under "Sound Bars In Picture" in paragraph below.

Loose tube socket contacts may sometimes be tightened by compressing contacts with an ice pick or a large needle. Defective tube socket contacts may sometimes be replaced individually.

For cleaning and adjusting coil contacts, see paragraphs "Cleaning Contacts" and "Adjusting Contact Springs In 94C21-2 Tuner" or "Repositioning Contact Plate In 94C21-1 Tuner".

Loose or intermittent connections can be found by tapping components or rotating the channel selector and watching the pattern on an oscilloscope. A visual inspection or a continuity check will also be helpful.

Apply a hot soldering iron to soldered joints which appear doubtful. Caution: do not change lead lengths or move components other than to slightly separate parts or leads which have caused trouble by contact with the chassis or other parts. See discussion in paragraph "General" on page 46.

SOUND BARS IN PICTURE (DUE TO MICROPHONICS)

Microphonics in this receiver will generally show up as sound bars as the volume is turned up or as the chassis or cabinet is tapped lightly.

Check for microphonic oscillator mixer tube, V102 (6J6). It is recommended that several tubes be tried, in order to select a tube which will be least microphonic and at the same time, causes a minimum of oscillator frequency shift, as noted with rotation of Sharp Tuning Control. In some cases, replacement of the oscillator mixer tube, may necessitate readjustment of the Overall Oscillator Adjustment (A11). Refer to page 8 and page 19 in this manual.

SHARP TUNING CONTROL

The Sharp Tuning control is a variable dielectric type condenser. The normal tuning range of the Sharp Tuning control for high channels is plus or minus 3 MC, for low channels plus or minus 1.5 MC.

Slight rubbing of the dielectric rotor of M104 against the grounded stator plate M107 is intentional, in order to avoid vibration with resulting microphonics. However, the dielectric rotor should not be allowed to rub or contact the circular disc riveted to the body of the tuner.

The Sharp Tuning control is permanently set at the factory and cannot be readjusted for frequency tuning range.

Sharp Tuning Control Difficult To Turn. If the Sharp Tuning control binds and is hard to turn even after the chassis is removed from the cabinet, loosen the screws holding the triangle-shaped bakelite bearing plate at the front of the chassis and try shifting the plate. If the shaft still binds, remove the bakelite bearing plate from the chassis.

REMOVING CHANNEL COILS

Insert a screwdriver blade between the coil retainer spring and the turret end plate. Twist the blade away from the turret and lift the end of the coil upward and remove.

CLEANING CONTACTS

Remove several sets of coils from turret and rotate turret to position making contact points of contact plate accessible for cleaning.

Using a small, stiff brush and carbon tetrachloride, clean contact surfaces of stationary contacts.

Remove accumulated dust or grease from stationary contacts and contact plate with a soft canvas cloth dampened with carbon tetrachloride. Accumulated rosin may be removed with a soft cloth dampened with denatured alcohol.

Clean contact surfaces of rotating coils in same manner.

TUNER LUBRICATION

In general the lubrication applied to points of wear or friction at time of manufacture should make lubrication seldom, if ever necessary. However, should tuner lubrication become necessary, it is important that the correct amount and type of lubricant be used.

Using a clean brush, apply a film of switch contact oil (Admiral part number 98A64-1 or Viscosity Oil Co. #7069) to the surfaces of the coil contacts and stationary contact points.

Lubricate all other moving parts and bearing surfaces with light vaseline or preferably Admiral part #98A64-2 or Viscosity Oil Co. #8072 lubricant.
WARNING: Do not use lubriplate or any similar lubricant containing zinc or cadmium.

ADJUSTING CONTACT SPRINGS
In 94C21-2 Tuner Only

Should the stationary contact springs make poor contact due to insufficient tension, remove several sets of coils from the turret. Rotate the turret to position making the bottom of the contact strip accessible for observation. With a narrow blade screwdriver, adjust the contact spring tension by carefully bending the spring inward until highest point on the spring extends about 9/64 of an inch above the plastic surface of the contact plate. With correct tension of the contact spring, the spring should clear the flat surface of the turret coil by about 1/64 of an inch.

OSCILLATOR SLUGS IN TOO FAR

If HF oscillator slugs M177 "fall into" coil form, remove the channel coil, move the slug retaining spring M112 aside, and tap the coil assembly until the slug slips forward. Set the coil retaining spring into position; it should rest firmly against the slug. See figure 80.

REMOVING TUNER TURRET ASSEMBLY

a. Remove retaining bracket M107 in front of the tuner. See figure 80.
b. Remove rotor shaft assembly, rotor contact spring and fibre washer. For reassembly, note order of parts removal.
c. Remove front and rear turret retaining springs by depressing straight end of spring from tab on chassis.
d. Using a screwdriver blade at the side of the tuner, press the detent spring M102 or M122 and roller M101 or M121 away from the turret detent plate.
e. Grasp tuner shaft and slip out of end plate bearings.

REPLACEMENT OF THE UNGROUNDED STATOR PLATE OF SHARP TUNING CONTROL

A new type (ceramic disc) ungrounded stator plate M118 will be supplied as a replacement for the metal stator plate with a phenolic wafer used in the 94C21-1 Tuner and early production 94C21-2 Tuners. The part number of the new type stator plate is 98A45-86. Note that this part is supplied with wiring lead and trimmer condenser C110 attached, because it is difficult to solder the wire lead to the silver plated surface on the ceramic stator plate disc.

To replace an early production stator plate (in 94C21-1 or very early 94C21-2 Tuner) remove turret assembly as described under "Removing Tuner Turret Assembly". Remove mounting rivets from stator plate by drilling out or clipping them out with diagonal wire cutters. Remove trimmer screw M115 and locking nut M114 from trimmer condenser C110. Unsolder wiring lead connecting trimmer to terminal on contact plate.

Assemble the replacement stator plate (M118) by placing the ceramic button over the $\frac{5}{8}$" hole in the chassis with the wiring lead extending into the chassis. Place the mounting bracket over the ceramic button and mount securely using #4x$\frac{3}{16}$ round head machine screws with #4-40x$\frac{3}{16}$ hex nuts and #4 shake proof lock washers. Mount trimmer condenser C110 in chassis and solder wire lead to its original terminal on the contact plate making this lead as short as possible. Dress wiring lead from ceramic stator plate to trimmer condenser C110 so it does not come in contact with the turret drum. After replacement of the stator plate, it will be necessary to make the overall oscillator adjustment A-11 on page 19.

REMOVING CONTACT PLATE ASSEMBLY

(M103 in 94C21-1 Tuner, M123 in 94C21-2 Tuner)

a. Remove turret as indicated under "Removing Tuner Turret Assembly".
b. Remove the mounting screws at the front and rear of Contact Plate and Bracket Assembly. See figure 78 for 94C21-1 tuner, figure 80 for 94C21-2 tuner.
c. Press outward the front and rear tuner chassis end plates.
d. To free contact plate assembly, release the contact plate tabs by pushing them away from the slots in the end plates.
e. Unsolder all connections to contact plate. Unsolder the solder joint holding contact plate to the center partition of the tuner chassis.
f. Reassemble in the same manner.

NOTE: In the 94C21-1 tuner only, when reassembling Contact Plate and Bracket Assembly M103, it will be necessary to reposition M103 as indicated in the next paragraph; it will also be necessary to reset the Detent Spring M102 as indicated under "Resetting The Detent Spring".

REPOSITIONING CONTACT PLATE ASSEMBLY M103 IN 94C21-1 TUNER ONLY

This adjustment is not required in 94C21-2 tuner.

a. Loosen the contact plate mounting screws.
b. With thumb pressure of right and left hands, press the upper end of the contact plate toward the turret.
c. The contacts on the contact plate should clear the plastic surface of turret coils by about 1/64 of an inch. Clearance can be observed by removing several sets of coils from the turret and slowly rotating turret.
d. After setting the contact plate for proper clearance, tighten the contact plate mounting screws.
e. Resolder wiring connections and solder joint. See figure 78.

RESETTING DETENT SPRING M102 IN 94C21-1 TUNER ONLY

This adjustment is not required in 94C21-2 tuner.

When servicing the Detent Spring M102, the Detent Roller M101, or when replacing the Contact Plate and Bracket Assembly M103, the detent spring should be reset as follows:

a. Loosen the detent spring mounting screw.
b. Observing the contacts on the contact plate, grasp the turret and the roller end of the detent spring. Rotate the drum slightly in one direction and then the other, until a point is reached where the contacts appear to have the greatest rise.
c. Check to see that the detent roller is set in the center of the depression on the edge of the turret detent plate. If setting is correct, tighten the detent spring mounting screw.
d. Rotate the turret, checking contacts on all channels.