

MOTOROLA INC.

SEARCH TUNER 77E535500 (MODEL ST-162)

(Used in Auto Radio 69MF and others)

GENERAL INFORMATION

This search tuner is a combination mechanical push-button tuner (with manual tuning) coupled to a search drive unit. This system provides three different methods of tuning the radio: manual tuning; pushbutton tuning; search tuning. The frequency range covered is 540 to 1600 Kc.

The pushbuttons tune to any one of five favorite radio stations to which they have been pre-set.

For search tuning, there are two different buttons; a "T" (town) button for tuning the radio to strong local stations and a "C" (country) button for tuning the radio when farther away from local broadcasting areas.

This radio will search radio stations with the tuner sweeping from either the high end to the low end of the band or while sweeping from the low end to the high end of the band.

MANUAL TUNING

When the manual tuning shaft is turned, the tuning gear and pinion gear (see Figure 2) rotate the crown gear and pinion assembly (6), which rotates the split gear and bushing assembly (7). As the split gear and bushing assembly (7) is frictionally coupled to the clutch and disc assembly (4), which is fixed to the treadle bar assembly, the treadle bar assembly moves the cores (5) in or out of the coils (L1, L4 & L5). Figure 3 shows that the different angles to which the treadle bar assembly may be moved, correspond to different frequency radio stations. The power transfer sequence is as follows: from the pinion gear of the manual tuning shaft (21) to the crown gear and pinion assembly (6), from the crown gear and pinion assembly (6) to the split gear and bushing assembly (7), from the split gear and bushing assembly (7) to the clutch and disc assembly (4), from the clutch and disc assembly (4) to the treadle bar assembly which moves the cores (5). The pinion gear of the tuner drive shaft (22) contacts the tuning gear of the manual tuning shaft (21). Therefore, when the manual tuning shaft (21) is turned, the tuner drive shaft (22) turns along with it. The tuner drive shaft (22) couples the manual tuning shaft (21) to the search drive unit. As the power take-off gear

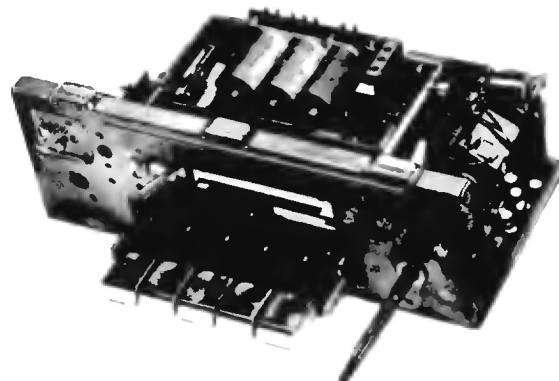


FIGURE 1. MODEL ST-162 SEARCH TUNER

contacts the planetary gear system, the planetary gear system rotates when the manual tuning shaft (21) is turned. Because the search selector button has not been depressed, the control clutch does not engage the carrier gear. Under this condition the planetary gear system is allowed to rotate without turning the motor (E2 -see Figure 9).

PUSHBUTTON TUNING

This tuner is equipped with five pushbuttons which may be set up in any sequence to tune any radio station within the tuning range of the radio. To set the pushbuttons, the station is first tuned in with the manual tuning knob; this adjusts the angle of the treadle bar assembly (see Figure 3) to an angle corresponding to a radio station. The pushbutton is then unlocked by pulling it out; this actually unlocks the adjustable cam on the push arm. When the pushbutton is depressed, the cam is locked to the angle of the treadle bar assembly and remains at that angle until changed. Therefore, whenever a pushbutton is depressed it will return the treadle bar assembly to the angle to which the cam was set.

The power transfer is directly from the push arm to the treadle bar assembly (see Figure 4). When a pushbutton is depressed, the clutch release arm disengages the split gears and bushing assembly (7) from the clutch and disc assembly (4), allowing the treadle bar assembly to rotate without turning the manual tuning shaft (21). When the pushbutton is released the split gears and bushing assembly (7) and clutch and disc assembly (4) are engaged, holding the tuner on station.

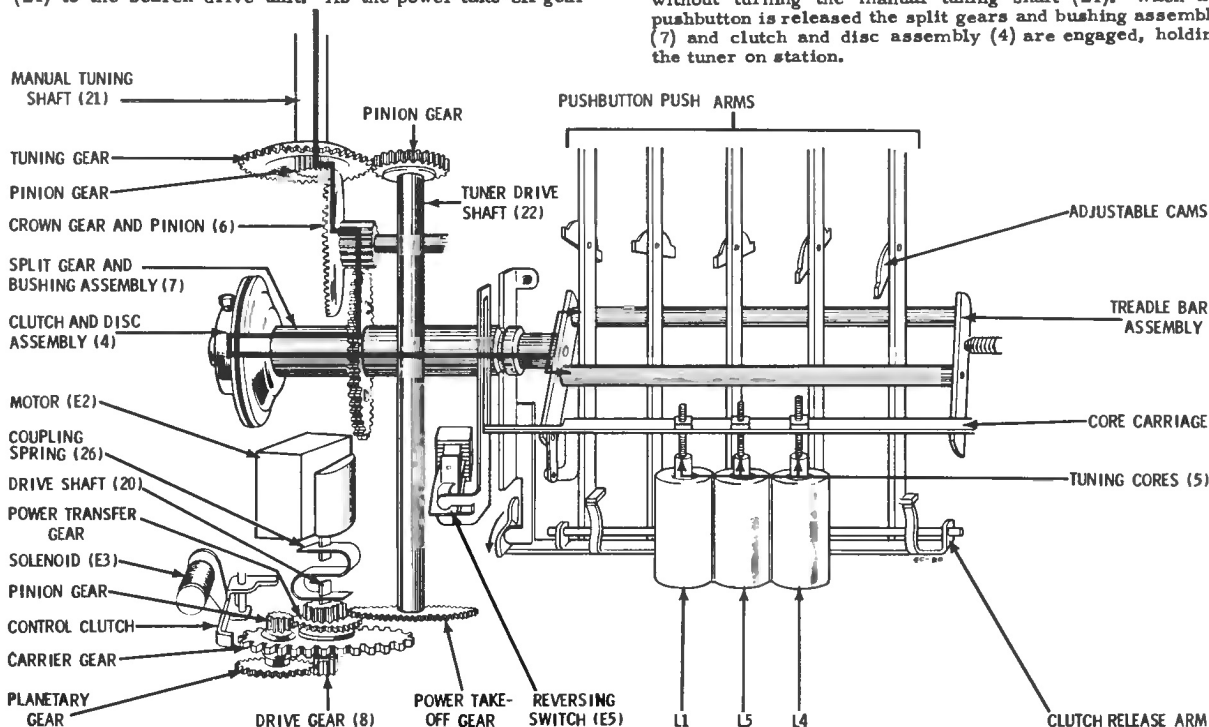


FIGURE 2. MANUAL TUNING

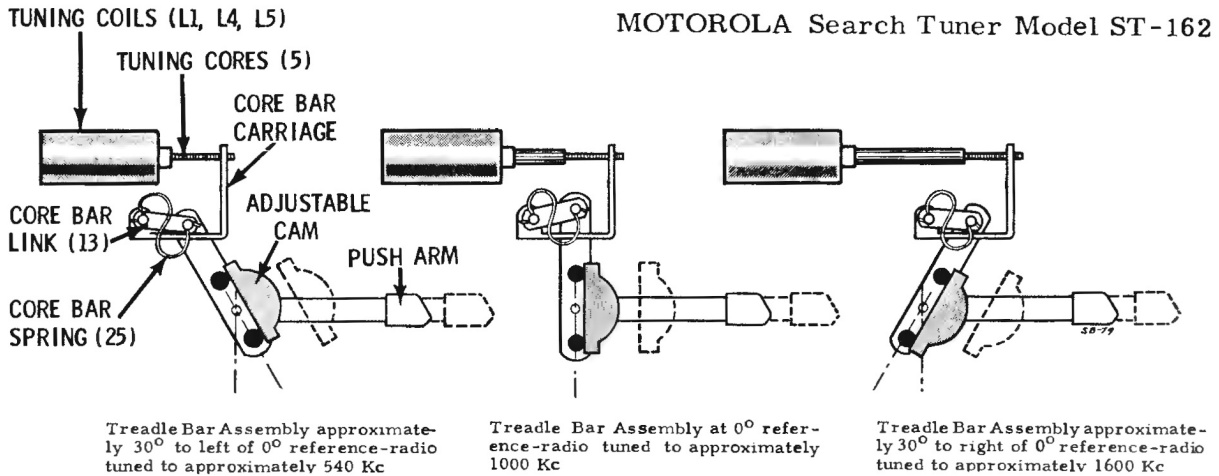


FIGURE 3. TREADLE BAR ASSEMBLY

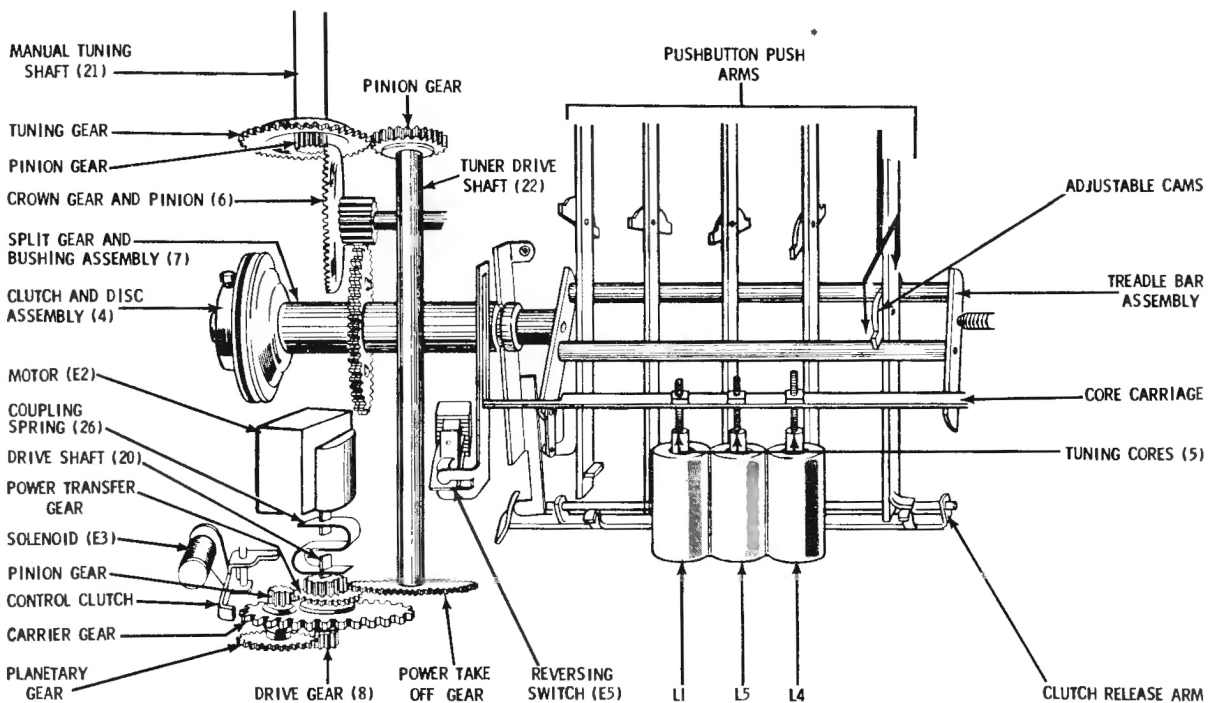


FIGURE 4. PUSHBUTTON TUNING

SEARCH TUNING

Search tuning provides a way of automatically tuning to the next radio station by merely depressing a search selector button. The search tuning mechanism can be operated by two search selector buttons marked "T" and "C"; the "T" (town) button for search tuning strong local stations and the "C" (country) for tuning weaker stations.

When a search selector button is depressed, the following occurs:

1. The sensitivity switch E6 is either opened or closed by the action of the sensitivity switching link (see Figure 5 and SENSITIVITY SWITCHING) and one of the search selector switches (E7 or E8) is momentarily closed.

2. With E7 or E8 momentarily closed the audio is muted and R34 is grounded (see Figure 7), which completes the relay (E4) circuit to ground. With the circuit complete, relay E4 becomes energized, grounding relay contacts A, B1, C and D, and ungrounding contact B2.

3. Contact A is connected to the output stage and grounding this contact mutes the output during search.

4. Contact B1 switches R28 across bias resistors R29, R30, and R33. This reduces the bias on the trigger tube. With the bias lowered, the relay section of the trigger tube conducts sufficient current to hold relay E4 energized after switch E7 or E8 is opened.

5. Contact B2 grounds the cathode resistor R13 of the RF and IF stages. While searching, when contact B2 is ungrounded, the bias of the RF and IF stages is determined by the position of switch E6 (see Figures 5 & 7). With switch E6 opened the bias is lowered while searching because the cathode circuit is completed to ground through the additional cathode resistor R15. With switch E6 closed the bias remains normal even while searching.

6. Contact C completes the motor (E2) circuit to ground, which starts the search mechanism operating. It will be noted that the motor is connected to a reversing switch which is operated by an actuator linked to the treadle bar

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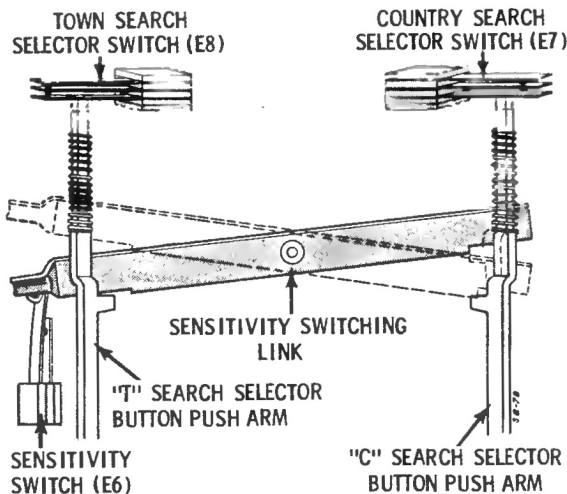


FIGURE 5. SWITCH OPERATIONS

assembly. When the treadle bar assembly reaches its end of travel position, the switch (E5) is tripped, reversing the direction of the motor. This allows the tuner to search radio stations in either direction.

7. Contact D completes the solenoid (E3) circuit to ground which causes the control clutch to engage the carrier gear (see Figure 10).

8. With the carrier gear engaged (because of the control clutch) the motor (E2) is allowed to transfer its power to the manual tuning shaft (21) as follows: (see Figure 6)

From the motor (E2) to the drive gear, from the drive gear to the planetary gear, from the planetary gear to the pinion gear, from the pinion gear to the power transfer gear, from the power transfer gear to the power take-off gear of the tuner drive shaft (22), from the tuner drive shaft (22) to the tuner drive shaft pinion gear, from the tuner drive shaft

pinion gear to the tuning gear of the manual tuning shaft (21), from the manual tuning shaft (21) to the treadle bar assembly, as explained under MANUAL TUNING. NOTE: The pinion gear of the tuner drive shaft (22) is secured to the shaft by a slip clutch which prevents damage to the motor in case the tuner is stopped while searching.

9. As the tuner approaches a station, a combined signal (WC Figure 7) is developed at the grid of the detector section of the trigger tube, by the addition of the AVC (WA Figure 7) voltage and the IF (WB Figure 7) voltage. As the signal becomes more positive, the detector draws more current through R32. The plate side of R32 develops a negative pulse (WD Figure 7) which is sufficient to cut off the relay tube. With the relay tube cut off, the relay E4 is de-energized and the relay contacts are returned to their original position. With the contacts in their original position, the detector tube is also cut off because resistor R28 is no longer across the biasing resistors (R29, R30 & R33). This also de-energizes the solenoid of the control clutch, disengaging the carrier gear allowing the motor to coast to a stop. The sensitivity of the radio is returned to the normal level.

SENSITIVITY SWITCHING

The sensitivity of the radio is automatically changed when one of the search buttons is depressed. The "T" button lowers the sensitivity of the radio by opening switch E6. The "C" button increases the sensitivity by closing switch E6 (see Figure 5). The position of the switch E6 affects the sensitivity only when the radio is searching. When the tuner stops on a station the sensitivity is returned to its normal strength.

DETECTOR CIRCUIT OF TRIGGER TUBE

The detector circuit functions as a cut-off device for the relay tube. The coast distance of the tuner, after the relay E4 is de-energized, is approximately 2.5 kilocycles. Therefore, the relay tube must be cut off 2.5 kilocycles before the tuner reaches the frequency of a radio station. The detector tube can actually control the relay tube on the IF signal alone, but because of the difference of power between radio stations, the AVC voltage must control the cut-off point. The AVC voltage controls this by re-shaping the waveform (WC Figure 7) where necessary, so that the RF cut-off level is 2.5 kilocycles ahead of the frequency of the radio station. Figure 8 shows the addition of the AVC voltage to a weak station and to a strong station. It can be seen that in the combined RF signal, the RF cut-off level is 2.5 kilocycles away from the frequency of the radio station. This allows the tuner to cut off and coast 2.5 kilocycles to the radio station.

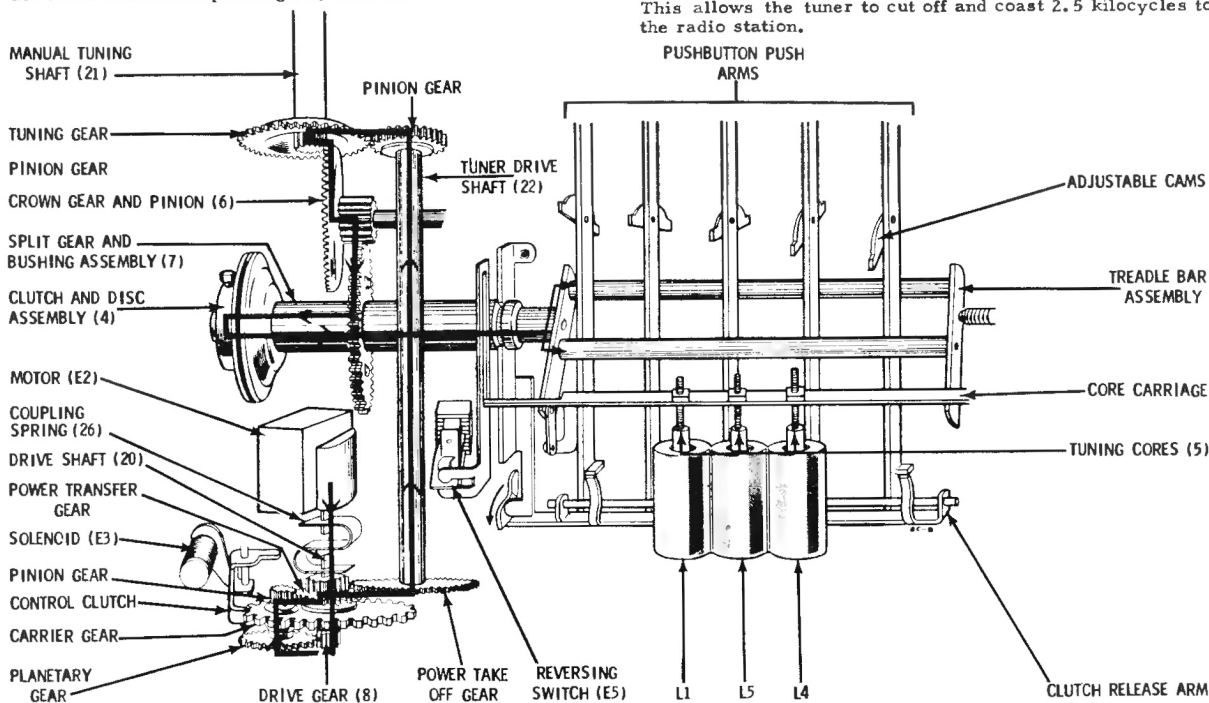


FIGURE 6. SEARCH TUNING

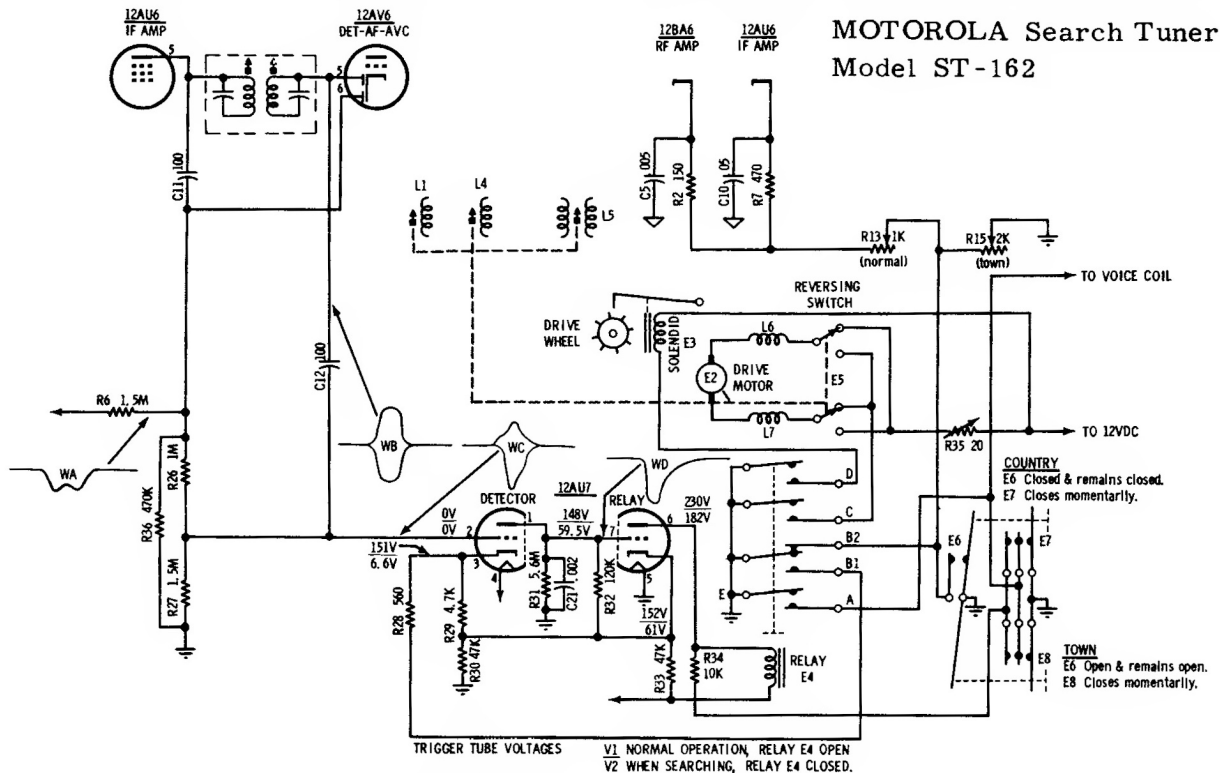


FIGURE 7. FUNCTIONAL SCHEMATIC

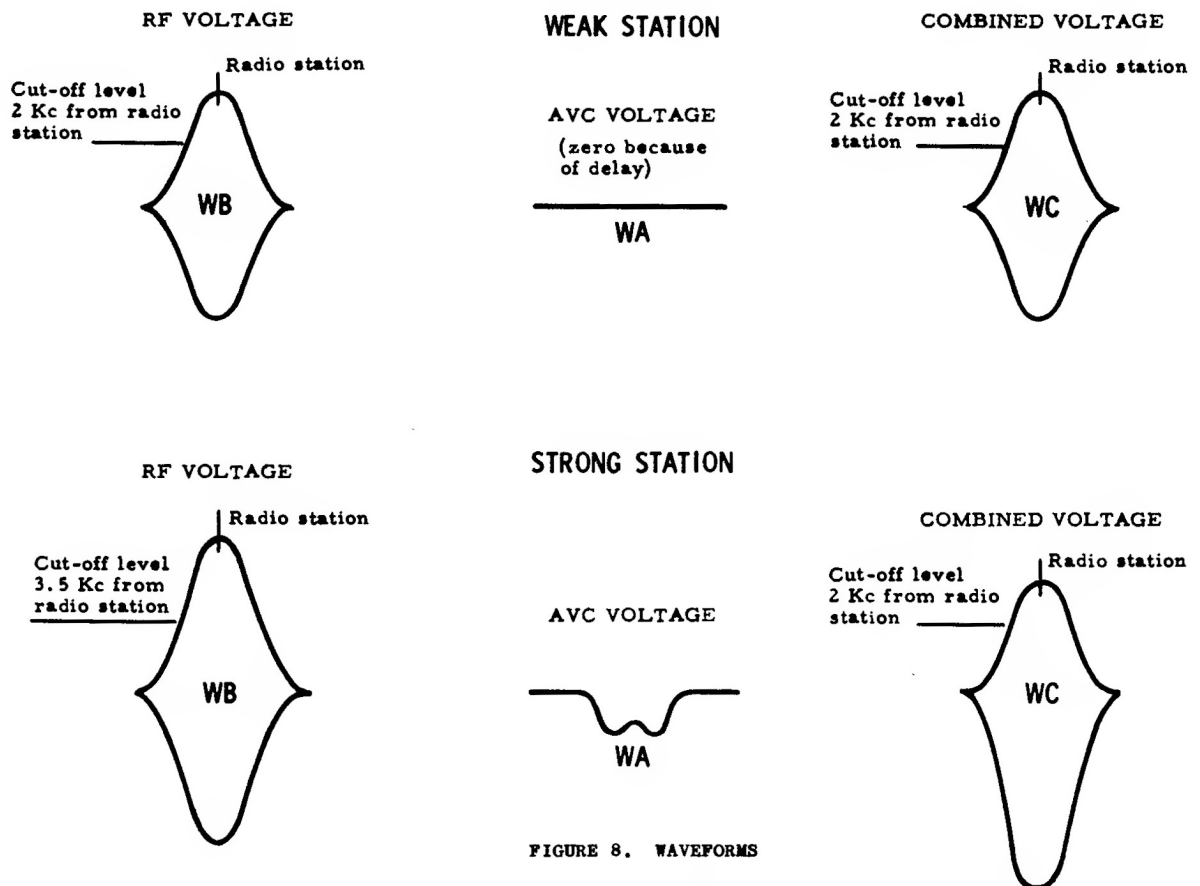


FIGURE 8. WAVEFORMS

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PLANETARY GEAR SYSTEM

The planetary gear system functions as a switch to transfer the motor (E2) power to the manual tuning shaft (21) or to allow the manual tuning shaft (21) to rotate without turning the motor (E2). When the control clutch engages the carrier gear (see Figure 10), the power of the motor turns the manual tuning shaft (21) as explained under SEARCH TUNING and Figure 6. When the control clutch does not engage the carrier gear, the motor does not turn the manual tuning shaft (21), but allows the manual tuning shaft (21) to be turned without turning the motor.

ADJUSTMENTS

MOTOR SPEED

In series to the motor (E2) is a variable resistor R-35. This resistor adjusts the sweeping speed of the motor (E2). The resistor (R-35) should be adjusted with 14.4 volts at the input of the radio. Proper adjustment causes the motor to sweep across the dial scale in approximately 6 seconds. To check the sweep time, hold one of the search selector buttons down and check the time it takes the pointer to travel from one reversing point to the other.

CONTROL CLUTCH

When the control clutch is disengaged from the carrier gear, the clearance between the control clutch and the tip of the carrier gear teeth, shall be no more than .015. If adjustment is required, bend the control clutch adjusting lug until the above clearance is obtained. (See Figure 11).

MOTOR REVERSING SWITCH

There are two adjustments provided for the motor reversing switch (E5); one for the high frequency stop reversal and one for the low frequency stop reversal.

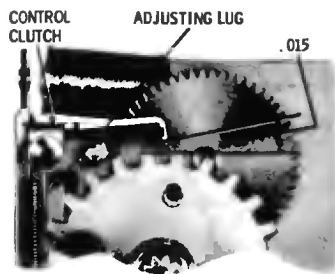


FIGURE 11. CONTROL CLUTCH ADJUSTMENT

To adjust the high frequency reversing position proceed as follows: trip the reversing switch (E5), manually, toward the rear of the radio; with the manual tuning knob tune the radio until the core carriage reaches 1/64" away from the high frequency stop; adjust the high frequency adjusting cam to trip the reversing switch (E5). (See Figure 12).

To adjust the low frequency reversing position proceed as follows: trip the reversing switch (E5), manually, toward the front of the radio; with the manual tuning knob tune the radio until the core carriage reaches 1/64" away from the low frequency stop; adjust the low frequency adjusting cam to trip the reversing switch (E5). (See Figure 12).

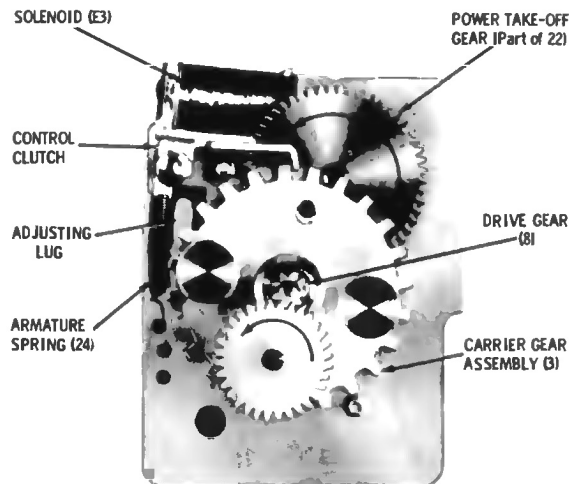


FIGURE 10. CLUTCH ENGAGED

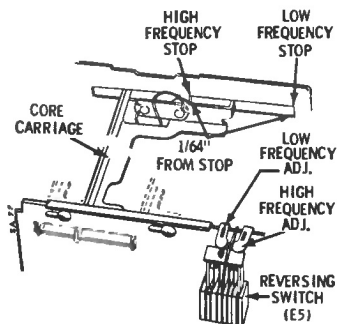


FIGURE 12. REVERSING SWITCH ADJUSTMENT

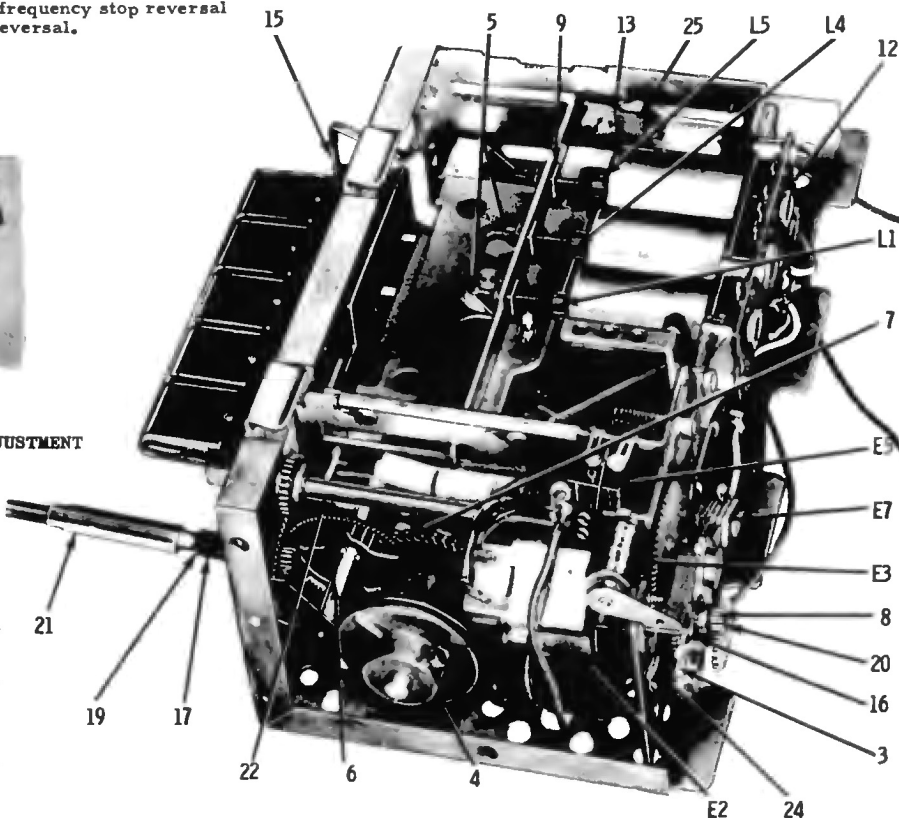


FIGURE 13. TUNER PARTS LOCATIONS