



# UNITED MOTORS SERVICE

DIVISION OF GENERAL MOTORS CORPORATION

General Offices - Detroit

## AUTO RADIO BULLETIN

Bulletin 6D-621

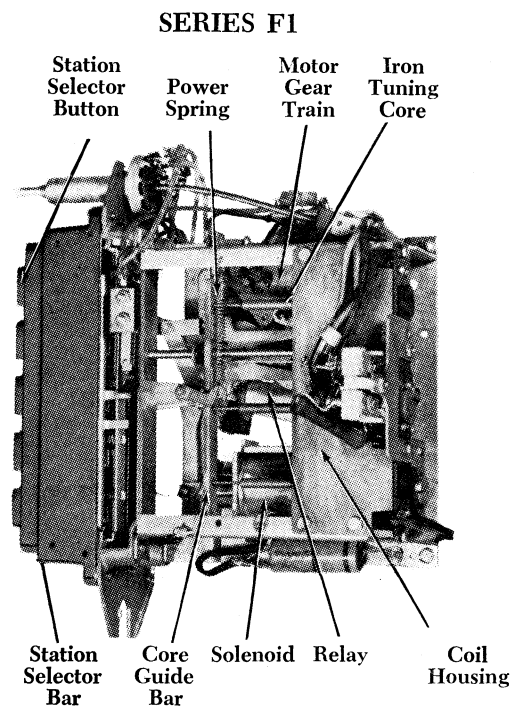
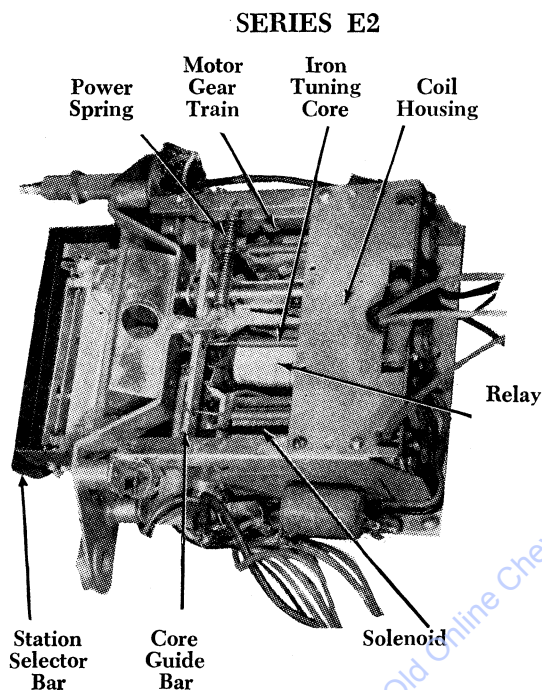
Delco TUNER

Date 11-15-52

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FIRST ISSUE

**SUBJECT: SERVICE INSTRUCTIONS FOR SIGNAL SEEKING TUNERS  
SERIES E2 AND F1**



### GENERAL:

Signal Seeking Tuners used in Delco Radios are as follows:

Series E1 Signal Seeking Tuner (See Bulletin 6D-620)

Series E2 Signal Seeking Tuner (See Bulletin 6D-621)

Series F1 Signal Seeking Tuner plus push button tuning (See Bulletin 6D-621)

These Tuners may also incorporate in addition, manual and/or foot switch tuning.

The service bulletin for any radio using Series E2 or F1 Tuners will refer to this bulletin for Tuner Servicing.

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### SERIES E2 TUNER

The Signal Seeking Tuner is an electronic and mechanical device incorporated into a conventional auto radio in such a way that change of stations is accomplished electronically by depression of a station selector bar or an auxiliary foot

switch. The mechanical portion of the tuner provides for automatic tuning of the radio from the low to the high frequency end of the broadcast band with a solenoid operated return to the low end of the band after the high frequency limit is

reached. The electronic portion of the tuner provides a means whereby the incoming signal from a station stops the tuner on that station. The strength of the signal selected is determined by the setting of a four position control on the radio called the sensitivity control. In the maximum sen-

sitivity setting the tuner will select all stations which are ordinarily listenable, while in the minimum sensitivity position (Fully counter clock wise) the tuner stops only on strong local stations. This control is effective only while the tuner is seeking and does not affect "on station" sensitivity.

## SERIES F1 TUNER

Series F1 Tuners provide five selector buttons in addition to the station selector bar or foot switch. Depression of any one button will cause the automatic mechanism to stop on a pre-selected station. The favorite station can be previously selected by the adjustment of a selector tab corresponding to that button.

When a button is depressed the tuning mechanism is started but the radio is rendered inoperative until such time as the tuner reaches the frequency of the pre-selected station. At this point

contact is made between the dial pointer and the selector tab restoring normal radio operation so the triggering circuit can automatically stop the tuner on the favorite station. The setting of the sensitivity control has no effect on the tuner stopping sensitivity when using pushbutton tuning.

When the station selector bar is depressed, any previously depressed button is mechanically unlatched, returning the circuit to automatic signal seeking tuning conditions.

## THEORY OF OPERATION

The following discussion of the signal seeking tuner does not refer to any particular model radio, but covers in general terms the mechanics and electronics involved in these tuners to assist in an

intelligent trouble shooting approach. The bulletin for the particular radio involved will give the details of the circuit used in the actual receiver.

### Mechanical Operation

The motive force on the signal seeking sweep of the tuner is provided by a constant speed spring driven gear train which is regulated by a nylon paddle wheel. This paddle wheel is the end gear in the gear train and acts as an air vane governor which tends to keep the speed constant. The entire gear train is stopped or started by the relay arm

engaging or disengaging the paddle wheel. The nearly instantaneous return of the pointer and the cocking of the power springs is accomplished by a solenoid which is energized by a cam operated switch. The complete mechanical cycle is developed and outlined below.

### Section 1—Sweep and Return Cycle (See Fig. 3)

One Power Spring, which is fastened to the lower plate of the Planetary Arm, pulls this arm around its pivot. The Planetary Arm is linked to the Core Bar. Thus, as the spring contracts and moves the Planetary Arm it also pulls the core bar and its iron cores from the tuning coils thereby changing the tuned frequency of the radio towards the high end of the broadcast band. After the tuner has swept beyond the top broadcast frequency, the High Frequency Switch Operating Cam on the lower Planetary Arm trips the Tuner Return Switch which in turn energizes the Solenoid and this quickly returns the Planetary Arm to its original position with the cores inserted fully into the coils (low frequency) and the power spring is now under maximum tension. As the Planetary Arm returns, the Low Frequency Switch Operating Cam trips the Tuner Return Switch to its

original position thus de-energizing the Solenoid and completing the cycle.

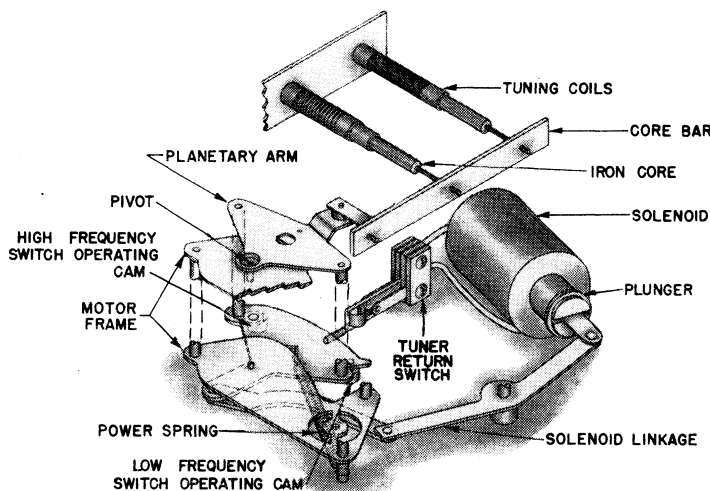


Fig. 3

## Section 2—Motor and Control (See Fig. 4)

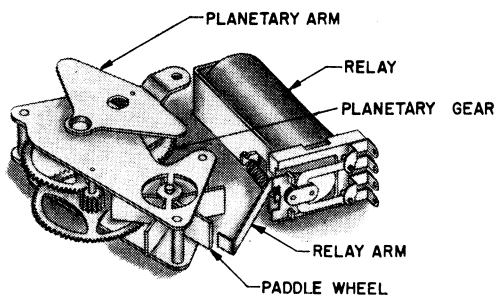


Fig. 4

The Power Spring tends to move the Planetary Arm about its pivot point thereby starting the Planetary Gear. This motion is transferred through the gear train to the Paddle Wheel which acts as an air vane governor keeping the motion at a constant speed. This movement of the Planetary Arm is then controlled by merely freeing or blocking the Paddle Wheel with the Relay Arm. Thus, the movement of the Planetary Arm which moves the tuning cores is started or stopped by the action of the Relay Arm.

## Section 3—Manual Tuning Gear Operation (See Fig. 5)

Manual tuning is accomplished by turning the Manual Control Shaft which turns the Worm Gear in its bracket. The Worm Gear is meshed with the Manual Drive Gear which in turn is meshed with the Planetary Pinion Gear. During manual tuning the Paddle Wheel is held in place by the Relay Arm and this Pinion Gear is not free to rotate, thus effectively locking the Planetary Arm to the outer edge of the Manual Drive Gear. Therefore as the Manual Drive Gear turns, the Planetary Arm moves in unison with it and varies the frequency of the tuner by varying the position of the iron cores in the tuning coils. (Notice that when the set is being tuned automatically and the Paddle Wheel is rotating, the Manual Drive Gear is held securely in place by the Worm Gear while the Planetary Pinion Gear "walks around" the periphery of the Manual Drive Gear thereby causing the Planetary Arm to move and change the position of the tuning cores.)

On sets which have no manual drive, the Manual Drive Gear is secured to the Motor Frame and the Control Shaft and Worm Gear are eliminated.

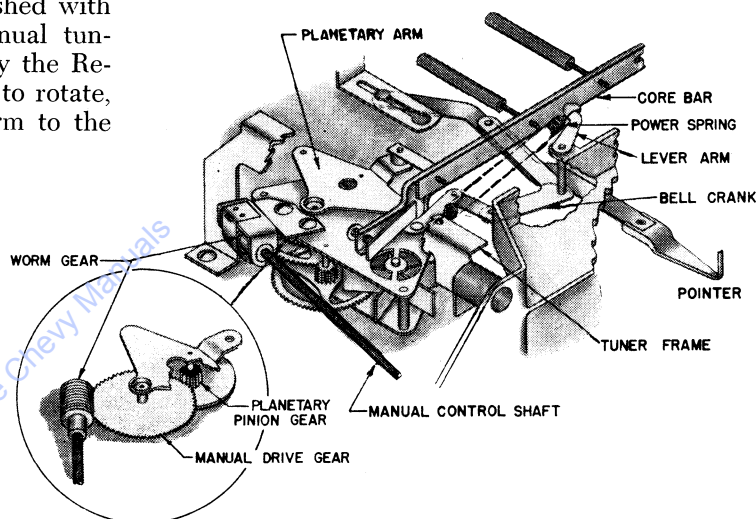


Fig. 5

## Section 4—Pointer and Core Bar Linkage (See Fig. 5)

The second power spring is shown in this view. It has a dual purpose, serving both as a power spring and an antiblacklash spring. The primary linkage is from the tuner frame to the Lever Arm which is securely staked to the Bell Crank. At the Bell Crank the linkage splits, with one arm linked

to the core bar at the extreme left end, and the other arm linked to the pointer. Thus, this spring helps pull the core bar in the high frequency direction when it is free to move and provides a spring loaded linkage between the core bar and the pointer preventing any tendency for backlash.

## Section 5—Clutching Operations (See Fig. 6)

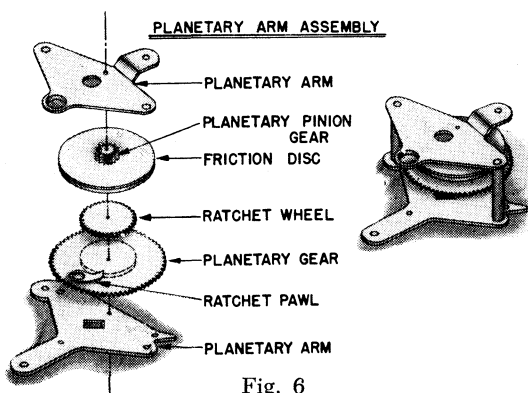


Fig. 6

The Ratchet Pawl and Wheel are used so that the Solenoid can cock the power springs without running the entire gear train in the reverse direction during the return sweep. Notice that the Ratchet also is used when the dial pointer has reached the high end of the band while tuning manually. When the Planetary Arm has reached the end of its tuning arc, the planetary pinion tends to be rotated by the Manual Drive Gear (see Fig. 5) and this turns the Ratchet Wheel out of the Pawl and allows the pinion gear to turn freely without exerting further force on the Planetary



Arm and thereby eliminates any possible damage to the mechanism.

The purpose of the Friction Disc is to prevent damage to the mechanism when manually tuned

past the low frequency stop. This is accomplished because the disc slips before excessive pressure is exerted when the Pinion Gear tends to rotate the Planetary Gear. The Friction Disc is not found on radios without a manual drive.

### Section 6—Station Selector Bar Operation Series F1 Tuner (See Fig. 7)

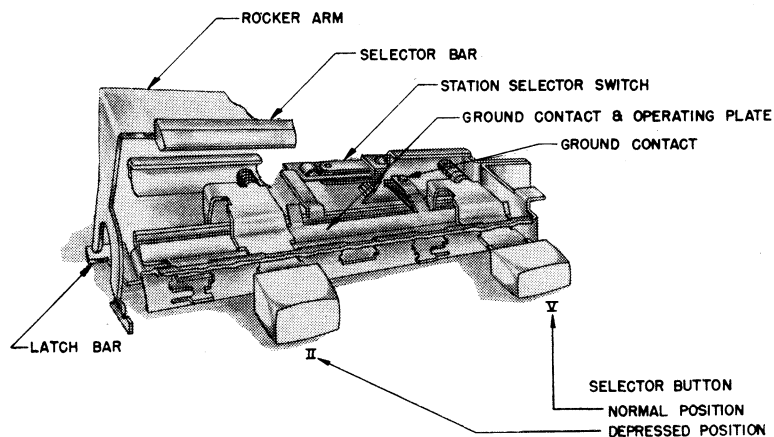


Fig. 7

1. The rear corner of the rocker arm rests on the arm on the end of the latch bar.
2. As the station selector bar is depressed the rocker arm causes the latch bar to move downward.
3. Any button which is in the depressed position will be released as the latch bar moves downward.
4. An arm on the rear of the latch bar moves downward operating the trip arm of the station selector switch causing the tuner to start seeking.

### Section 7—Station Selector Button Operation Series F1 Tuner (See Figs. 7 and 8)

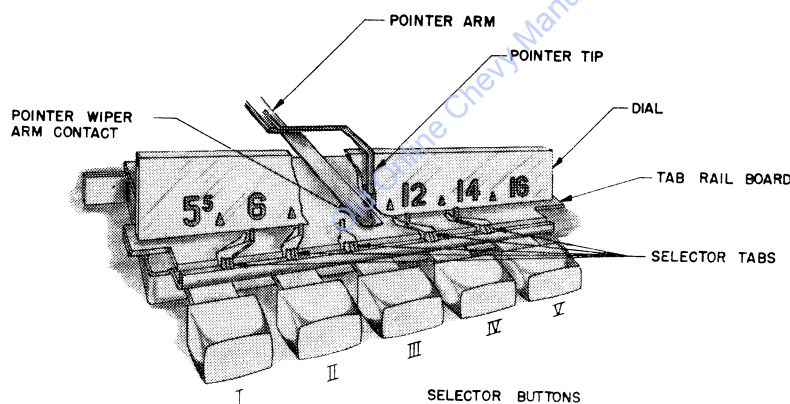


Fig. 8

The Station Selector Buttons are operated by pushing the button all the way in and releasing. The sequence of operation is as follows: (See Figs. 7 and 8).

1. The selector button is in its normal position and the relationship between the selector button slide and the latch bar is shown in Figure 7 for button number V.
2. As the selector button is pushed into the position shown in Figure 7, for button number II, the latch bar is moved downward by the cam on the selector button slide. This disengages any selector button which was previously in the depressed position. The arm on the rear of the latch bar operates the trip arm of the station selector switch and causes the tuner to start seeking.
3. When the selector button is pushed all the way in, the latch bar will hold the selector button slide in the depressed position as shown in Fig. 7, button number II.
4. The dial pointer will scan the dial as the tuner sweep cycle takes place (See Fig. 8). The pointer wiper arm contacts the selector tab corresponding to the depressed selector button, the pointer wiper arm, being grounded, completes the electrical circuit required to stop the tuner on stations.

## Section 8—Tuner Sweep Cycle Outline (Fig. 9)

- I. Tuner is started by removing Relay Arm from Paddle Wheel.
  - A. Spring driven gear train begins to sweep. (Fig. 4)
  - B. Planetary Arm moves. (Fig. 3)
  - C. Tuning cores are moved toward higher frequency by core bar linkage to Planetary Arm.
  - D. Spring loaded dial pointer scans dial. (Fig. 5)
- II. Signal actuates relay causing arm to stop paddle wheel.
  - A. Gear train stops. (Fig. 4)
  - B. Planetary Arm is stopped.
  - C. Core bar movement is stopped.
  - D. Dial pointer sweep is stopped.
- III. When tuner reaches high end of dial after last stop.

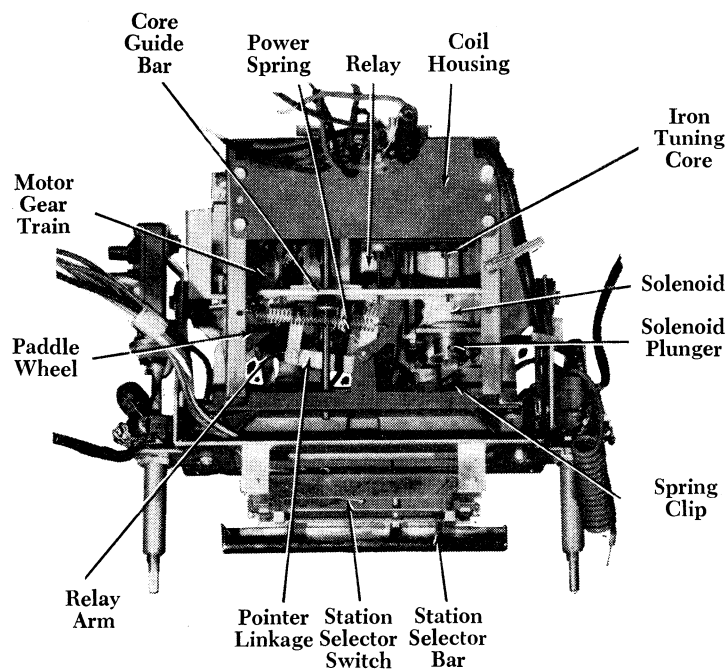


Fig. 9

- A. The High Frequency Switch Operating Cam trips Tuner Return Switch. (Fig. 3)
  - B. Solenoid is energized.
  - C. Plunger is pulled into the Solenoid.
  - D. Planetary Arm and pointer are returned to low end of dial.
- E. The Low Frequency Switch Operating Cam trips the Tuner Return Switch in the opposite direction. (Fig. 3)
  - F. The Solenoid is de-energized and the sweep starts from the low frequency stop.

## ELECTRICAL OPERATION

The purpose of the electrical components associated with the tuner is to control the relay so the operator may start the tuner sweeping cycle by merely depressing a station selector bar, a foot switch, or a push button, and so that the sweeping operation will continue until a signal is received. At that time it is the function of this circuit to accurately tune to the frequency of the select-

ed station. It also provides the necessary conditions to keep the tuner on the station until a change is desired. In every case the basic tuning cycle for automatic tuning is the same except for minor modifications. These modifications will be found in sections 10 and 11. (Illustration Numbers Called Out in the Outline Refer Only to the Simplified Schematic Diagram and in No Way Refer to Any Service Parts List.)

## Section 9—Electrical Operation Cycle (See Figure 10)

- I. To start the tuner the Station Selector Bar is momentarily depressed actuating the Station Selector Switch (32), which energizes the relay.
  - A. Contact #2 of the Station Selector Switch opens first, ungrounding the secondary of the output transformer (5) therefore, muting the radio before contact #1 closes.
  - B. Contact #1 closes and provides a circuit from B+ through the relay winding, the 13,000 ohm resistor (30) and the Station Selector Switch contact to ground.
  - C. The current through this circuit energizes the Relay (28) and removes the relay arm from the paddle wheel (29)—thus starting the tuner and opening contact #2 and closing contact #1 on the Relay Switch (27).
- II. To keep the tuner seeking after the station selector bar is released, the relay is held energized by a holding circuit.
  - A. Since contact #2 of the Relay Switch is now open, the path to ground for the cathodes of the RF and IF amplifier tubes is through the Sensitivity Control (4) so the sensitivity of the radio can be controlled during the sweeping operation.
  - B. Relay Switch contact #1 is grounded thereby lowering the cathode to ground resistance of the Relay Section of the Trigger

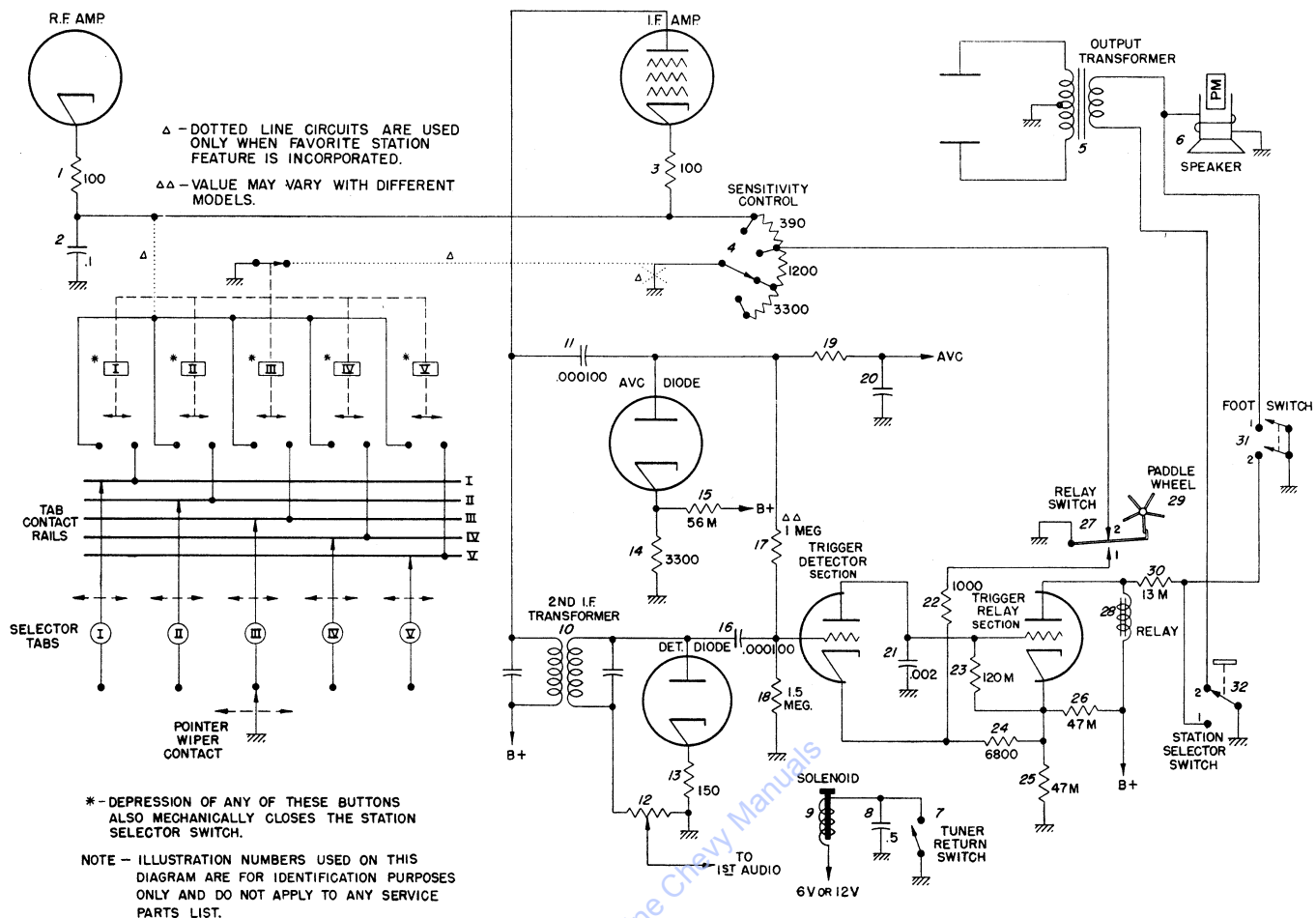


Fig. 10

This Diagram Does Not Refer to Any Particular Radio Model

Tube by putting the 6800 ohm resistor (24) and the 1000 ohm resistor (22) in parallel with the 47,000 ohm cathode resistor (25). This causes a lowering of the cathode voltage thereby causing an increased plate current flow in the Trigger Relay Section which is sufficient to keep the relay energized and the tuner seeking.

Note: The grounding of contact #1 of the Relay Switch also lowers the voltage on the cathode of the Trigger Detector Section of the Trigger Tube. With contact #1 open approximately half the B+ voltage was present at this cathode. With contact #1 shorted to ground the voltage on this cathode is approximately 10 volts. The Trigger Detector Section is now biased in such a manner that a positive voltage on its grid will cause the tube to conduct.

III. To stop the tuner on station, the relay is de-energized by an electronic triggering circuit actuated by an incoming signal.

- A. The incoming signal develops a voltage in the primary and secondary of the 2nd IF transformer. (10)
- B. The IF signal voltage in the secondary of the 2nd IF transformer is coupled thru the capacitor (16) to the grid of the Trig-

ger Detector Section of the Trigger Tube. This voltage is developed across the 1.5 Megohm grid resistor. (18)

- C. The Trigger Detector Section functions as a plate detector. The IF voltage appears on the grid and the tube conducts. The IF component is removed in the plate circuit by the .002 mfd. capacitor (21).
  - D. The plate current flow in the Trigger Detector Section develops a biasing voltage across the 120,000 ohm resistor (23) which is between grid and cathode of the Relay Section of the Trigger Tube, making the grid more negative than the cathode thus reducing the plate current flow through the relay.
  - E. The decrease in plate current flow causes the relay (28) to be de-energized and the Relay Arm again engages the Paddle Wheel (29) thereby stopping the tuner on the station, opening contact #1 and grounding contact #2 of Relay Switch (27).
- IV. To hold the Tuner on the new station until another station is desired, the relay is held de-energized until the starting circuit is again actuated by the operator.
- A. With Relay Switch contact #1 open the 1000 ohm resistor (22) and 6800 ohm re-

sistor (24) are no longer grounded, thus preventing any appreciable current flow in the relay. Since there is no longer any current flow thru the 6800 ohm resistor (24) the voltage at the cathode of the Trigger Detector Section will again go to approximately half the B+ value, making it

impossible for this triode to conduct until the relay is again energized.

- B. Relay Switch contact #2 is grounded which grounds the 390 ohm resistor in the sensitivity control string returning the radio to normal sensitivity.

## Section 10—Modification to the Electrical Cycle of Operation when favorite station tuning is employed (See Figure 10)

The purpose of the mechanical and electrical components of the station selector button circuit is to start the tuner sweep action and at the same time disable the radio until the pointer reaches the portion of the dial pre-selected by the setting of one of the Selector Tabs. At this point the radio is restored to normal operation and the tuner stops on the desired station.

The favorite station circuit is activated when any one of the buttons is depressed. This mechanically trips the Station Selector Switch (32) and at the same time shifts the ground for the RF and IF cathode string from the sensitivity control arm to ground through the Tab Contact Rails, the Selector Tabs, and the pointer wiper contact (See dotted line circuits in Fig. 10). Therefore, the ground is actually present only when the pointer wiper con-

tact brushes the selector tab contact corresponding to the push button which has been depressed. At all other times during the sweep action the RF and IF cathode string is open, hence the radio is dead and cannot stop on any stations. If the Selector Tab has been pre-set to one of the operators favorite stations the tuner stops on this station as outlined in the "Stopping" portion of the preceding Electrical Operation Cycle, with the exception that the ground for the RF and IF cathodes remains through the pointer wiper contact and not through the Relay Switch (27). If the Station Selector Bar is now depressed, the push button which was depressed is mechanically released from its depressed position and the ground for the cathodes is again through the arm of the sensitivity control (4).

## Section 11—Modification to the Electrical Cycle of Operation When Foot Switch (3) tuning is employed (See Figure 10)

The operation of the Foot Switch is essentially the same as the operation of the Station Selector Bar (32). When the foot switch is depressed the speaker voice coil is shorted out thereby muting the speaker during the time a B+ circuit is closed. This eliminates the pop that would normally occur in the speaker when the B+ circuit is completed.

When contact #2 is closed the circuit is completed from B+ through the Relay (28) through the Foot Switch to ground. This causes current to flow through the Relay thereby energizing it. From here on the operation is the same as was discussed in the Electrical Operation Cycle.

## Section 12—The Trigger Detection Circuit (See Figure 10)

The purpose of the trigger detector circuit is to take the input signal voltages of various amplitudes and trigger the relay tube so that the accuracy will be the same on all stations regardless of the signal strength. The grid of the plate detector (Trigger-Detector) is tied back into the AVC line. A portion of the AVC voltage is used to vary the bias on the plate detector in proportion to the strength of the incoming signal. With a strong incoming signal the bias voltage is high and triggering doesn't take place until the tuner gets very near the resonant frequency of the station providing the incoming signal. At this point the IF

signal is great enough to overcome the bias and the plate detector is caused to conduct, stopping the tuner. Likewise on a weak incoming signal the AVC voltage is small and the bias on the plate detector is small, therefore, a smaller amount of IF signal will stop the tuner at a point very close to the peak of the incoming signal. In other words, the AVC voltage raises and lowers the threshold over which the IF signal has to climb in order to stop the tuner. The circuit is so designed that the IF signal voltage is high enough to overcome the bias and stop the tuner only when the tuner has reached the station frequency.

## Section 13—Sensitivity Control (See Figure 10)

The Sensitivity Control (4) is a step switch with resistors of various values between each step. The control is inserted into the cathode circuits of the RF and IF amplifiers during the tuning sweep when contact #2 of the Relay Switch (27) is open.

It is the means by which the operator controls the number of stations on which the tuner will stop.

Note: When a Station Selector Button is used to change stations the sensitivity control has no effect on the stopping sensitivity of the radio.



## ADJUSTMENTS

All illustration numbers in this section can be used in conjunction with the bulletin for the radio involved and do not refer to the Theory of Operation portion of this bulletin.

All adjustments on Signal Seeking Tuners are made accurately at the factory and do not require further adjustment unless it is definitely proven they are wrong or tuner parts are replaced. These adjustments are readily accessible and can be made without removing the tuner from the radio. All adjustments are made with the antenna disconnected from the radio. All adjustments can be reached by removing the front and rear covers of the radio and the adjustment cover on the top of the radio. The correct procedures for making these adjustments are as follows:

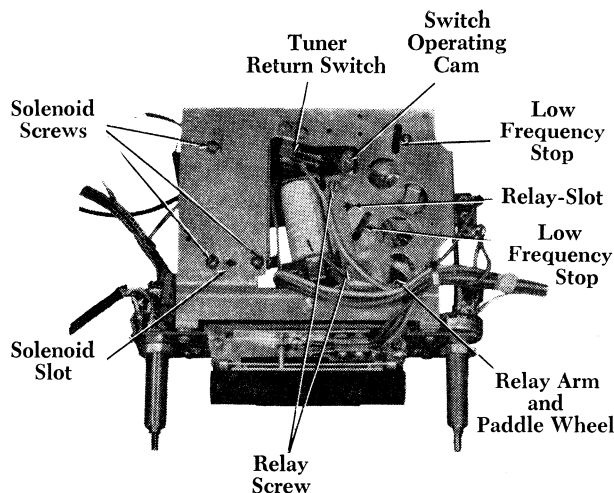
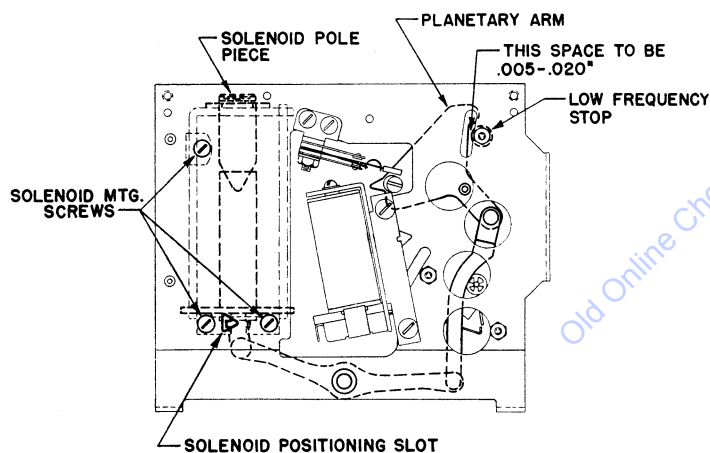


Fig. 11

### Section 14—Solenoid Pole Piece Adjustment (Fig. 12)



SOLENOID POSITIONING ADJUSTMENT

Fig. 12

This adjustment should be made whenever the Solenoid or Solenoid Plunger is replaced. Its purpose is to obtain the correct amount of force from the Solenoid and to prevent the Solenoid Plunger from sticking.

1. With a screwdriver back the Solenoid Pole Piece out of the Solenoid.
2. Bottom the Solenoid Plunger in the Solenoid. The plunger is bottomed when the "C" washer collar on the plunger hits the frame of the Solenoid.
3. Screw the Solenoid Pole Piece into the Solenoid until it just touches the plunger.
4. Back the pole piece off exactly  $1\frac{1}{2}$  turns.
5. Tighten the hex locking nut and seal with glyptal or shellac.

### Section 15—Solenoid Adjustment (Fig. 12)

The Solenoid adjustment should be made whenever solenoid or Solenoid plunger is replaced. Its purpose is to provide the correct amount of solenoid plunger movement to move the tuner to the low frequency end of the broadcast band.

1. With the radio turned off, connect a jumper wire across the 0.5 mfd condenser, Illustration #43, on the cold side of the Solenoid. This is the only paper condenser found on the tuner.
2. Turn the radio on. (This energizes the Solenoid.)

3. Energize the Relay by momentarily depressing the Station Selector Bar.
4. Loosen but do not remove the three solenoid mounting screws.
5. Using a screwdriver in the Solenoid Positioning Slot, turn the screwdriver and move the Solenoid until there is a 0.005 to 0.020 inch gap between the Planetary Arm and its Low Frequency Stop.
6. Tighten the three Solenoid Mounting Screws.
7. Turn the radio off and remove the jumper wire from the condenser.



## Section 16—Relay Adjustment (Fig. 13)

This adjustment should be made whenever the relay is replaced. This is the only adjustment of the relay that should be attempted in the field. The adjustment of the relay is to position the relay arm to have the correct engagement and clearance with the gear train paddle wheel.

1. With the radio turned off, connect a jumper wire across the 0.5 mfd condenser, Illustration #43, on the cold side of the Solenoid. This condenser is found on the tuner.
2. Turn the radio on. (This energizes the Solenoid.)
3. Energize the Relay by momentarily depressing the Station Selector Bar.
4. Loosen but do not remove the two Relay Mounting Screws.
5. Using a screwdriver in the Relay Positioning Slot, turn the screwdriver and move the relay until there is a gap of approximately 0.030 or  $\frac{1}{32}$  inch between the top of the Re-

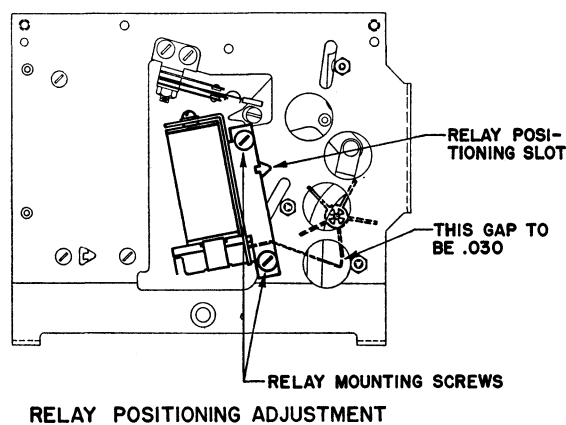
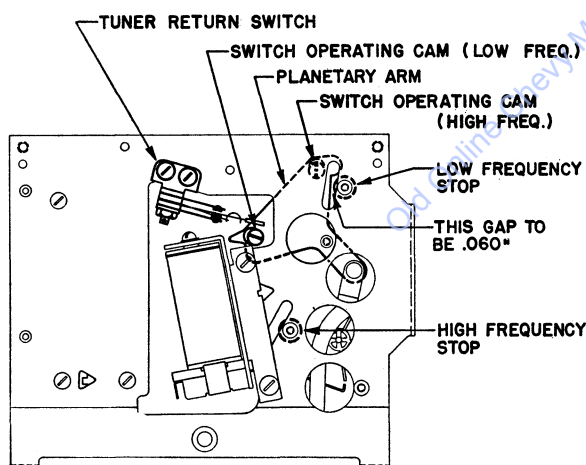


Fig. 13

lay Arm and the tip of the blades on the Paddle Wheel.

6. Tighten the two Relay Mounting Screws.
7. Turn the radio off and remove the jumper wire from the condenser.

## Section 17—Switch Operating Cam Adjustment (Fig. 14)



SWITCH OPERATING CAM ADJUSTMENTS

Fig. 14

This adjustment should be made whenever the Motor Gear Train or the Tuner Return Switch is replaced. Its purpose is to set the timing of the Tuner Return Switch.

1. With the radio turned off, insert a 0.060 inch feeler gauge through the slot against the Low Frequency Stop. Number 14 bare wire is a satisfactory gauge.
2. Position the Planetary Arm against the feeler gauge. This can be done with the manual tuning control or on radios without this control the Planetary Arm can be moved di-

rectly or by moving the core guide bar to the low frequency end of the broadcast band (tuning cores all the way in the coils).

**CAUTION.** ON RADIOS HAVING NO MANUAL TUNING CONTROL, THE PLANETARY ARM CAN BE MOVED ONLY TOWARD THE LOW FREQUENCY STOP WITHOUT DAMAGING THE MOTOR GEAR TRAIN.

3. With a small screwdriver, move the Low Frequency Switch Operating Cam to a position furthest from the Tuner Return Switch.
4. Trip the Tuner Return Switch so that its operating arm is toward the cam.
5. Turn the Low Frequency Switch Operating Cam in a counter clockwise direction until it trips the switch.
6. Insert a 0.060 inch feeler gauge through the slot against the High Frequency Stop.
7. Position the planetary arm against the feeler gauge. **CAUTION: DO NOT USE DIRECT FORCE TO MOVE THE PLANETARY ARM.** The Planetary Arm can be positioned either by using the manual tuning control or on radios without a manual control as follows:
  - (a) Turn the radio on and depress the Station Selector Bar.

- (b) Turn the radio off very close to the high frequency end of the broadcast band.
- (c) With a screwdriver turn the Switch Operating Cam to the position furthest from the Tuner Return Switch.
- (d) Turn the radio on and depress the Station Selector Bar.
- (e) Allow the Planetary Arm to run against the feeler gauge.

- (f) Turn the radio off.
8. Turn the Switch Operating Cam to the position furthest from the Tuner Return Switch if this has not already been done.
9. Trip the Tuner Return Switch so that its operating arm is towards the cam.
10. Turn the High Frequency Switch Operating Cam in a clockwise direction until it trips the Tuner Return Switch.

## REPLACEMENTS

All illustration numbers in this section can be used in conjunction with the bulletin for the radio involved and do not refer to the Theory of Operation portion of this bulletin.

This tuner has been designed to provide a maximum of servicing efficiency. All service parts have been made very accessible and easy to replace. The wiring to the tuner has been made long enough so that the tuner can be dismantled from the radio

case and worked on without disconnecting any leads.

(NOTE: It may be necessary to remove some connections of bond straps.) For most replacements such as the relay, the tuner return switch, etc., no special instructions other than being sure the proper adjustments are made are necessary. However, to facilitate fast replacement of some parts, the following instructions are included:

### Section 18—Motor Gear Train Replacement (Fig. 15)

1. Remove the front and rear cover of the radio.
2. Dismount the tuner from the case and move it out of case far enough so that it can be worked on.
3. Divide the tuner into two parts by:
  - (a) Removing the spring clip holding the gear train planetary arm to the core guide bar linkage.
  - (b) Removing the four tuner assembly screws. (Some tuners have two additional screws.)
  - (c) Separating the two halves of the tuner.
4. On radios having a manual tuning control, remove the worm gear and bracket from the gear train.
5. Disconnect the motor gear train from the solenoid plunger linkage by removing the spring clip holding them together.
6. Remove the three nuts mounting the motor gear train.
7. Mount the new motor gear train to the tuner with the three nuts.
8. Connect the gear train to the solenoid linkage with the spring clip.

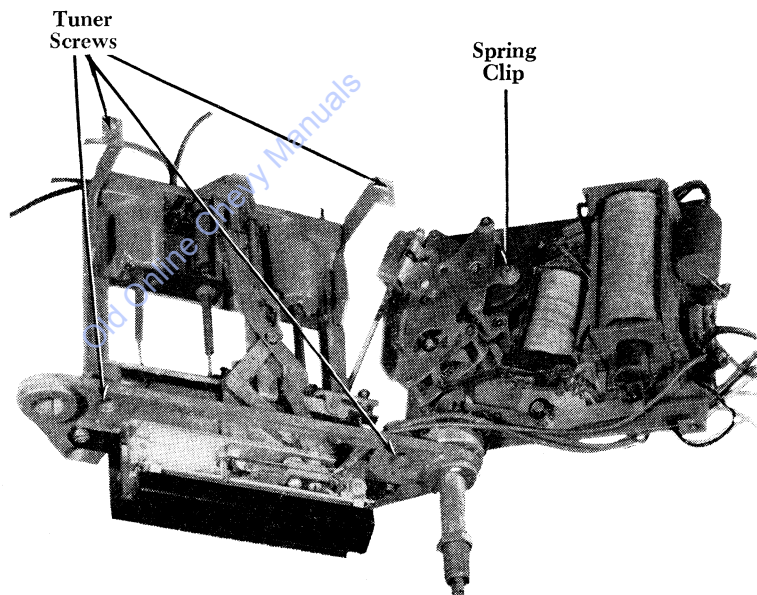


Fig. 15

9. On radios having a manual tuning control, remove the screw holding the manual gear of the gear train in position and mount the worm gear and bracket to the gear train. Be careful to get good gear mesh and do not lose the anti-squeak spring on the worm gear bracket.
10. Reassemble the tuner and make the Switch Operating Cam Adjustment.

### Section 19—Solenoid or Solenoid Plunger Replacement (Fig. 12)

1. Remove the front and rear cover of the radio.
2. Dismount the tuner from the case and move it out of the case far enough so that it can be worked on.
3. Remove the three solenoid mounting screws found on the top of the tuner.
4. Disconnect the two leads to the solenoid.

5. Remove the solenoid and bracket from the rear of the tuner. (It will be necessary to disconnect one lead of a 0.5 mfd condenser on some radios to give sufficient clearance.)
6. Remove the solenoid plunger from its linkage by removing the spring clip holding this linkage to it.
7. Place the plunger in the solenoid and make the Solenoid pole piece adjustment.
8. Install the solenoid plunger and solenoid in the tuner.
9. Fasten the solenoid plunger to its linkage with the spring clip.
10. Connect the leads to the terminals from which they were removed. (If the 0.5 mfd. condenser lead was removed, solder it in place.)
11. Mount the solenoid to the tuner with the three screws and make the solenoid adjustment.

## Section 20—Selector Button Assy. Replacement Series F1 Tuner (See Figs. 16 and 19)

1. Remove the escutcheon from the front of the radio.
2. Dismount the favorite station selector button assembly which is held in place with the two screws through the mounting frame and move it out of the tuner far enough so that it can be worked on.
3. Remove the selector tab rail board which is held in place by the two mounting screws. (The sliding contacts on the favorite station button slides are free to fall out of position after step 3.)
4. Remove the station selector switch.
5. Mount the station selector switch to the new selector button assy.
6. Mount the selector tab rail board to the favorite station selector button assy. (The sliding contacts on the favorite station but-

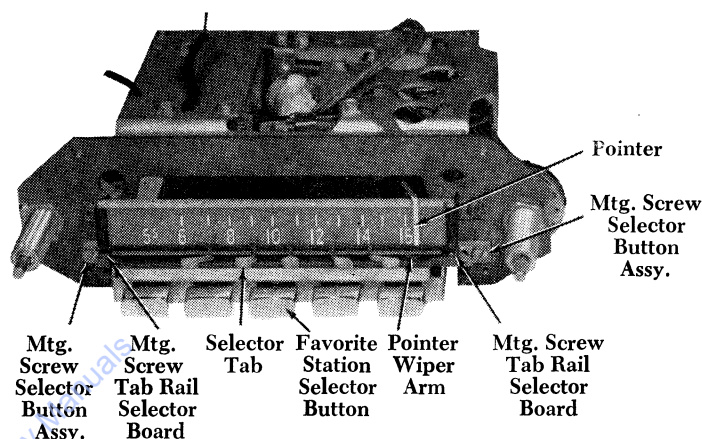


Fig. 16

ton slides must be in place.).

7. Return the favorite station selector button assy. to the tuner and fasten with the two screws. (The pointer wiper arm must be held up to slide the assembly under it.)

## Section 21—Station Selector Switch Replacement Series E2 Tuner (Fig. 17)

1. Remove the escutcheon from the front of the radio.
2. Remove the Station Selector Bar and switch assembly which is held in place with two screws through the mounting plate.
3. Remove the switch and disconnect the leads.
4. Connect the leads to the new switch and assemble to mounting plate.
5. Adjust the position of the Switch Operating Ring so that it over-travels the opening and closing of the switch contacts in both directions about .030 or  $\frac{1}{32}$  inch. This adjustment is made by inserting a screwdriver in the slot on the ring and sliding on the selector bar shaft.

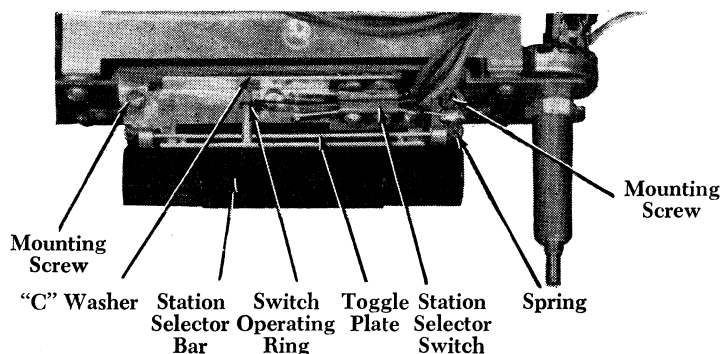


Fig. 17

6. Return the selector bar and switch assembly to the radio and fasten with the two screws.



## Section 22—Station Selector Switch Replacement Series F1 Tuner (Figs. 18 and 19)

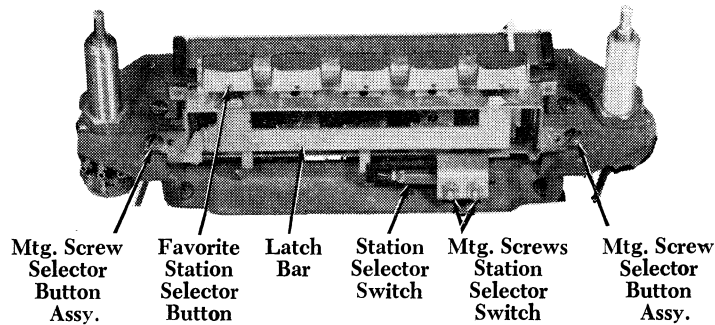


Fig. 18

1. Follow the procedure outlined in section 20 steps 1 and 2.
2. Remove the switch and disconnect the leads.
3. Connect the leads to the new switch and assemble to the mounting frame.
4. Follow the procedure outlined in section 20 step 7.

## Section 23—Station Selector Bar Replacement Series E2 Tuner (Fig. 17)

1. Remove the station selector bar and switch assembly from the radio as described in steps 1 and 2 of **Station Selector Switch Replacement**.
2. Remove the small "C" washer from the end of the station selector bar shaft.
3. Remove the two springs that hold the station selector bar and toggle plate to the mounting plate.
4. Assemble the new station selector bar and toggle plate with the two springs to the mounting plate as shown.
5. Place the "C" washer on the shaft and secure.
6. Adjust the position of the switch operating ring as described in step 5 of **Station Selector Switch Replacement**.
7. Return assembly to the radio and mount with the two screws.

## Section 24—Selector Tab Rail Board Replacement Series F1 Tuner (See Figs. 16 and 19)

1. Follow the procedure outlined in Section 20, steps 1, 2, and 3.
2. Disconnect the two leads from the selector tab rail board at the sensitivity control.
3. Solder the leads from the new board to the sensitivity control.
4. Place the selector tabs on the new board in the proper sequence. (See Fig. 19)
5. Follow the procedure outlined in section 20, steps 6 and 7. (**The sliding contacts on the favorite station button slides must be in place.**)

## Section 25—Selector Tabs Replacement Series F1 Tuner (See Figs. 16 and 19)

1. Follow the procedure outlined in Section 20, steps 1, 2, and 3.
2. Remove the tab which is to be replaced.
3. Slip the new tab on to the selector tab rail board.
4. Make certain the five selector tabs are in the proper sequence.
5. Follow the procedure outlined in Section 20, steps 6 and 7.

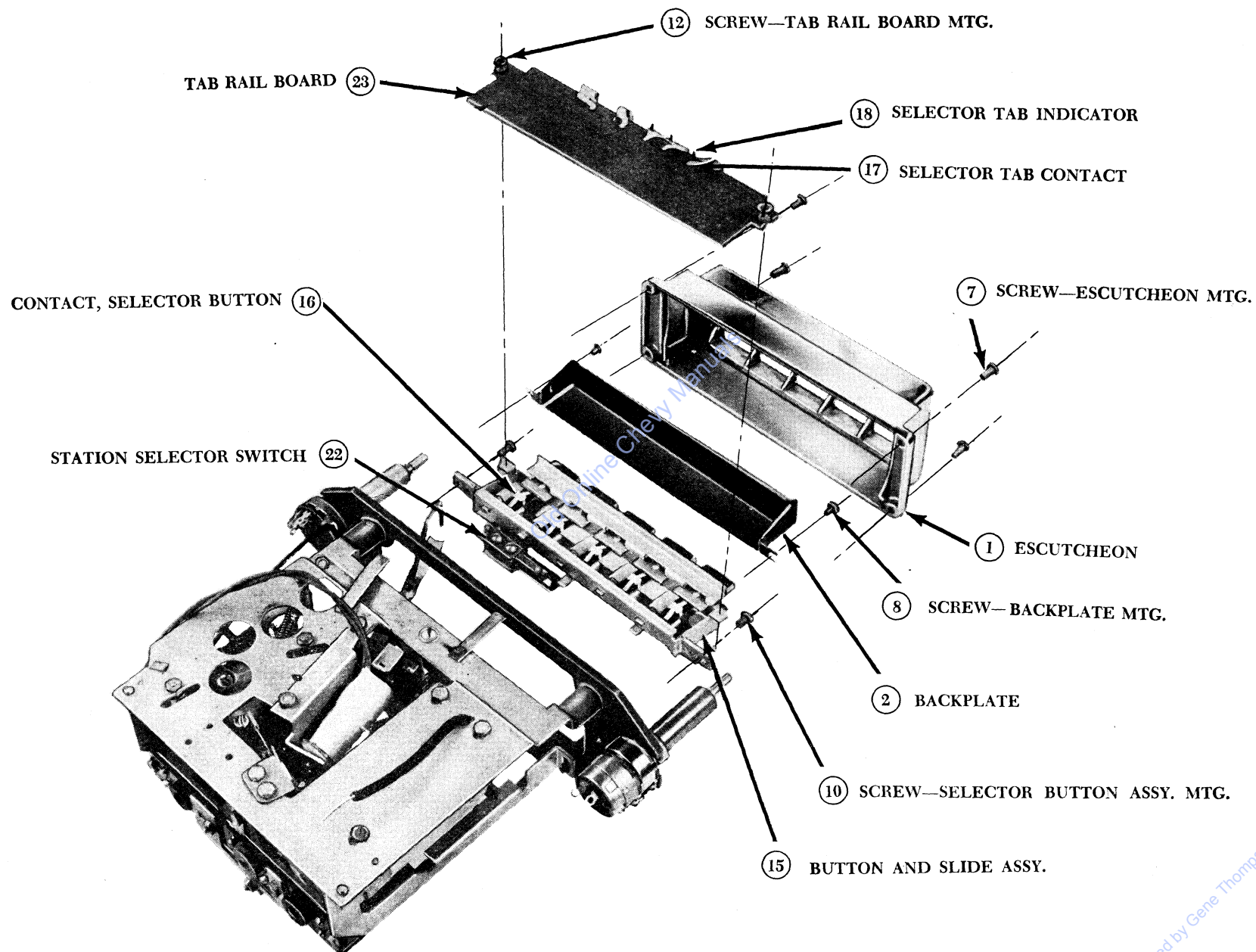


Fig. 19

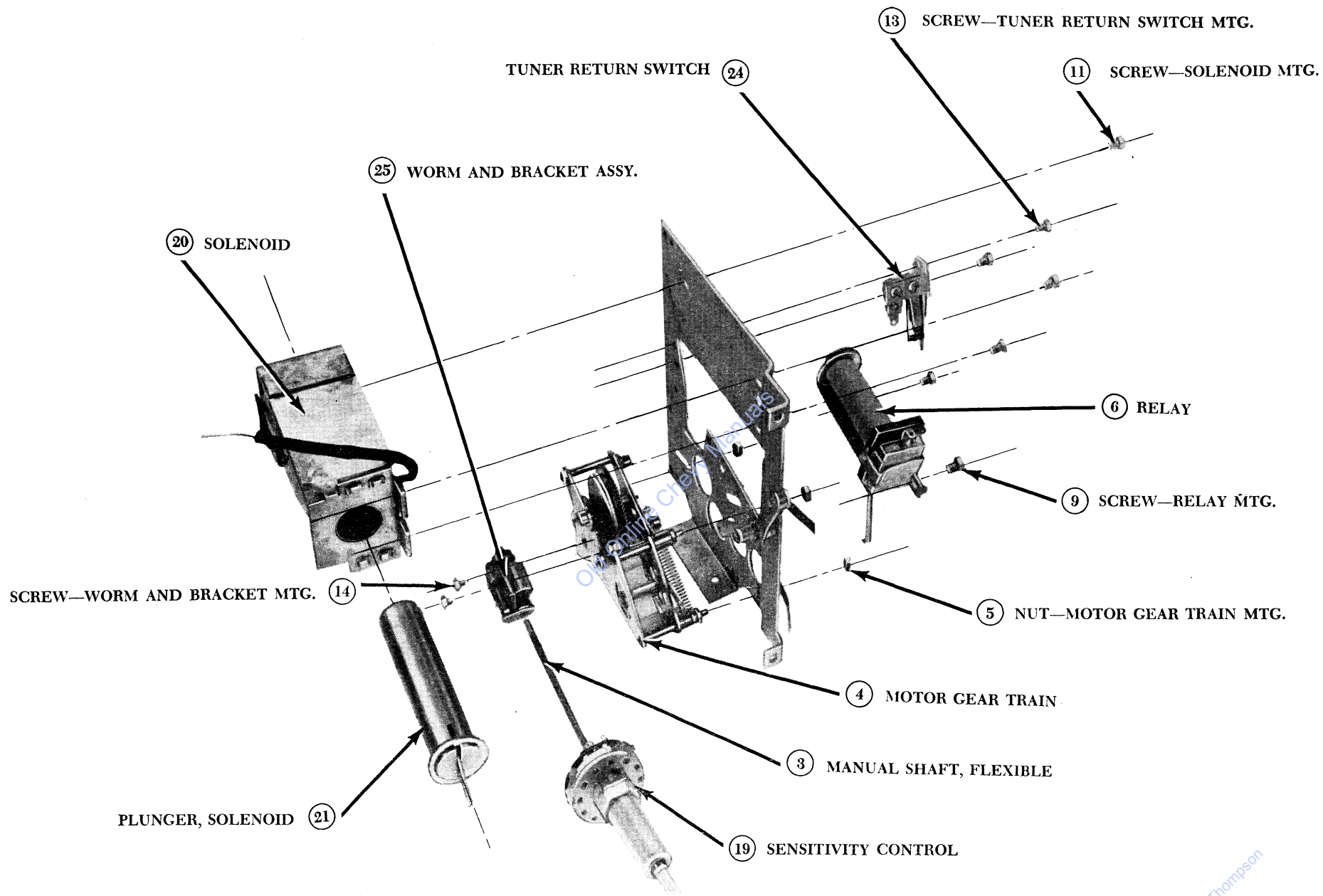


Fig. 20



## SERVICE PARTS LIST

The service part numbers shown below are identical for all series E2 and F1 Tuners. The parts designated (See Radio Bulletin) are different for the various radios and part numbers may be found in the individual bulletins (Tuner parts shown on pages 13 and 14, illustrations 19 and 20.)

Illus. No.	Part No.	Description
1	(See Radio Bulletin)	Escutcheon
2	(See Radio Bulletin)	Backplate
3	(See Radio Bulletin)	Manual Shaft - flexible
4	1219610 (Illus. 116 in Radio Bulletin)	Motor Gear Train
5	* 134524	Nut - Motor Gear Train Mtg.
6	7263365 (Illus. 87 in Radio Bulletin)	Relay
7	* (Description and Model)	Screw - Escutcheon Mtg.
8	* (Description and Model)	Screw - Dial and Backplate Mtg.
9	* 451694	Screw - Relay Mtg.
10	* 132684	Screw - Selector Button Assy. Mtg.
11	* 451694	Screw - Solenoid Mtg.
12	* 132622	Screw - Tab Rail Board Mtg.
13	* 451694	Screw - Tuner Return Switch Mtg.
14	* 451690	Screw - Worm and Bracket Mtg.
15	(See Illus. 111 in Radio Bulletin)	Button and Slide Assy.
16	(See Illus. 82 in Radio Bulletin) (Included with contacts)	Contact, Selector Button (Set of 5) Insulator, Contact
17	(See Illus. 83 in Radio Bulletin)	Selector Tab Contact (Set of 5)
18	(See Illus. 119 in Radio Bulletin)	Selector Tab Indicator (Set of 5)
19	(See Illus. 84 in Radio Bulletin)	Sensitivity Control
20	(See Illus. 88 in Radio Bulletin)	Solenoid
21	(Included in Solenoid Assy.)	Plunger, Solenoid
22	7263345 (Illus. 91 in Radio Bulletin)	Station Selector Switch
23	(See Illus. 81 in Radio Bulletin)	Tab Rail Board
24	7263340 (Illus. 90 in Radio Bulletin)	Tuner Return Switch
25	7259026 (Illus. 117 in Radio Bulletin)	Worm and Bracket Assy.

\* These parts are not required normally for service but may be ordered by specifying part number or illustration number, model number and description of part as shown in this parts list.

## TROUBLE SHOOTING PROCEDURE

To facilitate systematic trouble isolation, the trouble shooting portion of the bulletin starts with three tests to isolate the tuner trouble into a starting, holding, or stopping trouble. The fourth test involves repetition of these tests using push buttons or a footswitch if applicable.

The abnormal indications which can be obtained as a result of these initial tests are indicated below the tests in the blocks inclosed by the irregular lines, and further directs you to the approximate chart for further isolation tests.

The charts which follow the Initial Diagnosis Procedure show a simplified schematic diagram of the tuner portion of the radio, with that portion of the schematic which is involved in the particular trouble in heavy lines. This will help you to trace the circuit and find troubles which may have been omitted from the chart. The illustration numbers on these charts correspond to the illustration numbers of the particular set bulletins.

Through the use of this outlined procedure, the vast majority of tuner troubles can be solved in a minimum of diagnosis time.

## INITIAL DIAGNOSIS PROCEDURE

### Test 1 — Preliminary Test

CHECK TUBES AND VIBRATOR. CONNECT RADIO TO POWER SOURCE AND TURN ON. AFTER WARMUP, ADJUST INPUT VOLTAGE AT RECEIVER SPARK PLATE TO 6.0 VOLTS OR 12.0 VOLTS AS SPECIFIED. IF TUNER REMAINS STATIONARY GO TO TEST 2.

TUNER SWEEPS WHEN POWER IS TURNED ON—See Chart 4, Condition 2  
TUNER SWEEPS AFTER WARMUP —See Chart 4, Condition 3

### Test 2 — Starting and Holding Test

DEPRESS AND RELEASE THE STATION SELECTOR BAR. (Antenna disconnected)

TUNER STARTS WHEN BAR IS DEPRESSED AND CONTINUES THE SWEEP CYCLE, after the bar is released. Go to TEST 3.

TUNER WILL NOT START. Observe relay arm as bar is depressed.  
RELAY ENERGIZES AND FREES TUNER.—See Chart 1.  
RELAY ENERGIZES BUT DOES NOT FREE TUNER.—See relay adjustment. Page 9  
RELAY DOES NOT ENERGIZE.—See Chart 4, Condition 1

TUNER STARTS, BUT STOPS immediately when bar is released.—See Chart 2

TUNER DOES NOT SWEEP SMOOTHLY, through its cycle. See Chart 3.

### Test 3 — Stopping Test

CONNECT ANTENNA. SET VOLUME AND SENSITIVITY CONTROLS TO MAXIMUM. ADJUST ANTENNA TRIMMER.\* DEPRESS AND RELEASE STATION SELECTOR BAR.

TUNER STOPS ON STATIONS NORMALLY RECEIVED IN THE LOCALITY. Go to TEST 4 if applicable.

TUNER WILL NOT STOP ON STATIONS although stations can be heard momentarily as tuner rejects them. (Volume at maximum.) See Charts 5 and 7.

TUNER WILL NOT STOP ON STATIONS, and stations cannot be heard as tuner rejects them. (Volume at maximum.) See Chart 5.

TUNER STOPS ONLY ON STRONG STATIONS. See Chart 7.

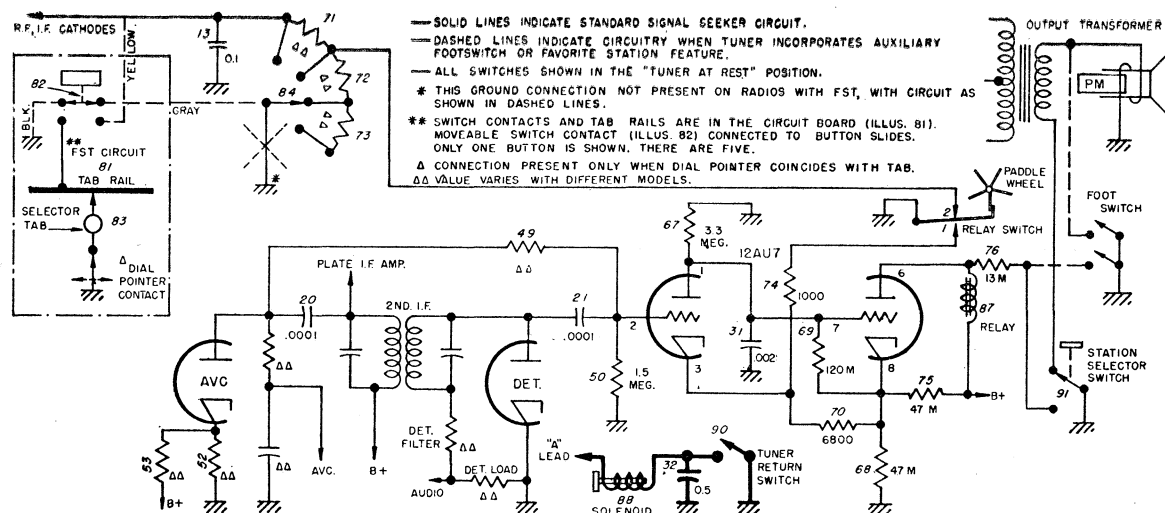
TUNER STOPS AT VARIOUS POINTS, but the audio is dead. See Chart 6.

### Test 4 — Pushbutton and Footswitch Test

REPEAT TEST 2 AND TEST 3 USING FOOTSWITCH AND/OR EACH PUSHBUTTON INSTEAD OF THE STATION SELECTOR BAR. Go to appropriate chart.

\*On radios not incorporating a manual tuning control, the radio can be tuned to a weak station by physically moving the core bar from HIGH to LOW frequency. DO NOT MOVE THE CORE BAR IN THE OTHER DIRECTION, AS DAMAGE TO THE GEAR TRAIN WILL RESULT.

## CHART 1



### CONDITION I:

POINTER STATIONARY AT **HIGH FREQUENCY** END OF DIAL.  
 MOMENTARILY SHORT OUT 0.5 MFD CAPACITOR, Illust. 32.

IF

SOLENOID OPERATES, check

1. Adjustment of high frequency tuner return switch operating cam. (See Adjustments)
2. Solenoid switch for possible open.
3. "A" circuit from "A" lead to solenoid for excessive voltage drops.

IF

SOLENOID DOES NOT OPERATE, check

1. Solenoid. Voltage across solenoid must be at least 5.5 volts or 11.0 volts to operate 6 or 12 volt solenoids.
2. Check for bind in tuner. See Condition III below.

### CONDITION II:

POINTER STATIONARY AT **LOW FREQUENCY** END OF DIAL  
 MAKE A VISUAL CHECK OF THE POSITION OF THE TUNER RETURN SWITCH.

IF

SWITCH IS CLOSED, check

1. Adjustment of low frequency tuner return switch operating cam. (See Adjustment. Page 9)
2. Switch for proper operation mechanically.

IF

SWITCH IS OPEN, check

1. Switch for possible shorted terminals.
2. 0.5 capacitor, Illust. 32.
3. Tuner bind. See Condition III.

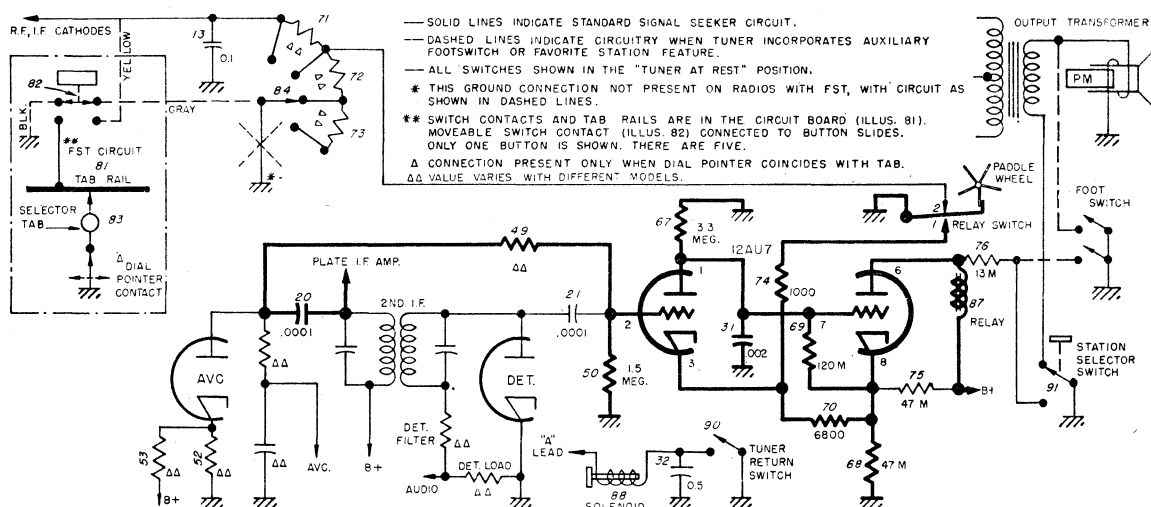
### CONDITION III:

POINTER STATIONARY AT A **MIDWAY POINT**, OR AT THE ENDS OF THE DIAL.  
 CHECK FOR MECHANICAL BIND.

1. Make a visual check for improperly routed wires which could be fouling mechanism.
2. Separate tuner into halves, (See Section 18, page 10.)
3. Check each half of the tuner to find defective half.
4. Disconnect spring clips and operate each mechanism separately to determine whether bind is in core guide bar, pointer linkage, solenoid, or motor gear train.



## CHART 2



DIAL POINTER STOPS INSTANTLY WHEN STATION SELECTOR BAR IS RELEASED.

I. Check Trigger Tube (12AU7). If ok go to next check.

II. Measure voltage across 120M ohm resistor (Illus. 69) with radio turned on, and selector bar depressed (Vacuum Tube Voltmeter required.)

IF

LESS THAN 15 VOLTS, CHECK

1. 1000 ohm resistor (Illus. 74)
2. Relay switch contact #1.
3. Ground connection of relay switch.
4. Relay.

IF

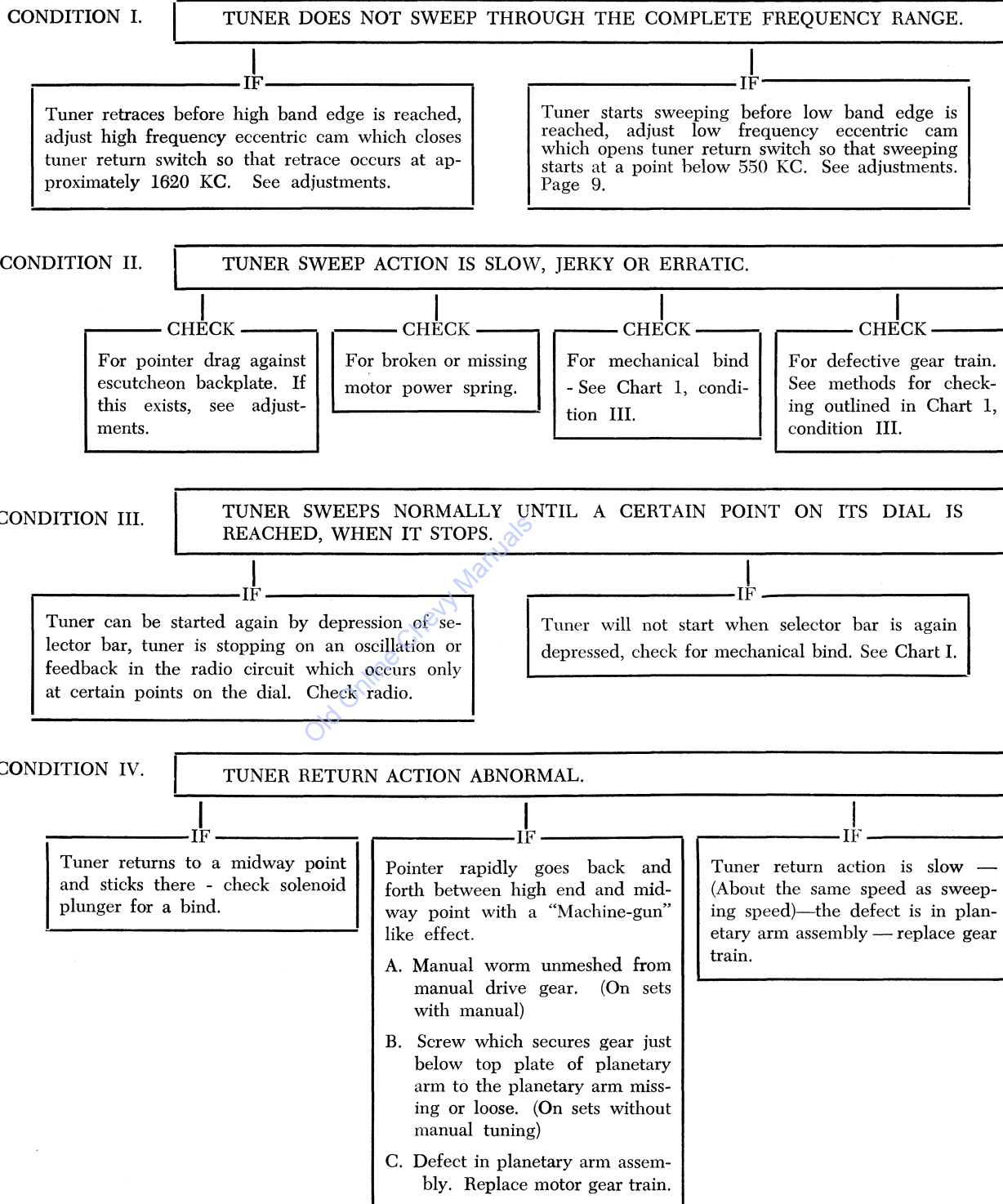
MORE THAN 15 VOLTS, CHECK

1. .002 mfd. capacitor, (Illus. 31)
2. \*Pin 1 and Pin 7 for shorts to chassis.
3. .0001 mfd. capacitor for leakage, (Illus. 20)
4. 120 M resistor, (Illus. 69)
5. \*Pin 1 to Pin 2 for short.
6. \*Pin 3 to chassis for short.
7. 6800 ohm resistor (Illus. 70)

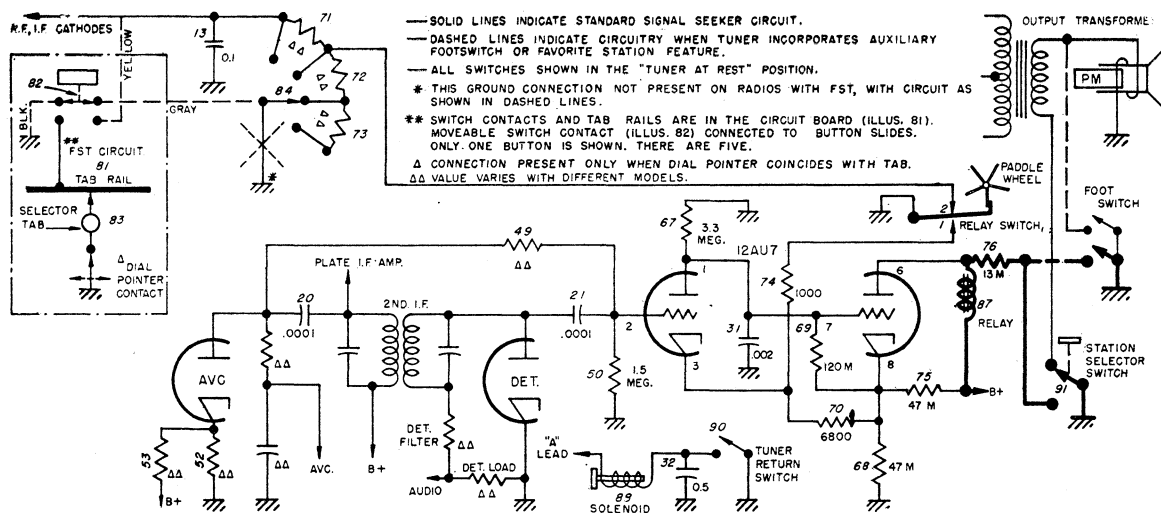
\* Pin number on 12AU7 socket.

## CHART 3

### Miscellaneous Defects in the Sweep Action of the Tuner



## CHART 4



CONDITION I: RELAY DOES NOT ENERGIZE WHEN SELECTOR BAR OR A PUSH BUTTON IS DE-PRESSED.

Observe whether the switch is operated mechanically. If not, correct mechanical trouble.

MEASURE VOLTAGE BETWEEN CHASSIS AND THE SWITCH SIDE OF THE 13 M ohm RESISTOR (Illus. 76) WITH NOMINAL INPUT VOLTAGE THE B+ VOLTAGE AT THIS POINT MUST BE AT 180 VOLTS FOR PROP-ER RELAY OPERATION.

IF

VOLTAGE IS LOW, check  
 1. Relay for open winding.  
 2. 13 M ohm resistor.  
 3. Radio B+ circuit.

IF

B+ VOLTAGE IS OBTAINED, check  
 1. Station selector switch, Illus. 91.  
 2. 13 M ohm resistor, Illus. 76.  
 3. Relay. Should energize at 9.5 m.a.

CONDITION II: TUNER STARTS WHEN RADIO IS TURNED ON, WITHOUT PREVIOUS OPERATION OF THE STARTING SWITCH, check

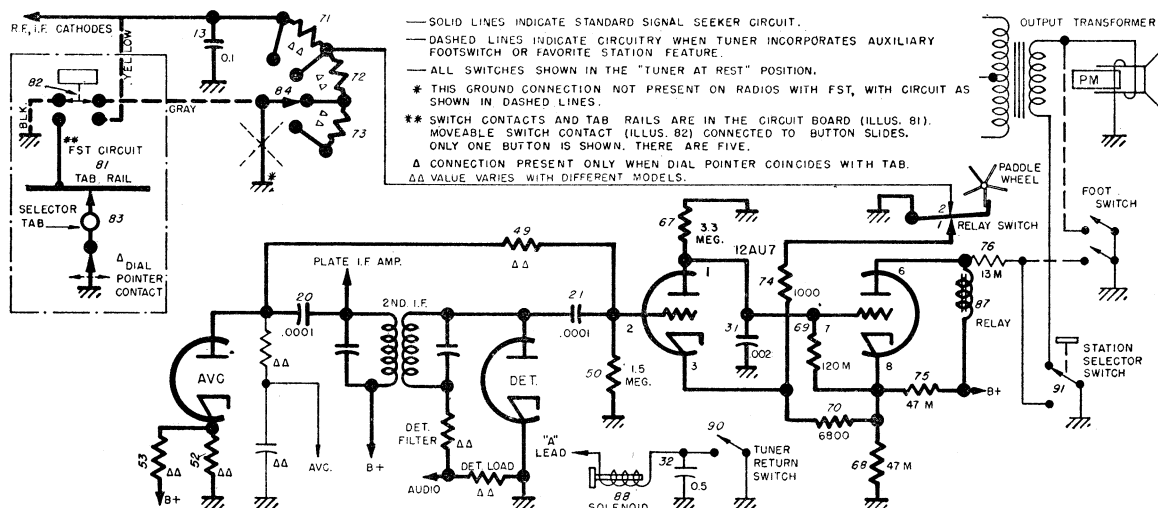
1. Station selector switch, Illus. 91.
2. Both ends of 13M resistor, Illus. 76, for possible chassis short.
3. Pin 6 of 12AU7 for short to chassis.

CONDITION III: TUNER STARTS AFTER RADIO WARMS UP, WITHOUT PREVIOUS OPERATION OF THE STARTING SWITCH, check

1. 12AU7 tube.
2. Pin 8 on 12AU7 for short to chassis or heater terminal.



## CHART 5



CONDITION I: TUNER WILL NOT STOP ON STATIONS, WHEN THE SELECTOR BAR IS USED.

CHECK RADIO SENSITIVITY UNDER "SEEKING" CONDITIONS WITH THE PADDLE WHEEL BLOCKED AND THE RELAY HELD ENERGIZED BY SHORTING OUT THE 47M RESISTOR, Illus. 68. OBSERVE WHETHER STATIONS NORMALLY RECEIVABLE IN YOUR LOCALITY CAN BE TUNED IN\* WITH NORMAL VOLUME OR MEASURE THE SENSITIVITY.

IF — SENSITIVITY IS NORMAL, check

1. 12AU7 tube.
2. .0001 mfd. capacitor, Illus. 21.
3. 1000 ohm resistor, Illus. 74.
4. 47M ohm resistor, Illus. 75.
5. Cathode at AVC tube for possible short to chassis.
6. B+ to AVC cathode bleeder resistor, Illus. 53. (Not present on some models.)
7. Sensitivity control, (Illus. 84) and associated resistors.
8. 2nd IF (Illus. 7.)
9. .002 capacitor, Illus. 31.

IF — SENSITIVITY IS BELOW NORMAL, check

1. Radio proper under relay energized conditions for defect which is causing low sensitivity.
2. RF and IF ground return through sensitivity control.
3. Pin 2 of 12AU7 for chassis short.
4. If tuner includes push button continuity to ground from sensitivity control arm through the circuit board, with all buttons in "out" position. If open, check for defective circuit board, switch contact in button and slide assembly or a defective pushbutton slide contact.

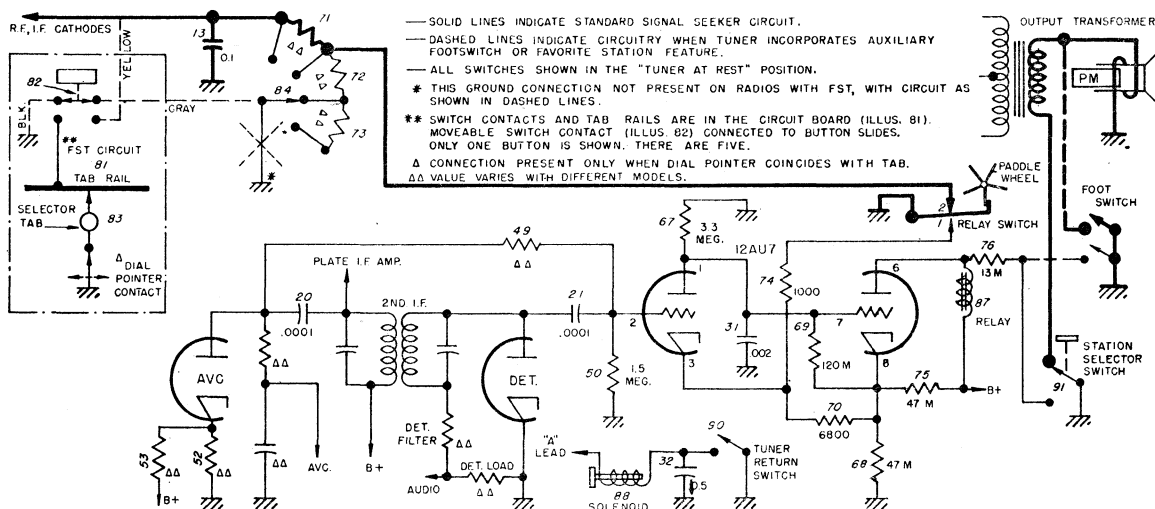
CONDITION II: TUNER STOPS ON STATIONS WHEN SELECTOR BAR IS USED, BUT NOT WHEN A BUTTON IS DEPRESSED.

Check for a ground return from the RF and IF cathode string with each button depressed in turn, and the corresponding selector tab adjusted to coincide with the dial pointer setting. If continuity is not obtained, check

1. Connection between cathode string and circuit board. (Illus. 80)
2. Connection between pointer contact and selector tab.
3. Selector tabs. (Illus. 83)
4. Tab rail circuit board. (Illus. 81)

\*This check made with antenna trimmer adjusted. On sets which do not have manual control, the radio can be tuned by moving physically the core guide bar from **HIGH** to **LOW** frequency. DO NOT MOVE CORE BAR FROM LOW TO HIGH FREQUENCY, as damage to the gear train will result.

## CHART 6



TUNER STOPS ON STATIONS WITH SELECTOR BAR TUNING, BUT RADIO IS DEAD OR WEAK AFTER STOP.

IF:

### DEAD, CHECK

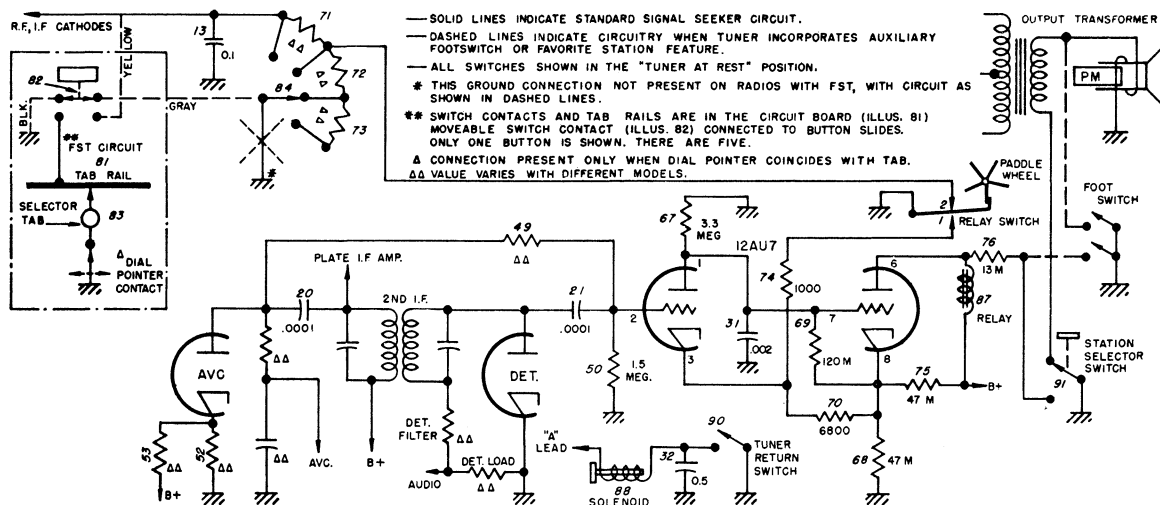
1. Detector and audio system for possible failure.
2. For open between station selector switch (Illus. 91) and output transformer.
3. Footswitch for possible sticking (If used.)
4. .002 mfd. capacitor (Illus. 31) for open.
5. For strong oscillation in RF or IF circuits.

IF:

### WEAK, CHECK

1. Relay (Illus. 87) contact #2 for continuity to chassis.
2. Radio sensitivity (See Chart 1)
3. For oscillation in RF or IF circuits.

## CHART 7



TUNER STOPS ON STRONG STATIONS ONLY, EVEN WITH SENSITIVITY CONTROL ADJUSTED TO MAXIMUM.

(Make certain radio sensitivity is normal, See Chart 5) CHECK,

1. .0001 mfd. capacitor (Illus. 21.)
2. 1.5 Meg. resistor (Illus. 50.)
3. 1.0 Meg. resistor (Illus. 49.)
4. 1000 ohm resistor (Illus. 74.)
5. Resistors (Illus. 52 and 53.)
6. AVC tube.
7. 2nd IF.
8. Plate load resistor of triode section of AVC tube.
9. .022 mfd. capacitor, (Illus. 31.)