

# Motorola **AUTO** Radio

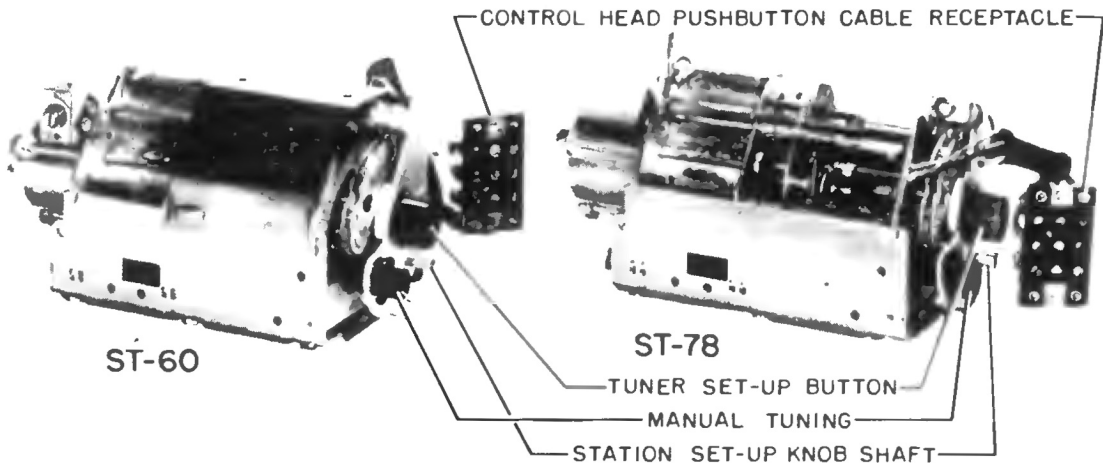
## SERVICE MANUAL

SOLENOID  
TUNER

MODELS

ST-60

ST-78



### GENERAL

Solenoid Tuners ST-60 and ST-78 are used in Motorola electric push-button standard auto receivers.

Fundamentally ST-60 and ST-78 tuners are the same. The two tuners differ in push-button switch lead lengths, oscillator coil, sleeve and shield, tuning cores, antenna trimmer and cover over ST-60 carriage. These tuners are similar to the original Motorola ST-54 solenoid tuner.

This is a 3 gang permeability type tuner operated by a solenoid. Five pre-set and one manual tuning positions are provided. The frequency range is 535 to 1600 kc. The pre-set positions can be set to any frequency within this range.

The tuner is designed to operate satisfactorily with 4.5 to 7.3 volts input. Before attempting any service work on a tuner that operates too slowly or one that doesn't operate at all, check the battery voltage directly at the receiver

spark plate. Normally, this voltage is 6.3 volts. At the moment any push-button is pressed, the voltage at the spark plate should not drop to less than 4.5 volts. If the voltage is less than 4.5, it is an indication of poor wiring between the car battery and receiver or a defective car battery.

This tuner depends on "dash-pot" action between the plunger and the solenoid for proper operation. When the fit between the plunger and solenoid is too tight, the air can't get out fast enough. The result is a slow or sluggish operating tuner. All ST-60 and ST-78 tuners have an adjustable air release in the solenoid end plate. See Figures 1 & 3.

The tuner solenoid coil must be in a horizontal or near horizontal position or the tuner will not operate properly. If it is operated with the coil in a vertical position, the solenoid and carriage return spring may not be strong enough to operate the tuner.

### TO SET UP AUTOMATIC TUNER

- a. Turn receiver on and allow it to warm up for a few minutes.
- h. Collapse antenna until signal is weak.
- c. Press Manual "M" button on control head.
- d. Turn tuning knob until desired station is tuned in. (Make a mental note of the program). For best results choose only local stations.
- e. Press desired button and wait until tuning mechanism completes its operation.
- f. Press automatic tuner set-up button until "click" is heard. (See detail above.)
- g. Turn automatic tuner set-up knob until previously noted program is heard. NOTE: Check the setting of the automatic button just set up by pressing the "M" button and manually tune in the station. There should be no difference in volume or clarity when the station is tuned in either manually or automatically. If a difference is noted, reset the automatic tuner push button more accurately by repeating above procedure. Also make sure the push button is set to same station that was selected manually and not to a weak distant station carrying the same network program.
- h. Repeat steps c, d, e, f and g for balance of buttons.

# MOTOROLA Auto Radio Solenoid Tuner, Models ST-60 and ST-78

## THEORY OF OPERATION

NOTE: Throughout these paragraphs, it is suggested that constant reference be made to Figure 1.

When any push-button is pressed, current flows through the solenoid coil, causing the plunger to pull into the coil. Near the end of the plunger travel, through a ratchet mechanism inside the plunger, the selector switch shaft is rotated 60°, moving the selector switch and stop plate to their new position.

An instant later, the solenoid switch is opened breaking solenoid current and the carriage return spring then pulls the plunger out, closing the solenoid switch again. If the selector switch is now resting at the position selected by the push-button (cut away section of selector switch resting in front of contact selected by push-button), the solenoid plunger will continue to be pulled out until the stop plate is resting on the selected lead screw stop. In the event the selector switch is not resting in the position selected by the push-button when the solenoid plunger is on its return trip, the moment the plunger moves out far enough to actuate the solenoid switch, current will again flow through solenoid causing the plunger to be pulled in again. The plunger's inward motion again rotates the stopplate and selector switch through another 60°. This last operation is repeated automatically until the selector switch comes to rest at the position selected by the push-button, at which time the solenoid circuit is opened and the plunger moves out until the

stop plate is resting on the selected lead screw stop. The stops are adjusted to the desired positions during the station setting up procedure, through the set-up gear train assembly.

Refer to Figure 2 for mechanics behind station setting-up mechanism detail.

When the button on which a station is to be set up is first pressed, the tuner operates and the stop plate comes to rest against the selected lead screw stop. The pressure of the stop plate against the lead screw stop moves the lead screw forward until its shoulder rests against the tuner end plate. The square end of the lead screw does not engage in the square hole of the set-up gear until the set-up button is pushed in and the station set-up knob is turned. A latch on one end of the detent lever engages the gear lever, holding the set-up gear train in contact with the selected lead screw. Now the selected lead screw stop can be moved on its lead screw by turning the station set-up knob. None of the other lead screws turn because the stop plate is not resting against them. After the button is set up, pressing any other button will unlatch the gear lever and disengage the lead screw from the set-up gear. See Figure 2.

Since the coil tuning iron cores are attached to the carriage plate and move in unison with the plunger, the point at which they are brought to a stop (by means of the lead screw stop) determines the frequency to which the coils are tuned.

## TO REMOVE TUNER FROM CHASSIS

Should it become necessary to remove the solenoid tuner from the receiver chassis, proceed as follows:

1. Remove the covers from the set, completely exposing the chassis.
2. Mark all leads connecting tuner to receiver.

3. Disconnect all leads connecting tuner to receiver. The control head connecting receptacle is to be removed by unscrewing the two self-tapping screws. Do not unsolder leads from the tuner selector switch.

4. The tuner is held to the chassis by self-tapping screws driven into the sides of the tuner. Do not remove any other screws.

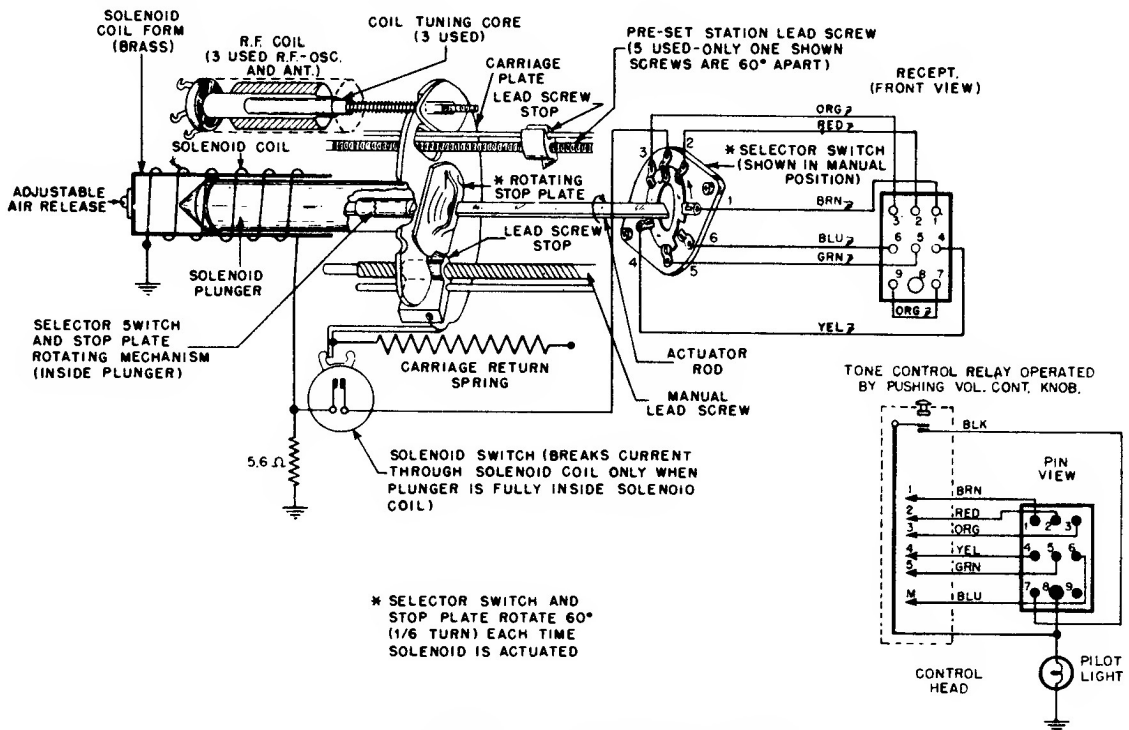
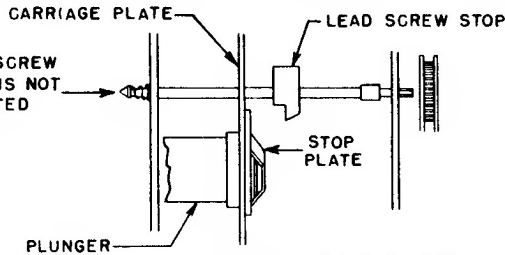


FIGURE 1. TUNER FUNCTIONAL DETAIL

# MOTOROLA Solenoid Tuner, Models ST-60 and ST-78

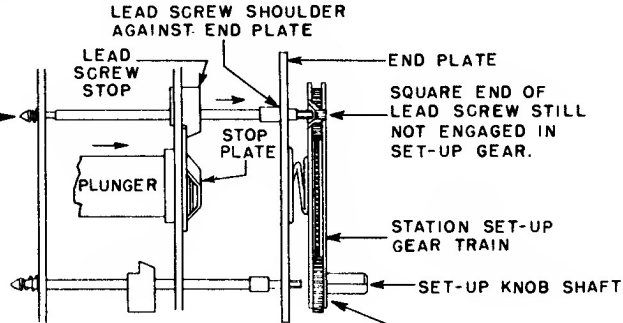
1.

POSITION OF LEAD SCREW WHEN STOP PLATE IS NOT RESTING ON SELECTED LEAD SCREW STOP.



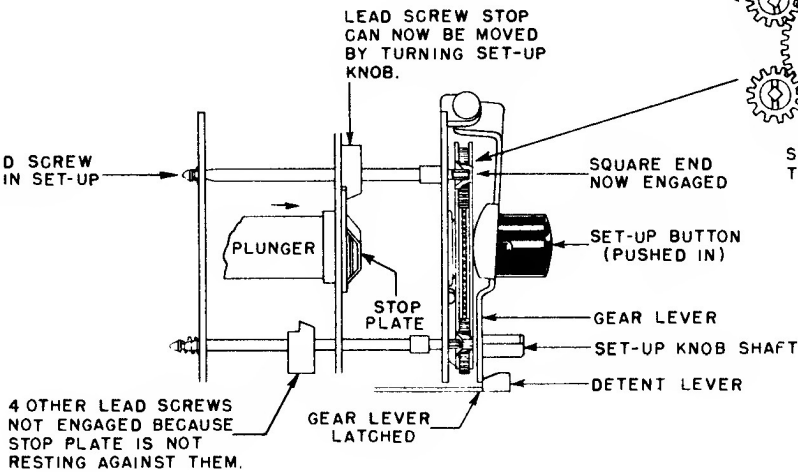
2.

POSITION WHEN STOP PLATE IS RESTING AGAINST LEAD SCREW STOP.



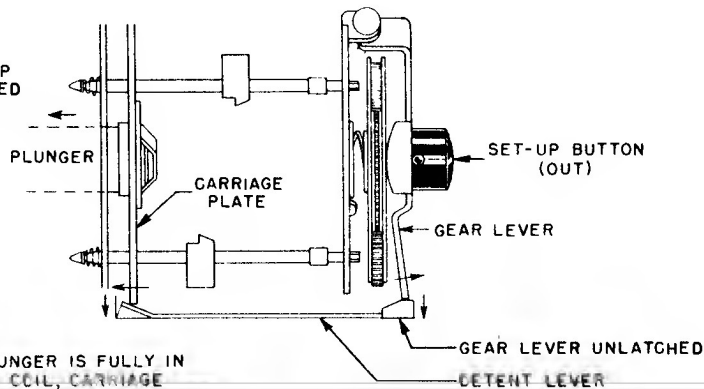
3.

SELECTED LEAD SCREW NOW ENGAGED IN SET-UP GEAR.



4.

AFTER STATION IS SET UP GEAR LEVER IS UNLATCHED BY PRESSING A BUTTON



WHEN PLUNGER IS FULLY IN SOLENOID COIL, CARRIAGE PLATE RELEASES GEAR LEVER AS SHOWN, DISENGAGING LEAD SCREW FROM SET-UP GEAR.

FIGURE 2. STATION SET-UP MECHANISM

# MOTOROLA Auto Radio Solenoid Tuner Models ST-60 and ST-78

## ADJUSTMENTS

### AIR RELEASE ADJUSTMENT

The speed at which the tuner operates is governed by dash-pot action of the solenoid plunger within the closed solenoid coil form. The rate at which air is allowed to enter or escape determines the speed of the plunger.

An adjustable air release is provided on all ST-60 and ST-78 tuners. See Fig. 3. To adjust, loosen the screw and move the eccentric washer which covers the air release hole to expose or cover more of the air release hole as required.

1. If tuner operates too slowly, open the air release hole. Open it only far enough to secure reliable operation. Too little "dash-pot" action (air release open too much) may cause the plunger to hammer and sometimes even to make the tuner operate continuously due to the selector switch rotor being turned so rapidly as to overshoot its contacts.
2. If the tuner operates too rapidly increase dash-pot action by closing the air release hole slightly. Close it only enough to eliminate hammering.

### PLUNGER RATCHET ADJUSTMENT

The plunger ratchet mechanism is shown in Figure 4. This mechanism rotates the actuator rod which, in turn, rotates the carriage stop plate and the selector switch  $60^\circ$  for each inward motion of the plunger.

If this adjustment is incorrect, tuner may operate continuously once current is applied.

Correct ratchet adjustment is indicated when  $1/64"$  to  $1/32"$  clearance is observed between selector switch contacts and the selector switch rotor as shown in Figure 5. Slowly work the plunger by hand and observe clearance at each contact position. If the average clearance is not  $1/64"$  to  $1/32"$ , correction can be made by loosening ratchet adjustment setscrew and turning actuator rod by hand until correct clearance is observed.

Before ratchet adjustment setscrew is finally tightened, push fixed ratchet  $1/32"$  back into plunger. This increases spring tension against rotating ratchet, thus insuring more positive operation.

### SOLENOID SWITCH TRIP ADJUSTMENT

The solenoid switch tripping mechanism should be adjusted as shown in Figure 6.

If the solenoid switch is tripped too early, the ratchet mechanism may fail to operate; if it trips too late, the plunger may hammer violently or should the solenoid switch fail to trip, the plunger would be held within the solenoid.

### FAILURE OF SOME LEAD SCREW TO ENGAGE IN SET-UP GEARS

If some of the lead screws fail to engage in the set-up gears during station setting up procedure, check the gear lever to see if it is bent. When the set-up button is pushed in and the gear lever latches on the detent lever, the set-up gear train should be parallel with the tuner end plate and the bottom of the gear train should be resting on the raised portions of the tuner end plate.

### END VIEW OF TUNER

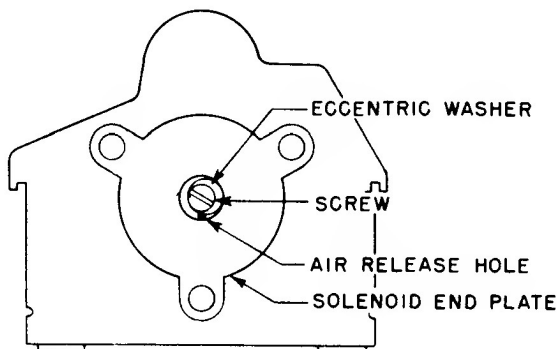


FIGURE 3. AIR RELEASE ADJUSTMENT

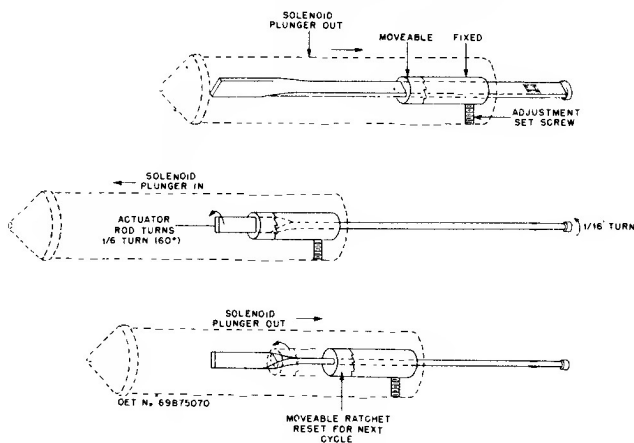


FIGURE 4. PLUNGER RATCHET MECHANISM

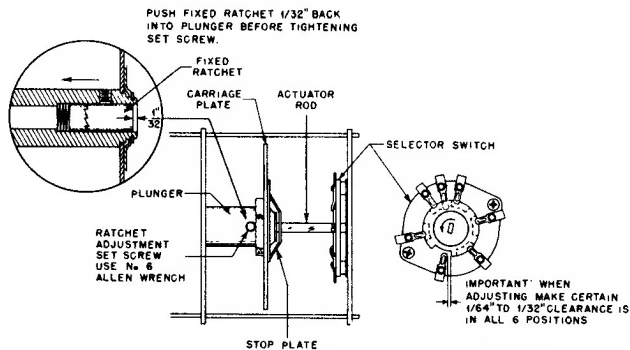


FIGURE 5. PLUNGER RATCHET ADJUSTMENT

## SERVICE NOTES

### LUBRICATION

Should lubrication ever be required, it is recommended that a very fine grease, commercially called DOW-CORNING Silicone (DC 44 Medium Grade), or its equivalent be used.

Remove all old and sticky lubricant with a solvent such as carbon tetrachloride and then, very sparingly, lubricate only the following points:

1. Carriage guide rods.
2. Actuator rod.
3. Manual lead screw.

Do not lubricate or permit lubricant to get on Selector Switch contacts.



## MOTOROLA Tuner ST-60, ST-78

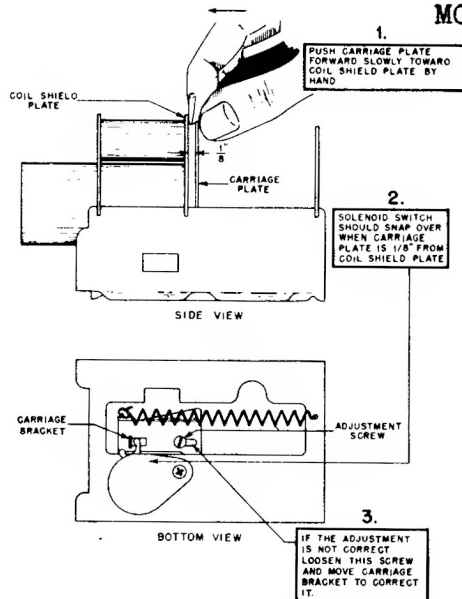


FIGURE 6. SOLENOID SWITCH ADJUSTMENT

### LEAD DRESSING

Make sure that the selector switch and solenoid coil leads are dressed so that carriage plate does not rub against them. Leads rubbing against the carriage plate may cause the tuner to stick, especially at the high frequency end.

### REPLACEMENT OF SOLENOID COIL OR SOLENOID PLUNGER

Should replacement of the solenoid coil or solenoid plunger be required, it will be necessary to replace the entire tuner. A close fit between solenoid plunger and solenoid coil form is required; a proper match can only be secured at the factory. When service of this kind is required, return the tuner to the factory for exchange.

### ALIGNMENT

In the event that some part of the R. F. circuit has been changed or the adjustments shifted by mishandling, it is suggested that the receiver be realigned. Follow the alignment instructions found in the receiver service manual.

The tuner must be in good working order and assembled onto the chassis before attempting alignment of its tuned circuits.

### TO REPLACE ANT. R. F., OR OSC. COILS

1. Unsolder the two lugs holding the coil to the tuner plate.
2. Carefully remove the old coil. Save the thin paper washer that is found at the base of the coil.
3. Slip the paper washer over the replacement coil and slip coil into shield can.
4. Orient coil so its lugs are in same position as before and resolder to tuner plate.
5. Reassemble tuner and install in receiver.
6. Realign ANT., R. F. and OSC. stages per instructions found in the receiver service manual.

### ADJUSTMENT OF GEAR LEVER LATCH

The gear lever latch holds the station set-up gear train in position while setting up stations. Failure of the latch to engage properly when the set-up button is pushed in will result in the inability to set up pre-set stations. Failure of the latch to disengage after station is set-up will result in faulty automatic tuning because the lead screws might not seat themselves properly against the tuner end plate. Figure 7 shows the latch detail and adjustment.

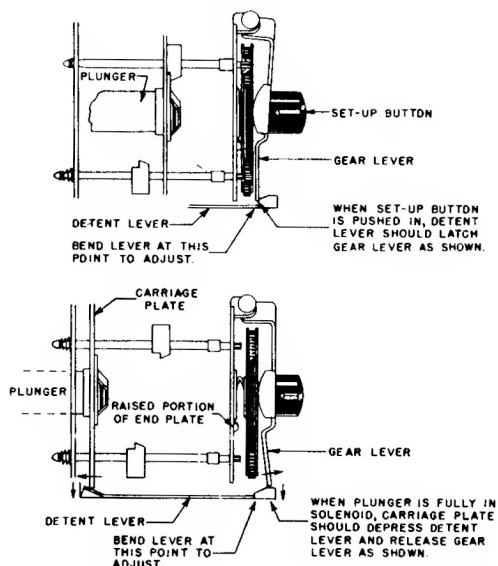


FIGURE 7. GEAR LEVER LATCH ADJUSTMENT

### TO REPLACE ANT. R. F. OR OSC. COIL TUNING CORES

1. Remove the carriage return spring.
2. Move the carriage plate back as far as it can go. The tuning cores can now be screwed "out" or "in" by grasping the portion that sticks out the back of the coil. When installing a new core, make sure that the insulating washer and adjustment clip are replaced properly. The insulating washer goes on the core side; the core adjustment clip has an ear on it and this ear must fit into a hole in the bakelite insulator on the carriage plate. Refer to Figure 8.
3. Replace the carriage return spring.
4. Install tuner in receiver.
5. Realign ANT., R. F. and OSC. stages following the instructions found in the receiver service manual.

### PLUNGER RATCHET REMOVAL

To remove ratchets, proceed as follows:  
(Refer to Figure 8 for parts identification).

1. Remove gear plate mounting screw (55).
2. Pull out actuator rod (46). Don't lose washers (83), (88) and (89).
3. Remove stop plate bracket (4) by sliding it out of the retaining slots.
4. Loosen setscrew (50).
5. The large fixed ratchet (34), small floating ratchet (35) and ratchet spring (70) can now be removed.
6. Reassemble in reverse order.

### TUNER HANGS UP

The beginning of this trouble is usually a condition where the tuner "runs wild" (fails to stop at a station). Eventually, the stop plate gets "hung up" by getting on the wrong side of the station stops (56). The cause of the trouble is that the selector switch (74) does not turn the correct amount with each dash of the plunger.

Since the actuator rod (46) determines the rotation of the selector switch, it is usually at fault. Check the twist in the actuator rod. It should be 82 degrees. Also check the fit between the "head" end of the actuator rod (46) and the rotary section of the selector switch (77). We have found that some sloppiness sometimes occurs at this point. If the fit is loose, replace the actuator rod (46). This can be easily done by removing gear plate mounting screw (55).

