SERVO
STEP-BY-STEP ASSEMBLY

NOTE: All four Servos must be completed according to the Step-By-Step Assembly instructions. They can be assembled one at a time or all four Servos can be assembled simultaneously.

CIRCUIT BOARD ASSEMBLY NOTES

The circuit board and the components to be installed on it are quite small. Therefore, we suggest that you take your time while assembling it.

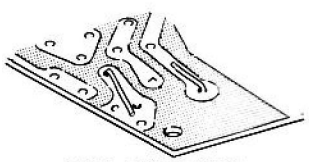
Because the circuit board is so small, there is not sufficient room on it to letter the value of each component. Therefore, all component locations except for resistors are shown on the board with only an outline of the component. See Figure 1-2 on Page 37. The locations where resistors are to be installed are blanked in. Holes outlined with a triangle are used for wires.

Use extreme care when installing components so that they fit directly over their outline on the circuit board. Position all components down tight against the circuit board unless directed otherwise. Be sure none of the components (except the two large transistors) are more than 5/16" above the circuit board at their maximum height. This is necessary to provide clearance when the case is installed.

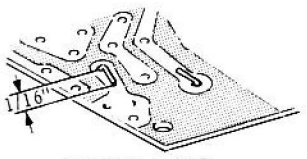
Complete each step on Pictorials 3-1 through 3-4.

IMPORTANT SOLDER NOTE

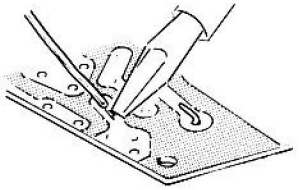
When you install each component, bend its leads flat against the same foil from which they extend, as shown below. It is important that each lead is bent toward the center of a foil pad, or in the same direction as the foil lead to prevent solder bridging between foils. Cut the leads 1/16" from the hole on the foil side of the circuit board. This will hold the components in place until they are soldered, and will provide a larger solder area. This larger solder area in important because of the great amount of vibration that the receiver and servos must withstand. This note applies to the leads of all components being installed in the following steps and pictorials.



BEND LEADS ONTO FOIL FROM WHICH THEY EXTEND



CUT OFF LEADS 1/16" FROM HOLE



SOLDER LEADS TO FOIL WHEN ALL THE HOLES IN A FOIL PAD ARE USED

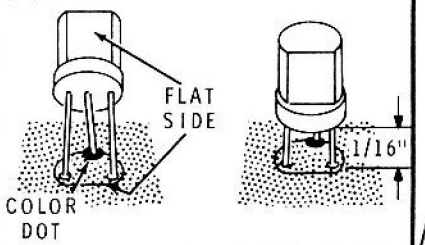
START

NOTE: There are no specific steps for soldering the component leads to the foil of the circuit board. When all the holes in a foil pad have been used, the component leads should be soldered to that foil. This will eliminate the possibility of covering unused holes. Also, be very careful not to make any solder bridges between adjacent foils.

( ) Locate the Servo circuit board and position it as shown.

NOTE: When installing transistors in the following steps, be sure to align the flat of the transistor with the flat of the outline on the circuit board. Also, place the collector lead of each transistor in the hole that is marked with a white dot. Position each transistor 1/16" above the circuit board.

( ) X29A826 transistor (#417-200).

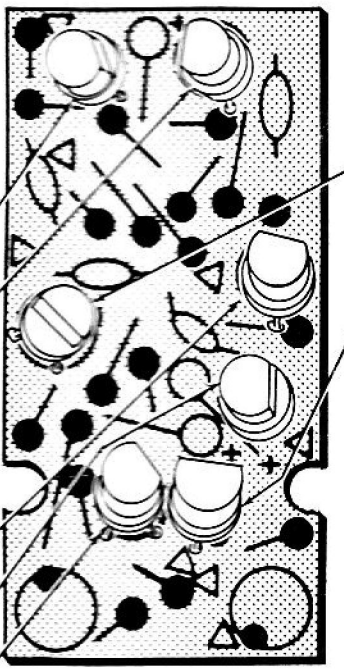


( ) X29A826 transistor (#417-200).

( ) X29A826 transistor (#417-200).

( ) X29A826 transistor (#417-200).

( ) X29A826 transistor (#417-200). Position this transistor 1/8" above the circuit board.



CONTINUE

( ) 2N5232A/2N3391A transistor (#417-91).

( ) 2N5232A/2N3391A transistor (#417-91). Position this transistor 1/8" above the circuit board.

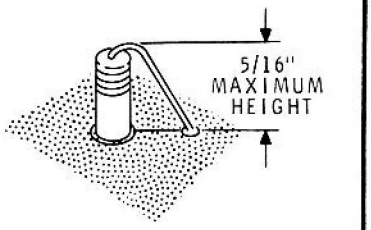
PROCEED TO PICTORIAL 3-2.

PICTORIAL 3-1

START

NOTE: Position all vertically mounted components as perpendicular to the circuit board as possible.

( ) 11 MΩ (brown-brown-blue).



( ) 47 Ω (yellow-violet-black).

( ) 1200 Ω (brown-red-red).

( ) 8200 Ω (gray-red-red).

( ) 4700 Ω (yellow-violet-red).

( ) 10 kΩ (brown-black-orange).

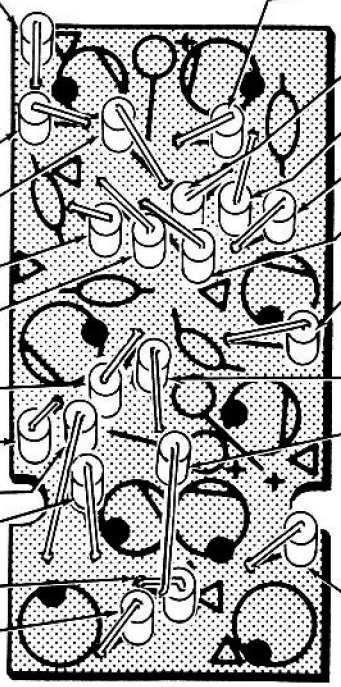
( ) 47 kΩ (yellow-violet-orange).

( ) 2200 Ω (red-red-red).

( ) 220 Ω (red-red-brown).

( ) 33 Ω (orange-orange-black).

( ) 47 Ω (yellow-violet-black).



CONTINUE

( ) 3300 Ω (orange-orange-red).

( ) 4700 Ω (yellow-violet-red).

( ) 22 kΩ (red-red-orange).

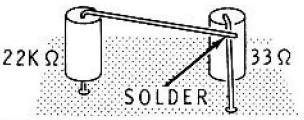
( ) 4700 Ω (yellow-violet-red).

( ) 2200 Ω (red-red-red).

( ) 47 kΩ (yellow-violet-orange).

( ) 2200 Ω (red-red-red).

( ) 22 kΩ (red-red-orange). Lay the end of the free lead against the 33 Ω (orange-orange-black) resistor lead as shown and solder the connection. Do not wrap the connection. Due to other components, this resistor may not sit down against the circuit board.



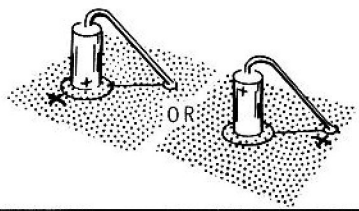
( ) 820 Ω (gray-red-brown).

PROCEED TO PICTORIAL 3-3.

PICTORIAL 3-2

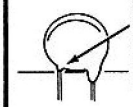
START

NOTE: When installing electrolytic capacitors, be sure to position the positive (+) lead (red end of capacitor) in the positive (+) marked hole in the circuit board.



( ) 1.0 μF electrolytic. Position (+) end down.

NOTE: When installing disc capacitors, remove any excess coating from the leads. Use long-nose pliers to remove this coating.



( ) .0033 μF disc.

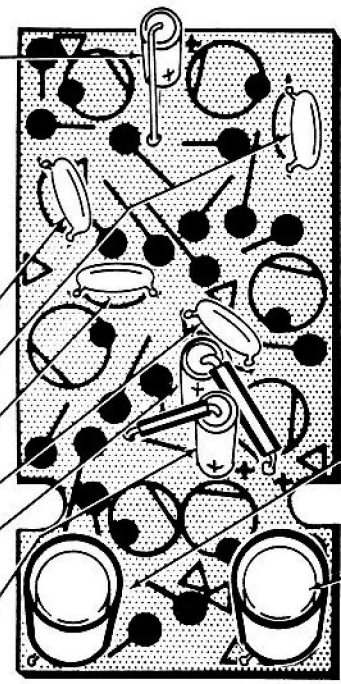
( ) .001 μF disc.

( ) .05 μF disc.

( ) .05 μF disc.

( ) 1.0 μF electrolytic. Use a 5/16" length of small sleeving on the indicated lead. Position (+) end up.

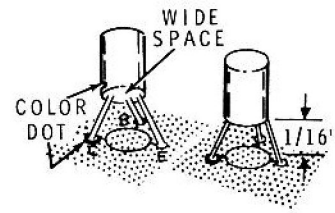
( ) 1.0 μF electrolytic. Use a 5/16" length of small sleeving on the indicated lead. Position (+) end down.



CONTINUE

NOTE: When installing the transistors in the following steps, align the color dot of the transistor with the dot on the circuit board. Position each lead in its proper hole and position the transistor 1/16" above the circuit board.

( ) 2N2430 transistor.



( ) 2N2431 transistor.

( ) Place a 1/2" length of large sleeving over each of these two transistors. Press the sleeving down tight against the circuit board.

PROCEED TO PICTORIAL 3-4

PICTORIAL 3-3

START

NOTE: When a wire is called for in a step, remove 1/8" of insulation from only one end of a wire of the specified length and color. Twist the small strands of each lead together and melt a small amount of solder on the exposed wire to hold the small strands together. Position the prepared end of the wire in the indicated hole (△). Bend the end over and solder it in place. The free end of each wire will be connected later.

( ) 2-1/2" green wire.

( ) 7-1/2" green wire.

( ) 7-1/2" black wire.

( ) 2" red wire.

( ) 7-1/2" red wire.

( ) 2-1/2" white wire.

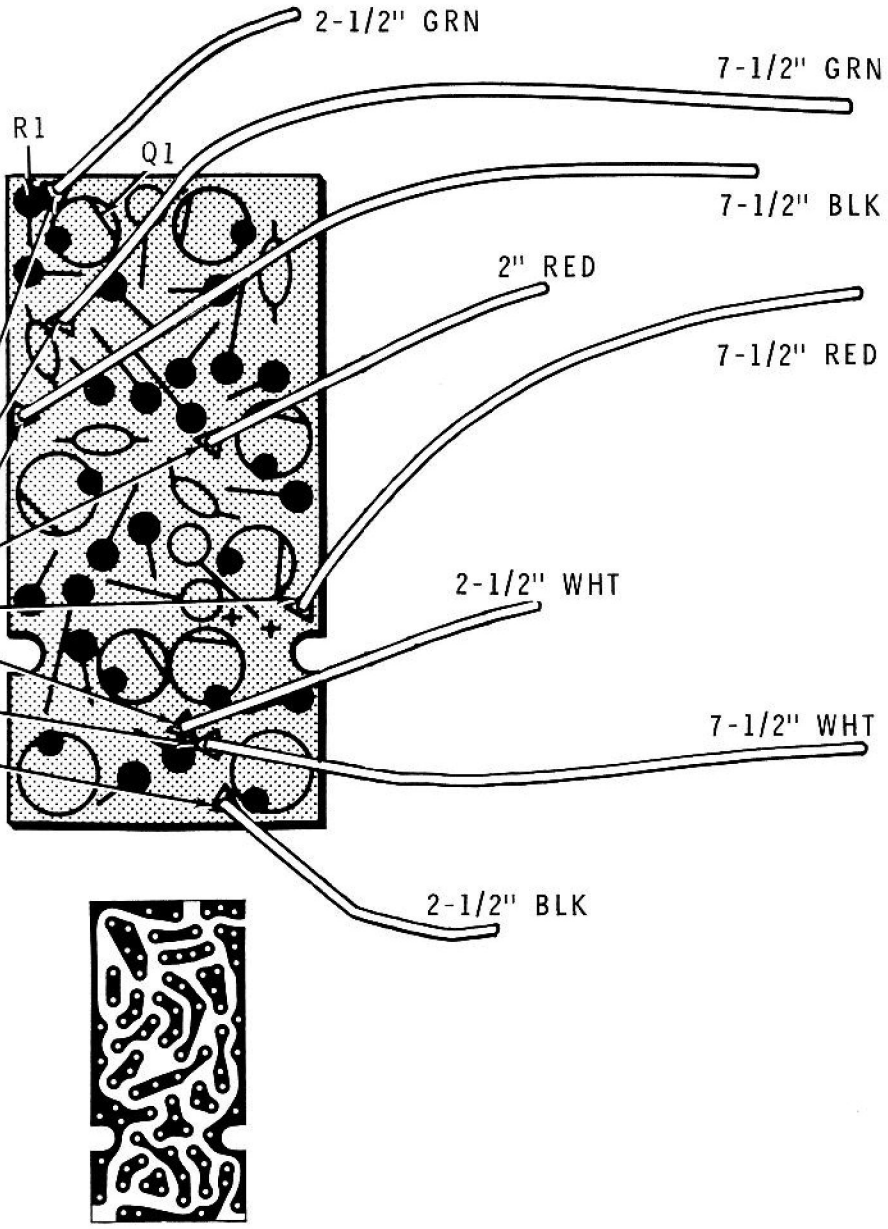
( ) 7-1/2" white wire.

( ) 2-1/2" black wire.

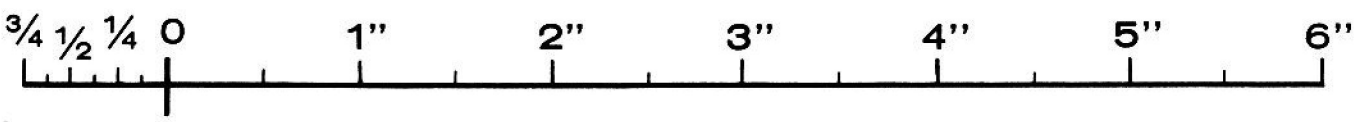
Reheat the connections to straighten any components that may have tipped over during assembly. Be careful not to break any components as you straighten them.

NOTE: This completes the assembly of the circuit board. Check to see that all connections are soldered and that all excess lead lengths have been cut off. To make it easier to locate any possible solder bridges between adjacent foil pads, it is suggested that you compare the foil side of the circuit board with the foil view shown.

FINISH



PICTORIAL 3-4



WIRING

CONNECTOR WIRING

Refer to Pictorial 3-5 for the following steps.

( ) Pass the small rubber grommet over the long black, red, green, and white wires coming from the servo circuit board.

( ) Twist these wires together as shown.

( ) Cut the ends of these wires even with the end of the shortest wire. Be sure the wires are positioned as shown in Pictorial 3-5 before cutting.

( ) Prepare the ends of these four wires by removing 1/8" of insulation and melting a small amount of solder on the exposed wire ends.

( ) Cut and place a 1/2" length of small sleeving on each of these four wires.

Refer to Pictorial 3-5 and connect these four wires to the 4-pin connector as shown.

Connect the wires to a four pin plug as follows:

( ) Green to lug 1 (S-1).

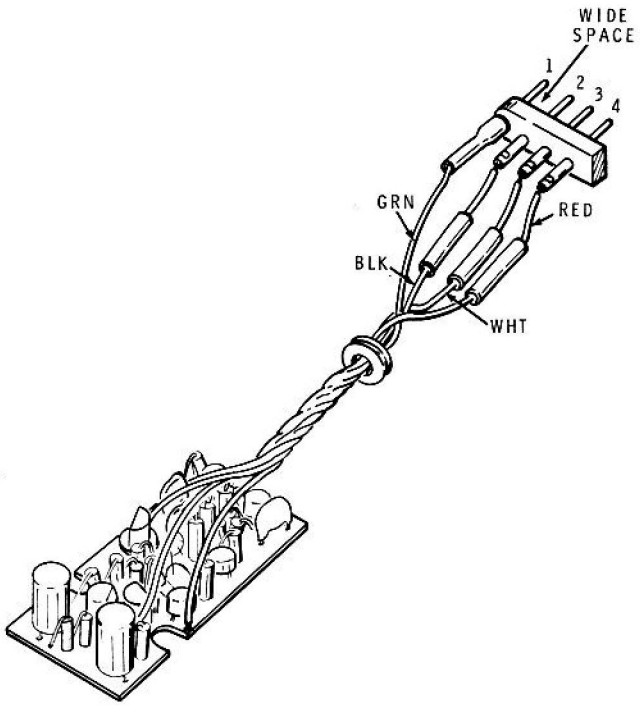
( ) Black to lug 2 (S-1).

( ) White to lug 3 (S-1).

( ) Red to lug 4 (S-1).

( ) Push the lengths of sleeving over the lugs of the connector.

( ) Twist the wires up to the ends of the sleeving.



PICTORIAL 3-5

Proceed to Variable Capacitor Wiring.

VARIABLE CAPACITOR WIRING

Refer to Detail 3-6A for the following steps.

( ) Locate the variable capacitor (#26-121) and bend the lugs as shown.

CAUTION: When soldering to the variable capacitor, do not touch its plastic case with the soldering iron, as the case will melt.

( ) Cut one lead of a 27 pF disc capacitor to 1/4". Connect this lead to lug 2 of the variable capacitor (S-1). Position the body of the disc capacitor against the variable capacitor as shown.

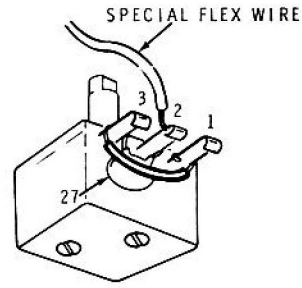
( ) Wrap the other lead of the disc capacitor around lug 3 of the variable capacitor as shown (S-2). Then place a 1/2" length of small sleeving on this lead, connect the lead to lug 1 of the variable capacitor (S-1), and cut off the excess lead length.

( ) Carefully remove 1/4" of insulation from one end of the length of special flex (gray) wire. Melt solder only on this end of the wire.

( ) Connect this end of the special flex wire to lug 2 of the capacitor (S-1). The disc capacitor has already been soldered. The other end of this wire will be connected later.

Refer to Pictorial 3-6 for the following steps.

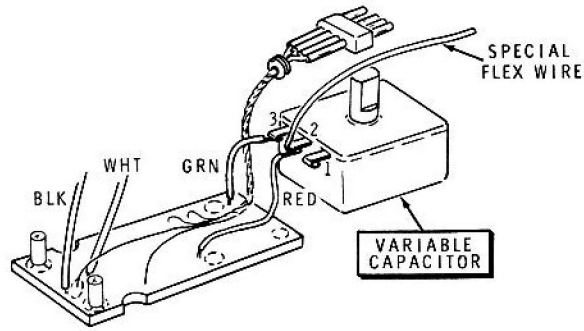
( ) Prepare the free ends of the red and green wires that come from the circuit board. Remove 1/4" of insulation from the end of each lead, twist the small strands of each lead together, and melt a small amount of solder on each lead.



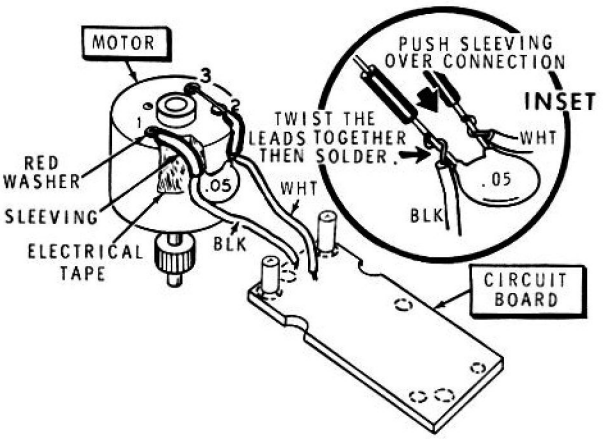
Detail 3-6A

( ) Remove 1/4" of insulation from the remaining black and white wires. Do not apply solder to these leads.

( ) Connect the red wire to lug 2 (S-1) and the green wire to lug 3 (S-1) of the variable capacitor. The disc capacitor leads and the special flex wire have already been soldered. Position the connector cable under the green wire as shown.



PICTORIAL 3-6



PICTORIAL 3-7

MOTOR WIRING

Refer to Pictorial 3-7 for the following steps.

( ) Cut one lead of a .05 μF disc capacitor to 3/4" and the other lead to 1". Remove any excess coating from the capacitor leads.

NOTE: In the following two steps, make the connections to the capacitor by twisting the leads as shown in the inset drawing on Pictorial 3-7.

( ) Connect the white wire from the circuit board to the long lead of the capacitor (S-1).

( ) Connect the black wire from the circuit board to the short lead of the capacitor (S-1).

( ) Place 5/8" lengths of small sleeving on each lead of the capacitor. Push the sleeving tight against the capacitor so that the bare leads are not exposed.

NOTE: In the following steps, be sure the capacitor is positioned as shown, and bend the motor lugs over the leads.

( ) Solder the short lead of the capacitor to lug 1 (indicated by the red washer) on the motor (S-1). Be sure the solder does not touch the case of the motor.

( ) Position the long lead of the capacitor next to lug 2 (NS) and to lug 3 (S-1) of the motor.

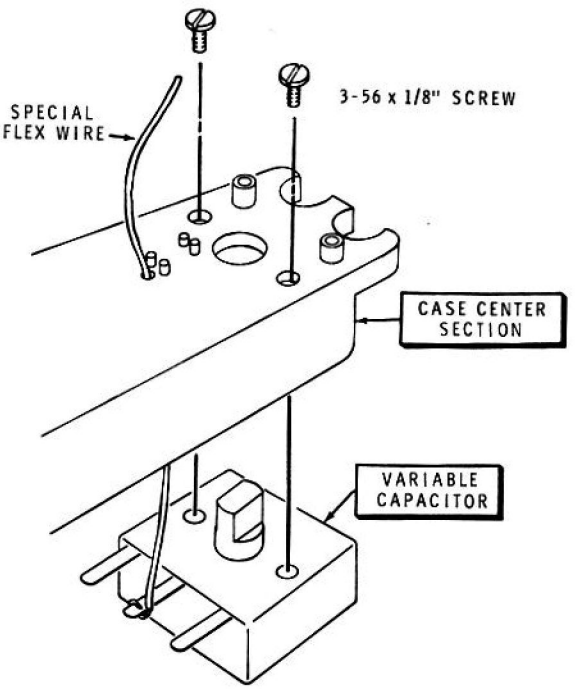
( ) Now solder the capacitor lead to lug 2. More heat is required for this connection, as the motor frame conducts the heat away from the lug.

( ) If electrical tape is available, place a length of it on the motor housing under the capacitor lead connected to lug 1 of the motor. This is further protection against a short circuit.

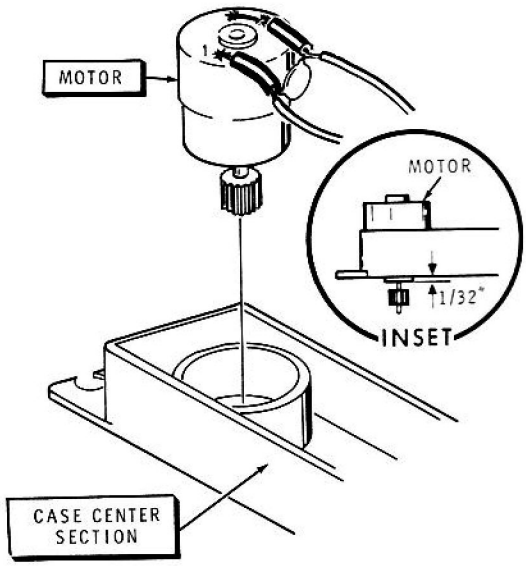
( ) Bend the capacitor flat against the side of the motor.

This completes the wiring of the Servo with the exception of the special flex wire which will be connected later. Check all connections to see that they are soldered.

( ) Refer to Detail 3-7A and mount the variable capacitor in the case center section with two 3-56 x 1/8" screws. Do not overtighten the screws. Be sure to pull the special flex (gray) wire all the way through the indicated hole in the case. The free end of this wire will be connected later. Be sure the shaft of the variable capacitor turns freely.



Detail 3-7A



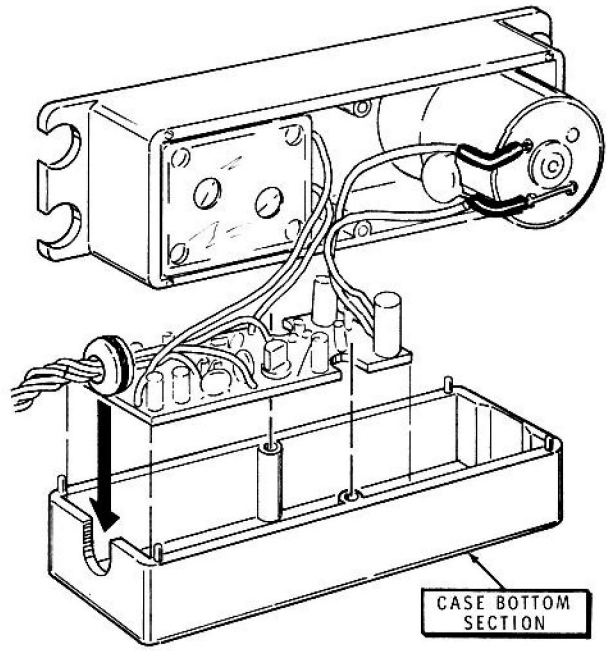
Detail 3-7B

( ) Refer to Detail 3-7B and install the motor in the case center section. Position the motor as shown in Detail 3-7C and push it as far as possible into the case; see inset drawing. NOTE: This is a force fit, so some pressure must be applied to do this.

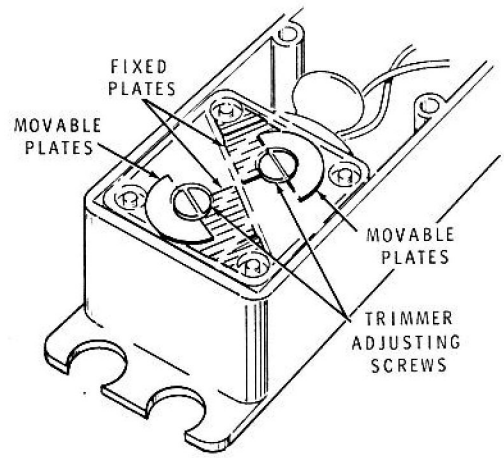
CAUTION: Be sure the capacitor lead connected to lug 1 of the motor does not touch the motor housing.

( ) Refer to Detail 3-7C and install the circuit board into the case bottom section. Be sure to position the rubber grommet in the notch as shown. Push the circuit board all the way down into the case.

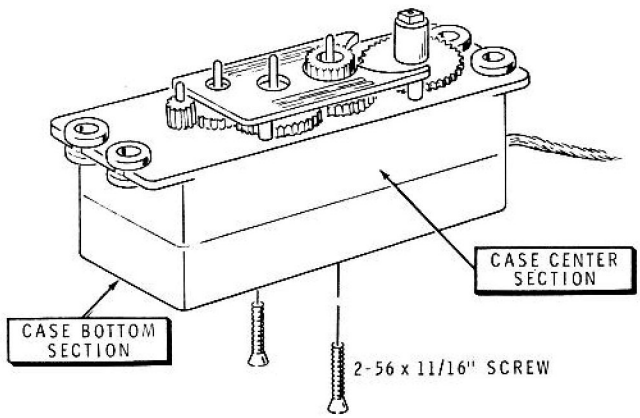
( ) Refer to Detail 3-7D and set both trimmer sections of the variable capacitor so that one-half the movable plates cover one-half the fixed plates.



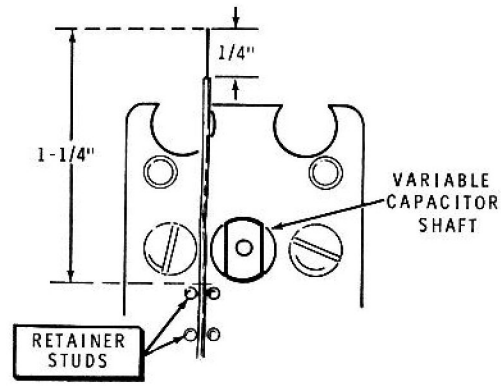
Detail 3-7C



Detail 3-7D



PICTORIAL 3-8



Detail 3-8A

GEAR INSTALLATION

Refer to Pictorial 3-8 for the following steps.

NOTE: When performing the following step, position the wires so they are not pinched between the circuit board components and the variable capacitor.

( ) Position the case bottom section and case center section of the Servo together. Align the pins of the bottom section with the holes in the center section. Temporarily install two 2-56 x 11/16" screws.

Refer to Detail 3-8A for the following steps.

( ) Position the shaft of the variable capacitor to the center of its rotation.

( ) Push the special flex (gray) wire down between the two sets of retainer studs as shown.

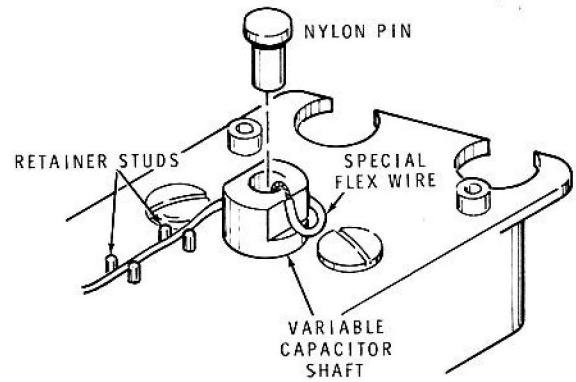
( ) Cut the special flex (gray) wire to a length of 1-1/4". Measure from the indicated retaner stud.

( ) Remove 1/4" of insulation from the free end of this wire. DO NOT apply solder to the wire end.

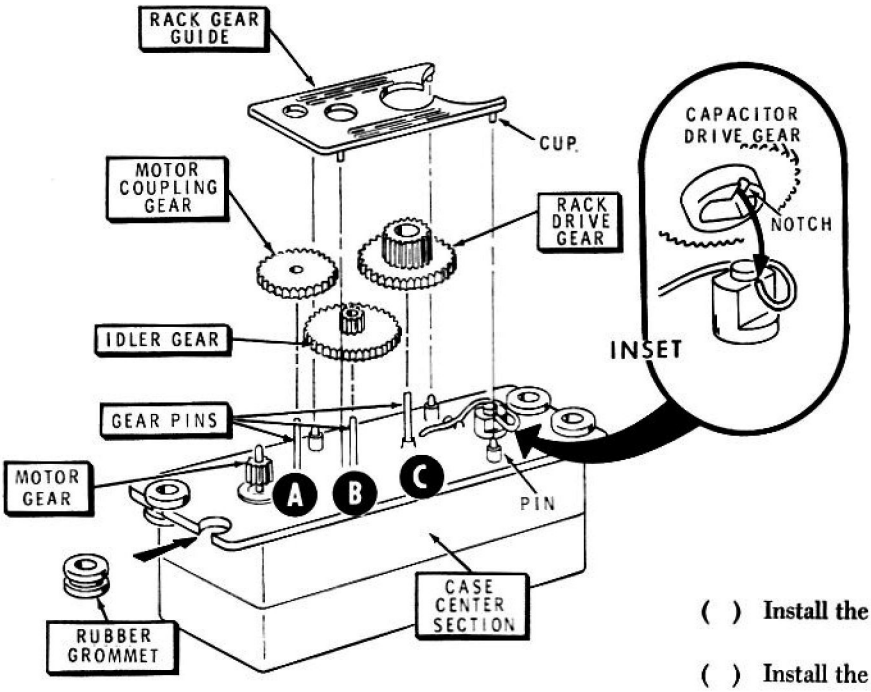
Refer to Detail 3-8B for the following steps.

( ) Install the free end of this wire into the hole in the end of the variable capacitor shaft. Be sure only the bare end of the wire is in the hole and position the wire as shown.

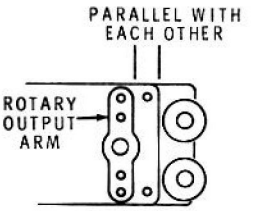
( ) Secure the wire with the nylon pin. Push it in tightly with the handle of a screwdriver. NOTE: This wire is a back-up circuit providing an extra measure of safety. It parallels a mechanical contact in the capacitor shaft, thus providing two connections instead of one.



Detail 3-8B



Detail 3-8C



Detail 3-8D

Refer to Detail 3-8C for the following steps.

( ) Install rubber grommets in the notches at the ends of the case center section.

CAUTION: Do not grip the gear pins with pliers or scratch them in any way. They must be perfectly smooth to provide proper operation of the Servo.

( ) Install the three gear pins in holes at locations A, B, and C. Use the handle of a screwdriver to push the pins all the way in place.

NOTE: In the following steps, be sure to position each gear as shown. You may find it necessary to rotate a gear back-and-forth slightly to get its teeth to engage with another gear.

( ) Install the idler gear at B.

( ) Install the motor coupling gear at A.

( ) Install the rack driver gear at C.

( ) Install the rack gear guide on the case center section. Align the four pins of the case center section with the four pin cups in the rack gear guide. Push the rack gear guide down as far as possible.

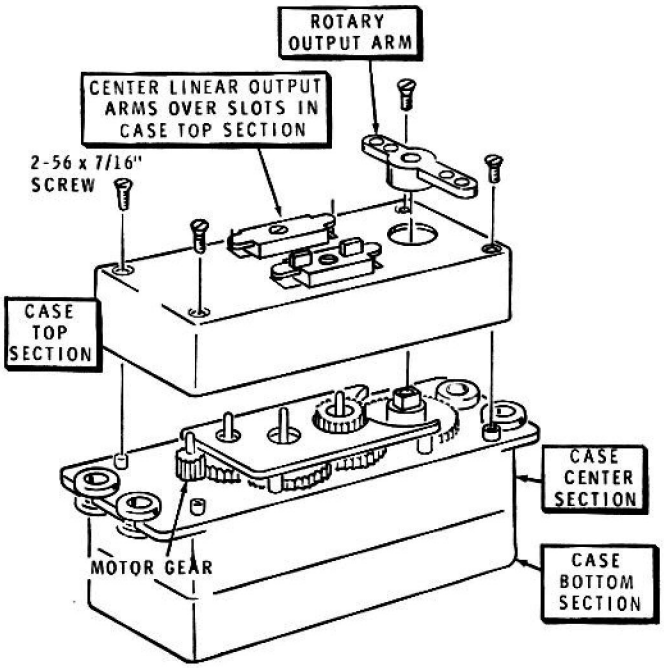
( ) Be sure the shaft of the variable capacitor is set to the center of its rotation.

( ) Install the capacitor drive gear on the shaft of the variable capacitor of the Servo. Be sure the notch in the gear fits over the wire connected to the capacitor shaft. See the inset drawing on Detail 3-8C.

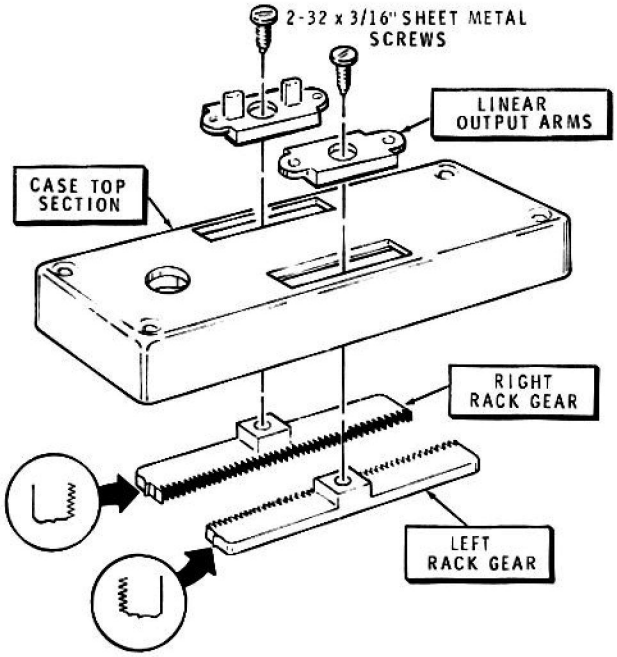
( ) Temporarily install the rotary output arm on the capacitor drive gear as shown. Do not install a screw at this time.

( ) Turn the motor gear by hand to the point where the rotary output arm is perfectly parallel to the end of the Servo case, as shown in Detail 3-8D.

( ) Remove the rotary output arm; be careful that you do not change the gear position.



PICTORIAL 3-9



Detail 3-9A

( ) Set the Servo assembly aside until it is called for later.

Refer to Pictorial 3-9 for the following steps.

NOTE: It is very important that the left rack gear and right rack gear be installed properly in the next step. One end of each gear has a step in it. Position this end of each gear as shown in Detail 3-9A.

( ) Refer to Detail 3-9A and install the left rack gear, right rack gear, and linear output arms on the case top section. Use 2-32 x 3/16" sheet metal screws. Be sure to position the rack gears and output arms as shown. Do not overtighten the screws as the rack gears can be damaged. Be sure both rack gears slide easily.

( ) Center the linear output arms over the slots in the case top section.

( ) Place the case top section on the case center section. It may be necessary to move the linear output arms slightly so the teeth of the rack gears line up with the teeth of the rack drive gear. Be sure the linear output arms are still centered over the slots of the case top section.

( ) Fasten the case top section to the case center section with four 2-56 x 7/16" screws. Do not overtighten the screws as this can strip out the holes in the case center section.

( ) Install the rotary output arm on the capacitor drive gear with a 2-32 x 3/16" sheet metal screw. Be sure to position the rotary arm parallel with the end of the servo case.

This completes the "Step-By-Step Assembly," proceed to the "Test And Adjustments" section.