

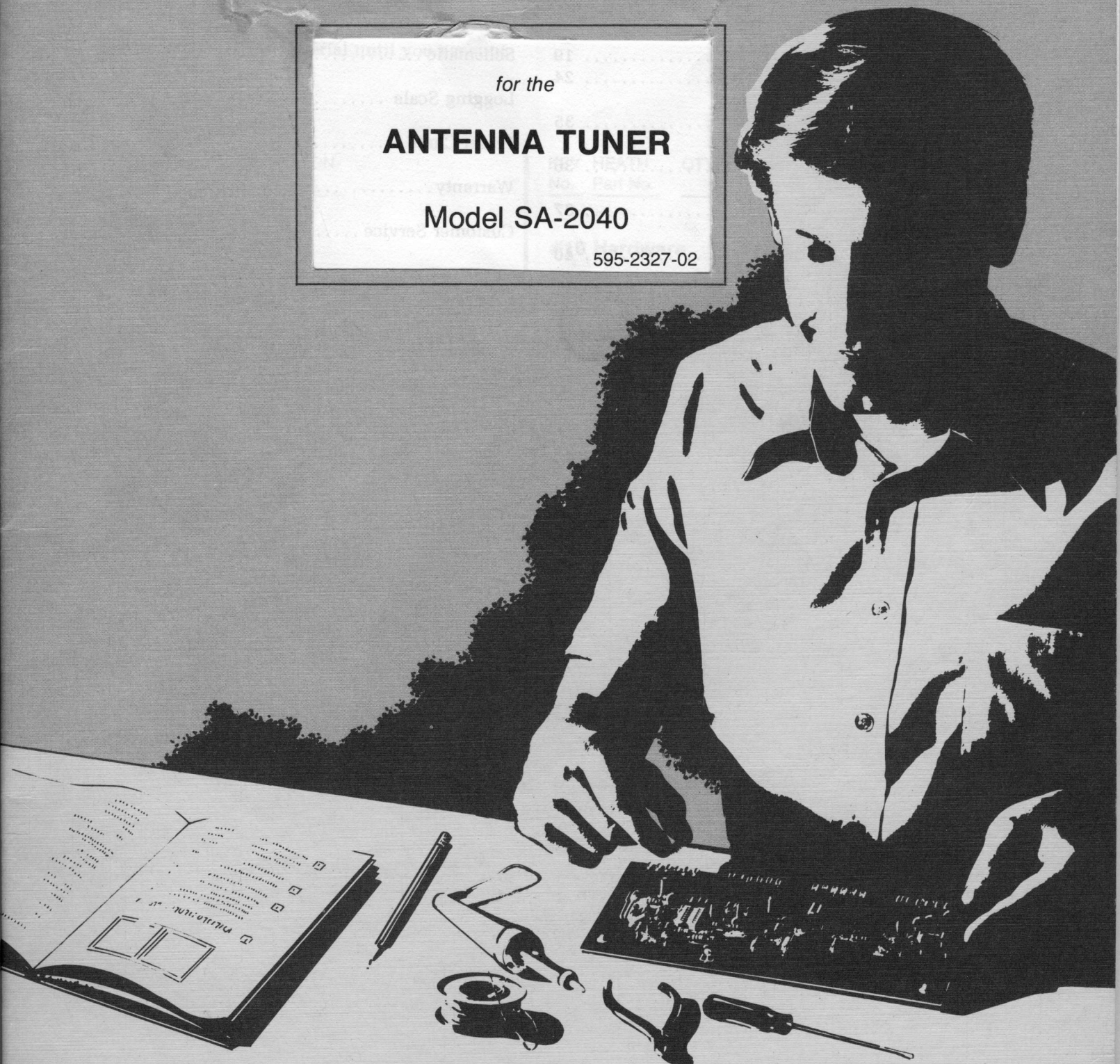
# HEATHKIT<sup>®</sup> MANUAL

for the

## ANTENNA TUNER

Model SA-2040

595-2327-02



HEATH COMPANY • BENTON HARBOR, MICHIGAN

D. GERVASI K14BRI: KF42S

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(FACTORY BUILT) AT HEATHKIT  
CENTER IN GREENSBORO, NC.

# Heathkit® Manual

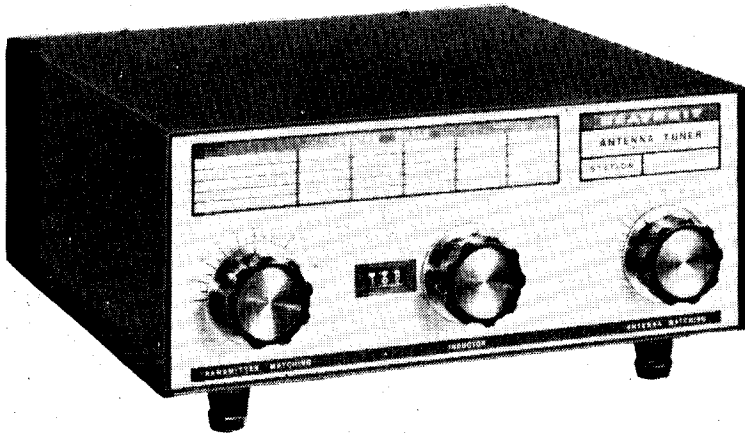
for the

## ANTENNA TUNER

Model SA-2040

595-2327-02

SN 01007



HEATH COMPANY  
BENTON HARBOR, MICHIGAN 49022

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## PARTS LIST

Unpack the kit and check each part against the following list. The key numbers correspond to the numbers on the "Parts Pictorial" (Illustration Booklet, Pages 1 and 2). Return any part that is packed in an individual envelope, with the part number on it, back in its envelope until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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### HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW#4, or HDW#6, etc.). You may have to open more than one packet to locate all of the hardware of any one size (#6, for example).

#### #4 Hardware

A1	250-156	4	4-40 × 1/8" setscrew
A2	250-213	2	4-40 × 5/16" screw
A3	254-9	2	#4 lockwasher

#### #6 Hardware

B1	250-230	6	6-32 × 1/8" setscrew
B2	250-89	13	6-32 × 3/8" screw
B3	250-270	8	6-32 × 3/8" black screw
B4	250-434	2	6-32 × 3/8" flat head screw
B5	250-1264	1	6-32 × 3/8" hex head screw
B6	250-162	4	6-32 × 1/2" screw
B7	250-134	1	6-32 × 3/4" screw (brass)
B8	250-79	2	6-32 × 1-1/4" screw
B9	252-3	17	6-32 nut
B10	253-127	2	Small #6 flat washer
B11	253-714	26	Large #6 flat washer
B12	254-1	20	#6 lockwasher

#### #8 Hardware

C1	250-16	6	8-32 × 3/16" setscrew
C2	250-137	16	8-32 × 3/8" screw
C3	250-329	13	8-32 × 5/8" screw
C4	252-4	1	8-32 nut
C5	252-180	1	8-32 wingnut
C6	253-9	10	#8 steel flat washer
C7	253-715	40	#8 fiber flat washer
C8	254-2	8	#8 lockwasher
C9	259-2	2	#8 solder lug

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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### #10 Hardware

D1	252-163	3	10-32 wingnut
D2	252-199	42	10-32 nut
D3	253-19	6	#10 steel flat washer
D4	253-716	24	#10 fiber flat washer
D5	254-3	5	#10 lockwasher
D6	259-26	4	#10 solder lug

### Other Hardware

E1	250-1235	2	1/4-32 × 1/4" setscrew
E2	252-39	2	1/4-32 nut
E3	252-701	9	Control nut (brass)
E4	253-36	1	Brass spring washer
E5	254-5	3	Control lockwasher
E6	258-704	2	Dished spring
E7	258-705	2	Forked spring
E8	258-734	2	Contact spring
E9	259-10	1	Control solder lug
E10	455-13	3	Short shaft bushing
E11	455-26	2	Long shaft bushing
E12	455-642	1	Shaft collar

### SPACERS

F1	255-59	2	Tapered spacer
F2	255-719	44	Large 17/64" spacer
F3	255-720	2	Large 3/16" spacer
F4	255-721	84	Small 17/64" spacer
F5	255-722	4	Small 3/16" spacer
F6	255-727	8	1-31/32" spacer
F7	255-728	4	8-32 × 8-5/16" tapped spacer
F8	255-729	2	8-32 × 5-11/16" tapped spacer



KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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**SHAFTS**

G1	266-896	4	10-32 × 9-7/8" threaded rod
G2	266-897	2	10-32 × 6-3/4" threaded rod
G3	266-1047	1	Tension rod
G4	453-265	1	2-3/4" extension shaft (metal)
G5	453-277	2	2-3/8" extension shaft (fiberglass)
G6	453-278	1	9-13/16" shaft
G7	453-279	1	7-3/16" shaft

**COUPLERS**

H1	456-7	3	Shaft coupler
H2	456-44	1	Stepped coupler

**METAL PARTS**

J1	90-1257-1	1	Cabinet top shell
J2	200-1362-1	1	Chassis
J3	204-2207	6	Capacitor mounting bracket
J4	204-2441	1	Counter mounting bracket
J5	205-1679	2	Capacitor front plate
J6	205-1680	2	Capacitor rear plate
J7	205-1681	41	Stator plate
J8	205-1682	44	Rotor plate
J9	205-1727	1	Shorting bar
J10	212-55	1	10-1/4" strap
J11	212-56	1	5-1/2" strap
J12	212-57	1	4-1/4" strap

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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**MISCELLANEOUS**

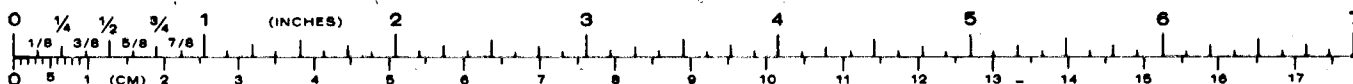
K1	40-1903	1	Roller inductor
K2	71-11	4	Ceramic feedthrough insulator (disassembled in bag)
	74-31	1	Glass-cloth tape (roll)
K3	205-1741	2	Inductor end plate
K4	261-9	4	Round foot
K5	266-894	9	Ceramic insulator plate (1 extra)
K6	266-898	2	Steel ball
K7	266-1048	1	Roller contact
	340-11	6"	Bare wire
	344-147	11'	Teflon *-insulated wire
K8	352-14	1	Grease pod
K9	436-55	2	Coaxial jack (with hardware)
K10	446-711	1	Window
K11	451-61	2	Nylon gear
K12	462-934	3	Knob
K13	465-6	1	Counter
K14	475-19	2	Toroidal core
K15	490-5	1	Nut starter
K16	490-14	1	Large allen wrench
K17	490-23	1	Small allen wrench
K18	490-168	1	Open-end wrench

Solder

**PRINTED MATERIAL**

L1	390-147	1	Danger label
L2	390-1685	1	Front label
L3		1	Blue and white label
L4	390-1087	1	Call letter label sheet
	597-260	1	Parts Order Form
		1	Assembly Manual (See first page for part number.)

\*DuPont Registered Trademark



## STEP-BY-STEP ASSEMBLY

### NOTES:

1. Follow the instructions carefully and read the entire step before you perform the operation.
2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps", continue using that Pictorial until you are referred to another Pictorial for another group of steps.
3. This kit uses a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
4. Position all parts as shown in the Pictorials.
5. Solder a part or a group of parts only when you are instructed to do so.

### ANTENNA MATCHING CAPACITOR (C2)

Refer to Pictorial 1-1 for the following steps.

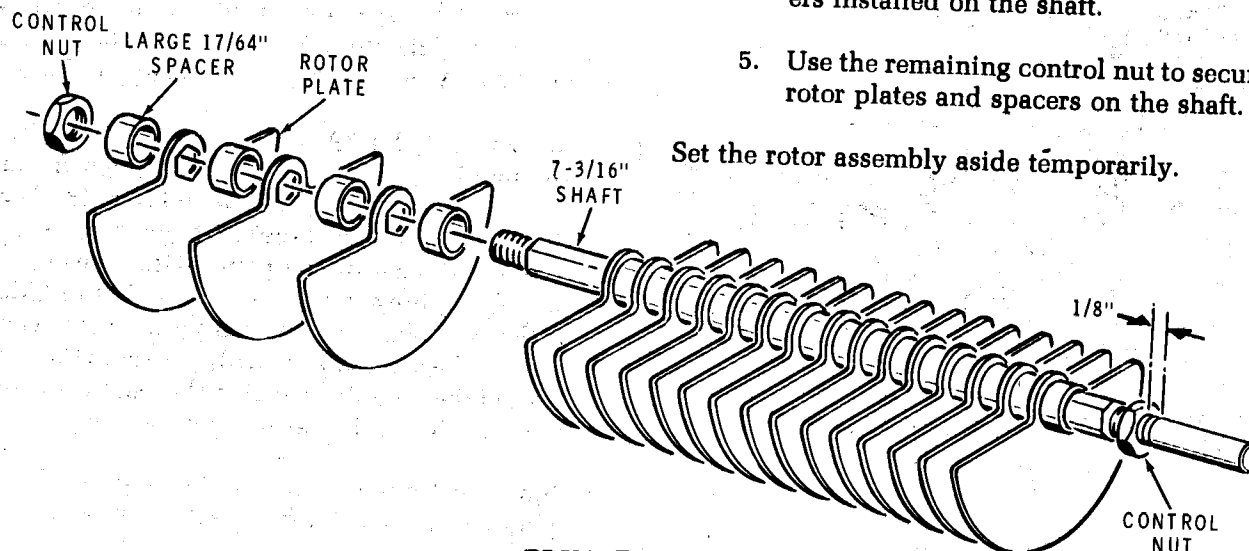
- ( ) Locate the following parts:

7-3/16" shaft  
Two control nuts  
Nineteen large 17/64" spacers  
Eighteen rotor plates

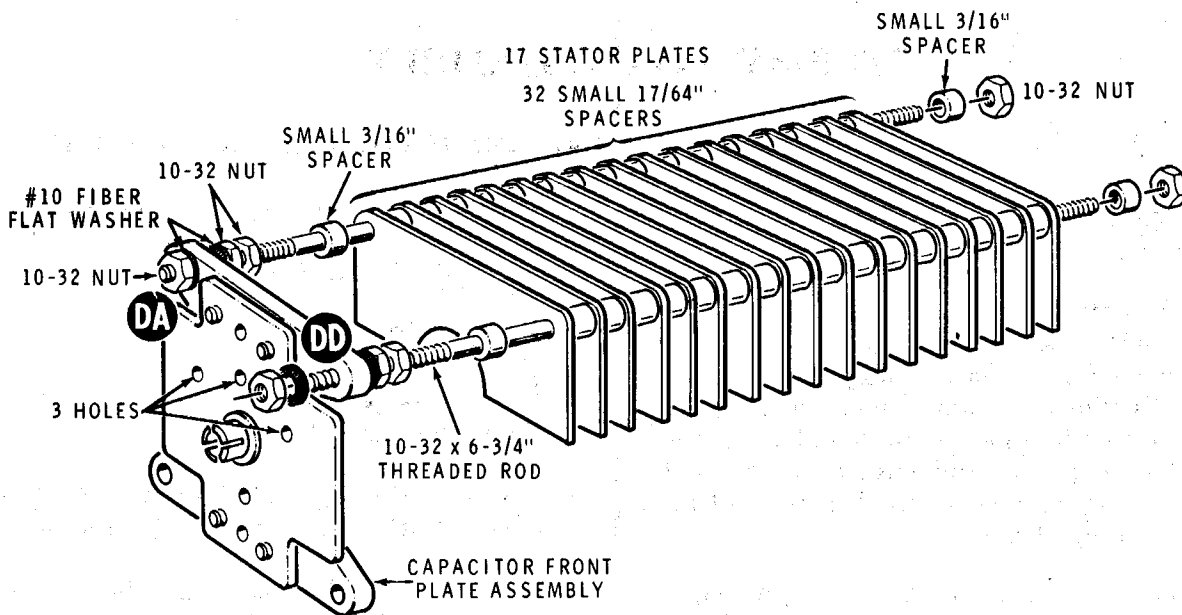
- ( ) Use the following procedure to assemble the antenna matching capacitor rotor assembly:

1. Turn a control nut onto the indicated end of the 7-3/16" shaft. Adjust this control nut so the outside of the nut is 1/8" from the end of the threaded part of the shaft. Try not to disturb this nut when you perform the following steps.
2. Slide a large 17/64" spacer all the way onto the shaft so it is against the control nut.
3. Match the hex shaped hole in a rotor plate with the hex shape on the shaft. Then slide the rotor plate onto the shaft until it is against the 17/64" spacer.
4. Repeat steps 2 and 3 until you have eighteen rotor plates and nineteen large 17/64" spacers installed on the shaft.
5. Use the remaining control nut to secure the rotor plates and spacers on the shaft.

Set the rotor assembly aside temporarily.



PICTORIAL 1-1

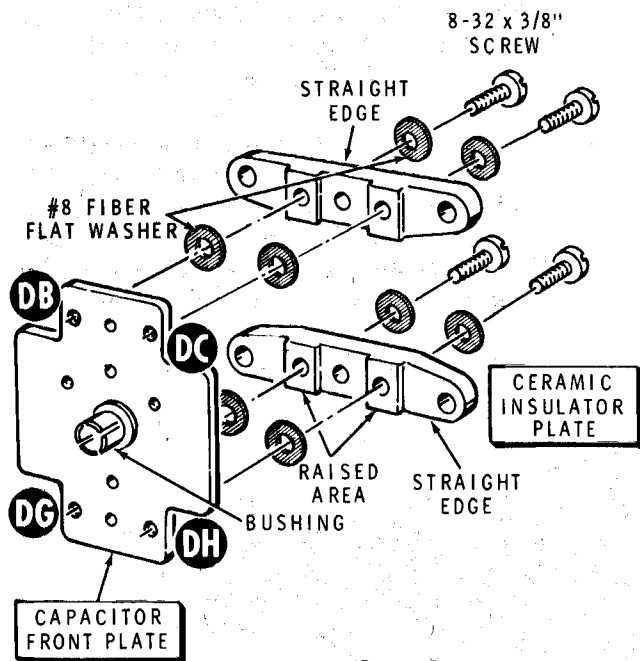


PICTORIAL 1-2

Refer to Pictorial 1-2 for the following steps.

NOTES:

1. The ceramic insulator plates have two raised areas on one side. When you are instructed to mount these plates to a capacitor plate, as in the next step, be sure you position the side with the raised area toward the capacitor plate. Also be sure you orient each insulator plate so its straight edge is positioned as shown in the detail.
2. When you tighten the 8-32 x 3/8" screws to secure the capacitor insulator plate to a capacitor plate, do NOT overtighten the screws as you may break the ceramic insulator plate.



Detail 1-2A

- ( ) Refer to Detail 1-2A and mount a ceramic insulator plate to a capacitor front plate at DB and DC. Use an 8-32 x 3/8" screw and two #8 fiber flat washers at each of the two holes. Make sure you install the insulator plate on the side opposite the bushing as shown. Also, hold this side of the front plate against a flat surface when you tighten the screws. This will make sure the top edge of the ceramic insulator plate is flush with the top edge of the capacitor front plate.
- ( ) Similarly, mount another ceramic insulator plate to the capacitor front plate at DG and DH.

( ) Locate the following parts:

- Two 10-32 × 6-3/4" threaded rods
- Four #10 fiber flat washers
- Eight 10-32 nuts
- Four small 3/16" spacers
- Thirty-two small 17/64" spacers
- Seventeen stator plates
- One capacitor front plate assembly (assembled in a previous step)

NOTE: In the following step, you will assemble the antenna matching capacitor stator assembly. Carefully assemble the parts as shown in the Pictorial. Be sure each part is in its proper place, and that you tighten the indicated nuts properly.

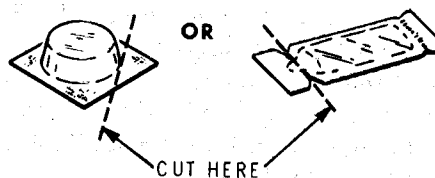
( ) Assemble the stator section of the antenna matching capacitor as follows:

1. Start two 10-32 nuts onto one end of each threaded rod. Turn these nuts onto the threaded rods until they are almost all the way onto the threaded portions of the rods. NOTE: These nuts will be readjusted later.
2. Slide a #10 fiber flat washer onto the end of each threaded rod.
3. Position the capacitor front plate assembly as shown (note the position of the ceramic insulator plates and the three indicated holes.) Then insert the ends of the threaded rods (that have the nuts) through holes DA and DD in the indicated ceramic insulator plate.
4. Slide a #10 fiber flat washer onto the end of each threaded rod.
5. Start a 10-32 nut onto the end of each threaded rod. Turn these nuts onto the rods until the ends of the rods just extend through the nuts.
6. Use the open-end wrench to tighten the second nut on each rod against the back of the ceramic insulator plate. No NOT over-tighten these nuts; the ceramic insulator may break.
7. Adjust the third nut on each rod until it is against the second nut (finger tight).

8. Slide a small 3/16" spacer onto each threaded rod.
9. Slide a stator plate onto the two threaded rods. Be sure to orient the stator plate as shown in the Pictorial.
10. Slide a small 17/64" spacer onto each threaded rod. NOTE: Do not use the two remaining small 3/16" spacers until a step specifically directs you to do so.
11. Repeat steps 7 and 8 until you have the thirty-two small 17/64" spacers and seventeen stator plates installed on the threaded rods.
12. Slide one of the remaining small 3/16" spacers onto each threaded rod and secure them with a 10-32 nut on each rod. Tighten these nuts only finger tight.

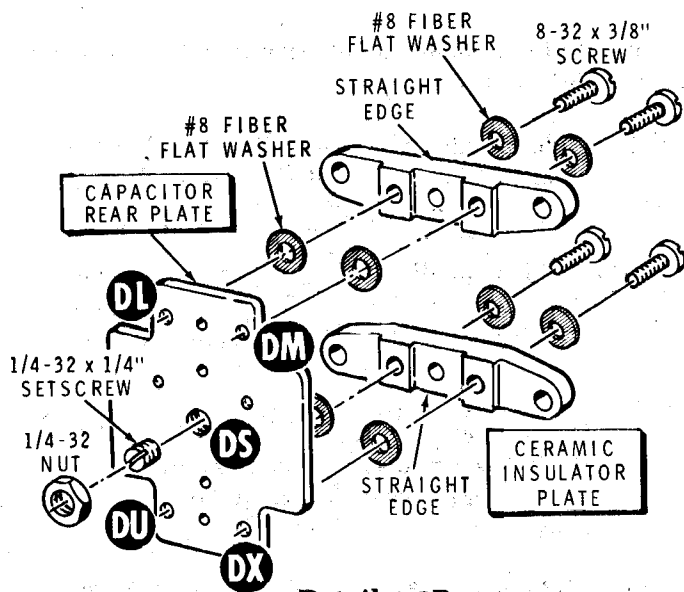
Refer to Pictorial 1-3 (Illustration Booklet, Page 3) for the following steps.

- ( ) Refer to Detail 1-3A and open the grease pod by cutting across one corner and into the pod just enough to make a small opening. Use diagonal cutters or scissors.
- ( ) Squeeze out an amount of grease equal to a medium-sized pea; then use a toothpick and apply the grease to the rotor shaft at the three locations shown in the Pictorial.
- ( ) Refer to inset drawing #1 on the Pictorial and identify the curved side of a dished spring. Then slide the spring onto the rotor shaft so the curved side is toward the rotor plates.
- ( ) Position the rotor and stator assemblies as shown in the Pictorial. Then push the rotor shaft through the bushing in the capacitor front plate as far as it will go.



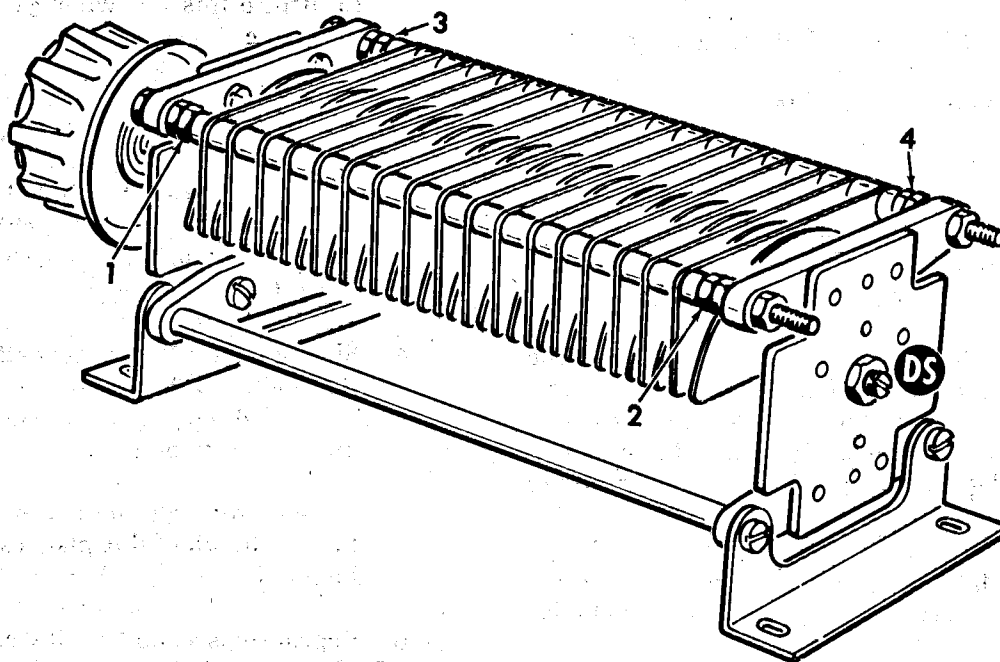
Detail 1-3A





Detail 1-3B

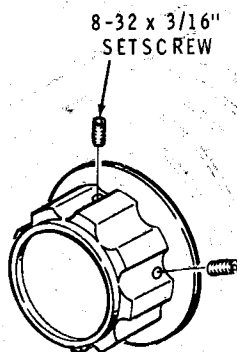
- ( ) Refer to Detail 1-3B and mount a ceramic insulator plate to a capacitor rear plate at DL and DM. Use an 8-32 × 3/8" screw and two #8 fiber flat washers at each of the two holes. Hold this side of the rear plate against a flat surface when you tighten the screws. This will make the top edge of the ceramic insulator plate flush with the top edge of the capacitor rear plate.
- ( ) Similarly, mount another ceramic insulator plate to the capacitor rear plate at DU and DX. Use an 8-32 × 3/8" screw and two #8 fiber flat washers at each of the two holes.
- ( ) Refer again to Detail 1-3B and start a 1/4-32 × 1/4" setscrew into a 1/4-32 nut. Then install the setscrew in hole DS. Turn the screw in until the unslotted end is flush with the other side of the plate. Do NOT tighten the nut yet.
- ( ) Position the capacitor assembly as shown in the Pictorial.
- ( ) Turn a 10-32 nut onto each of the two threaded rods of the capacitor assembly. Hold the end of one of the 5-11/16" tapped spacers against the back of the front ceramic insulator. Then turn the nuts on the free ends of the threaded rods until the outside of the nuts are flush with the end of the tapped spacers.
- ( ) Slide a #10 fiber flat washer onto the end of each threaded rod.
- ( ) Apply a small amount of grease in the recessed area in the end of the setscrew installed in hole DS of the rear capacitor plate. Then place a steel ball in the recessed area of the rotor shaft.
- ( ) Position the capacitor rear plate assembly as shown (note the position of the ceramic insulator plates and the three indicated holes). Then insert the ends of the threaded rods through the corresponding holes in the ceramic insulator plate. Use 10-32 nuts and #10 fiber flat washers to secure the assembly. Do NOT overtighten these screws.
- ( ) Mount a capacitor mounting bracket on each end of the capacitor assembly as shown. Use four 8-32 × 5/8" screws, eight #8 fiber flat washers, and two 5-11/16" tapped spacers. Set the capacitor assembly on a flat surface before you tighten the screws. Do NOT overtighten the screws.
- ( ) Tighten the setscrew in hole DS of the capacitor rear plate only until you feel some resistance; then tighten the setscrew 1/4-turn more. Now tighten the 1/4-32 nut at DS.
- ( ) Refer to inset drawing #2 on the Pictorial and form the end of each of the two forked springs into a small tab, if this has not already been done. Use a pair of long-nose pliers. Set one of these springs aside until it is called for during the assembly of the transmitter matching capacitor.
- ( ) Refer to inset drawing #3 on the Pictorial and form the curved part of each forked spring so it is exactly like the drawing. You can position the forked springs over the actual size drawing to check them.
- ( ) Use long-nose pliers to hold a forked spring. Then lower the spring over the end of the rotor shaft. Push the spring down and insert the tab of the spring into hole DP in the capacitor rear plate.



PICTORIAL 1-4

Refer to Pictorial 1-4 for the following steps.

- ( ) Position the capacitor assembly as shown in the Pictorial.
- ( ) Refer to Detail 1-4A and start two 8-32  $\times$  3/16" setscrews into each of the three knobs.
- ( ) Push one of the knobs onto the capacitor shaft. Then temporarily tighten the two setscrews in the knob.
- ( ) Turn the capacitor shaft so the plates are fully meshed (closed).
- ( ) Turn nuts 1, 2, 3 and 4 (as necessary) to position each plate in the stator halfway between two corresponding rotor plates. Carefully inspect the capacitor assembly from one side, then the other side, to make sure each stator plate is positioned properly. Then tighten the four nuts.
- ( ) Turn the knob several times each way and note the torque needed to turn the shaft. This is the recommended tension adjustment. If you desire to have the shaft turn easier or harder, loosen or tighten the setscrew in the capacitor rear plate as desired. Keep in mind that the tension will loosen somewhat by itself during normal operation.
- ( ) Loosen the setscrews in the knob and remove the knob from the shaft. Set the knob aside temporarily.



Detail 1-4A

This completes the assembly of the antenna matching capacitor. Set the capacitor aside until it is called for in a step.



### TRANSMITTER MATCHING CAPACITOR (C1)

Refer to Pictorial 2-1 for the following steps.

( ) Locate the following parts:

- 9-13/16" shaft
- Two control nuts
- Two large 3/16" spacers
- Twenty-five large 17/64" spacers
- Twenty-six rotor plates

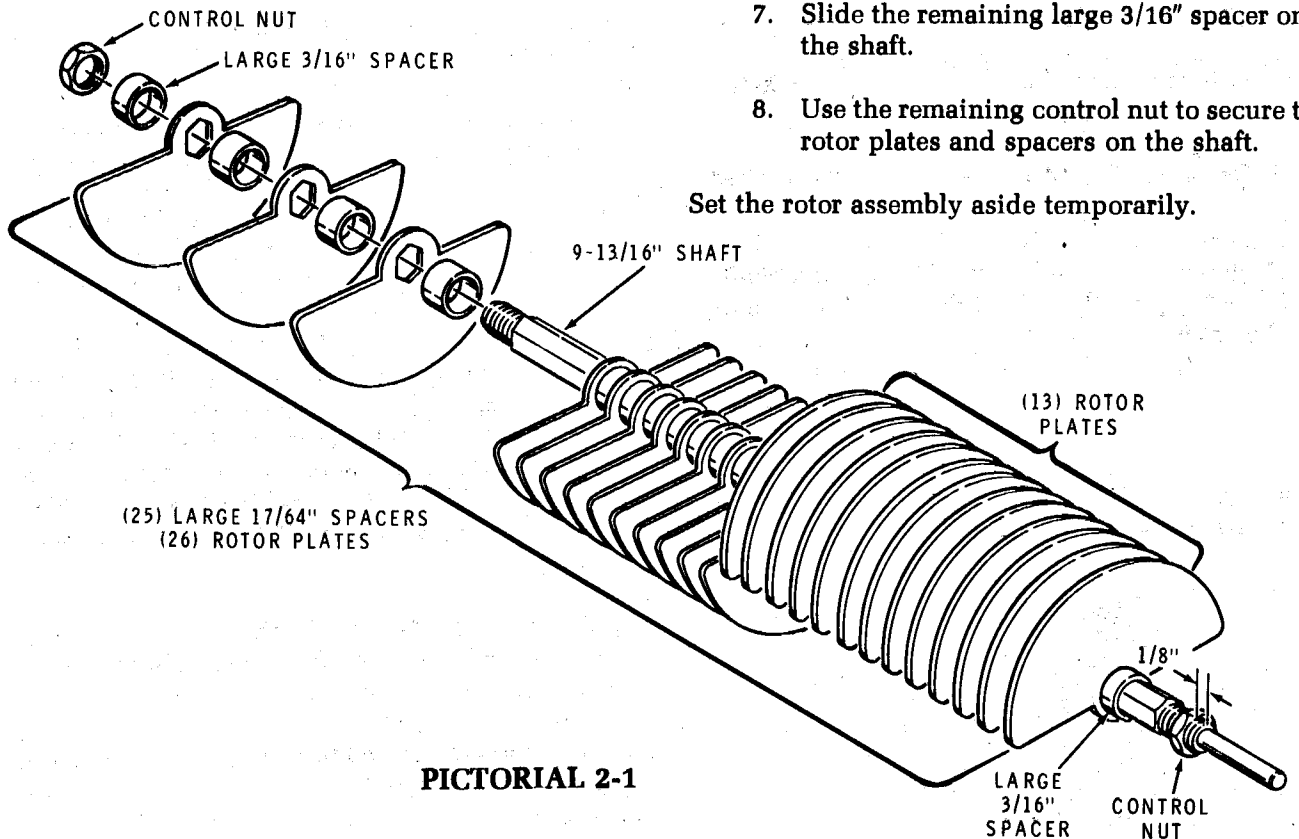
NOTE: In the following step, you will assemble the input capacitor rotor assembly. Carefully assemble the parts as shown in the Pictorial. Be sure each part is in its proper place. Particularly note that one section of the rotor plates is oriented opposite to the other section.

( ) Use the following procedure to assemble the transmitter matching capacitor rotor assembly:

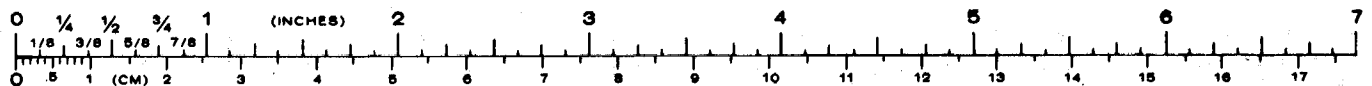
1. Turn a control nut onto the indicated end of the 9-13/16" shaft. Adjust this control nut so the outside of the nut is 1/8" from the end of

- the threaded part of the shaft. NOTE: Try not to disturb this nut when you perform the following steps:
2. Slide a large 3/16" spacer all the way onto the shaft so it is against the control nut.
3. Match the hex shaped hole in a rotor plate with the hex shape on the shaft. Then slide the rotor plate onto the shaft until it is against the 3/16" spacer.
4. Slide a large 17/64" spacer all the way onto the shaft. NOTE: Do not use the remaining large 3/16" spacer until a step specifically directs you to do so.
5. Slide a rotor plate all the way onto the shaft. Be sure to orient this plate as shown in the Pictorial.
6. Repeat steps 4 and 5 until you have 13 rotor plates installed on the shaft one way and 13 rotor plates installed on the shaft opposite the first.
7. Slide the remaining large 3/16" spacer onto the shaft.
8. Use the remaining control nut to secure the rotor plates and spacers on the shaft.

Set the rotor assembly aside temporarily.



PICTORIAL 2-1



Refer to Pictorial 2-2 (Illustration Booklet, Page 4) for the following steps.

( ) Refer to Detail 2-2A and mount a ceramic insulator plate to a capacitor front plate at AB and AC. Use an 8-32 x 3/8" screw and two #8 fiber flat washers at each of the two holes. Make sure you install the insulator plate on the same side of the bushing as shown. Also, hold this side of the front plate against a flat surface when you tighten the screws. This will make the top edge of the ceramic insulator plate flush with the top edge of the capacitor front plate.

( ) Similarly, mount another ceramic insulator plate to the capacitor front plate at AG and AH.

( ) Locate the following parts:

- Two 10-32 x 9-7/8" threaded rods
- Four #10 fiber flat washers
- Eight 10-32 nuts
- Twenty-six small 17/64" spacers
- Four 1-31/32" spacers
- Twelve stator plates
- One capacitor front plate assembly (assembly in a previous step)

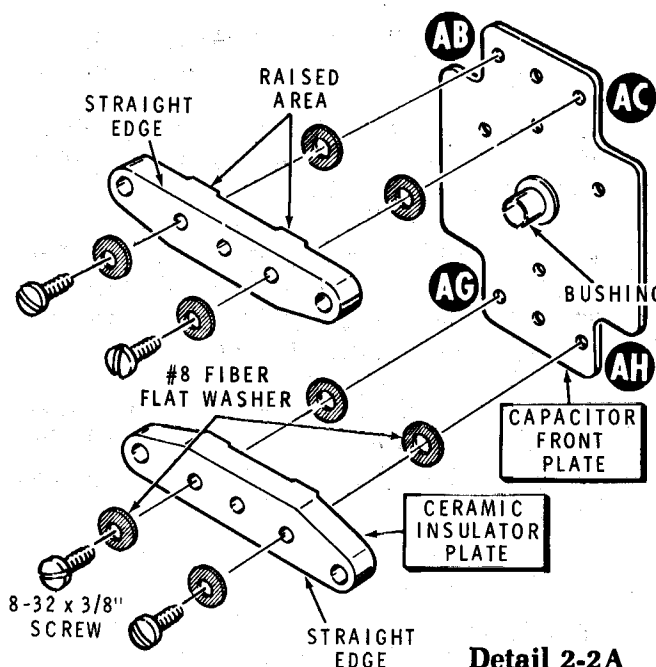
NOTE: In the following step, you will assemble one of the stator sections for the transmitter matching capacitor. Carefully assemble the parts as shown in the Pictorial. Be sure each part is in its proper place, and that you tighten the indicated nuts properly.

( ) Assemble stator section #1 of the transmitter matching capacitor as follows:

1. Start two 10-32 nuts onto one end of each threaded rod. Turn these nuts onto the threaded rods until they are almost all the way onto the threaded portions of the rods. NOTE: These nuts will be readjusted later.

2. Slide a #10 fiber flat washer onto the end of each threaded end.

3. Position the capacitor front plate assembly as shown (note the position of the ceramic insulator plates and the three indicated holes). Then insert the ends of the threaded rods (that have the nuts) through holes AA and AD in the indicated ceramic insulator plate.



Detail 2-2A

4. Slide a #10 fiber flat washer onto the end of each threaded rod.

5. Start a 10-32 nut onto the end of each threaded rod. Turn these nuts onto the rods until the ends of the rods extend 1/8" through the nuts.

6. Use the open-end wrench to tighten the second nut on each rod against the back of the ceramic insulator plate. Do NOT over-tighten these nuts; the ceramic insulator may break.

7. Adjust the third nut on each rod so it is about 1/4" from the second nut as shown.

8. Slide a small 17/64" spacer onto each threaded rod.

9. Slide a stator plate onto the two threaded rods.

10. Repeat steps 8 and 9 until you have the twelve stator plates and twenty-six small 17/64" spacers installed on the threaded rods.

11. Slide two 1-31/32" spacers onto each rod and secure them with a 10-32 nut on each rod. Tighten these nuts only finger tight.



Refer to Pictorial 2-3 (Illustration Booklet, Page 4) for the following steps.

- ( ) Locate the rotor assembly (assembled earlier). Then apply grease to the shaft in the areas shown in the Pictorial.
- ( ) Refer to the inset drawing #1 on the Pictorial and identify the curved side of a dished spring. Then slide the spring onto the rotor shaft so the curved side is toward the rotor plates.
- ( ) Position the rotor assembly and stator section #1 as shown in the Pictorial. Then push the rotor shaft through bushing AB in the capacitor front plate.

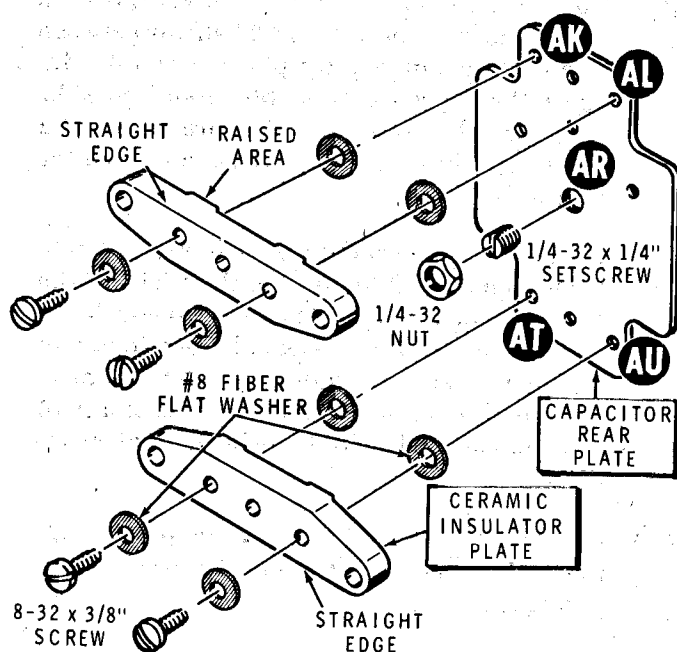
- ( ) Locate the following parts:

Two 10-32 × 9-7/8" threaded rods  
 Four #10 fiber flat washers  
 Ten 10-32 nuts  
 Twenty-six small 17/64" spacers  
 Four 1-31/32" spacers  
 Twelve stator plates  
 One capacitor mounting bracket

- ( ) Assemble stator section #2 of the transmitter matching capacitor as follows:

1. Start two 10-32 nuts onto each end of each threaded rod. Turn these nuts onto the threaded rods until they are almost all the way onto the threaded portions of the rods. NOTE: The nuts will be tightened later.
2. Slide a #10 fiber flat washer onto the end of each threaded rod.
3. Insert the end of the threaded rods (that have the nuts) through holes AS and AX in the indicated ceramic insulator plate.
4. Slide a #10 fiber flat washer onto the end of each threaded rod.

5. Start a 10-32 nut onto the end of each threaded rod. Turn these nuts onto the rods until they are finger tight.
6. Slide the capacitor mounting bracket onto the ends of the threaded rods. Be sure to position this bracket as shown in the Pictorial.
7. Start a 10-32 nut onto the end of each threaded rod. Turn these nuts onto the rods until the ends of the rods extend 1/8" through the nuts.
8. Use the open-end wrench to tighten the second nut on each rod against the back of the capacitor mounting bracket.
9. Use the open-end wrench to tighten the third nut on each rod against the back of the ceramic insulator plate. Do NOT over-tighten these nuts; the ceramic insulator may break.
10. Adjust the fourth nut on each rod so it is about 1/4" from the second nut as shown in inset #2 on the Pictorial.
11. Slide two 1-31/32" spacers onto each rod.
12. Slide a small 17/64" spacer onto each threaded rod.
13. Slide a stator plate onto the two threaded rods.
14. Repeat steps 12 and 13 until you have the twelve stator plates and twenty-six small 17/64" spacers installed on the threaded rods.
15. Turn a 10-32 nut onto each threaded rod until it is finger tight.



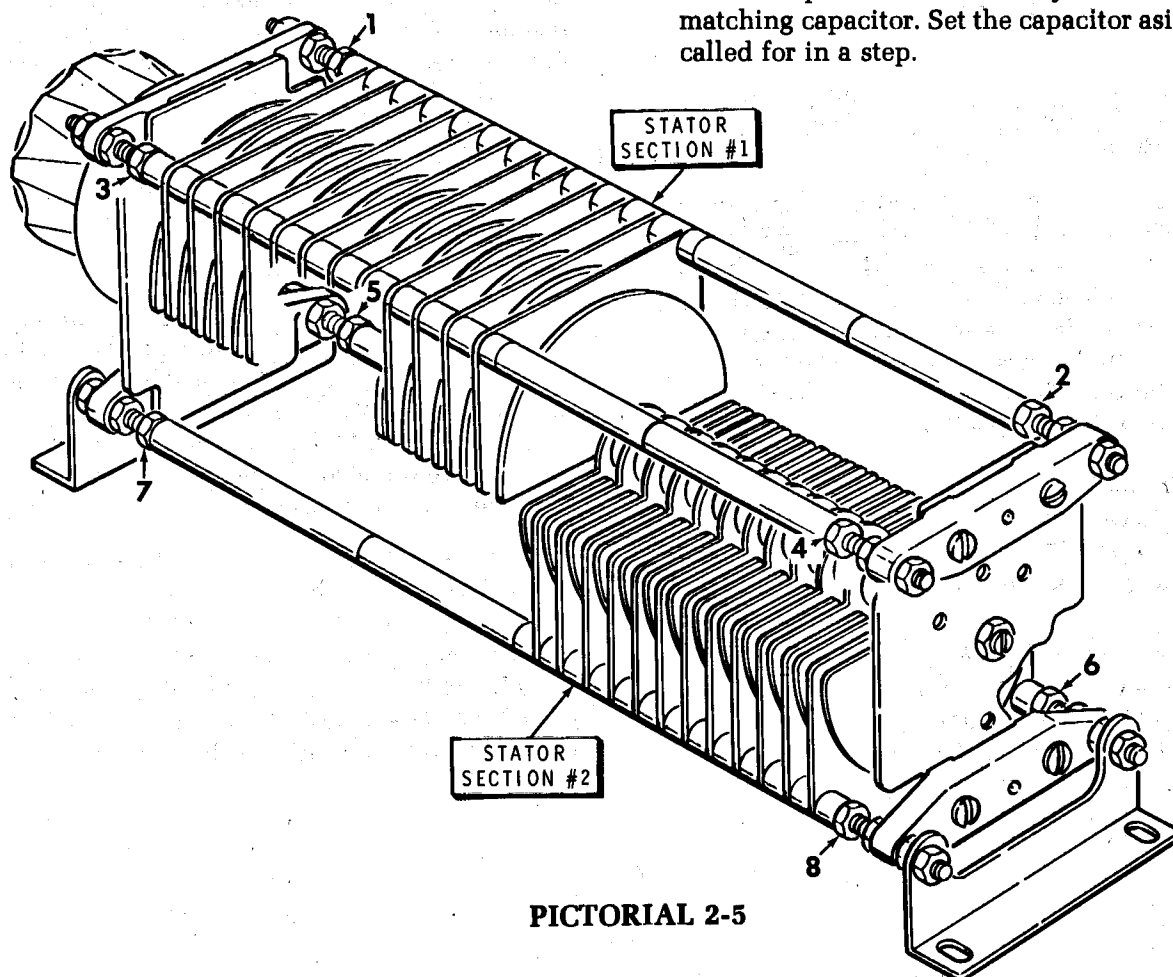
Detail 2-4A

Refer to Pictorial 2-4 (Illustration Booklet, Page 5) for the following steps.

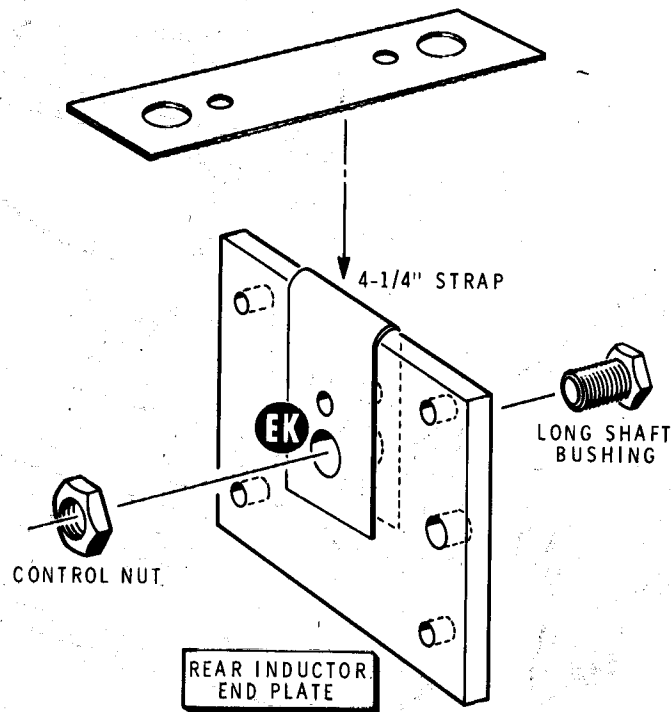
- ( ) Position the capacitor assembly as shown in the Pictorial.
- ( ) Turn a 10-32 nut onto each of the four threaded rods of the capacitor assembly. Turn these nuts on the threaded rods until the outside of each nut is exactly 8-5/8" from the back of the front ceramic insulators as shown in the Pictorial.
- ( ) Apply a small amount of grease in the recessed area in the end of the setscrew installed in hole AR of the rear capacitor plate. Then place a steel ball in the recessed area of the rotor shaft.
- ( ) Slide a #10 fiber flat washer onto the end of each threaded rod.
- ( ) Position the capacitor rear plate assembly as shown (note the position of the ceramic insulator plates and the three indicated holes). Then insert the ends of the threaded rods through the corresponding holes in the ceramic insulator plates. Use 10-32 nuts and #10 fiber flat washers to secure the assembly. Do NOT overtighten these nuts.
- ( ) Tighten the setscrew in hole AR of the capacitor rear plate only until you feel some resistance; then tighten the setscrew 1/4-turn more. Now tighten the 1/4-32 nut at AR.
- ( ) Set the capacitor assembly on a flat surface. Then mount a capacitor mounting bracket onto the indicated threaded rods at the rear of the capacitor assembly. Use two 10-32 nuts to secure the bracket. Make sure the front and rear brackets are flat against your work surface before you tighten these nuts.
- ( ) Locate one of the forked springs set aside earlier.
- ( ) Use long-nose pliers to hold the forked spring. Then lower the spring over the end of the rotor shaft. Push the spring down and insert the tab of the spring into hole AN in the capacitor rear plate.
- ( ) Refer to Detail 2-4A and mount a ceramic insulator plate to a capacitor rear plate at AK and AL. Use an 8-32 x 3/8" screw and two #8 fiber flat washers at each of the two holes. Hold this side of the rear plate against a flat surface when you tighten the screws. This will make the top edge of the ceramic insulator plate flush with the top edge of the capacitor rear plate.
- ( ) Similarly, mount another ceramic insulator plate to the capacitor rear plate at AT and AU. Use an 8-32 x 3/8" screw and two #8 fiber flat washers at each of the two holes.
- ( ) Refer again to Detail 2-4A and start a 1/4-32 x 1/4" setscrew into a 1/4-32 nut. Then install the setscrew in hole AR. Turn the screw in until the unslotted end is flush with the other side of the plate. Do NOT tighten the nut yet.

- ( ) Refer to Pictorial 2-5 for the following steps.
- ( ) Position the capacitor assembly as shown in the Pictorial.
- ( ) Push one of the knobs onto the capacitor shaft. Then temporarily tighten the two setscrews in the knob.
- ( ) Turn the capacitor shaft so the plates are fully meshed (closed).
- ( ) Turn nuts 1, 2, 3 and 4 (as necessary) to position each plate in stator section #1 halfway between two corresponding rotor plates. Carefully inspect the capacitor assembly from one side, then the other side, to make sure each stator plate is positioned properly. Then tighten the four nuts.
- ( ) Turn nuts 5, 6, 7 and 8 (as necessary) to position each plate in stator section #2 halfway between two corresponding rotor plates. Carefully inspect the capacitor assembly from one side, then the other side, to make sure each stator plate is positioned properly. Then tighten the four nuts.
- ( ) Turn the knob several turns each way and note the torque needed to turn the shaft. This is the recommended tension adjustment. If you desire to have the shaft turn easier or harder, loosen or tighten the setscrew in the capacitor rear plate as desired. Keep in mind that the tension will loosen somewhat by itself during normal operation.
- ( ) Loosen the setscrews in the knob and remove the knob from the shaft. Set the knob aside temporarily.

This completes the assembly of the transmitter matching capacitor. Set the capacitor aside until it is called for in a step.



PICTORIAL 2-5

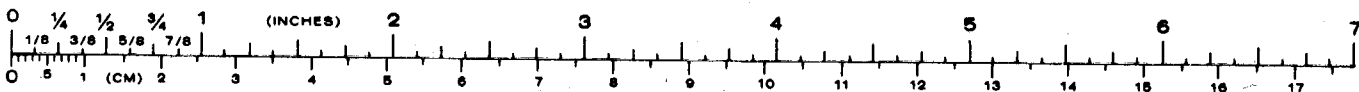


Detail 3-1A

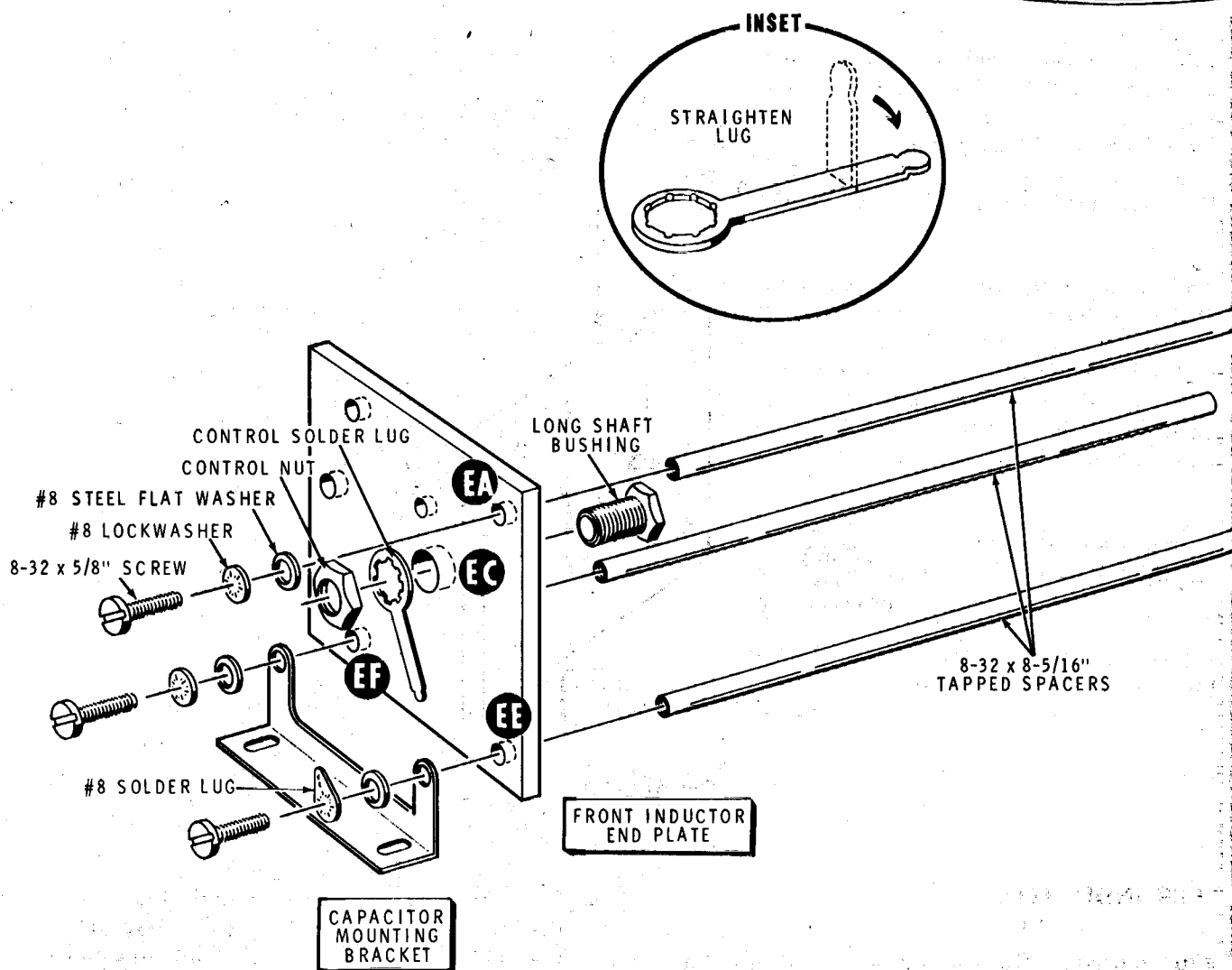
## ROLLER INDUCTOR

Refer to Pictorial 3-1 (Illustration Booklet, Page 6) for the following steps.

- ( ) Peel the paper from both sides of the two inductor end plates.
- ( ) Position one of the inductor end plates as shown in Detail 3-1A (note the position of the seven holes in the plate).
- ( ) Bend the 4-1/4" strap over the indicated edge of the inductor end plate. Secure the strap to the plate at hole EK with a long shaft bushing and a control nut. Be sure the small holes in the strap line up with the corresponding hole in the inductor end plate before you tighten the hardware.



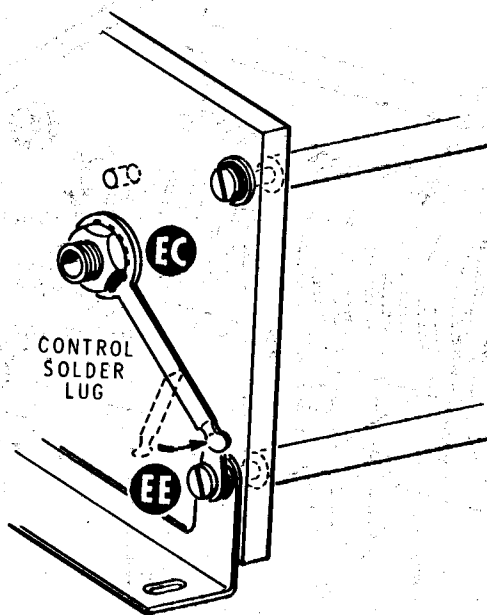




Detail 3-1B

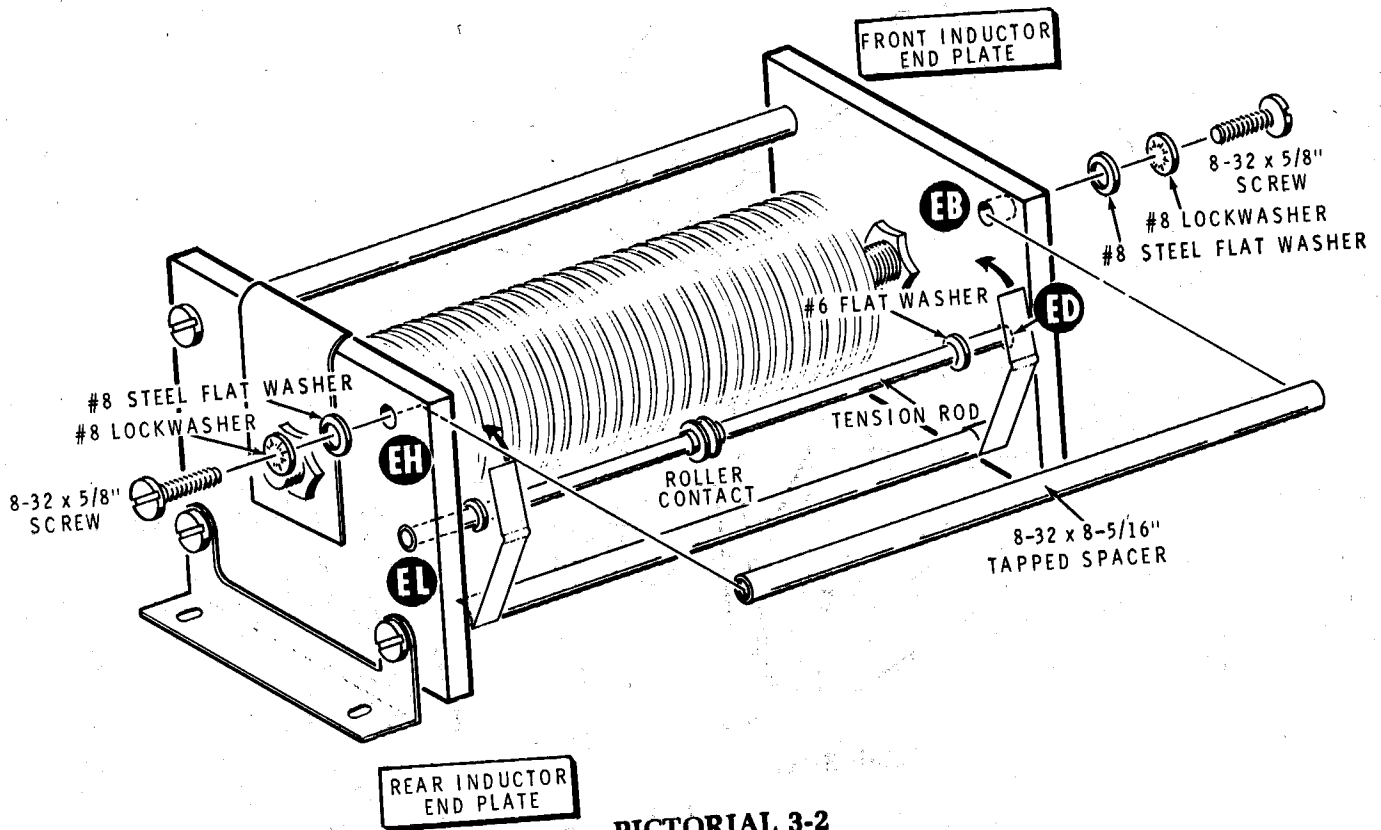
**NOTE:** The inductor end plate you just prepared will be referred to as the rear inductor end plate. Set the rear inductor end plate aside temporarily.

- ( ) Position the remaining inductor end plate as shown in Detail 3-1B (note the position of the seven holes in the plate).
- ( ) Refer to the inset drawing on Detail 3-1B and straighten the control solder lug. Then mount the control solder lug at hole EC with a long shaft bushing and a control nut. Tighten the nut only finger tight at this time.
- ( ) Mount an 8-32 x 8-5/16" tapped spacer to the inductor end plate at EA. Use an 8-32 x 5/8" screw, a #8 lockwasher and a #8 steel flat washer. Tighten the screw only finger tight.
- ( ) Mount a capacitor mounting bracket to the inductor end plate at EE and EF. Use an 8-32 x 8-5/16" tapped spacer, an 8-32 x 5/8" screw, a #8 solder lug, and a #8 steel flat washer at EE. Use an 8-32 x 8-5/16" tapped spacer, an 8-32 x 5/8" screw, a #8 lockwasher, and a #8 steel flat washer at EF. Tighten these screws only finger tight. Position the solder lug at EE straight up (toward the spacer at EA).



Detail 3-1C

- ( ) Refer to Detail 3-1C and position the control solder lug at EC so it touches the #8 solder lug at EE. Then solder these lugs together. Now tighten the control nut at EC.
- ( ) Apply grease to both ends of the inductor shaft at the locations shown in the Pictorial.
- ( ) Note that the bushing on one end of the roller inductor is longer than the bushing at the other end. Slide the shaft at this end of the roller inductor into the bushing at EC in the front inductor end plate.
- ( ) Refer to inset drawing #1 on the Pictorial and start a 4-40 × 1/8" setscrew into a shaft collar. Then slide the collar onto the rear shaft of the roller inductor. Do NOT tighten the setscrew in the shaft collar yet.
- ( ) Refer to inset drawing #2 on the Pictorial and identify the curved side of a brass spring washer. Then slide the spring washer on the rear shaft of the roller inductor with the curved side of the spring washer toward the inductor.
- ( ) Slide two contactor springs onto the spacer mounted at EF. Be sure to position these springs as shown in the Pictorial.
- ( ) Start the bushing in the rear inductor end plate (assembled earlier) onto the rear shaft of the roller inductor. Be sure to position the end plate as shown in the Pictorial.
- ( ) Line up hole EG with the spacer coming from hole EA of the front end plate. Then mount the rear inductor end plate to the spacer. Use an 8-32 × 5/8" screw, a #8 lockwasher and a #8 steel flat washer. Tighten the screw only finger tight.
- ( ) Mount a capacitor mounting bracket to the rear inductor end plate and the remaining spacers at EM and EN. Use two 8-32 × 5/8" screws, two #8 lockwashers, and two #8 steel flat washers. Tighten these screws only finger tight.



PICTORIAL 3-2

Refer to Pictorial 3-2 for the following step.

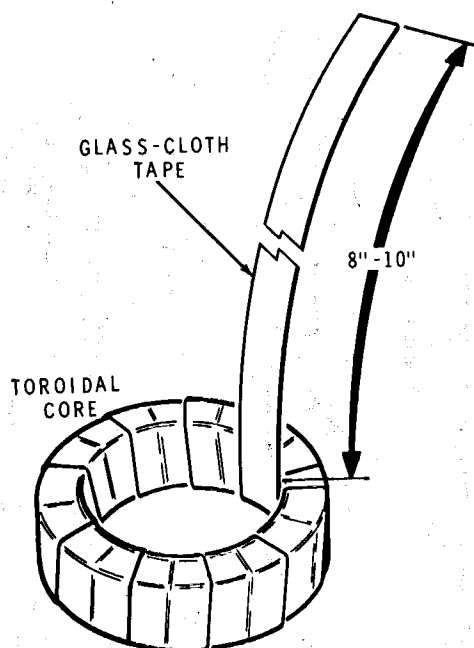
- ( ) Slide a roller contact onto the tension rod. Then slide a small #6 flat washer onto each end of the tension rod.
- ( ) Start one end of the prepared tension rod into hole ED in the front inductor end plate.
- ( ) Start the free end of the tension rod into hole EL in the rear inductor end plate. Be sure the groove in the roller contact rests on one of the wire turns of the inductor. Also be sure the #6 flat washers are on the side of the contactor springs away from the end plates.
- ( ) Position the two contactor springs toward the ends of the tension rod. Be sure the flat washers on the tension rod are on the indicated sides of the contactor springs.

- ( ) Push an 8-32 × 8-5/16" tapped spacer between the front and rear inductor end plates. Be sure the contactor springs are **inside** the spacer as shown. Then mount the spacer at EB and EH. Use two 8-32 × 5/8" screws, two #8 lockwashers, and two #8 steel flat washers. Tighten the screws only finger tight.

- ( ) Set the roller inductor assembly on a flat surface. Then tighten the four screws on each inductor end plate.

- ( ) Push the inductor against the bushing in the front inductor end plate. Then push the collar on the rear inductor shaft firmly toward the rear inductor end plate and tighten the setscrew.

This completes the assembly of the roller inductor. Set the roller inductor aside until it is called for in step.



PICTORIAL 4-1

**BALUN COIL**

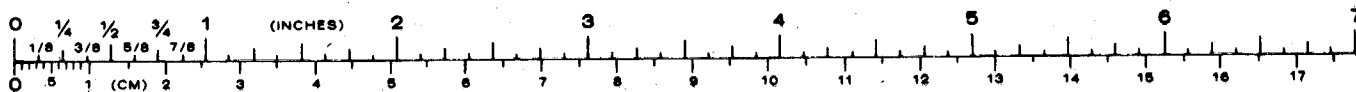
Refer to Pictorial 4-1 for the following steps.

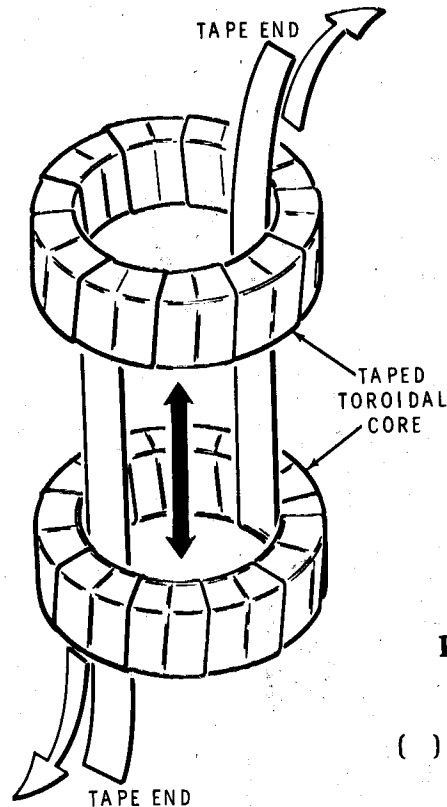
**NOTE:** In the following steps, be careful so the adhesive on one side of the tape does not stick to itself when you handle the tape.

- ( ) Cut a 36" length off the roll of glass-cloth tape.
- ( ) Wrap this length of tape around one toroidal core to cover it completely with one layer. As

you wrap the tape around the core, make sure you pull the tape snug. Make sure each turn overlaps the previous turn about 1/4". When you have covered the whole core with tape, you should have 8-10" remaining. Do NOT cut this end off.

- ( ) Similarly, use another 36" length of tape to cover the remaining toroidal core with one layer of tape.





PICTORIAL 4-2

- ( ) Similarly, wrap the other 15" length of tape around the cores at the area opposite the one covered in the last step. If necessary, cut off any excess tape.

Refer to Pictorial 4-2 for the following steps.

- ( ) Hold one pretaped core between the thumb and index finger on your left hand. Then grasp the remaining pretaped core with your right hand, slip the free end of the tape down through the center of the first core and place the cores on top of each other as shown.
- ( ) Position the pretaped cores so the tape ends are located opposite each other. Then while you hold both cores in place, firmly wrap the whole length of each tape around both cores. As before, make sure each turn overlaps the previous turn about 1/4".
- ( ) Cut two 15" lengths of glass-cloth tape.
- ( ) Wrap one of the tape lengths around the stacked cores at one of the two areas not previously covered with tape. Make sure you wrap the tape so it will overlap part of the tape ends already wrapped around the cores. If necessary, cut off any excess tape length.

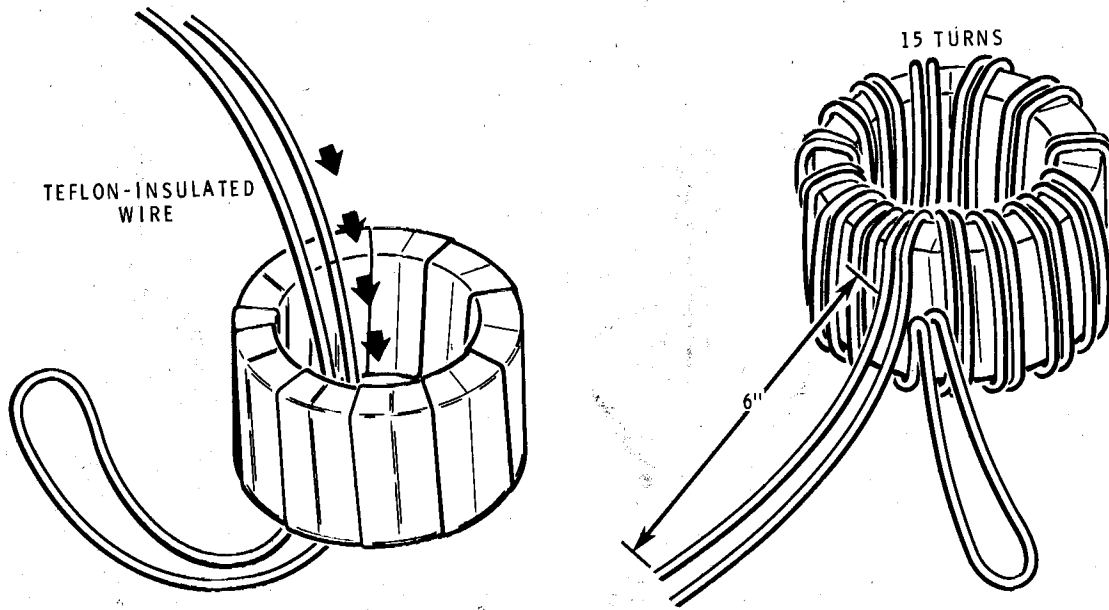
Refer to Pictorial 4-3 for the following steps.

- ( ) Locate the Teflon-insulated wire and cut it to a length of 11 feet.

NOTE: When you perform the next two steps, be sure to pull each winding until it is snug. An easy way to do this is to hook the folded end of the wire around a door knob or similar object and then pull the wire until it is tight.

- ( ) Fold the 11-foot wire in the middle. Then push the folded end through the center of the dual core assembly and wind one turn onto the cores. Adjust the two free wires until you have a length of about 6" from the cores to the wire ends. Pull the wires firmly against the cores.
- ( ) Continue to loop the folded end of the wire around the core assembly, through the center of it, until you have a total of 15 turns wound on the cores. Make sure you pull the wires snug for each turn you wind. Make sure the wires do not twist or overlap the other wires.





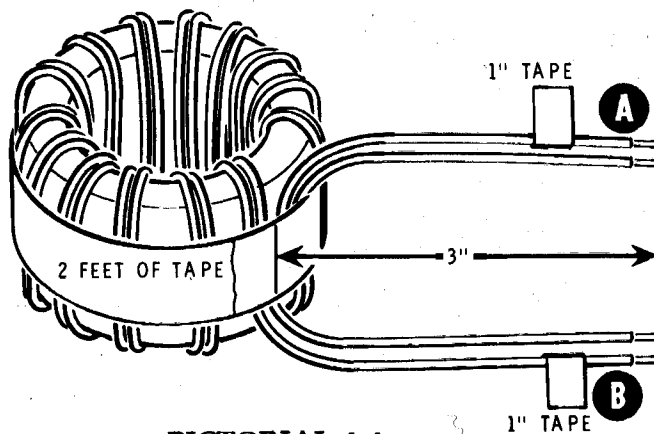
PICTORIAL 4-3

Refer to Pictorial 4-4 for the following steps.

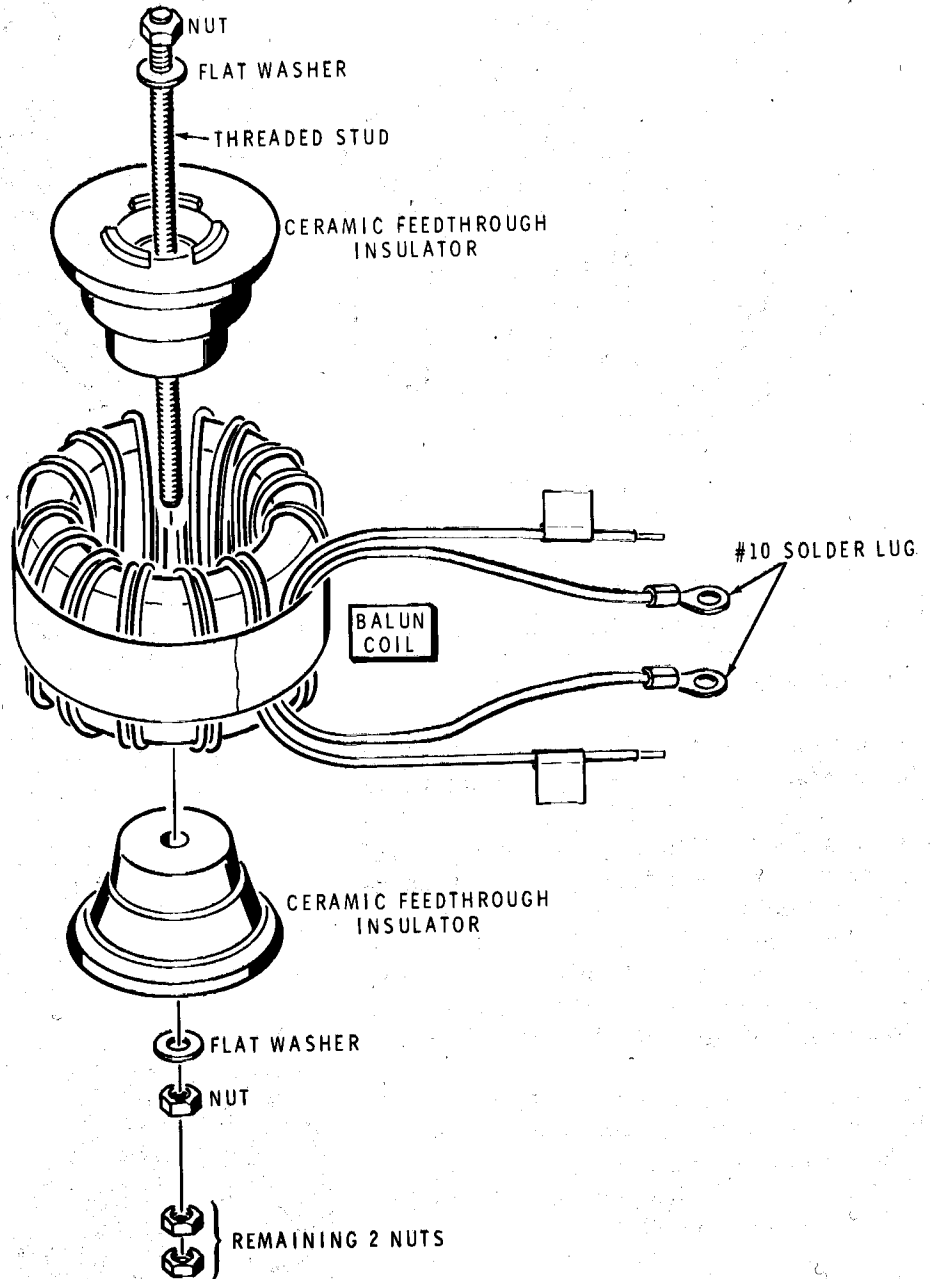
- ( ) Cut a 2-foot length of glass-cloth tape.
- ( ) Position the wire ends of the balun assembly as shown. Make sure the first and the last turns of the winding are pushed firmly down against the cores. Then start to wrap the 2-foot length of tape around the outer circumference of the assembly to hold these turns in place. As you wrap the tape onto the assembly, position each pair of wires so they are about evenly spaced all the way around the assembly. Wrap the entire 2-foot length of tape onto the assembly.
- ( ) Cut the wire ends to the dimensions shown in the Pictorial and remove  $1/4$ " of insulation from each wire end. Then twist the strands on each wire together and melt a small amount of solder on the wire ends to hold the strands together.

- ( ) At end A of the balun, wrap a 1" piece of tape around one of the two wire ends.
- ( ) Turn on your ohmmeter and set it to the  $R \times 10$  range. The meter should indicate infinity if the test leads are not connected together.
- ( ) Connect one of the test leads to the wire with tape around it. Then connect the other test lead to one of the wires at end B of the balun. Wrap a 1" length of tape around the wire end that does NOT show continuity.

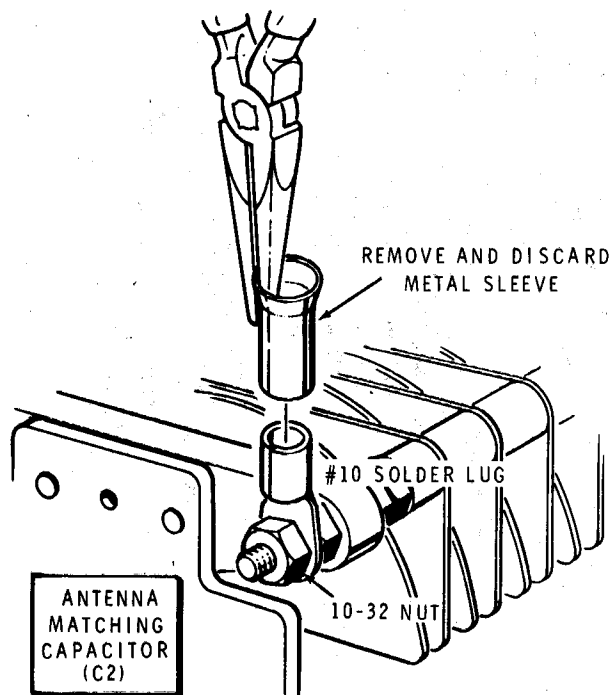
**NOTE:** The balun coil consists of two separate windings. When you install the balun, one wire end from each winding will be connected to the chassis. Complete the next three steps carefully to make sure you select the proper wire ends.



PICTORIAL 4-4



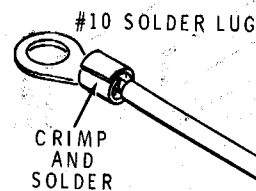
PICTORIAL 4-5



Detail 4-5A

Refer to Pictorial 4-5 for the following steps.

- ( ) Refer to Detail 4-5A and temporarily mount a #10 solder lug on a threaded rod of the antenna matching capacitor (C2). Secure the solder lug with a 10-32 nut, but tighten it only enough to prevent the lug from turning. Now use a pair of long-nose pliers to remove and discard the metal sleeve from the lug. Then remove the nut and the solder lug from the threaded rod.
- ( ) Similarly, remove and discard the metal sleeve from the three remaining #10 solder lugs. Set two of these lugs aside for use later. Also set capacitor C2 and the 10-32 nut aside for use later.

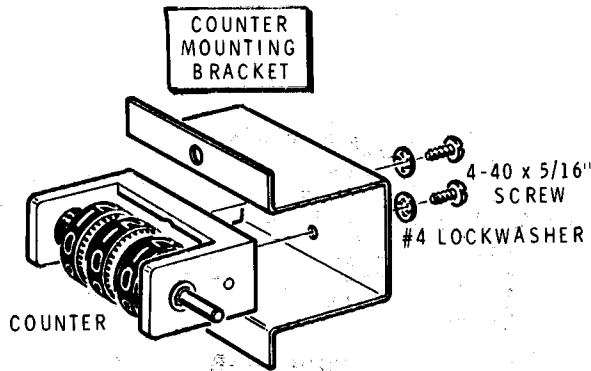


Detail 4-5B

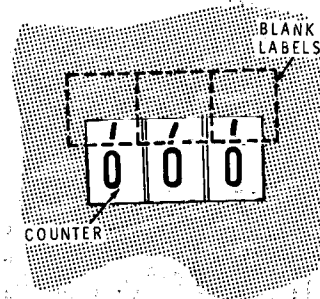
- ( ) Refer to Detail 4-5B and insert the bare end of one of the **untaped** balun coil wires into a #10 solder lug as shown. Crimp the tabs of the solder lug tightly against the wire. Then solder the connection.
- ( ) Similarly, install a #10 solder lug on the remaining **untaped** balun coil wire.
- ( ) Locate one of the ceramic feedthrough insulators. Then use the hardware supplied with the insulator to mount the insulator in the balun coil as follows:
  1. Push an insulator into each side of the balun coil.
  2. Use two flat washers and two nuts to secure the insulators in the balun. Do **NOT** over-tighten the hardware. When correctly assembled, one end of the threaded stud should just extend through one of the nuts.
  3. Temporarily turn the remaining two nuts onto the free end of the threaded stud. These nuts will be used later when you mount the balun in the chassis. Discard the unused parts that were supplied with the insulator.

This completes the assembly of the balun coil. Set the balun coil aside until it is called for in a step.





Detail 5-1A



Detail 5-1C

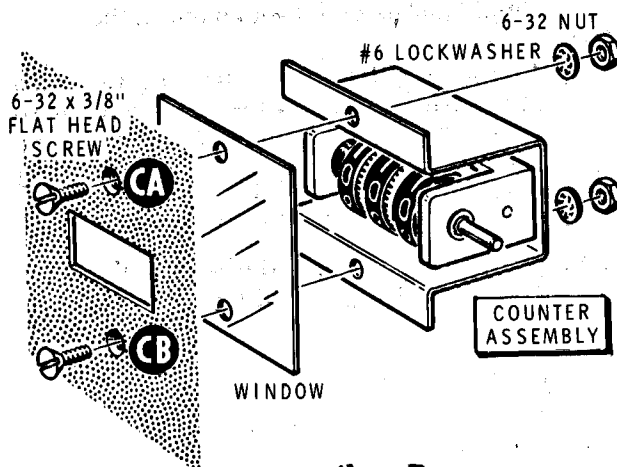
**CHASSIS ASSEMBLY**

Refer to Pictorial 5-1 (Illustration Booklet, Page 6) for the following steps.

- ( ) Refer to Detail 5-1A and mount the counter to the counter mounting bracket. Use two 4-40 x 5/16" screws and two #4 lockwashers. Be sure the edges of the counter are parallel to the edges of the mounting bracket before you tighten the screws.

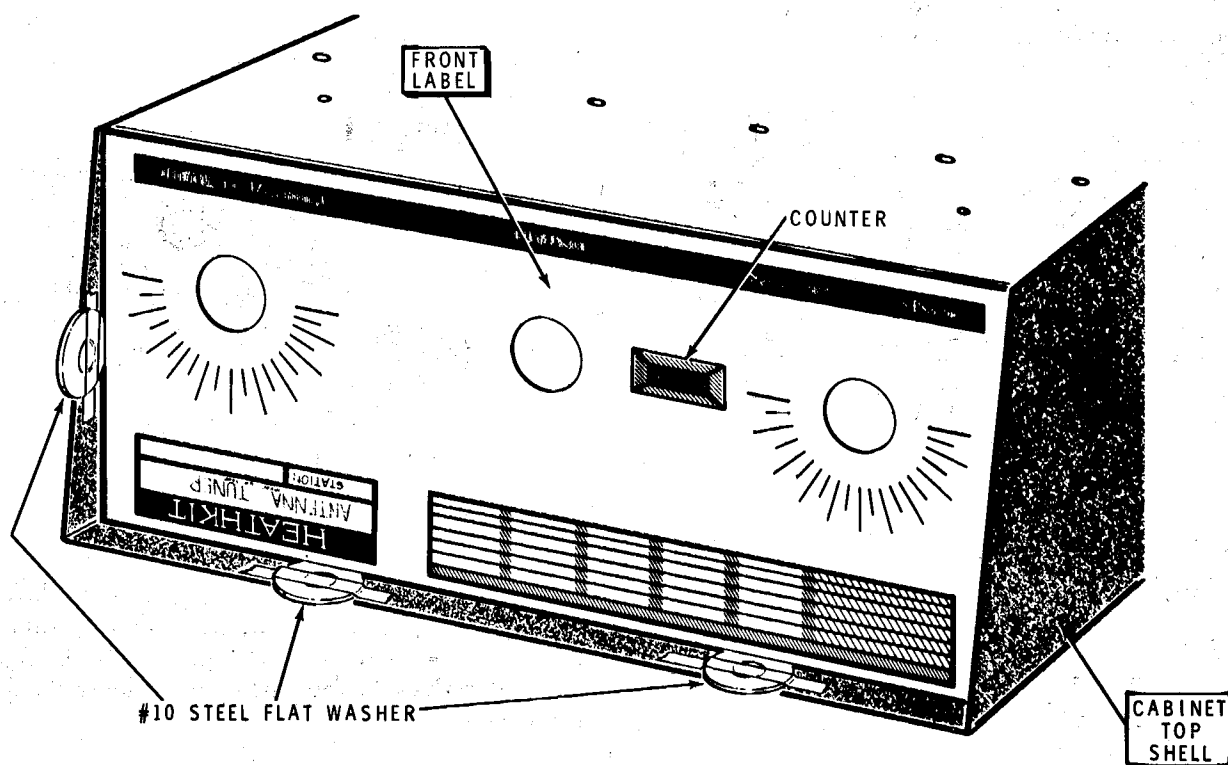
**NOTE:** Use the plastic nut starter to hold and start 6-32 nuts on screws.

- ( ) Refer to Detail 5-1B and mount the counter assembly and a window to the front of the chassis at CA and CB. Use two 6-32 x 3/8" flat head screws, two #6 lockwashers, and two 6-32 nuts.



Detail 5-1B

- ( ) Use the following procedure to install three blank labels (from the call letter label sheet) on the front of the chassis.
  1. Turn the shaft of the counter until the three digits are in line.
  2. Remove three blank labels from the label sheet and press them on the indicated side of the hole for the counter (see Detail 5-1C). Be sure to install these labels so you can see only the three correct digits.
- ( ) Temporarily mount the cabinet top shell onto the chassis. Note the position of the wide lip. Use eight 6-32 x 3/8" black screws.
- ( ) Place a soft cloth on your work surface while you perform the following steps. This will help keep the cabinet top shell from becoming scratched.
- ( ) Use tape (not supplied) to temporarily hold #10 steel flat washers to the front lip of the cabinet top shell at the three locations shown. Be sure the edge of each washer touches the front of the chassis.



PICTORIAL 5-2

Refer to Pictorial 5-2 for the following steps.

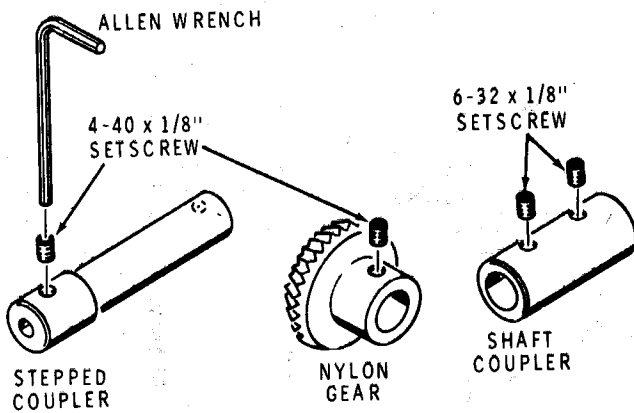
**NOTE:** When you install the front label onto the chassis, in the following steps, you will use the flat washers taped to the cabinet top shell to help you center the label.

( ) Install the front label onto the front of the chassis as follows:

1. Use a soft cloth to wipe fingerprints etc. from the front of the chassis.
2. Hold the front label against the front of the chassis so the top and right edges of the label are against the #10 steel flat washers. The label should be centered on the chassis and the counter should be centered in the corresponding hole in the label. If it is not, note how much you will have to move the label when you install it in the next step.

**NOTE:** The front label is very difficult to remove once it is mounted on the chassis. Perform the next step carefully to make sure you install the label correctly.

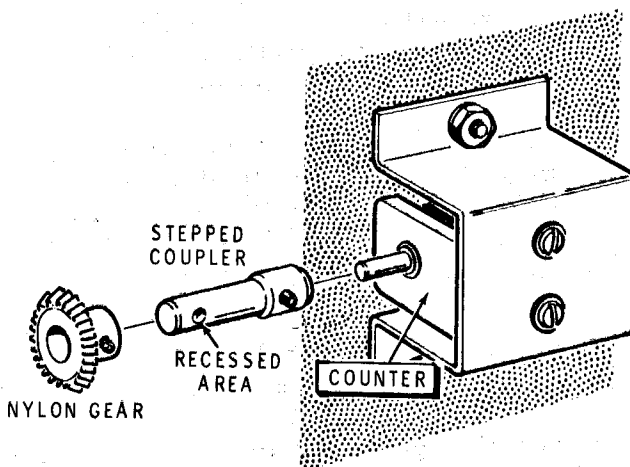
3. Carefully peel the backing paper from the front label. Then press the label against the front of the chassis. Be sure the label is centered on the chassis and the counter is centered in its hole in the label.
- ( ) Remove the tape from the three washers. Save these washers for use later.
- ( ) Remove the eight screws from the cabinet top shell. Then set these screws and the shell aside for use later.



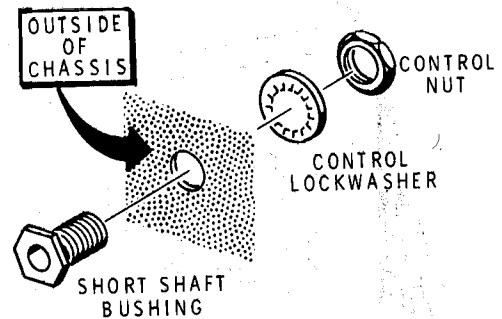
Detail 5-3A

Refer to Pictorial 5-3 (Illustration Booklet, Page 7) for the following steps.

- ( ) Refer to Detail 5-3A and use the small allen wrench to start a 4-40 × 1/8" setscrew in the stepped coupler.
- ( ) Similarly, start 4-40 × 1/8" setscrews in the two nylon gears.
- ( ) Use the large allen wrench to start two 6-32 × 1/8" setscrews into each of the three shaft couplers.
- ( ) Set one of the nylon gears and the three shaft couplers aside until they are called for in a step.



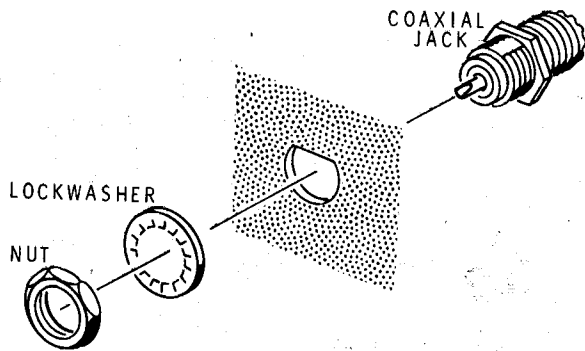
Detail 5-3B



Detail 5-3C

**CAUTION:** You can very easily strip the threads in the nylon gears when you mount them on their shafts, as in the next step. Therefore, do NOT overtighten the setscrews when you secure the gears on their shafts.

- ( ) Refer to Detail 5-3B and mount a nylon gear onto the stepped coupler as shown. Be sure the setscrew enters the recessed area on the coupler. Then carefully tighten the setscrew.
- ( ) Turn the shaft of the counter until you can read 000 through the front panel window. Then temporarily mount the stepped coupler onto the shaft of the counter. Push the stepped coupler all the way onto the shaft of the counter before you tighten the setscrew. Tighten the setscrew only enough to hold the coupler in place.
- ( ) Refer to Detail 5-3C and mount a short shaft bushing at CC on the chassis front. Be sure to insert the bushing from the outside of the chassis. Use a control lockwasher and a control nut. Tighten the nut only finger tight.
- ( ) Similarly, mount short shaft bushings at CD and CE on the chassis front. Tighten these nuts only finger tight.

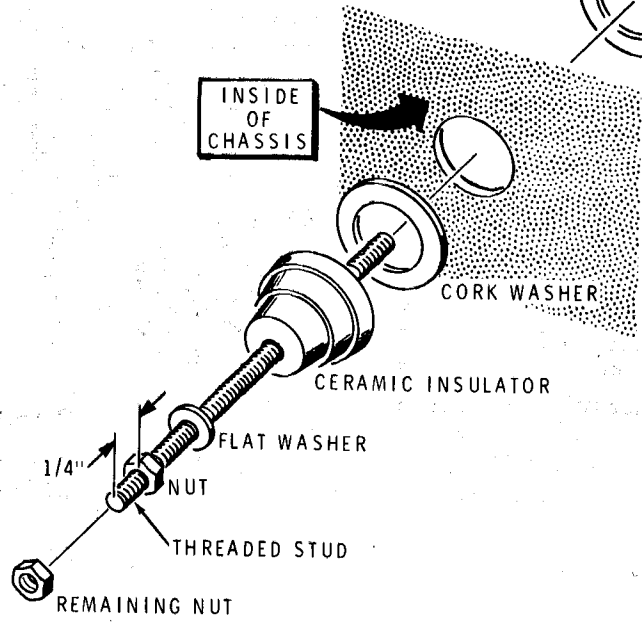
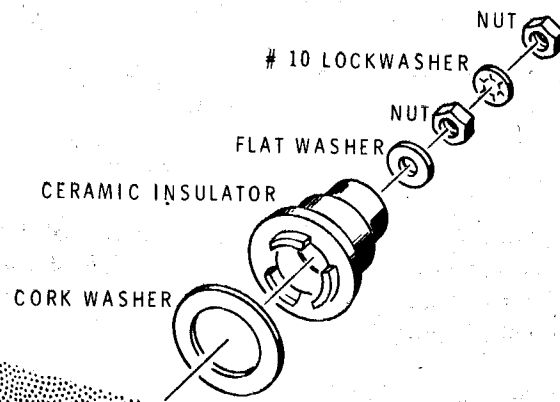


Detail 5-3D

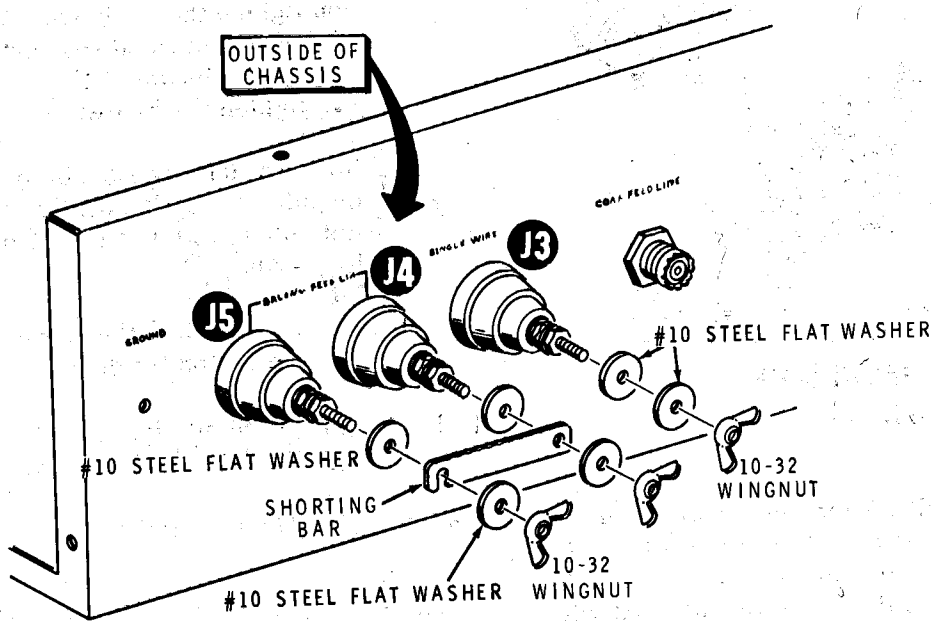
1. Mount a ceramic insulator as shown. Before you tighten the hardware, make sure about 1/4" of the threaded stud extends from the nut on the inside of the chassis. Do NOT overtighten the hardware.
2. Slide a #10 lockwasher onto the stud on the outside of the chassis. Then turn another nut onto the stud and tighten it against the lockwasher.
3. Temporarily turn the remaining nut onto the stud on the inside of the chassis.

( ) J4 and J5: Similarly, mount ceramic feed-through insulators at J4 and J5.

- ( ) J1: Refer to Detail 5-3D and mount a coaxial jack at J1 on the rear of the chassis. Be sure to match the flat in the side of the jack with the flat in the chassis hole. Use the hardware supplied with the jack as shown.
- ( ) J2: Similarly, mount a coaxial jack at J2 on the rear of the chassis.
- ( ) J3: Refer to Detail 5-3E and mount a ceramic feedthrough insulator at J3 on the chassis rear as follows. NOTE: In addition to the parts supplied with the insulator, you will need a #10 lockwasher.

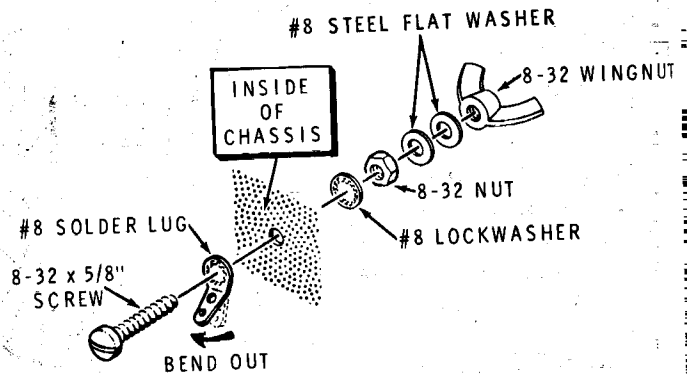


Detail 5-3E

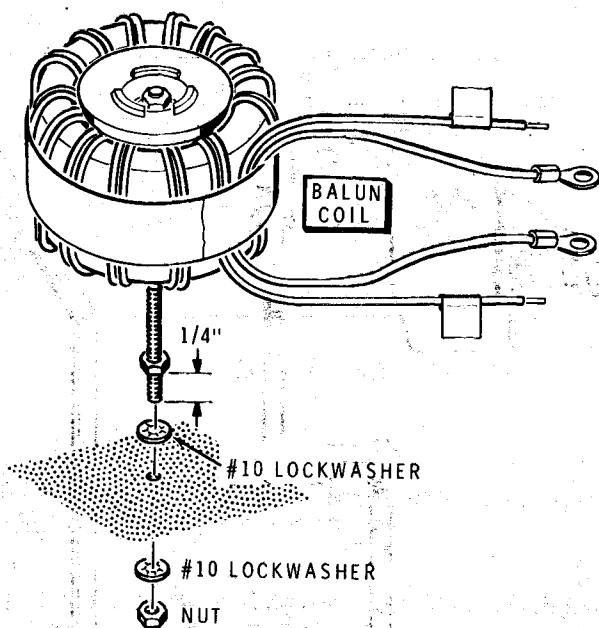


**Detail 5-3F**

- ( ) Refer to Detail 5-3F and slide two #10 steel flat washers onto the stud on the outside of the chassis at J3. Then turn a 10-32 wingnut onto the stud against the flat washers.
- ( ) Refer again to Detail 5-3F and mount the shorting bar onto the studs of ceramic feedthrough insulators J4 and J5. Be sure the shorting bar is between the #10 steel flat washers. Also be sure the open side of the shorting bar is on the stud of J5 as shown.
- ( ) Form a #8 solder lug as shown in Detail 5-3G. Then mount the solder lug at CF on the chassis as shown in the Detail. Use an 8-32 x 5/8" screw, the #8 steel flat washers, and an 8-32 wingnut. Position the solder lug as shown in the Pictorial.



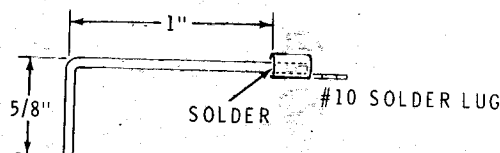
**Detail 5-3G**



Detail 5-4A

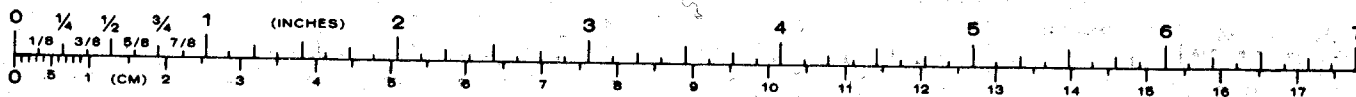
Refer to Pictorial 5-4 (Illustration Booklet, Page 7) for the following steps.

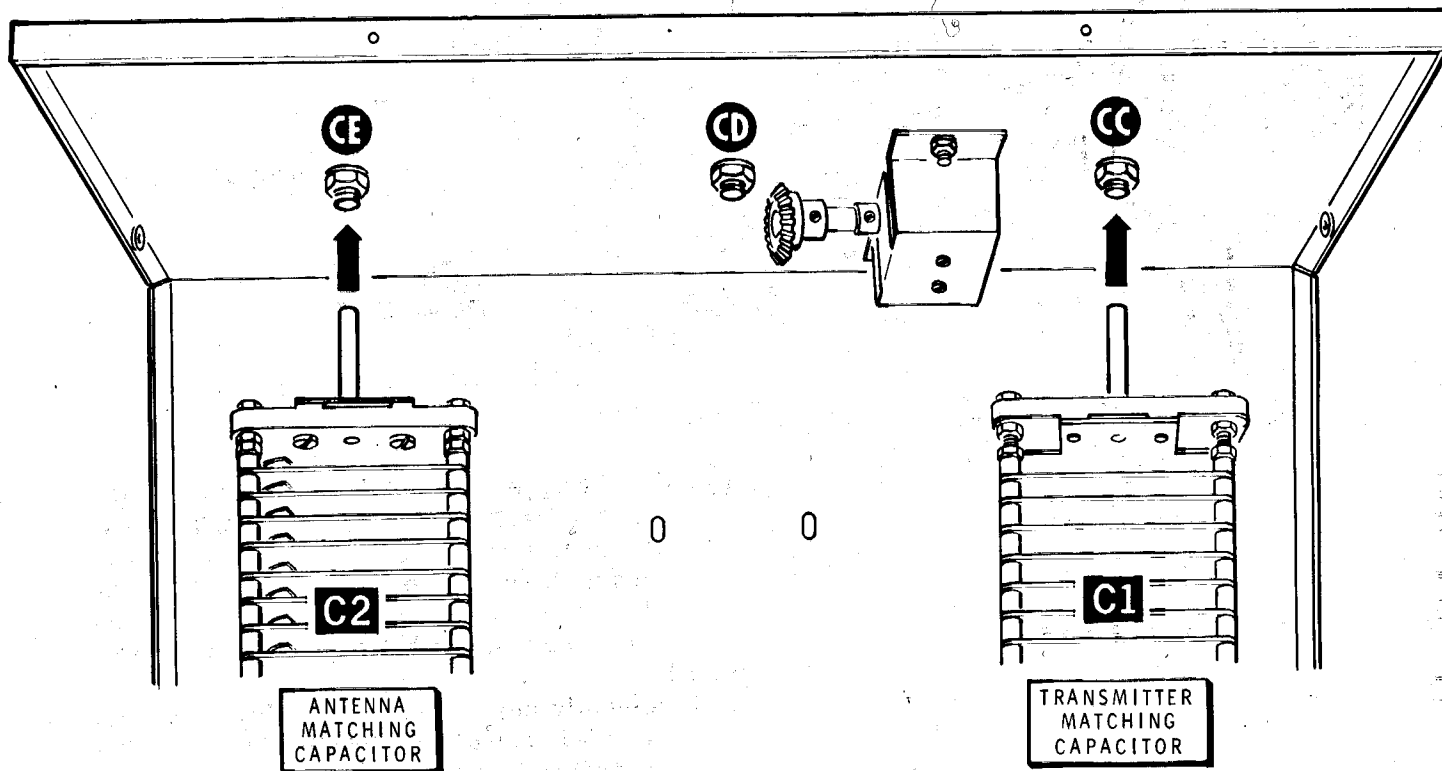
- ( ) T1: Refer to Detail 5-4A and mount the balun coil at T1 in the chassis as follows:
  1. Temporarily remove one of the nuts from the long stud coming from the balun coil. Adjust the remaining nut until the outside of the nut is  $1/4$ " from the end of the stud.
  2. Mount the balun coil at T1 as shown. Use two #10 lockwashers and the nut you just removed. Be sure to position the balun coil so the wires are toward the rear of the chassis as shown in the Pictorial.
- ( ) Connect both of the taped wires coming from the balun coil to solder lug CF. Be sure to make mechanically secure connections as shown in the inset drawing on the Pictorial. Then solder the wires to the solder lug.



Detail 5-4B

- ( ) Remove the first nut from the stud of the ceramic feedthrough insulator at J5. Then use the nut to mount the #10 solder lug on the wire coming from the **top** of the balun coil on the stud of this insulator. Be sure to position the solder lug as shown before you tighten the nut.
- ( ) Similarly, mount the #10 solder lug on the wire coming from the **bottom** of the balun coil on the stud of the insulator at J4. Be sure to position the solder lug as shown before you tighten the nut.
- ( ) Refer to Detail 5-4B and prepare a jumper wire as follows:
  1. Cut a 2" bare wire.
  2. Solder a #10 solder lug to one end of this bare wire.
  3. Form a 90° bend in the bare wire 1" from the end of the solder lug as shown.
  4. Cut the free end of the bare wire  $5/8$ " from the bend.
- ( ) Remove the first nut from the stud of ceramic feedthrough insulator J3. Then connect the wire from the insulator to coaxial jack J2 as shown in the Pictorial. Turn the nut back onto the stud of J3. Tighten this nut only finger tight. Now solder the end of the bare wire to coaxial jack J2.



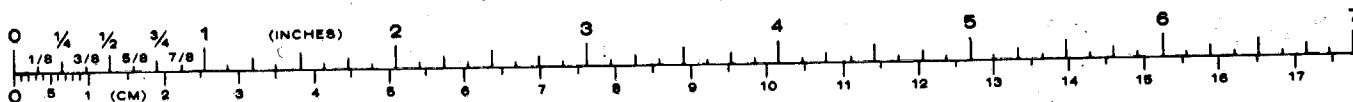


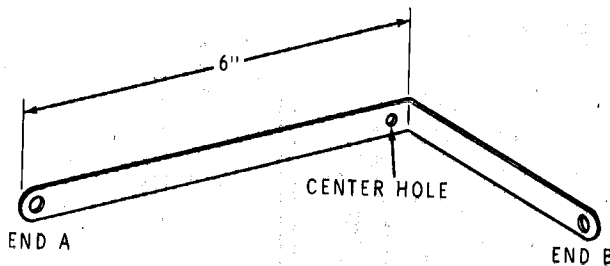
PICTORIAL 5-5

Refer to Pictorial 5-5 for the following steps.

- ( ) Position the chassis as shown in the Pictorial.
- ( ) Set the antenna matching capacitor (C2) in the chassis so it is resting on its mounting brackets. Then slide the capacitor forward and adjust the bushing at CE so the shaft of the capacitor passes through the bushing. Be sure the mounting brackets on the capacitor are flat against the chassis. Then tighten the hardware on bushing CE.
- ( ) Remove the antenna matching capacitor from the chassis and set the capacitor aside temporarily.
- ( ) Similarly, set the transmitter matching capacitor (C1) in the chassis so it is resting on its mounting brackets. Then slide the capacitor forward and adjust bushing CC so the shaft of the capacitor passes through the bushing. Be sure the mounting brackets on the capacitor are flat against the chassis. Then tighten the hardware on bushing CC.
- ( ) Remove the transmitter matching capacitor from the chassis and set the capacitor aside temporarily.

NOTE: The bushing at CD will be tightened later.





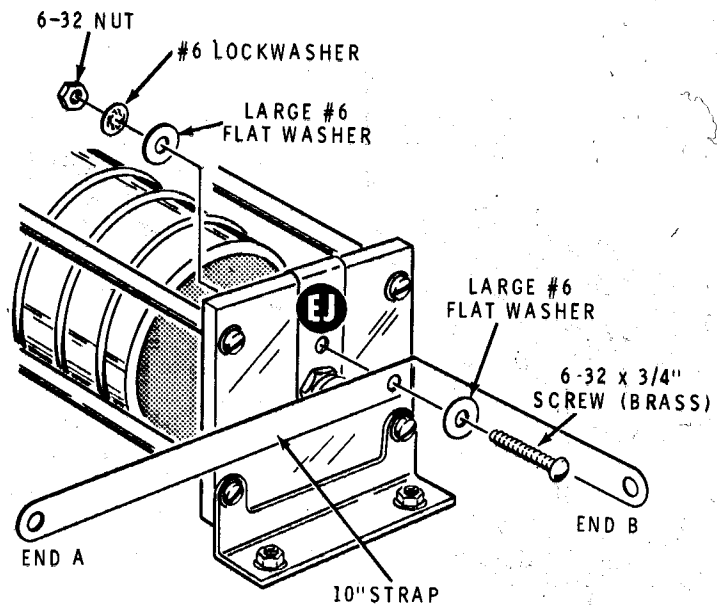
Detail 5-6A

Refer to Pictorial 5-6 (Illustration Booklet, Page 8) for the following steps.

- ( ) Locate the three shaft couplers. Then push half the length of a shaft coupler onto each of the capacitor shafts and the roller inductor shaft. Tighten the rear setscrew in each coupler onto the shafts.
- ( ) Refer to Detail 5-6A and form a 90° bend in the 10-1/4" strap at the location shown. Note the position of the center hole in the strap. The hole should be only about 3/8" from the bend.
- ( ) Refer to Detail 5-6B and mount the prepared strap at EJ on the rear inductor end plate as shown. Use a 6-32 x 3/4" screw (brass), two large #6 flat washers, a #6 lockwasher and a 6-32 nut. Be sure the strap is parallel to the top edge of the end plate and ends A and B are oriented as shown. Then tighten the hardware.

**NOTE:** When you perform the next step, carefully position end B of the strap inside the chassis and toward jack J1. The end of this strap will be connected to the transmitter matching capacitor later.

- ( ) L1: Loosely mount the roller inductor assembly to the chassis at holes CK, CL, CS and CT (see inset drawing #1). Use a 6-32 x 3/8" screw, two #6 flat washers, a #6 lockwasher and a 6-32 nut at each of the four locations.
- ( ) Refer to inset drawing #2 on the Pictorial and apply a thin layer of grease to the 2-3/4" extension shaft (metal) in the area shown.

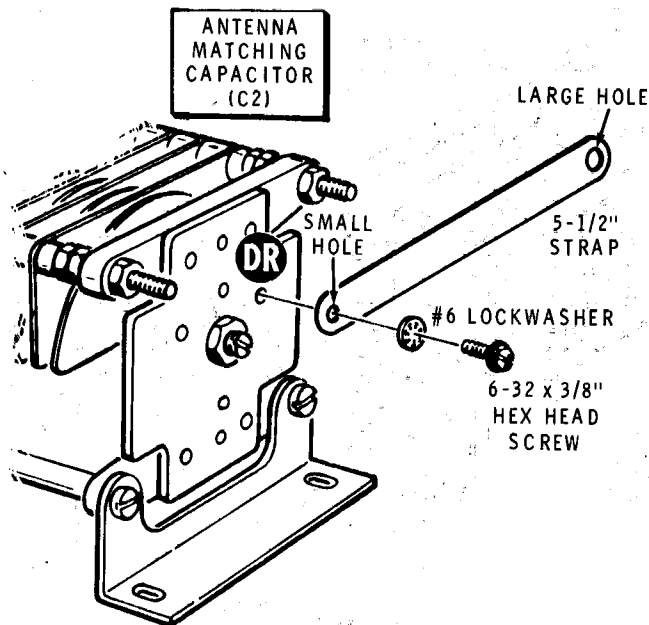


Detail 5-6B

- ( ) Push the end of the extension shaft through the shaft bushing at CD in the chassis front. Then slide the remaining nylon gear on the extension shaft as shown and push the shaft into the shaft coupler. Tighten the shaft coupler screw. Do NOT tighten the setscrew in the gear yet.
- ( ) Tighten bushing CD. Then tighten the hardware at CK, CL, CS and CT.
- ( ) Use the following procedure to calibrate the counter against the roller inductor.

1. Turn the shaft of the roller inductor until the contact roller is against the rear stop of the inductor. **NOTE:** If you wish, you may install a knob on the shaft while you perform this step.
2. Make sure the counter still indicates 000 through the front panel window.
3. Loosen the setscrew in the stepped coupler. Then adjust the two gears until they mesh perfectly. Then tighten the setscrew in the gear on the inductor shaft and the setscrew in the stepped coupler.



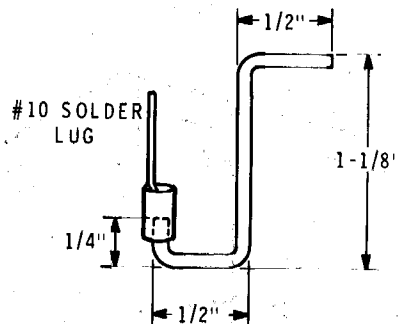


Detail 5-6C

- ( ) Refer to Detail 5-6C and mount the end of the 5-1/2" strap (the end with the smaller hole) to the back of the antenna matching capacitor at DR. Use a 6-32 x 3/8" hex head screw and a #6 lockwasher. Be sure the strap is parallel to the top of the capacitor rear plate assembly before you tighten the screw.

NOTE: When you perform the next step, carefully position the free end of the 5-1/2" strap toward jack J3. Be sure the strap hardware remains tight.

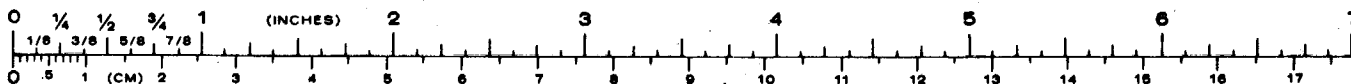
- ( ) C2: Loosely mount the antenna matching capacitor to the chassis at holes CM, CN, CU and CV. Use a 6-32 x 3/8" screw, two large #6 flat washers, a #6 lockwasher, and a 6-32 nut at each of the four locations.
- ( ) Refer to inset drawing #2 on the Pictorial and apply a thin layer of grease to a 2-3/8" extension shaft (fiberglass) in the area shown.
- ( ) Push the extension shaft through the shaft bushing at CE into the shaft coupler of capacitor C2. Then tighten the setscrew in the shaft coupler.

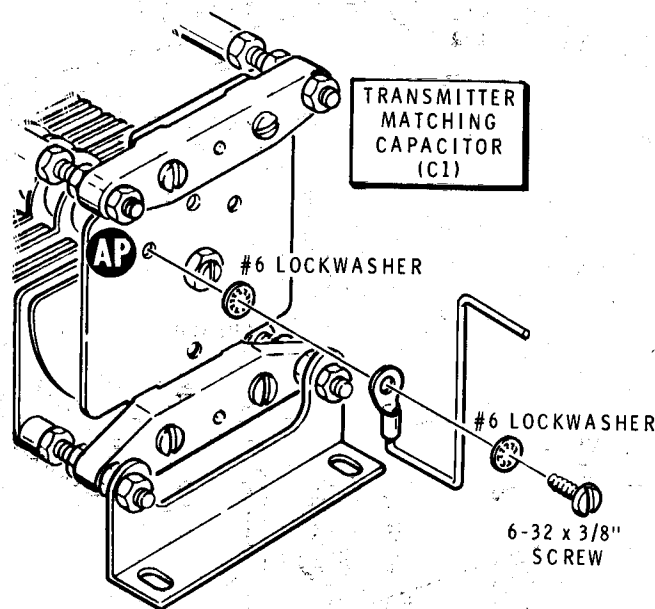


ACTUAL SIZE

Detail 5-6D

- ( ) Place end A of the 10-1/4" strap, coming from the roller inductor, over the threaded rod of capacitor C2 (at DN). Then secure the strap with a 10-32 nut. Be sure to position the strap as shown. Also make sure the strap does not touch any other mounting hardware on the roller inductor.
- ( ) Remove the first nut from the stud of ceramic feedthrough insulator J3. Then place the free end of the 5-1/2" strap, coming from capacitor C2, over the stud and secure it with the nut. Be sure to position the strap as shown.
- ( ) Use the open-end wrench to tighten the hex head screw at DR on the antenna matching capacitor (C2), if necessary.
- ( ) Tighten the hardware at CM, CN, CU and CV.
- ( ) Cut a 2-1/2" bare wire. Then refer to Detail 5-6D and prepare and form the wire as follows:
  1. Crimp and solder a #10 solder lug on one end of the wire.
  2. Form the wire as shown in the Detail. After you make the last bend, cut off any excess wire length.



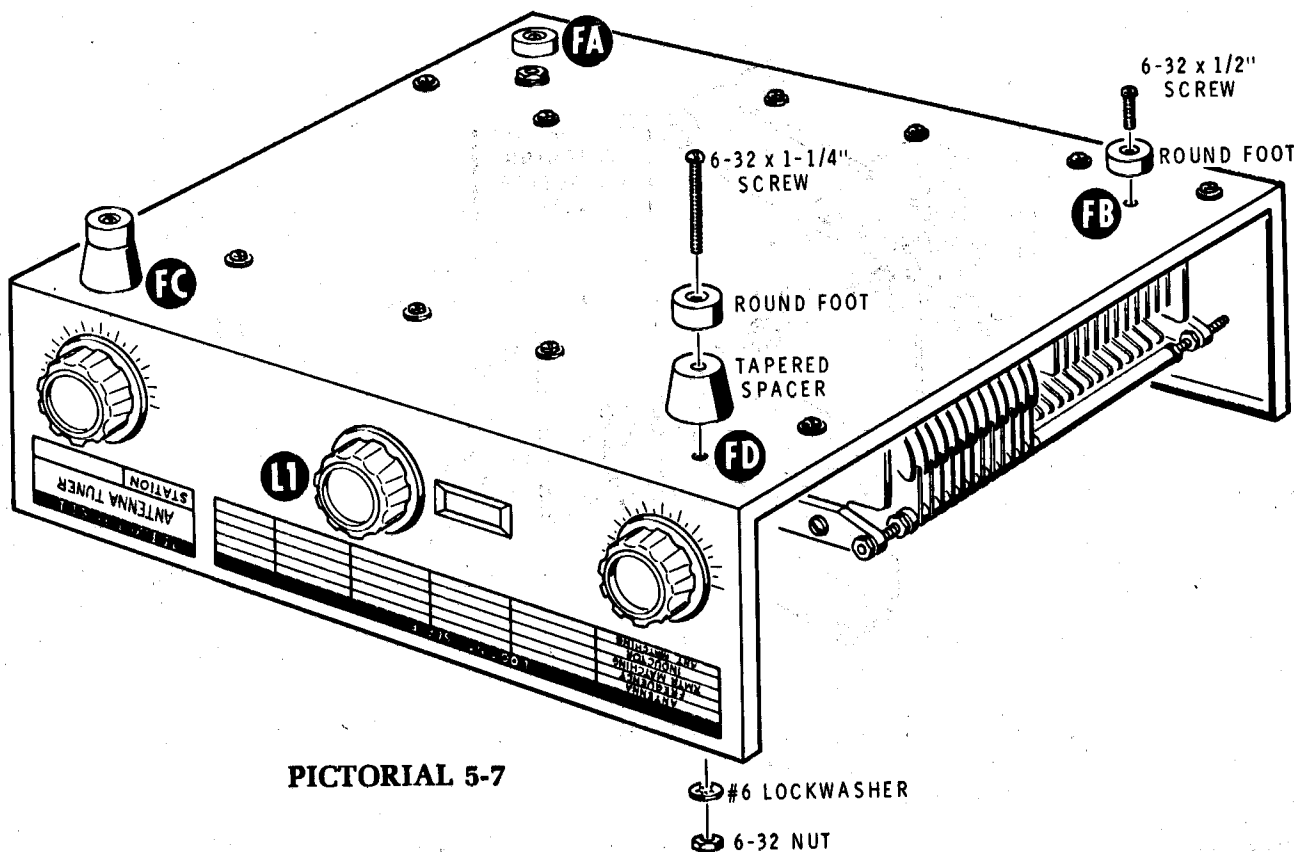


Detail 5-6E

- ( ) Refer to Detail 5-6E and mount the solder lug with the wire, prepared in the above step, at AP on the rear plate of transmitter matching capacitor C1. Use a 6-32  $\times$  3/8" screw and two #6 lockwashers. Position the lug as shown before you tighten the screw.
- ( ) Loosely mount the transmitter matching capacitor to the chassis at holes CH, CJ, CP and CR. Use a 6-32  $\times$  3/8" screw, two large #6 flat washers, a #6 lockwasher and a 6-32 nut at each of the four locations.
- ( ) Place end B of the 10-1/4" strap, coming from the roller inductor, over the threaded rod of capacitor C1 (at AJ). Then secure the strap with a 10-32 nut. Be sure to position the strap as shown.
- ( ) Refer to inset drawing #2 on the Pictorial and apply a thin layer of grease to a 2-3/8" extension shaft (fiberglass) in the area shown.
- ( ) Push the extension shaft through the shaft bushing at CC into the shaft coupler of capacitor C1. Then tighten the setscrew in the shaft coupler.
- ( ) Tighten the hardware at CH, CJ, CP, and CR.
- ( ) Connect the free end of the bare wire, coming from solder lug AP on the rear plate of capacitor C1, to coaxial jack J1. Solder the connection.
- ( ) Carefully peel the backing paper from the danger label. Then press the label onto the back of the chassis. Center the label in the clear area above ceramic feedthrough insulator J4.

**NOTE:** The blue and white label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications you have with the Heath Company about your kit. This assures you that you will receive the most complete and up-to-date information in return.

- ( ) Carefully peel the backing paper from the blue and white label. Then press the label on the inside of the chassis rear as shown in the Pictorial.



PICTORIAL 5-7

Refer to Pictorial 5-7 for the following steps.

- ( ) Position the chassis as shown in the Pictorial.
- ( ) Mount round feet at FA and FB on the bottom of the chassis as shown. Use  $6-32 \times 1/2"$  screws.

NOTE: Perform only one of the following two steps.

1. ( ) If you wish to have your Antenna Tuner set level, install only round feet at FC and FD on the bottom of the chassis. Use two  $6-32 \times 1/2"$  screws, two #6 lockwashers, and two 6-32 nuts.
2. ( ) If you wish to have the front of the chassis tilted upward, mount round feet and tapered spacers at FC and FD on the bottom of the chassis. Use two  $6-32 \times 1-1/4"$  screws, two #6 lockwashers and two 6-32 nuts.

- ( ) Push a knob onto the shaft of the inductor at L1. Then tighten the two setscrews in the knob.
- ( ) Make sure the plates of both variable capacitors are meshed (closed). Then push the remaining knobs onto the shafts of these capacitors. Make sure there is a  $1/16"$  space between each knob and the front label and the pointer on each knob is at 100; then tighten both setscrews in each knob.

This completes the chassis assembly of your Antenna Tuner. Make the following checks before you proceed to "Final Assembly":

1. Make sure all hardware is tight.
2. Make sure there are no unsoldered connections.

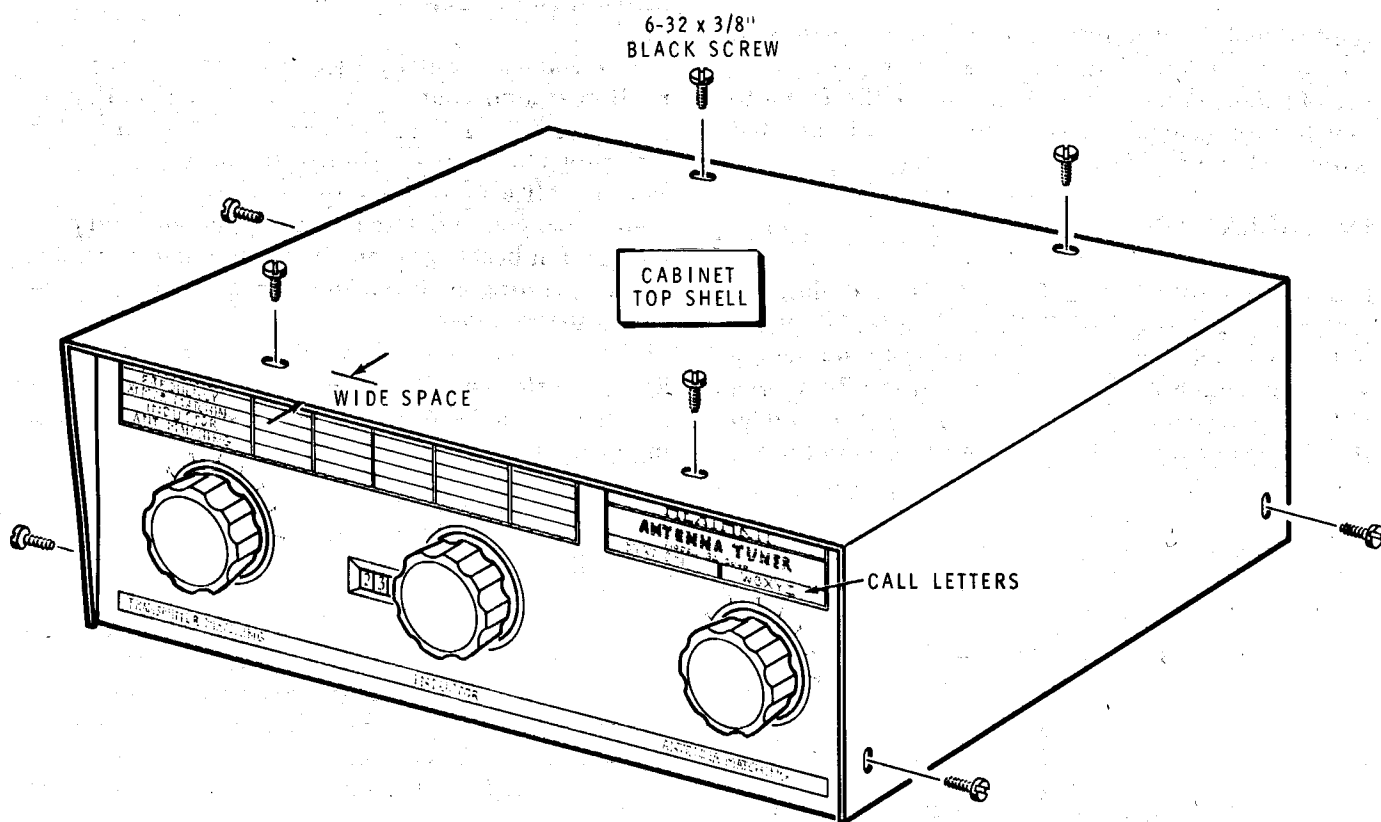
## FINAL ASSEMBLY

Refer to Pictorial 6-1 for the following steps.

NOTE: When you install the cabinet top shell on the chassis, in the next step, make sure you position it with the wide space as shown.

( ) Use eight 6-32 × 3/8" black screws to mount the cabinet top shell onto the chassis.

NOTE: If you wish, you can use letters from the call letter label sheet to put your call sign on the front panel in the space provided. Be sure to center your call sign in the space. Then use blank labels to fill up any extra space.



PICTORIAL 6-1

## APPLICATIONS AND INSTALLATION

### APPLICATIONS

This Antenna Tuner will convert a reactive and/or resistive load to a nonreactive, 50-ohm load. You can adjust it to tune out load reactance and, when necessary, transform the load impedance to the required 50-ohm transmitter (or amplifier) output impedance. The Tuner uses a roller inductor along with two variable capacitors to provide an almost unlimited matching range, and features 80-meter through 10-meter coverage without band switching.

A 4-to-1 (balanced-to-unbalanced) balun transformer, on the output side of the Antenna Tuner, permits the use of balanced feed lines. You can use the Tuner to match into coaxial lines, random-length end-fed wires, or balanced feeders.

### INSTALLATION

Pictorial 7-1 (Illustration Booklet, Page 9) shows a typical fixed-station installation. Pictorial 7-2 (Illustration Booklet, Page 10) shows an installation where a coaxial switch may be used to feed the RF source either to your Antenna Tuner or any one of several 50  $\Omega$  antennas or RF loads. If an amplifier is not used,

connect the cable from the transmitter's antenna connector directly to the RF input jack on the rear panel of the Antenna Tuner.

Use coaxial cable, like RG-8/U, to interconnect the various pieces of equipment. NOTE: Cables should not be longer than necessary.

A ground post is located on the rear panel of the Antenna Tuner. Connect this ground post to a good earth ground or a water pipe. Use the **shortest and heaviest connection possible**.

Before you use a water pipe ground, inspect the connection around your water meter. Make sure that no plastic or rubber hose connections are used which interrupt electrical continuity to the water supply line. Install a jumper around any insulating water connectors you find. Use heavy copper wire and pipe clamps. It is best to ground all equipment to one point at the operating position; and then ground this point as discussed above.

Refer to various publications, such as the ARRL Radio Amateur Handbook, for more information concerning ground.

## OPERATION

Refer to Pictorial 7-3 (Illustration Booklet, Page 11) to identify the front panel controls and the counter readout. A description of the function of each is included. Refer to Pictorial 7-4 (Illustration Booklet, Page 12) for the rear panel connections.

### EXCITER TUNE-UP

The final stage of some transmitters must be tuned up before they can be placed on the air. It is important that you tune up an exciter on a "dummy load" before you use it with your Antenna Tuner. You can use any load that has a constant, resistive impedance of 50 ohms that can dissipate the necessary power for a reasonable length of time. As an example, the Heathkit "Cantenna" is a satisfactory load. NOTE: Do NOT use light bulbs as a "dummy load." Their resistance varies with the current, and their reactance varies with frequency.

### COUPLER TUNING

NOTE: When you turn the roller inductor, be careful that you do not turn it past its end stops. This could cause the roller contact to jump off the wire turns on the inductor.

This part of the "Operation" section includes the procedure for using your Antenna Tuner with various antenna systems. The chart on Page 45 gives the approximate settings for the Antenna Tuner controls when a 50  $\Omega$  resistive RF dummy load is used. Be sure to record the settings of both variable capacitor knobs and the counter so you can preset the controls the next time you use a particular band. For your convenience, a "Logging Scale" is included on Page 44 of this Manual as well as on the front of the Tuner.

NOTE: The "ARRL Antenna Book" is readily available and includes comprehensive information on transmission lines and antennas. You can purchase other similar radio amateur handbooks and some are available in public libraries.

Before you proceed, make sure you connect your transmitting equipment as shown in Pictorial 7-1 (Illustration Booklet, Page 9) or Pictorial 7-2 (Illustration Booklet, Page 10). NOTE: If you are not using an amplifier, connect the coaxial cable from the exciter's RF output connector directly to the input connector of your SWR meter.

### IMPORTANT:

1. During the tuning procedure, apply only enough RF power from the exciter to get a meaningful reading on the SWR indicator in its most sensitive position. When you have made coarse adjustments to the Antenna Tuner, as indicated by minimum reflected power, you may increase the power from the exciter. At this time, you can make final adjustments to the Antenna Tuner.
2. When you tune your exciter, be **SURE** to observe the duty cycle limitations, if any.
3. Only one antenna at a time may be connected to the Antenna Tuner.

### COAXIAL-FED ANTENNAS

An antenna fed with a coaxial line, such as a beam antenna or a centerfed dipole, can easily be matched with your Antenna Tuner to provide a good match to the transmitter across the entire band. This will be particularly beneficial when, for example, you use an 80-meter dipole that has been cut for a particular portion of the band.

For coax-to-coax feeder matching, use the following tuning procedure.

1. Preset your Antenna Tuner controls as follows:

TRANSMITTER MATCHING (C1) —	} Refer to chart on Page 45.
INDUCTOR (L1) —	
ANTENNA MATCHING (C2) —	

2. Connect the antenna feed line to the COAX FEED LINE connector, J2, on the Antenna Tuner rear panel.
3. Set the SWR indicator's function switch to measure forward power.
4. Set the sensitivity control of the SWR indicator to the most sensitive position.
5. Turn the exciter power on.
6. With the exciter in either the tune or CW mode, advance the exciter's gain for a full-scale reading on the SWR indicator.
7. Set the function switch of the SWR indicator to read reflected power. Then adjust L1, the roller inductor, until there is a drop in the reflected reading.
8. Readjust capacitors C1 and C2, along with inductor L1, until you obtain the lowest SWR reading.

**NOTE:** With many antenna systems, you can obtain several different matching combinations. Always use the matching setting that uses the most capacitance for C1 and C2, as maximum capacitance provides the best harmonic attenuation.

9. Advance the exciter's gain for full power. Then readjust C1, C2 and L1 for minimum reflected power.

This completes the tuning procedure for coaxial-fed antennas. You can now use an amplifier without retuning the Antenna Tuner.

### SINGLE-WIRE ANTENNAS

**NOTE:** If possible, use a quarter-wavelength antenna or an odd multiple of a quarter-wavelength. Such an antenna will have low impedance and will reduce the chances of high RF voltages appearing on the Antenna Tuner or associated equipment.

For end-fed wires, random-length wires or windom type antennas, use the following tuning procedure.

1. Preset your Antenna Tuner controls as follows:

TRANSMITTER  
MATCHING (C1) —

INDUCTOR (L1) —

ANTENNA  
MATCHING (C2) —

} Refer to chart on  
Page 45 for approx-  
imate settings.

2. Connect the antenna to SINGLE WIRE connector J3 on the Antenna Tuner rear panel.
3. Set the SWR indicator's function switch to measure forward power.
4. Set the sensitivity control of the SWR indicator to the most sensitive position.
5. Turn the exciter power on.
6. With the exciter in either the tune or CW mode, advance the exciter's gain for a full-scale reading on the SWR indicator.
7. Set the SWR indicator's function switch to measure reflected power. Then adjust L1, the roller inductor, until there is a drop in the reflected reading.
8. Readjust capacitors C1 and C2 along with inductor L1, until the lowest SWR reading is obtained.

**NOTE:** With many antenna systems, you can obtain several different matching combinations. Always use the matching setting that uses the most capacitance for C1 and C2, as maximum capacitance provides the best harmonic attenuation.

9. Advance the exciter's gain for full power. Then readjust C1, C2, and L1 for minimum reflected power.

This completes the tuning procedure for single-wire antennas. You can now use an amplifier without retuning the Antenna Tuner.



## BALANCED FEED LINE ANTENNAS

For antennas using balanced feeders, use the following tune-up procedure.

1. Preset your Antenna Tuner controls as follows:

TRANSMITTER  
MATCHING (C1) —

INDUCTOR (L1) —

ANTENNA  
MATCHING (C2) —

} Refer to chart on  
Page 45 for approx-  
imate settings.

2. Connect a shorting bar between connectors J3 and J4 on the rear panel of the Antenna Tuner.
3. Connect the antenna feedline to BALANCED FEED LINE connectors J4 and J5.
4. Set the function switch of the SWR indicator to read forward power.
5. Set the sensitivity control of the SWR indicator to the most sensitive position.
6. Turn the exciter power on.

7. With the exciter in either the tune or CW mode, advance the exciter's gain for a full-scale reading on the SWR indicator.
8. Set the SWR indicator's function switch to measure reflected power. Then adjust L1, the roller inductor, until there is a drop in the reflected reading.
9. Readjust capacitors C1 and C2, along with inductor L1, until you obtain the lowest SWR reading.

**NOTE:** With many antenna systems, you can obtain several different matching combinations. Always use the matching setting that uses the most capacitance for C1 and C2, as maximum capacitance provides the best harmonic attenuation.

10. Advance the exciter's gain for full power. Then readjust C1, C2, and L1 for minimum reflected power.

This completes the tuning procedure for balanced feed line antennas. You can now use an amplifier without retuning the Antenna Tuner.





## TYPICAL OPERATING CHARACTERISTICS

- A severe mismatch may cause a transmitter to become unstable until the SWR is reduced to a low value (1.5:1 or better). This is especially true of broadband solid-state transmitters. However, this can also occur with tube-type tuned transmitters.
- You may find that you have no reflected power, as indicated by your SWR indicator, at a number of settings of the roller inductor and the capacitors for some band/antenna combinations. Always use the matching setting that uses the most capacitance for the variable capacitors.

## IN CASE OF DIFFICULTY

Due to the simplicity of this kit, about the only cause for trouble will be errors in wiring or wires shorted to metal parts. Recheck your wiring against the Pictorials. Position the bare wires away from other metal parts. Also make sure the wires are properly soldered to the various solder lugs and spade lugs.

The antenna you use must be insulated along its en-

tire length from contact with any parts of buildings, trees, etc. It should be kept as far as possible from all objects for maximum efficiency of operation.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

## SPECIFICATIONS

Frequency Range .....	3.5 — 30 MHz.
Power Capability (input) .....	SSB: 2000 watts PEP. CW: 1000 watts.
Input Impedance .....	50 ohms.
Impedance Transformation .....	4:1 (balanced-to-unbalanced) balun.
Output Impedance .....	Wide range.
Cabinet Dimensions .....	14-15/32" W × 5-3/4" H × 13-7/8" D. (36.8 × 14.6 × 35.2 cm).
Net Weight .....	10.5 lbs. (4.8 kg).

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The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.



## CIRCUIT DESCRIPTION

Refer to the Schematic Diagram on Page 43 while you read this "Circuit Description."

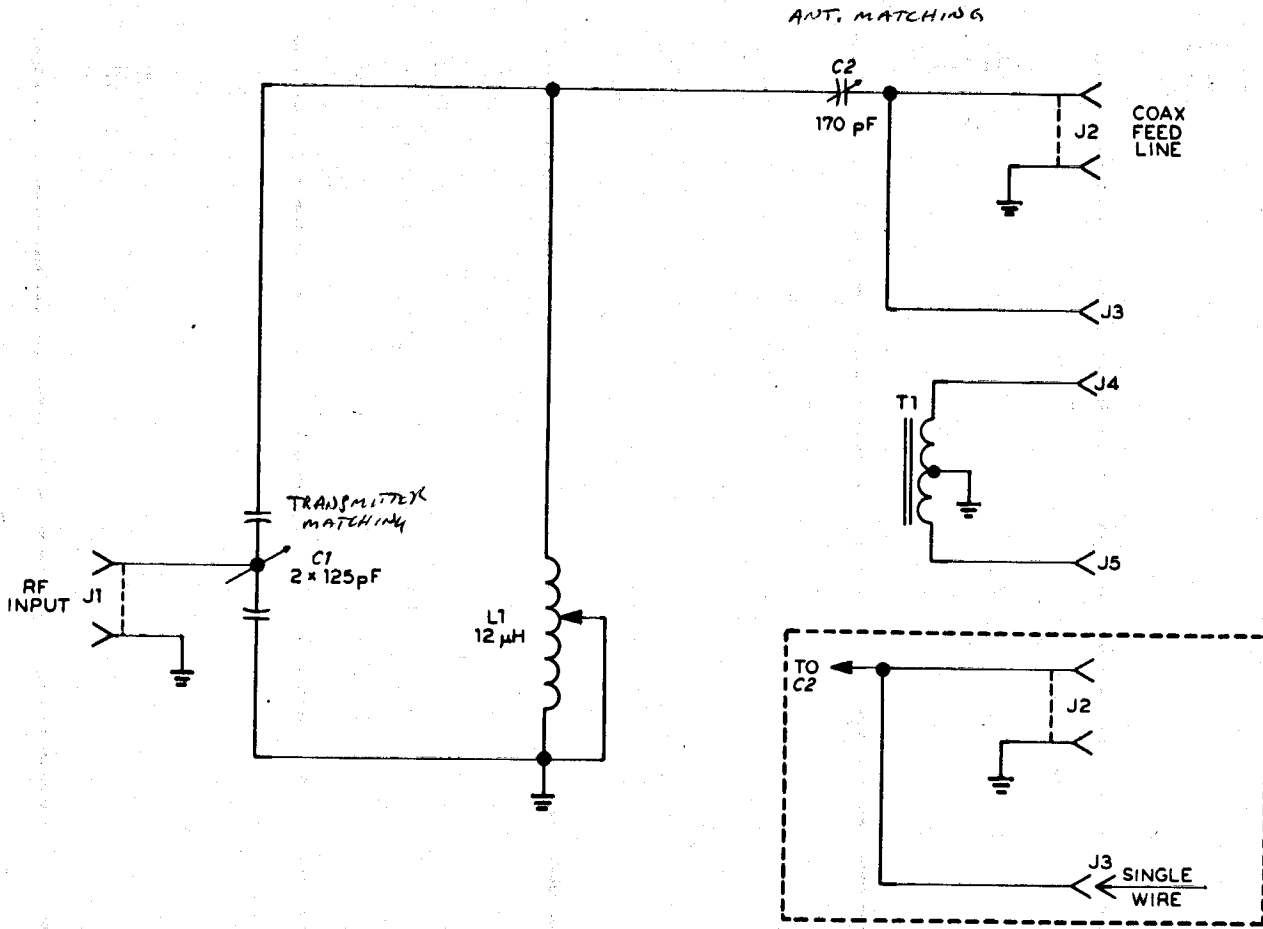
The Antenna Tuner is an adjustable RF transformer that can match the unknown load presented by an antenna to the required 50-ohm transmitter impedance.

Coupling capacitor C2 modifies the load impedance fed back to the tuned circuit formed by capacitor C1 and inductor L1. The total resonant impedance across

the tuned circuit depends on the L/C ratio of C1 and L1, and the load impedance as transformed by C2. Capacitor C1 performs capacitive tapping which results in a 50-ohm impedance at RF input connector J1.

The reactive loads at output connector J2 are compensated for as you adjust C1 and C2 to resonance.

A 4:1 (balanced-to-unbalanced) balun coil, T1, is used for balanced line operation.



**SCHEMATIC OF THE  
HEATHKIT®  
ANTENNA TUNER  
MODEL SA-2040**

3.5 TO 29.7 MHz



## PRESET CHART

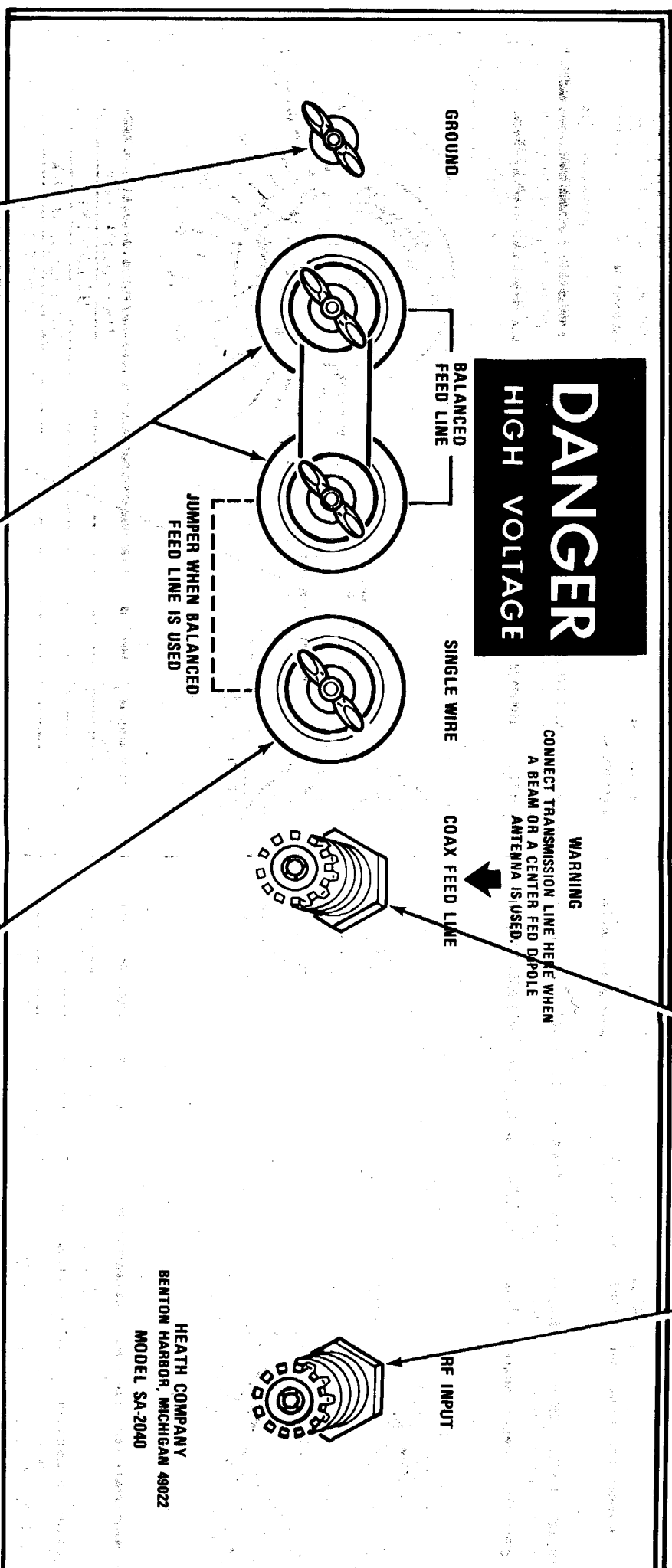
FREQUENCY (IN MHZ)	TRANSMITTER MATCHING	INDUCTOR	ANTENNA MATCHING
3.500 -	100	202	66
3.750	100	183	66
4.000	100	164	66
7.000	95	73	60
7.150	95	72	60
7.300	95	70	60
14.000	95	30	50
14.100	95	30	46
14.350	92	29	45
21.000	80	19	35
21.200	75	19	35
21.450	70	19	35
28.000	77	13	30
29.000	73	12	30
29.700	71	12	30

**DANGER**  
HIGH VOLTAGE

**COAX FEED LINE**  
Connector for your transmission line when you use a beam antenna or a center-fed dipole.

**RF INPUT**  
RF input to antenna coupler from your exciter amplifier.

**WARNING**  
CONNECT TRANSMISSION LINE HERE WHEN A BEAM OR A CENTER FED DIPOLE ANTENNA IS USED.



**GROUND**  
Connect this terminal to your station ground system with heavy wire.

**BALANCED FEED LINE**  
When you use an antenna with balanced feed line, use these posts. Connect the jumper to the single wire post.

**SINGLE WIRE**  
When you use a single-wire-fed antenna, connect it to this post. Connect the jumper between the balanced feed line posts.

HEATH COMPANY  
BENTON HARBOR, MICHIGAN 49022  
MODEL SA-2040

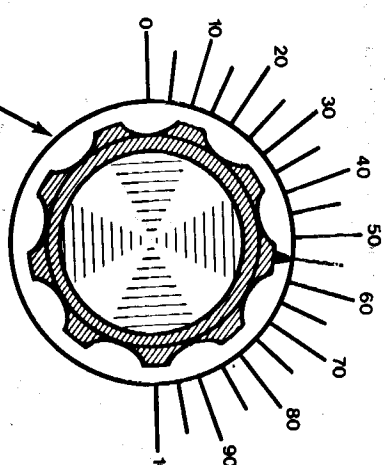
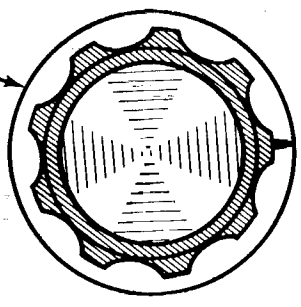
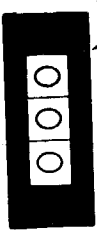
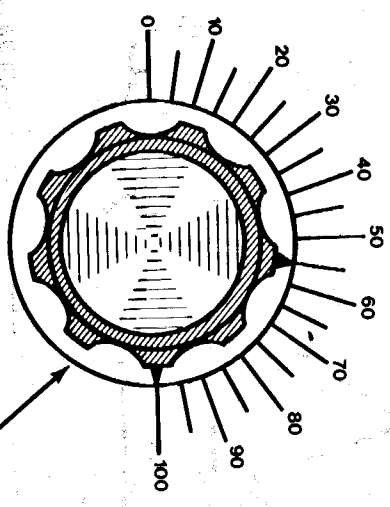
PICTORIAL 7-4

**COUNTER**  
 Divide the displayed number by ten (10) to get the number of active turns used for a certain setting of roller inductor L1.

**LOGGING SCALE**  
 Write in presets on each band for quick tune-ups.

<b>LOGGING SCALE</b>										
ANTENNA FREQUENCY										
XMTR MATCHING										
ANT MATCHING										

**HEATHKIT**  
**ANTENNA TUNER**  
 MODEL SA-2040  
**STATION**



**TRANSMITTER MATCHING**

**INDUCTOR**

**ANTENNA MATCHING**

**TRANSMITTER MATCHING:**  
 Tunes to or near resonance at the operating frequency (with inductor L1). Also matches the impedance of the cable connected to the RF INPUT connector.

**INDUCTOR**  
 Tunes to or near resonance at the operating frequency (with inductor L1 and capacitor C1). Also matches the impedance of the antenna system.

**ANTENNA MATCHING**  
 Tunes out any reactance in the antenna system.

**PICTORIAL 7-3**



\* BE SURE THAT ONLY ONE ANTENNA IS CONNECTED TO YOUR ANTENNA TUNER AT ONE TIME.

**DANGER**  
HIGH VOLTAGE

WARNING  
CONNECT TRANSMISSION LINE HERE WHEN A BEAM OR A CENTER FED DIPOLE ANTENNA IS USED.

TO EARTH GROUND

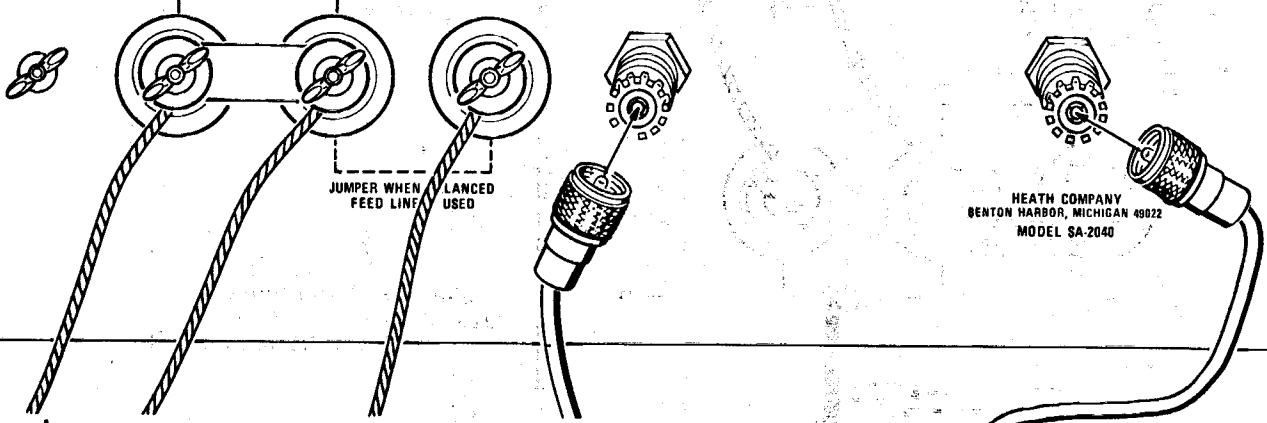
GROUND

BALANCED FEED LINE

SINGLE WIRE

COAX FEED LINE

RF INPUT



HEATH COMPANY  
BENTON HARBOR, MICHIGAN 48022  
MODEL SA-2040

\* TO BALANCED FEED LINE ANTENNA  
(CONNECT JUMPER TO SINGLE WIRE POST)

\* TO END-FED WIRE, RANDOM LENGTH WIRE OR WINDOM ANTENNA

\* TO BEAM ANTENNA OR CENTER-FED DIPOLE ANTENNA

(CONNECT JUMPER BETWEEN THE BALANCED FEED LINE POSTS)

RG-8/U

COAXIAL SWITCH

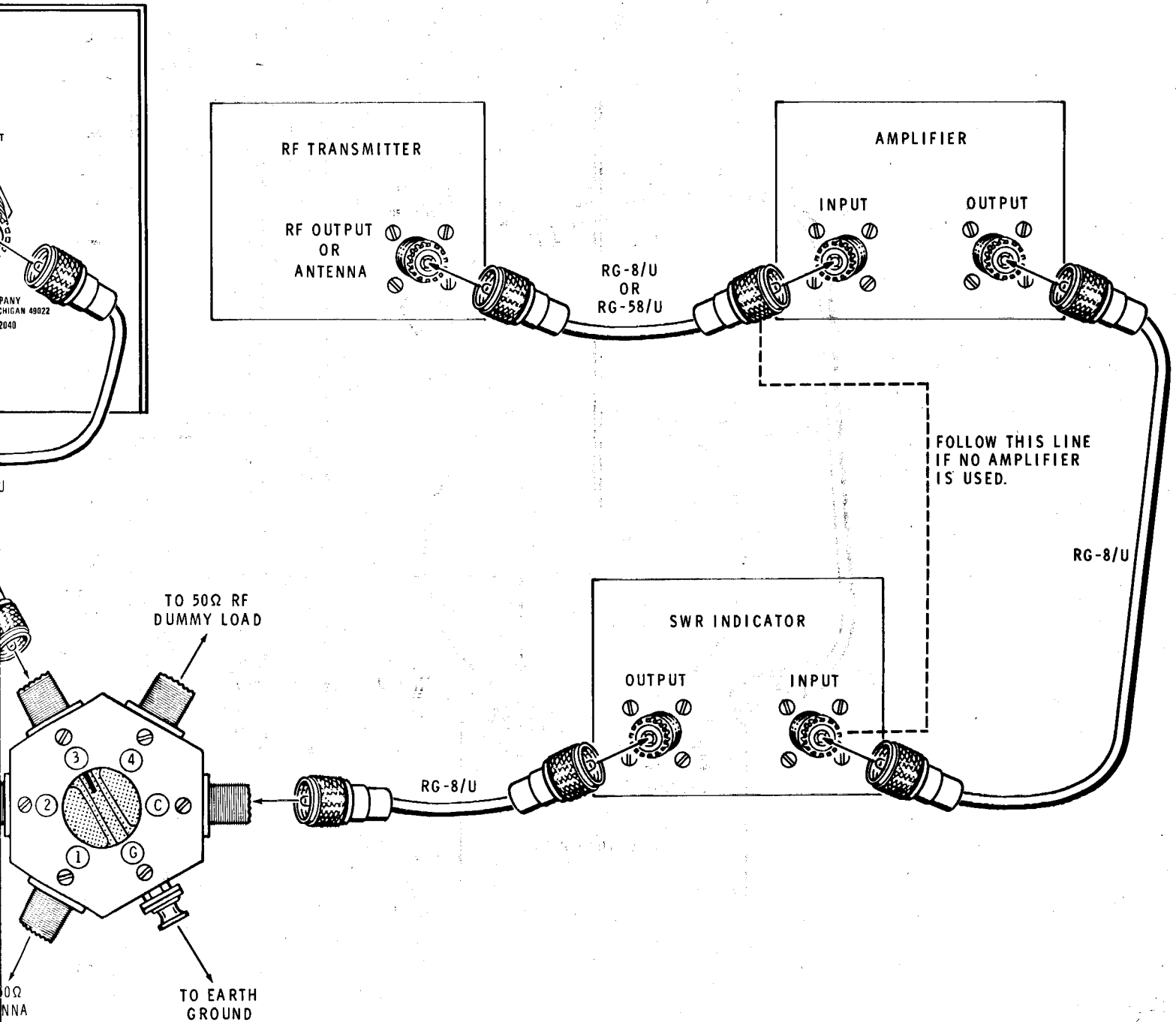
TO 50Ω ANTENNA

TO 50Ω DUMMY

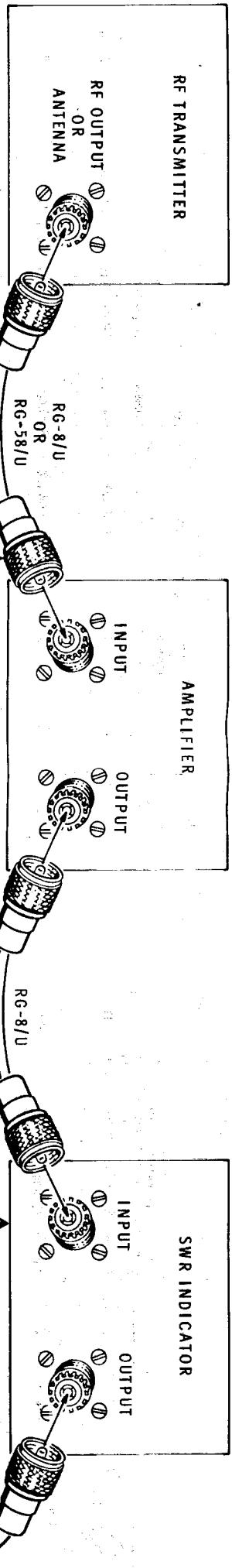
TO 50Ω ANTENNA

TO GROUND

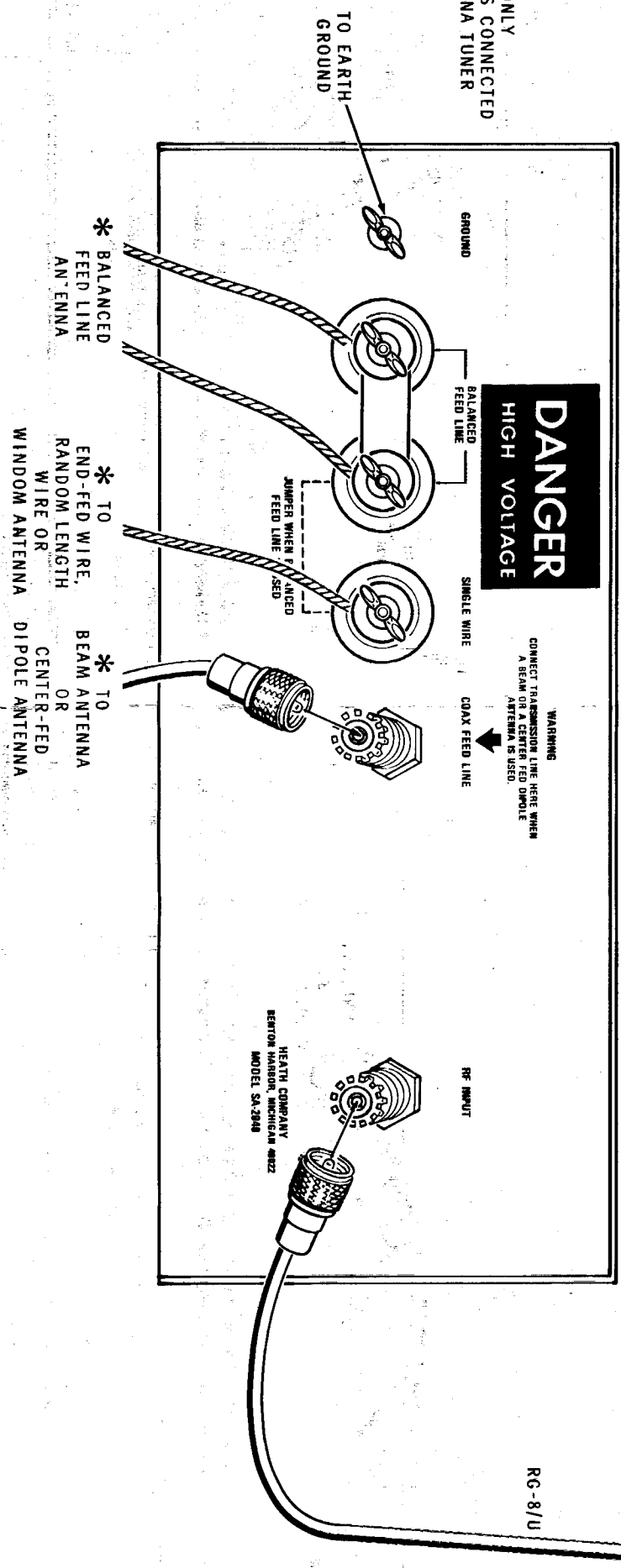
**PICTORIAL 7-2**



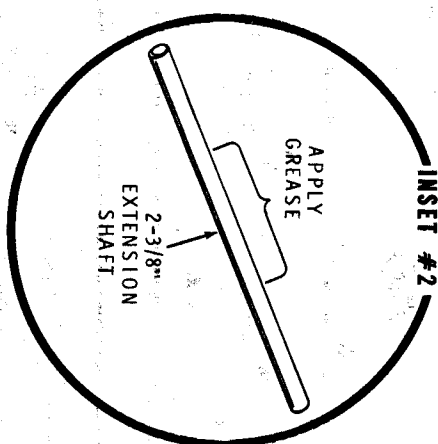
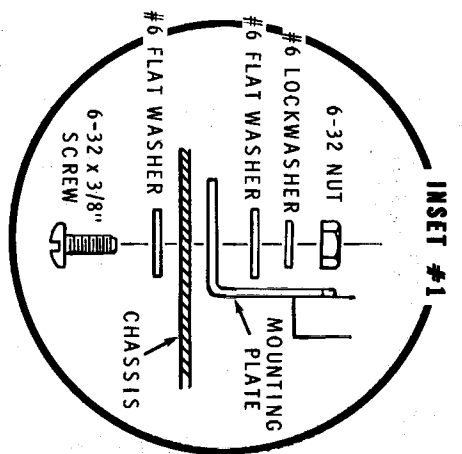
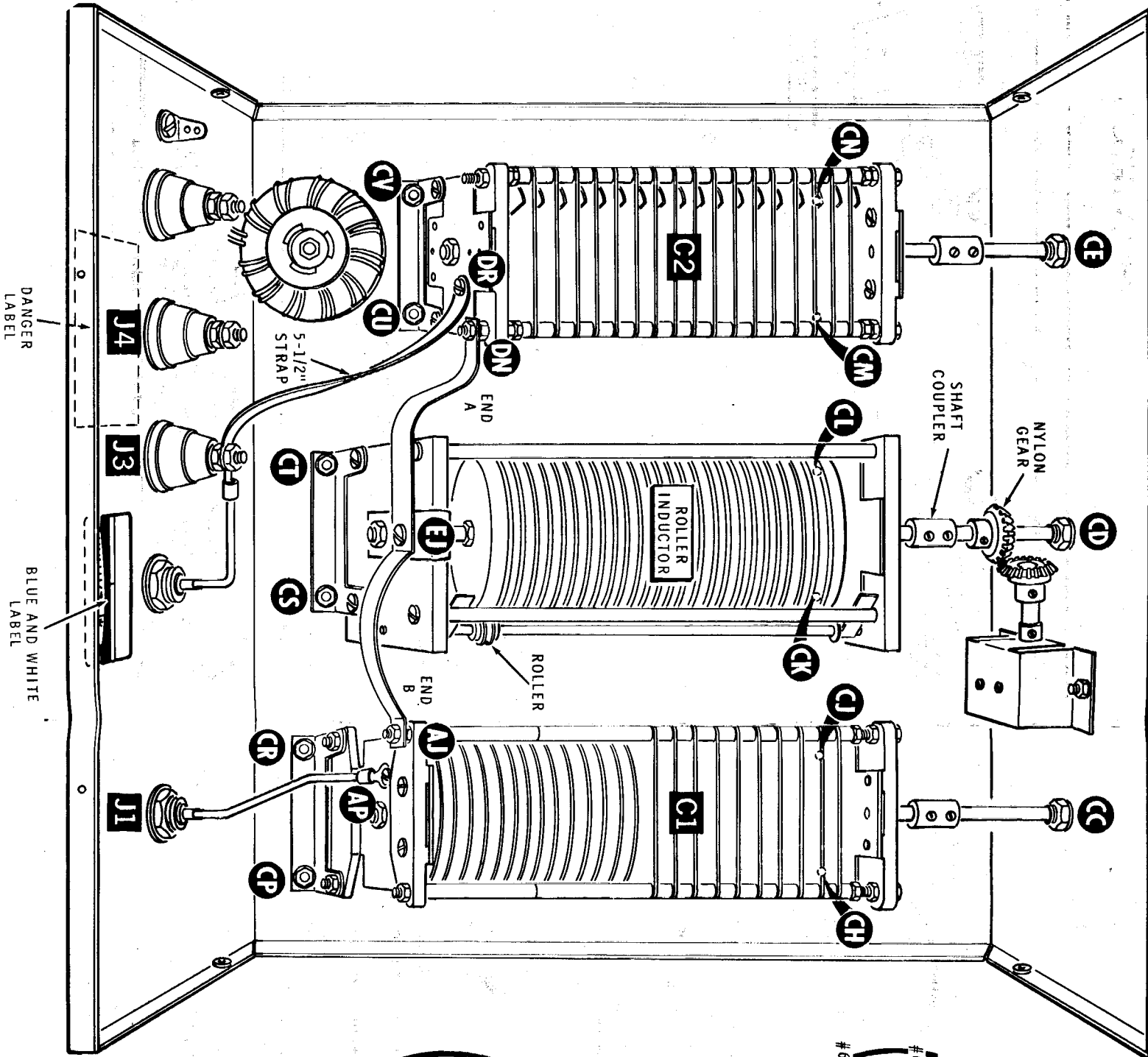
PICTORIAL 7-2

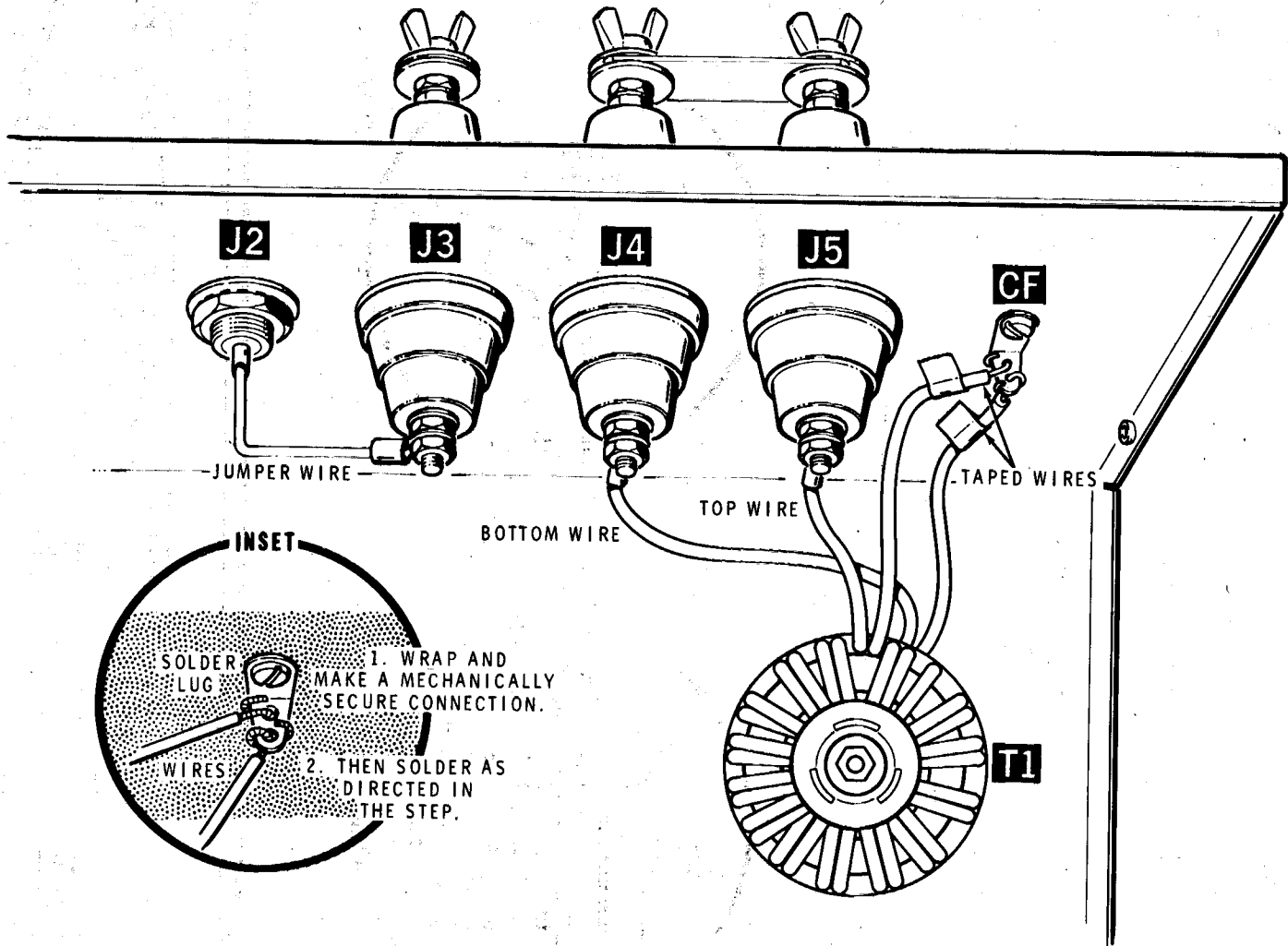


\* BE SURE THAT ONLY ONE ANTENNA IS CONNECTED TO YOUR ANTENNA TUNER AT ONE TIME.

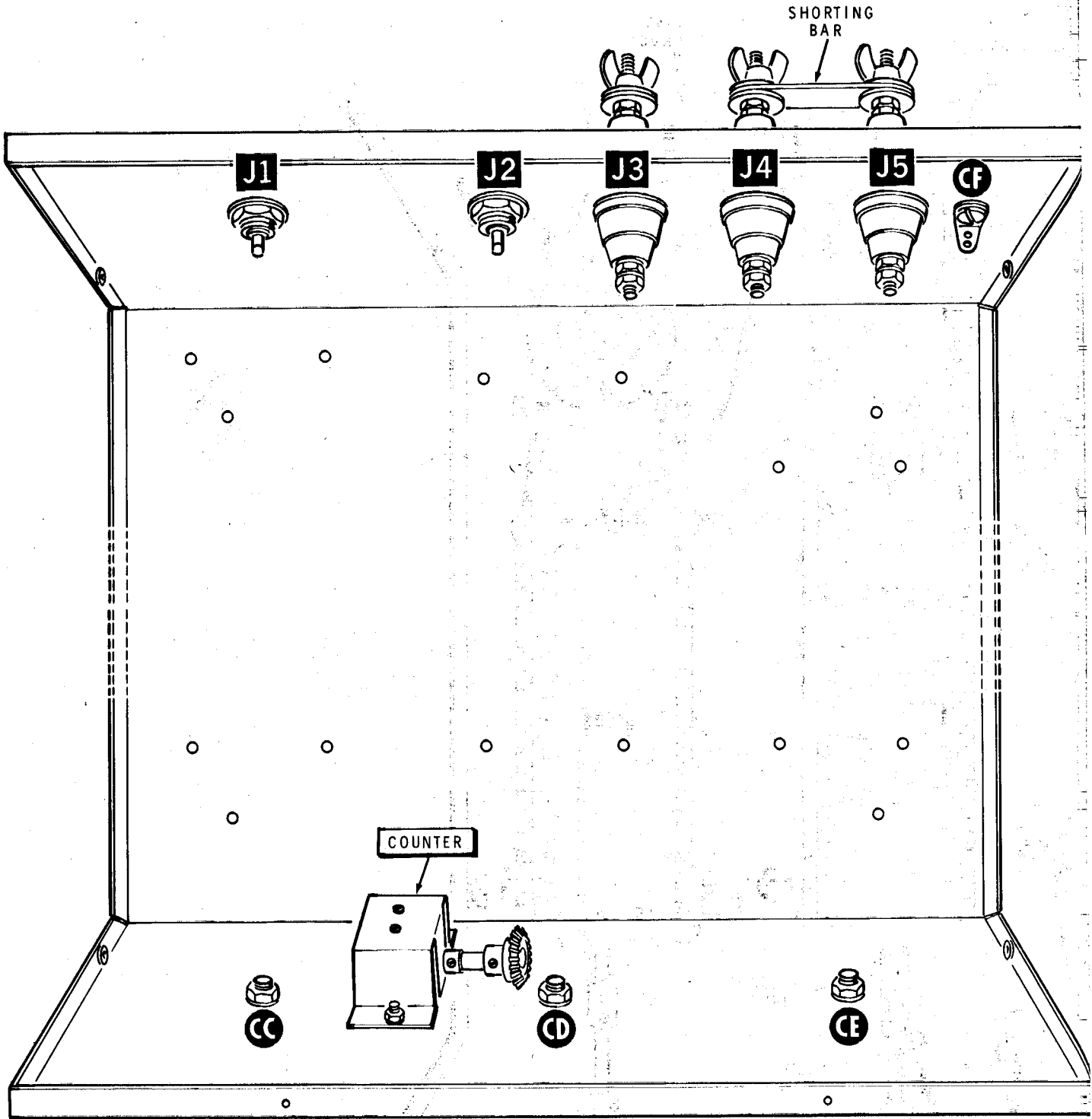


PICTORIAL 7-1

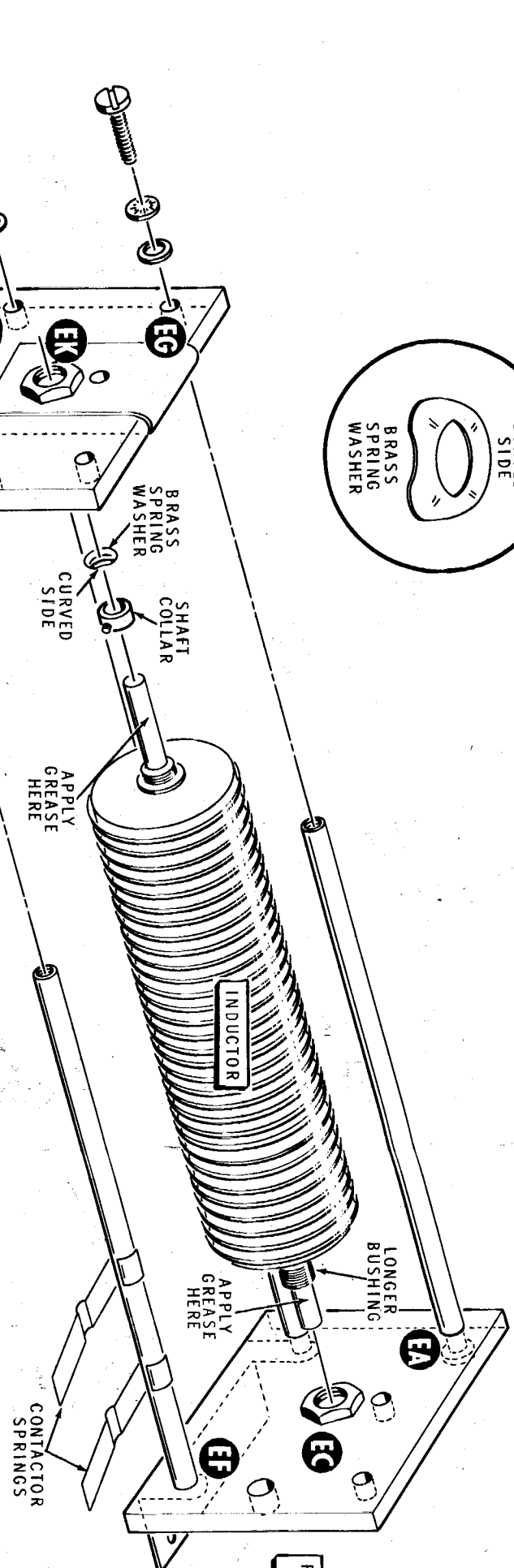
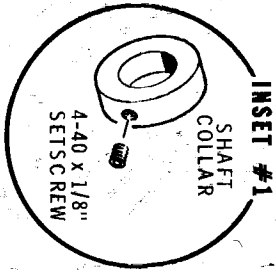
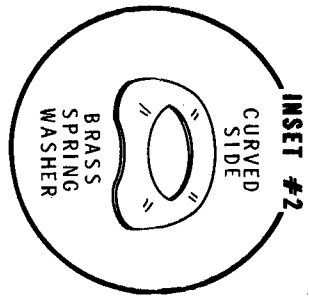




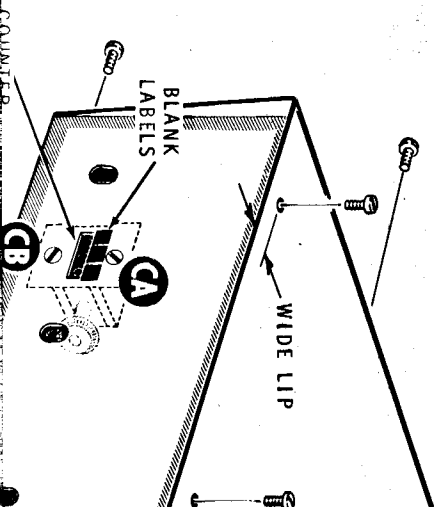
**PICTORIAL 5-4**

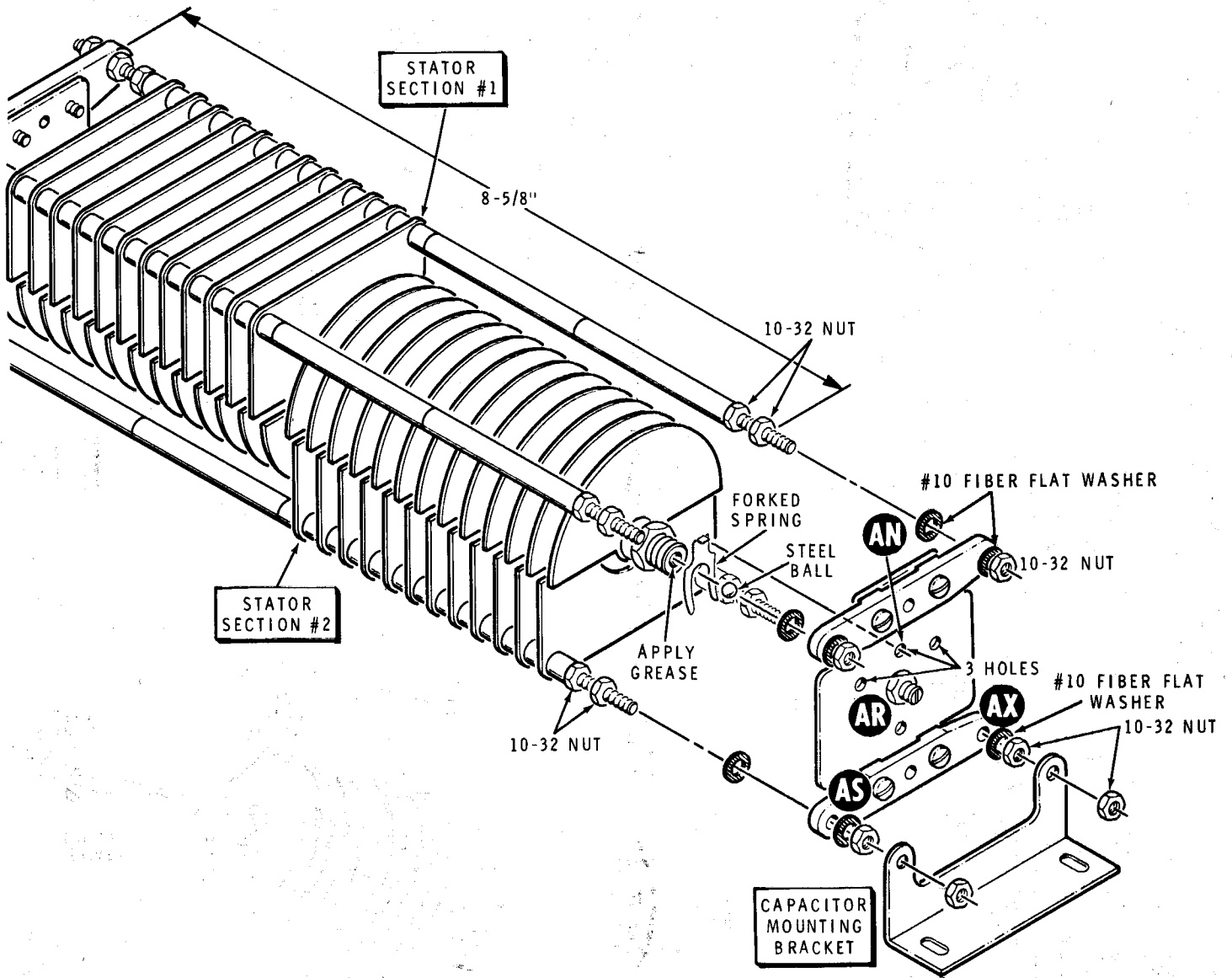


PICTORIAL 5-3



PICTORIAL 3-1



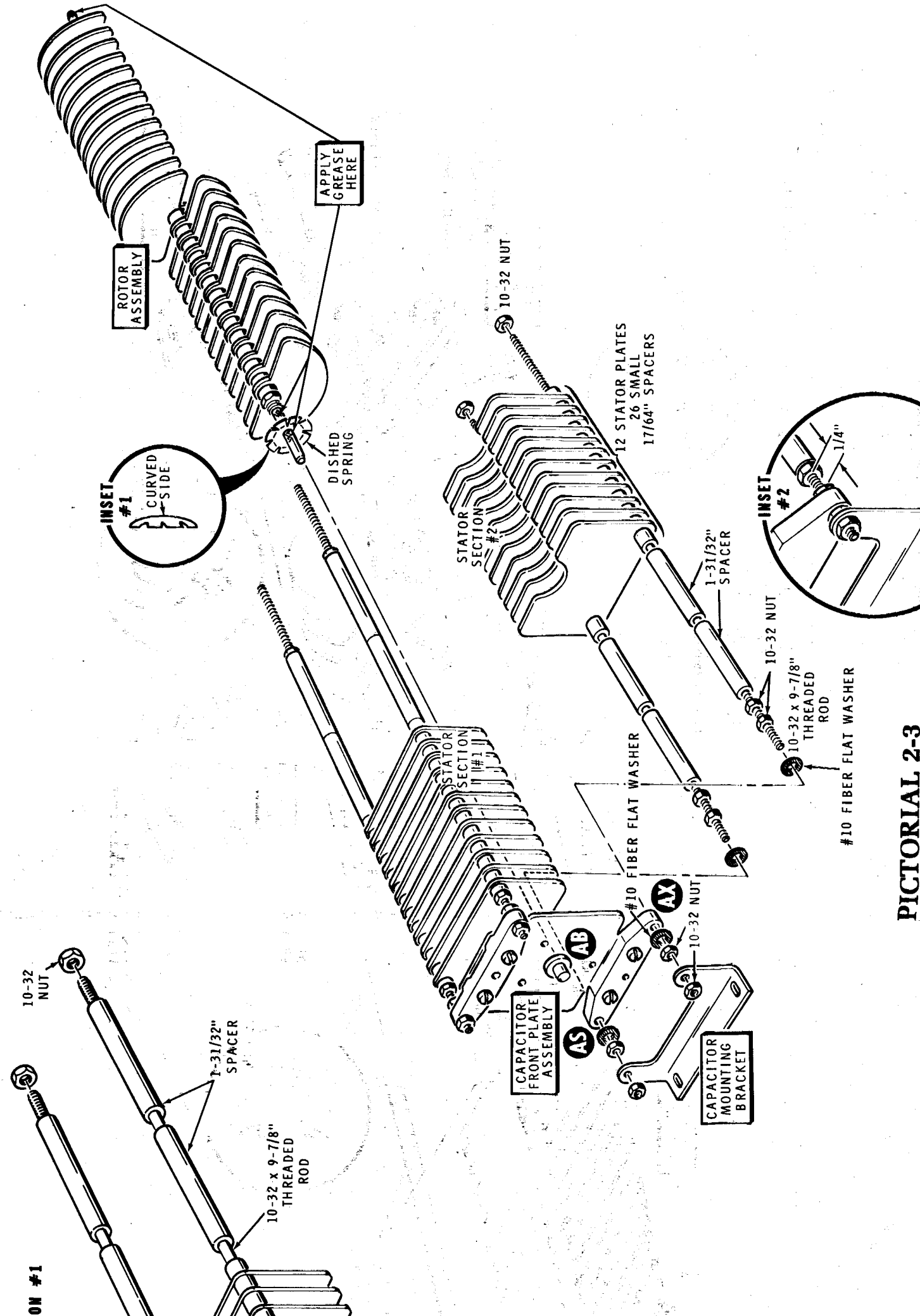


**PICTORIAL 2-4**









PICTORIAL 2-3

# CUSTOMER SERVICE

## REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

## ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company  
Benton Harbor  
MI 49022  
Attn: Parts Replacement

**Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.**

## OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

## TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

**Please do not send parts for testing**, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

## REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

**If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.**

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company  
Service Department  
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN  
**THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM**

LITHO IN U.S.A.