

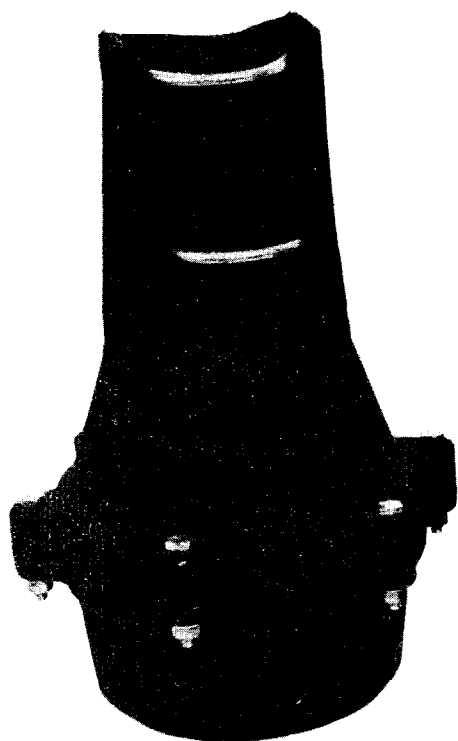
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TAIL TWISTER™ MODEL T²X – ROTATOR

ORDER 303 – 120 VAC
NO. 303-2 – 220 VAC

OWNER'S MANUAL

AA-0303-A-005



TELEX **hy-gain**

TELEX COMMUNICATIONS, INC.

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CHAPTER 1

INSTALLATION AND OPERATION

Section 1. Components of the Tailtwister

GENERAL DESCRIPTION

The Tailtwister rotator consists of an extra heavy duty rotator and control unit. The rotator is designed to be mounted on a plate inside a tower. A mast to support and turn large communications beams (see Figure 3) is then attached to the top of the rotator. However, in some instances, mast mounting is desired. The Lower Mast Support Kit, PN 51467-10, contains a lower mast support and the necessary hardware to facilitate mounting the Tailtwister rotator on top of a mast.

CAUTION

When using the lower mast support, antenna size is restricted to 10 square feet of wind surface area.

The rotator unit must be wired to the control unit with an 8-wire cable. The control unit must be placed inside the house or other protected location. Included in the rotator box are:

- A. Owner's Manual, PN 801765-2
- B. Rotator, PN 51486-10
- C. Mounting Hardware, 51422-10
- D. Control Unit, 51479-10

Due to the wide variety of towers available, each installation will have different requirements. The gauge of the 8-wire cable to connect the control unit to the rotator depends

upon the distance between the rotator and control. The longer the distance, the larger the diameter of the wire required. Various antennas or beams require different installation methods. For this reason, the owner must procure the remainder of the components after checking their compatibility. In general, these will be:

- A. The beam or antenna desired and a suitable antenna mast.
- B. A tower or other mechanism to position the rotator and beam for safe and effective rotation (see **CAUTIONS**).
- C. 8-wire cable to connect the control to the rotator (see Section 5).
- D. Coaxial cable to connect the beam to the communications equipment.
- E. Appropriate guy wires as required.
- F. Ground hardware.
- G. Optional Heavy Duty Lower Mast Support Kit must be procured if the owner elects to use a Mast Mount (see Figure 7). The part number for the Lower Mast Support Kit is 51467-10. "Inside" Tower Mount (Figure 3) is recommended.

Section 2. Specifications

SPECIFICATIONS

Input Voltage	120 VAC 50/60 Hz
Optional	220 VAC 50/60 Hz
Motor	24 VAC, 2.25 Amp, capacitor start, capacitor run
Power Transformer	120 VAC/26 VAC 10% duty, thermal switch protected
Optional	220 VAC/26 VAC 10% duty, thermal switch protected
Meter Transformer	120 VAC/13VAC continuous duty
Optional	220 VAC/13 VAC continuous duty
Meter	DC voltmeter 1000 ohms/volts, 1 MA full scale
Meter Scale	Direct Reading: North centered, 5° increments
Optional	Direct Reading: South centered, 5° increments
Maximum Antenna Size:	
A. Tower Mounted as per Figure 3	20 square feet (1.86 m ²) of wind surface area
B. Outside Tower or Mast Mounted as per Figure 5 or 6	10 square feet (.93 m ²) of wind surface area
Maximum Interconnect Cable Resistance:	
A. Terminals 1 and 28 ohm
B. Terminals 3, 4, 5, 6, 7 and 8	2.0 ohms
Rotation Time	45-60 seconds with 60 Hz input
Brake	positive, electrically operated wedge, 60 segments spaced 6° apart
Rotator Size	9 inches (23.7) maximum diameter by 14.07 inches (35.7 cm) high
Maximum Antenna Mast Size	2 ¹ / ₁₆ " O.D. (52 mm)
Mounting Hardware	stainless steel hardware and plated steel clamp plate
Control Unit Size	8.5 inches (21.6 cm) wide x 9.0 inches (22.8 cm) deep x 4.3 inches (11.0 cm) high
Shipping Volume	2,280 cubic inches (37,350 ccms)
Shipping Weight	28 pounds (12.7 kg)

Section 3. Cautions

CAUTIONS

- A. Install *properly and safely*.
 - B. Towers, often the highest metal parts in the vicinity, require extreme caution during erection and placement. Extreme care must be taken during erection so that metal towers and beams do not contact power lines even if the beams slip or rotate, towers fall or fracture or metal wires blow in the wind, etc..
 - C. Metal towers or other position mechanisms must be placed so that if they fracture or blow over in high winds, they cannot contact power lines, be a hazard to individuals, or endanger property.
 - D. When not mounted within a tower with a thrust bearing, as shown in Figures 6 & 7, the rotator must be *derated*.
 - E. Metal towers must be grounded properly at the tower location before the tower is erected. This is to minimize electrical hazard and the possibility of lightning damage. Do not bury bare aluminum wires or stakes in the ground. Use copper ground stakes. The service entrance ground should be checked. The household convenience outlet should be the 3-prong type (grounded back to the service entrance).
 - F. The Control Box is not weatherproof and must be located in the house, ham shack or other protected location.
 - G. Read this manual fully before proceeding.
- The Tailtwister rotator has been carefully designed and manufactured to give many years of trouble-free service when carefully and professionally installed. It consists of the strongest and best commercially available components.

Section 4. Installation Information

TYPES OF INSTALLATION

There are three general types of installations (see Figures 3, 6 and 7).

1. The Recommended Installation is an "Inside" Tower Mount with a thrust bushing or bearing to provide support and resist high wind loads.

When the rotator is properly mounted this way, it can be rotated to turn an antenna or beam of 20 square feet (1.86 m²) wind surface area. The wind loading during storms, the rotational inertia of the beam and unbalanced weight are more important than the dead weight of the beam. It is important to minimize the height of the beam above the rotator to minimize the overturning force induced in a high wind (see "Unbalanced Weight" and "Wind Pressure").

2. An "Outside" Tower Mount (see Figure 6) is optional. The rotator is not as well protected but the installation is simpler. With an "Outside" Tower Mount, the rotator must be derated to 10 square feet (.93 m²).
3. A telescoping or other type mast (see Figure 7) can also be used. This installation is similar to number 2 above and requires the optional Heavy-Duty Lower Mast Support Kit and must be derated to 10 square feet (.93 m²).

There are variations of mounting falling generally into one of the above categories. For example, the rotator may be mounted lower in the tower than shown in Figure 3. In that case, more than one bushing or thrust bearing for the beam mast may be required and longer coast down time allowed in operation. These factors are interrelated and the components must be matched together.

UNBALANCED WEIGHT AND WIND PRESSURE

1. **Unbalanced Weight:** Weight should be as closely balanced as possible. Unbalanced weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the rotator.

This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stress on the motor gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotator is increased.

2. **Wind Pressure:** Wind pressure against the boom and elements produces a bending force on the mast which can cause the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure the top mast should be as short and as strong as possible. In multiple arrays, the heaviest should be closed to the rotator. In order to distribute the bending stress and prevent fracture of the mast, the Ham IV rotator includes a specially designed steel clamping plate to clamp the mast to the rotator.

After procuring the type of tower or other positioning mechanism of the owner's choice, the next step is to wire the rotator to the control box and check out its operation prior to installation.

Section 5. Wiring and Check-Out

WIRING AND CHECK-OUT

A preliminary operation check should be made prior to installation. We recommend the following procedure:

- A. Decide the wire gauge (size) required and procure the number of feet of the proper cable (see Table 1).

Maximum Length	Gauge for Terminals 1 & 2	Gauge for Terminals 3-8
125' (38 m)	#18 (1.19 mm)	#22 (.76 mm)
200' (61 m)	#16 (1.42 mm)	#20 (.97 mm)
300' (91 m)	#14 (1.75 mm)	#18 (1.19 mm)
500' (152 m)	#12 (2.12 mm)	#16 (1.42 mm)
800' (244 m)	#10 (2.95 mm)	#14 (1.75 mm)

Table 1

- B. Strip and tin $\frac{3}{8}$ " on both ends (16 wires) after removing about 4 inches of the jacket. Tinning can be accomplished, after twisting the strands together, with an ordinary soldering iron and radio solder, being careful not to melt the insulation.
- C. With the Control Unit and the Rotator on the work table, connect the cable between the Rotator and Control Unit using the full length of cable that will be used in the installation. *It is important that Terminal #1 on the Rotator is connected to Terminal #1 on the Control Unit and so on.*

NOTE: The specifications call for *heavier* gauge wire in two locations. Leads #1 and #2 must be heavier gauge and less total lead resistance (see Specifications, page 2). Wire the control to the rotator as shown in Figures 1 and 2.

CAUTION

Shorts between terminals or grounded leads may damage the rotator.

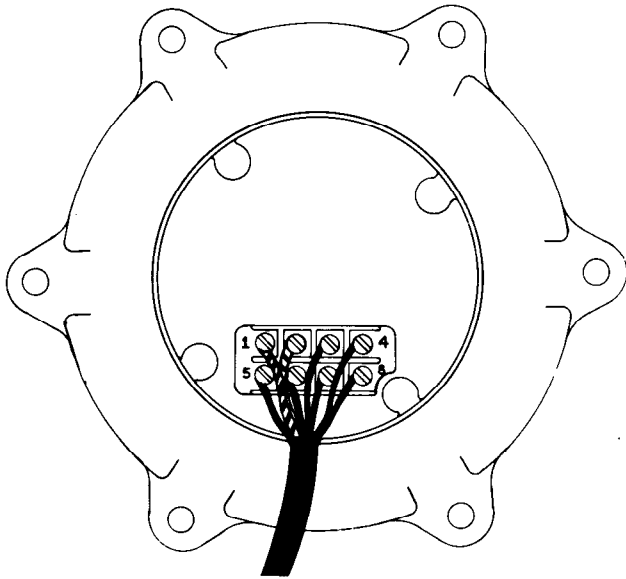


Figure 1
Rotator Wiring (Base)

- D. With the rotator sitting in the upright position and connected to the control unit by the 8-wire cable, plug the control unit power cord into a receptacle.

- E. Turn the power switch on. The meter should be illuminated. See Figure 11.
- F. Depress the "Brake Release" (center) lever, then release it. An audible click should be heard in the rotator. This is the solenoid operating the brake wedge.
- G. Depress the "Brake Release" (center) lever, hold it, and simultaneously depress the CCW direction switch (left). The rotator should turn CCW (looking from the top). This is S-E-N-W-S. Release the CCW direction switch; the rotator will coast down and stop. Now release the brake switch. The rotator is now locked into position. The red lamps should indicate direction of rotation. Note that the red lamp will not operate unless the green lamp is lighted showing that the brake has been retracted.
- H. Repeat steps A through G for CW direction by depressing the brake switch first, then the CW direction switch (right).

CAUTION

It is best to release the direction switch just prior to the end of rotation (extreme CW or CCW position) in order not to cause undue stress on the stop arm and/or the gears.

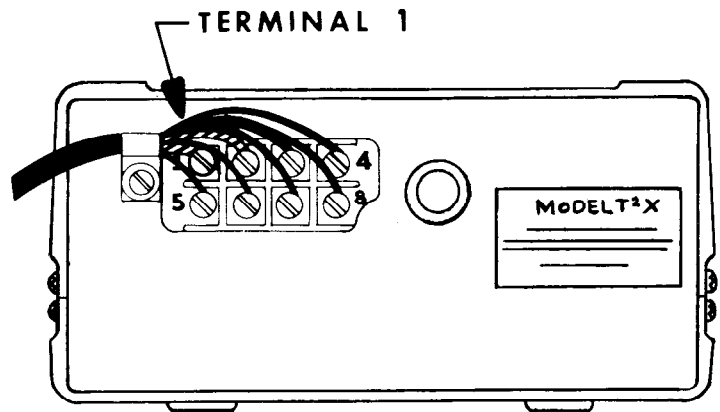


Figure 2
Control Unit Wiring (Rear Panel)

ANTENNA OR BEAM—NOT TO EXCEED 20
SQUARE FEET (1.86 m²) WIND SURFACE
AREA LOAD.

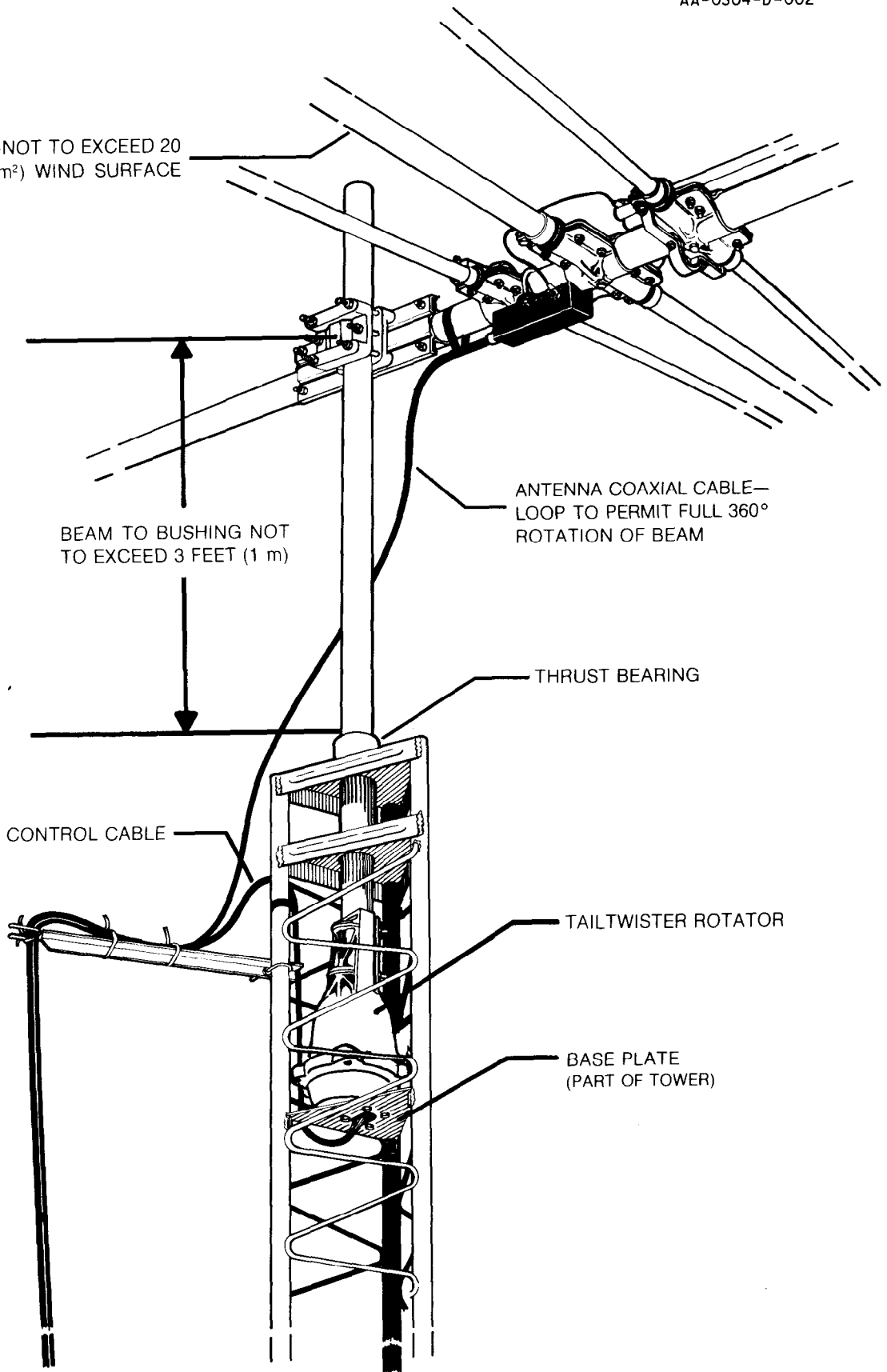


Figure 3
Rotator Mounted Inside Tower

I. Return the rotator to full CW position.

FOR CUSTOMER USE:

Enter the number/color of each lead connected to the terminals.

1	2	3	4
5	6	7	8

Section 6. Mounting the Rotator

INSIDE TOWER

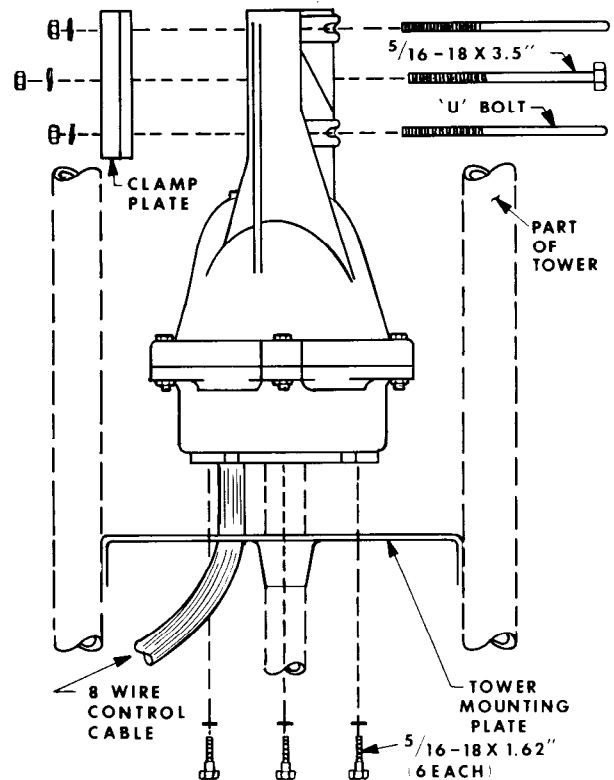
The rotator is mounted inside a tower (see Figure 3) to the flat tower plate by means of six (6) bolts furnished in the hardware kit. Use the following procedure:

1. Locate the rotator in the tower directly under the bushing. **Note that the tower plate must be cut out to allow the connecting 8-wire cable to pass through the plate. Use the template in the back of the manual. Too small of a hole can cause the terminal wiring to short out.**
2. Reattach the wires in exactly the same manner as used in the trial assembly and secure the wires to the tower in such a manner that the wires will not be strained.
3. The rotator is attached to the tower plate by means of six (6) bolts and lockwashers (see Figure 4). The flat tower plate must be drilled in six (6) places using the template provided with this manual unless the tower plate is already properly drilled.
4. Tighten the six (6) bolts, but not to final tightness. Observe how the rotator turns. It must rotate in such a manner as to turn the mast concentrically to the thrust bearing.
5. Trial assemble the mast to the top of the rotator using the U-bolts, nuts and

lockwashers through the rotator and clamp plate as shown in Figure 4. The maximum mast diameter that may be used is 2 1/16" O.D. We recommend 1 1/2" nominal steel pipe with 1.9" O.D. in standard wall thickness of .145". For stacked arrays or very large beams, we recommend extra heavy-duty wall thickness of .200". Both steel pipes can be purchased to specification ASTM-120.

NOTE: Apply a coating of heavy motor oil or grease to the threads of the stainless steel bolts and U-bolts to prevent seizing.

On any inside tower installation, care must be exercised to get the antenna mast shimmed to the exact rotational center of the rotator. The geometry is such that a mast of 2.062" (2 1/16" [52 mm]) O.D. pipe will be exactly centered. If the O.D. of your mast is less than this, you should shim out to these dimensions. For each .0625" (1/16" [1.6 mm]) less mast diameter used, .031" (1/32" [.8 mm]) of shim stock must be



**Figure 4
Rotator Mounting in a Tower**

wrapped around the mast at the clamping points. Put differently, subtract your mast diameter from $2\frac{1}{16}$ " and divide the difference by 2.

Example 1

Proper O.D. = 2.062"
 Your O.D. = $\frac{1.900}{}$ " (Nominal $1\frac{1}{2}$ " pipe
 Difference = .162" has O.D. of 1.9")

Shim to Use = .081" ($.162 \div 2 = .081$)

Example 2

Proper O.D. = $2\frac{1}{16}$ "
 Your O.D. = $\frac{2}{}$
 Difference = $\frac{1}{16}$ "

Shim to Use = $\frac{1}{32}$ " or .031 ($\frac{1}{16} \div 2 = \frac{1}{32}$ ")

Example 3

Proper O.D. = $2\frac{1}{16}$ "
 Your O.D. = $\frac{1\frac{3}{4}}{}$
 Difference = $\frac{5}{16}$ "

Shim to Use = $\frac{5}{32}$ " or .156" ($\frac{5}{16} \div 2 = \frac{5}{32}$ ")

Example 4

Proper O.D. = 52 mm
 Your O.D. = 48 mm
 Difference = 4 mm

Shim to Use = 2 mm ($4 \text{ mm} \div 2 = 2 \text{ mm}$)

6. If the rotator, top bushing and mast are properly aligned, there should be unrestricted rotation through 360°. If not, the rotator may have to be moved slightly on the flat plate. If a high quality bearing is used in the top of the tower (*recommended*), the shimming procedure must be done more carefully as closer tolerances are required. ***It is important that the rotator does not try to turn the mast eccentrically with the top bushing or bearing.***

7. Tighten the six (6) bolts carefully—to approximately 175 inch-pounds of torque.
8. Drill through the antenna mast and rotator casting, using a $\frac{5}{16}$ " drill. Locate the hole in the clamp plate that is furnished. Insert the bolt through the clamp plate, mast and rotator and tighten all bolts to 150 inch-pounds. Refer to Figure 4.
9. Return the rotator to the full CW "S" position. Mount the beam pointing South. The coaxial cable should be looped as per Figure 3, in such a manner that it will not foul or tangle when the beam turns around in a circle to the full 360° counterclockwise position.

OUTSIDE TOWER

Referring to Figures 5, 6 and 7, an outside tower or pole mount is made in the same manner except that the rotator is fastened by four (4) bolts only (not six) to the Lower Mast Support, PN 51467-10. Since the eccentricity of the rotator turning in reference to the tower is no longer important, the shimming procedure is not necessary. The four (4) screws must be torqued to the same specification and the 8-wire cable securely fastened. The lower mats should be pinned with the $\frac{5}{16}$ "-18 x 4" bolt as shown in Figure 5.

CAUTION

The rotator is designed for vertical operation with the bell shaped housing in the up position. Water and other contamination will get into the motor unit if it is mounted horizontally or upside down.

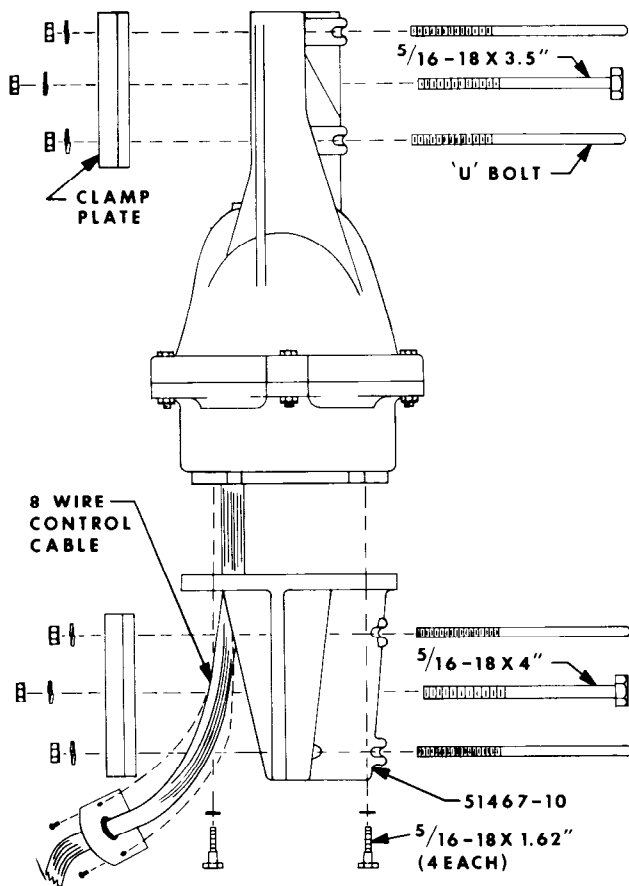


Figure 5

Rotator Mounting with Lower Mast Support

Section 7. Thrust Bearing with Sleeve (121B)

GENERAL

Product 121B is a thrust bearing that utilizes a bronze/oil bearing. It will clear up to a 2³/₁₆" diameter mast. It can be bolted to all Hy-Gain crank-up towers when the rotator is mounted inside the tower.

Section 8. Optional Accessory Kits

HEAVY-DUTY LOWER MAST SUPPORT KIT (51467-10)

The stock Tailtwister T²X is intended to mount on the base plate inside of the tower. However, in some instances, outside tower or mast mounting is desired as per Figures 5 and 7. This kit, Part Number 51467-10, contains a heavy-duty lower mast support and the necessary hardware to facilitate mounting the T²X on top of a tower stub or mast.

CAUTION

When the rotator is installed using the lower mast support kit, the antenna size must be restricted to 10 square feet (.93 m²) of wind surface area.

MOUNTING HARDWARE KIT FOR LOWER MAST SUPPORT KIT (51491-10)

This Mounting Hardware Kit, Part Number 51491-10, is offered for replacement of the hardware only of the Heavy Duty Lower Mast Support Kit. Parts included are:

Mast Clamp Plate	1
U-Bolt (stainless steel)	2
Bolt, hex head, 5/16"-18 x 1.62",	4
(stainless steel)	
Bolt, hex head, 5/16"-18 x 4.0"	1
(stainless steel)	
Nut, hex 5/16"-18 (stainless steel)	5
Lockwashers	11
Screws	2
Cover, Terminal	1
Grommet	1

Section 9. Operation

PRELIMINARY CHECK AND CALIBRATION

NOTE:

THERMAL PROTECTION: If the rotator fails to turn after 4 or 5 minutes of continuous operation, the thermal switch has come into play. This protective device in the transformer automatically shuts off power if the rotator is used continuously for too long. It will automatically reset after 10 minutes.

1. Turn the Control Unit Power "ON" with the upper right "ON-OFF" switch. The meter should be illuminated and the needle should be to the right.
2. Depress the brake lever (center) and hold. Depress the CCW lever (left) and operate the rotator to its full CCW position. If the meter does not move from the right to the left hand position, press and release the "Calibrate" switch.
3. With the rotator in its full CCW position, if the meter is not at its full left position,

BEAM NOT TO EXCEED 10.0 SQUARE FEET (.93 m²) WIND SURFACE AREA LOAD

BEAM TO TOP OF ROTATOR NOT TO EXCEED 2 FEET (607 mm)

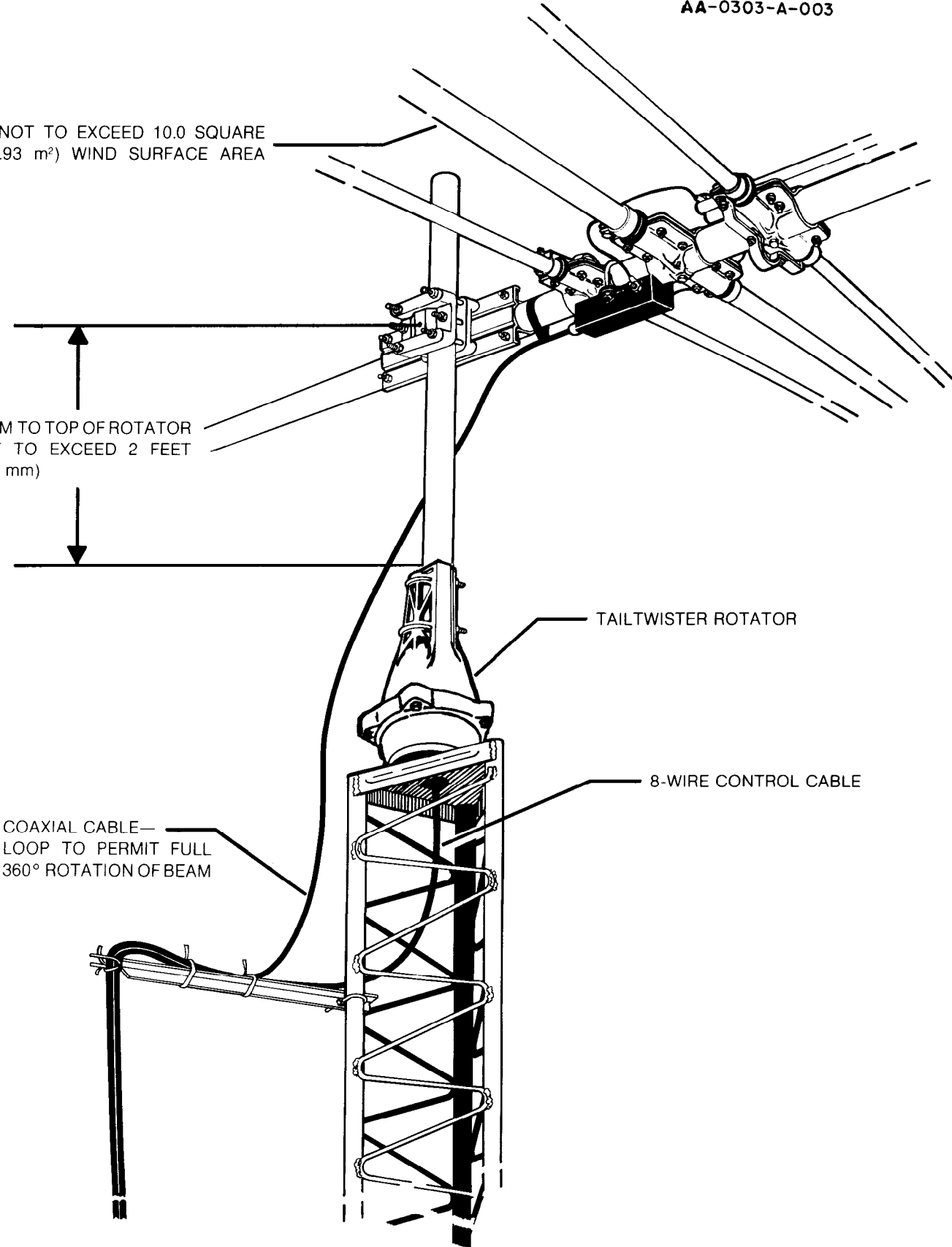


Figure 6
Rotator Mounted on Tower Top Plate

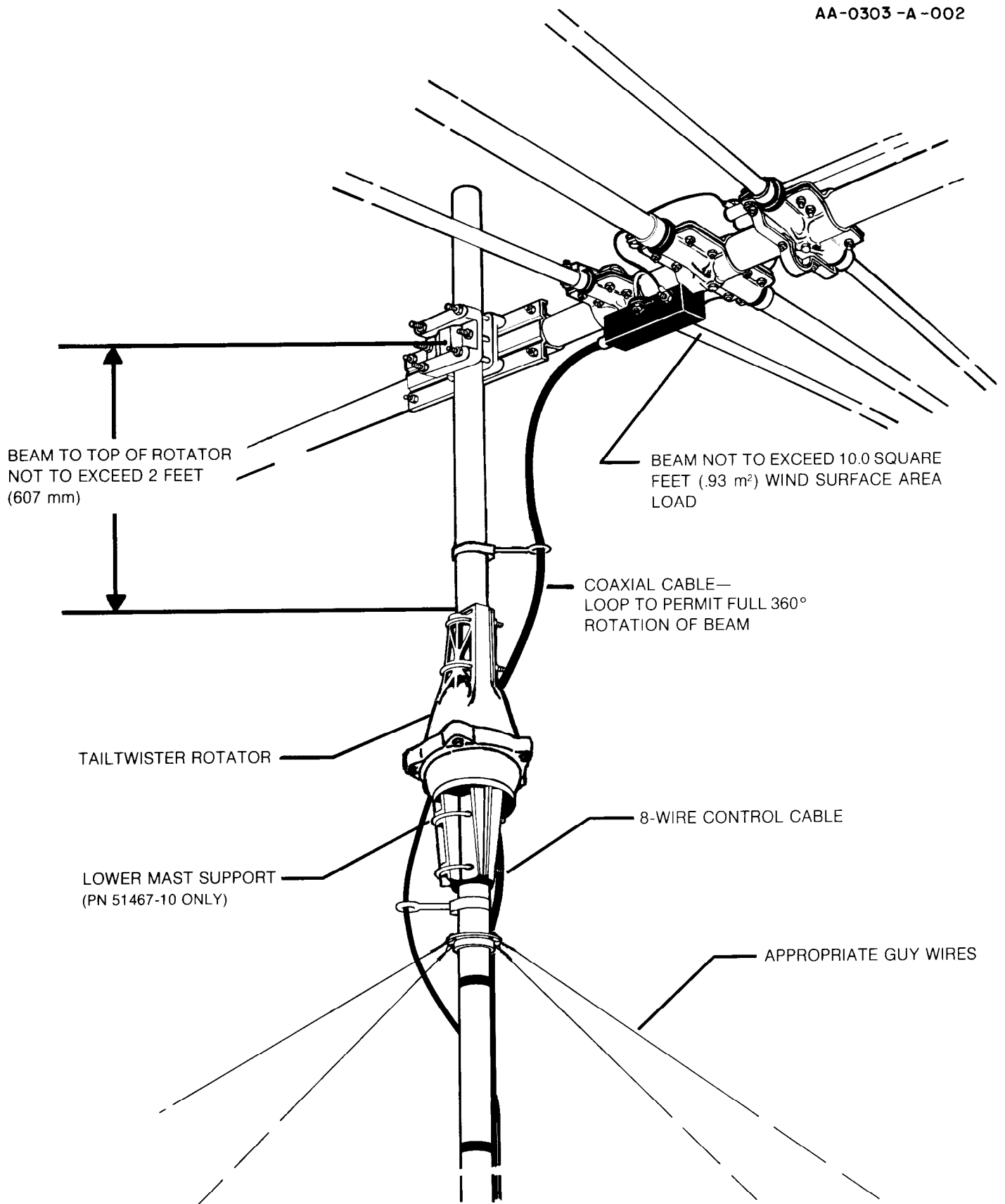


Figure 7
Pole Mounted Rotator

carefully adjust the zero (CCW South) position with the screw directly under the meter to exactly South.

4. **Meter Calibration** of the extreme full scale (right hand or clockwise South) can be accomplished at any time without disturbing the rotator using the following procedure:
 - a. With the Control Unit "ON", push in and release the "Calibrate" knob.
 - b. The meter should now indicate full scale to the right. If it does not, turn the calibrate knob until it does.
 - c. Without turning the knob, push it in and release it. The right scale is now fully calibrated to adjust for minor variations in components values. *Do not turn the knob*, even in the "push-off" position because to do so will require that it again be recalibrated.
5. Return rotator to its full CCW end of rotation.

When the control unit is turned "OFF", the meter needle will fall to the left "S" position and return to indicate the rotator position as soon as the control unit is turned "ON" again. It will not damage the unit to leave it turned "ON" for extended periods.

NORMAL OPERATION

To operate the rotator, it is necessary to understand the T²X Brake Release Lever and its function. The brake lever (middle lever) on the Control Unit operates a brake wedge mechanism in the rotator which locks the rotator into position mechanically. The rotator cannot turn unless the wedge is retracted by depressing the middle lever. The normal operation is as follows:

1. Retract the brake wedge by holding down the "Brake Release", middle lever. (Green light on.)
2. Turn the rotator to the compass location by pushing down and releasing either the left hand lever or the right hand lever.

Allow a few seconds for the rotator to coast down. Then re-engage the brake wedge by releasing the "Brake Release" (middle) lever.

OPERATING PRACTICE

The rotator has several mechanisms to protect it from misuse, but the following precautions are advisable:

1. If you have a very large beam, the rotator can be "nudged" to exactly the desired position by alternately working the left and right control, allowing it to coast down before the brake wedge is allowed to engage.
2. It is advisable not to run it full speed into the end of rotation.
3. Upon completion of turning, always allow the rotator to *coast down* by keeping your finger on the "Brake Release" after you have released the rotation lever. This procedure will allow the rotator to stop *before* you re-engage the brake wedge. Observing this sequence prevents the rotator from stopping suddenly thus preventing undue stress on the rotator beam and tower.

The motor has an internal brake which controls the coast down time and deceleration. The internal motor brake is usually strong enough to prevent pinwheeling during operation even in high winds. If the rotator is being operated in a very high wind, observe the operation of the needle. A little practice will acquaint the owner on how to operate the rotator smoothly.

Section 10. Grounding

GENERAL

The tower, or other metal support device, must be grounded to an *earth* ground at its location. Use heavy copper cable looped so that if the tower comes down for any reason, there will be adequate slack to prevent the ground wire from breaking. Use one or more 8 foot copper jacked steel stakes driven into the moist earth and fasten the wire securely at the stake and at the tower.

As mentioned in the "Cautions" portion, the steel chassis of the control box should be either grounded to a metal cold water pipe in the house or back to the electric service entrance box where the power comes into the house. This normally is accomplished with the wire of the 3-prong plug which then depends on the wall outlet being adequately grounded back to the service entrance as to the utility ground. If there is any doubt, have this checked by a licensed electrician.

Section 11. South Centered Meter Scale Conversion

GENERAL

The stock Taitwister Control Unit is shipped with the meter scale installed for "North" center operation; ends of rotation are at the "South" position. Some geographic locations and/or popular working areas may favor having the meter "South" center; ends of rotation are at the "North" position. We have provided the Taitwister with a reversible meter scale.

We recommend the following procedure:

1. Disconnect the power cord.
2. Remove the 8-wire control cable, carefully labeling each wire with its corresponding terminal number. This operation may be omitted if the control box can be worked on easily without removing the leads.
3. Remove the top and bottom covers.
4. Slip the lamp and holder off the lamp holder bracket. Loosen the hex nut on the transformer that is holding the lamp holder bracket and swing the bracket clear of the wires leading to the printed circuit board.
5. Carefully remove the hex nuts on the meter studs to free the printed circuit board. Slip the P.C. Board off the studs and pull it down under the chassis.

CAUTION

It is good practice to use a short test lead or jumper wire to short the meter studs when it is not in the circuit.

6. Loosen the meter retaining clips and remove the meter from the chassis.
7. Insert a small pen knife between the clear meter cover and black housing at either corner of the top edge and gently pry the cover loose from that corner. Repeat for the other corner. The meter cover should pop off.
8. Carefully slip a pen knife under each corner of the lower edge of the white meter scale and twist slightly until the scale clears the two small indexing pins. Remove the scale, turn it over and reinstall it. Make sure the scale fits over the indexing pins and that it is flush and tight against the black housing. This will assure free movement of the indicator needle.
9. Reinstall the meter (remove the temporary jumper), the P.C. Board and lamp hardware. Check for pinched, shorted end, or overstressed wires.
10. Reinstall the top and bottom covers.
11. Reconnect the 8-wire control cable in the exact sequence as they were removed.

If your beam was installed originally using the T²X with a "North" center scale, the antenna mast must be loosened and repositioned. In order for the meter to indicate properly, the front of your beam must point "North" when the rotator is at the ends of rotation.

Recalibrate the meter.

CHAPTER 2

CONSTRUCTION AND SERVICING

Section 1. Control Unit

GENERAL DESCRIPTION

1. **Power:** The On/Off switch is a toggle type. The unit is protected by a 3 amp line fuse which is located in a fuse holder on the back panel. The power transformer supplies power for the rotator motor. The transformer is protected by a thermal cut-out switch located in the primary. If the cut-out switch opens, turn the unit off and wait 10-15 minutes before resuming operation.
2. **Meter Circuit:** The position indicator meter and its circuitry is powered by the meter transformer. When the power switch is "ON", the meter is illuminated and continually indicates rotator position. Stability is assured by the 13 volt zener regulated power supply. The meter circuit is protected by the 1/8 amp fuse.
3. **Calibration:** The calibration switch is a push-on/push-off, turn-to-adjust type. It calibrates the right hand position (full scale) of the meter.
4. **Rotator Control:** Counterclockwise rotation is controlled by the left hand lever and CW rotation by the right hand lever. The center lever is the brake release.
3. **Drive:** A low voltage AC motor and its associated gears drive the output ring gear at about 1 RPM. The ring gear in turn is mechanically interlocked in the upper mast support (Bell).
4. **Brake:** The brake wedge and its associated components are enclosed by the lower housing casting. Sixty (60) grooves are cast into the inside surface of the brake casting walls which are engaged by the brake wedge. The wedge is retracted by a solenoid which is controlled by the "Brake Release" (center) switch on the Control Unit.
5. **Rotation Limits:** Activated by the stop arm are two electrical end of rotation switches which disconnect the motor power just before the rotating bell housing reaches its full CW (0°) or CCW (360°) positions.
6. **Bearings:** Three rows of ball bearings are provided. Lubricate sparingly with factory approved special low temperature grease (PN 51497-10).

Section 2. Rotator

(Refer to Figures 10, 11 and 12)

GENERAL DESCRIPTION

1. **Outer Housing:** The upper mast support (Bell) and the brake housing are cast aluminum. The upper mast support is secured to the brake housing by six (6) 5/16"-18 stainless steel bolts.
2. **Position Sensor:** The position sensing potentiometer is located in the top of the bell casting.

Section 3. Troubleshooting

CAUTION

This unit has been thoroughly tested and cycled before shipment. Follow the terminal board wiring carefully between Rotator and Control Box. Incorrect wiring will burn out the rotator potentiometer and void the warranty.

Be sure Rotator and Control Units are compatible. Do not intermix models with different operating voltages. This results in sluggish or non-operating performance, burned out motors, overheated transformers and

burned out rotator potentiometers, etc.

Most operational difficulties with rotators are traceable to broken, shorted or grounded wires usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact lengths and clamping to prevent strain on any single wire, will pay dividends.

MECHANICAL PLAY

Frequently, the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and mast than it is due to actual play in the rotator mechanism. A slight amount of "play" is built into the rotator to avoid binding due to environmental changes.

ANTENNA ROTATES IN HEAVY WIND

This is usually a matter of the mast slipping in the support. For large arrays, it is often necessary to drill a $\frac{5}{16}$ " hole through the clamping plate, mast and mast supports and pin them together with the stainless steel bolt supplied. If "slipping" or "turning" is suspected, return the rotator to the end of rotation and visually check to be sure that the antenna is in the original stop location as installed.

LACK OF POWER

If the antenna rotation is slow or sluggish or hard to start, check for proper voltages. If the voltages are correct, the 120-140 MFD motor start capacitor could be at fault. It is recommended that a new capacitor be tried before further action is taken.

If the electrical circuit is okay, then check for mechanical binding. Pay particular attention to bearings and alignment of the shaft on an inside tower mount. On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support.

IMPROPER METER INDICATION

The brake and motor operate independently of the indicating system. If the pilot light burns at proper brilliancy, the instrument

transformer is okay and the output is not shorted. Check the 1/8 amp meter circuit fuse with the ohmmeter. Check for about 13 VDC across Terminals No.3 and No. 7 with the switch operated. If the proper voltage is not obtained, check the individual components in the meter circuit. If the 13 VDC is present, check for 500 ohms across rotator leads No. 3 and No. 7. If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms.

NOTE: If the needle remains in the right hand "S" position, check to be sure the calibration switch is not in the "calibrate" position. An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible cause of such trouble may be localized by placing a test DC meter across Terminals No. 1 and No. 3 or No. 1 and No. 7 comparing the action of the test meter with the panel meter.

NO ROTATION—INDICATION OK

Either the thermal cut-out in the power transformer has opened or there is actually trouble in the motor circuit. After allowing time for the thermal cut-out to restore service, proceed to "Checking the Control Unit" and "Checking the Rotator from the Ground".

GROUND WIRES

Grounds on cable leads can burn out either the line fuse or the small fuse in the meter circuit. If lead No. 3 or lead No. 7 is grounded, it shorts out part of the potentiometer so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that the potentiometer burns out. Note also that any grounds may put an overload on the power transformer which could cause the line fuse to blow or overload the rectifier circuit so that the 1/8 amp fuse blows.

HELPFUL SUGGESTIONS

Be sure to check your rotator cable for shorting, open circuits, incorrect wiring, intermittent connections, shorted terminals, poor lead dress at terminals, rodent damage, and mast support or thrust bearing binding.

CHECKING THE CONTROL UNIT

1. Voltages with Unit Plugged In.

To check the control unit, plug the line cord into AC power. With no connections to the terminals, turn the on-off switch to the "ON" position, the meter light will illuminate. The meter needle will remain on the left hand "S".

Terminals 1 and 2 should show 30 volts AC (approximately) when the brake lever is depressed.

Terminals 1 and 5 should show 30 volts AC with brake release lever depressed and CW lever depressed.

Terminals 1 and 6 should show 30 volts AC with brake release lever depressed and CW lever depressed.

Terminals 3 and 7 should show approximately 13 VDC.

2. Resistances with Unit Not Plugged In.

Disconnect the AC power source and remove the 8-wire control cable. Be sure to tag each wire with the corresponding terminal number.

The control box can be checked without removing the cover by using a volt-ohmmeter to check values across terminals. Resistance across Terminals 1 and 2 should read .4 ohms. Read same value across Terminals 1 thru 5 with clockwise switch lever (right hand) depressed and across Terminals 1 thru 6 with counterclockwise switch lever (left hand) depressed. Resistance across input line cord with on-off switch in the "ON" position and the brake lever depressed should read 3.8 ohms.

CHECKING THE ROTATOR FROM THE GROUND

You may possibly avoid bringing the rotator down by making electrical checks from the control box position. This is done by disconnecting the eight (8) wires from the screw terminals and tagging them carefully Numbers 1 through 8 to correspond with the

terminal numbers from which they were removed. From the schematic diagram, it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks as shown in Table 2.

To Check	Read Resistance	Between Terminals
Brake Solenoid	.75 ohms + leads	1-2
1/2 Motor Winding	2.5 ohms + leads	1-8
1/2 Motor Winding	2.5 ohms + leads	1-4
1/2 Motor + Switch	2.5 ohms + leads	1-6
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot Switch	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to - End	0 to 500 ohms	1-7

Table 2

ADDITIONAL CHECKLIST

1. Check continuity of control wires for loose connections caused by wind.
2. Tape down control cable securely all the way to rotator.
3. Check motor winding through control cable as outlined in Table 2.
4. Check cable between leads. Static lightning charges or direct hits will cause carbon arcs in control cable at numerous spots along the cable that cannot be seen. This resistive path will break down with voltage applied to rotator. (Replace cable.)
5. Check both control and rotator terminal strips for shorts.
6. Rotation in one direction usually indicates a loose or broken cable wire, bad relay, and bad sensing transistors in some units.
7. Be sure cable is of proper size for length used. Refer to Table 1.
8. Substitute a 3 foot piece of new rotator cable to bench test unit. Proper operation

will indicate a defective rotator cable on the mast or tower, or a cable not large enough to create proper turning torque.

9. Low line voltage and cold weather will slow rotation. Using an extra long or small wire extension cord can lower line voltage.
10. Remove any rust from the terminal strip. Rust causes high resistance causing control/rotator not to work properly.

Section 4. Disassembly of the Rotator

(This applies only to Out-of-Warranty Units.)

DISASSEMBLY OF THE ROTATOR

In order to service the rotator, the unit must be disassembled. We recommend the following procedure:

1. Set the rotator on a flat surface.
2. Remove the six (6) $\frac{5}{16}$ "-18 bolts and hex nuts and carefully raise the top casting to expose the potentiometer and drive mechanism.
3. Carefully remove upper ball retaining ring. Keep it circular and lay it on clean paper.
4. See that the potentiometer strip is clean and not burned at either end and that the arm is clean at the point of contact. Use only fine rouge cloth to polish the contact arm.
5. If the drive ring happens to be near the end of rotation, hold the unit horizontal, operate the spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positioned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also, see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.

Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.

6. Lift the motor and brake mechanism out of the brake housing. Carefully remove the ball bearing retainer and place it on a clean piece of paper.
7. Remove the ring gear from the motor base. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train so that it will slide out from under the gears. Examine closely for evidence of broken or worn teeth.
8. Examine the inside of the screw terminal strip to see that there is proper clearance between the solder lugs and frame, and that there are no breaks in the insulation. Pay particular attention to the insulation at the point where the wires are held in the metal clip.
9. Examine the teeth in the brake casting.
10. To separate the motor, pot and gear assembly from the brake assembly, unsolder the solenoid leads from Terminals 1 and 2. Remove the screws holding the terminal board to the casting. Then remove the four (4) large screws in the base. Be careful to clear the wires and the terminal strip through the opening.
11. Carefully remove the ball bearing retaining ring from the lower portion of the brake housing.
12. To remove the potentiometer, remove the hex nuts and unsolder the leads. The mounting studs are integral to the motor and bell. In replacing the pot, be sure the connections are on the side which overhangs the motor.

13. To replace the motor, first remove the pot per step 12, then unsolder the black motor lead from the screw Terminal 1, the red lead from the inside left limit switch lug and the blue lead from inside the right switch lug. The fastenings holding the motor on the studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use a double locknut on this stud near the limit switch to provide clearance for leads. Use special internal/external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastener over the slot.
14. When it is necessary to closely inspect or replace gears, it is possible to remove the motor, limit switch, pot, and terminal strip without unsoldering more than the solenoid leads from Terminals 1 and 2. Remove the motor fastenings from the mounting studs. Work the motor up and out, exercising care in pulling the leads and terminal strip through the window in the gear housing. Remove the plate to expose the gears. Carefully note the positions for proper replacement.

Section 5. Reassembly of the Rotator

REASSEMBLY OF THE ROTATOR

It is assumed in the following instructions that the brake mechanism is assembled and operative. The motor and gear train along with the potentiometer and the limit switches are likewise assembled, wired and operative.

It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason, it is necessary to operate the brake mechanism electrically during step 8 of the assembly of the rotator unit.

1. See that a small amount of low temperature, high quality, light weight grease is

conservatively distributed around the ball bearings, ring gear and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures.

2. Rotate the upper spur gear until the inwardly protruding mechanical stop on the ring gear touches the channel shaped stop lever and pushed it far enough to the left to just open the left hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme clockwise end of rotation. The potentiometer arm must then be rotated to its extreme clockwise position against the top stop.
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss, which drives the potentiometer arm that is located in the bottom part of the housing, will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then, carefully insert one ball bearing assembly with the fringed rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving bosses on the ring gear must engage into the mating recesses in the top housing. This situation will result automatically if the previous instructions have been followed.
6. Clean the exposed bearing race and apply a film of grease. Then apply the top bearing assembly to the race with the rim downward.

7. Clean the brake housing and bearing race and apply a light film of grease. Place the ball bearing assembly in the lower portion of the brake housing with the retainer flange in the up position. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the bell housing. ***Do not mechanically force an exact alignment of these holes without electrically retracting the brake mechanism.***
8. Connect control unit Terminals 1 and 2 only to the corresponding terminals on the rotator while it remains clamped in the vise. Momentarily operate the "Brake Release". This will permit the brake housing to freely rotate the exact alignment of the holes. With the brake retracted, use the six (6) $\frac{5}{16}$ "-18 x 1.62" bolts, lockwashers and hex nuts to secure the upper mast support (bell) to the lower brake housing. Tighten finger tight. With the brake re-engaged, tighten all six (6) bolts in an alternate pattern to approximately 175 inch-pounds of torque. Recheck the brake to make sure that it operates freely.

It is suggested that all eight (8) wires be connected from the control box while the rotator is still on the bench and that its complete operation is checked.

Section 6. How to Get Factory Service

If service is required, the unit must be packed securely and sent prepaid to:

TELEX WARRANTY SERVICE CENTER,
DEPT. 623
Telex Communications, Inc./Hy-Gain Division
8601 N.E. Highway 6
P.O. Box 5579
Lincoln, NE 68505 U.S.A.
Phone: (402) 467-5321

For units that are in warranty, no charge will be made for any repair work required. Include a copy of your sales receipt. For out-of-warranty units, call the Warranty Service Department for prices.

The price includes rebuilding the unit, replacing all defective and/or worn parts, and return freight charges. Hy-Gain reserves the right to change prices at its option. When returning items for repair, a check or money order for the repair charges must be included. Be sure to include your name, address, zip code, and telephone number. Also, give a brief description of the problem.

12-MONTH LIMITED WARRANTY

TELEX COMMUNICATIONS, INC. ("Telex") warrants to the user, who originally purchased the product, that the product will be free from defects in material and workmanship for the following periods after such date of purchase: Material, 12 months; Workmanship, 12 months. Telex will, at its option, repair or replace free of charge such defective products subject to the following conditions:

- 1) Delivery of the product or parts postage prepaid to Telex dealer, authorized service facility or factory.
- 2) Determination by Telex that a defect exists and is covered by limited warranty. Defects due to alterations, repair by unauthorized person, insertion of non-Telex parts, misuse, accidental damage, use of the equipment for purposes other than those for which it was designed, and the like are

not covered by this limited warranty and repairs thereof will be subject to normal service charges.

- 3) Repairs and replacement parts are covered under this limited warranty only for the unexpired term of the original limited warranty.
- 4) Products purchased from unauthorized dealers are not warranted.

All claims of defect or shortge should be sent postage prepaid to:

TELEX WARRANTY SERVICE CENTER,
DEPT. 623
Telex Communications, Inc./Hy-Gain Division
8601 N.E. Highway 6
P.O. Box5579
Lincoln, NE 68505 U.S.A.
Phone: (402) 467-5321

VALID ONLY IN U.S.A.

THIS LIMITED WARRANTY IS EXPRESSLY IN LIEU OF ANY EXPRESS OR IMPLIED WARRANTY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE WHICH EXTENDS BEYOND THE TERM HEREOF. THE REMEDIES PROVIDED BY THIS LIMITED WARRANTY ARE THE ONLY REMEDIES AVAILABLE TO ANY PERSON. NO PERSON HAS ANY AUTHORITY TO BIND TELEX TO ANY REPRESENTATION OR WARRANTY OTHER THAN THOSE PROVIDED BY THIS LIMITED WARRANTY. TELEX SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES CAUSED BY FAILURE OR OTHERWISE OF THE PRODUCT.

Some states do not allow exclusions or limitations of incidental or consequential damages or limitations on how long an implied warranty lasts, so the limitations or exclusions herein may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

IF YOUR UNIT IS DAMAGED, CONTACT YOUR DEALER OR THE SHIPPER. IF ANY OF THE ITEMS ARE MISSING, RETURN THE COMPLETE UNIT TO YOUR DEALER OR WRITE THE FACTORY FOR ASSISTANCE. A COPY OF YOUR SALES RECEIPT MUST ACCOMPANY ANY RETURN.

CHAPTER 3 PARTS LIST

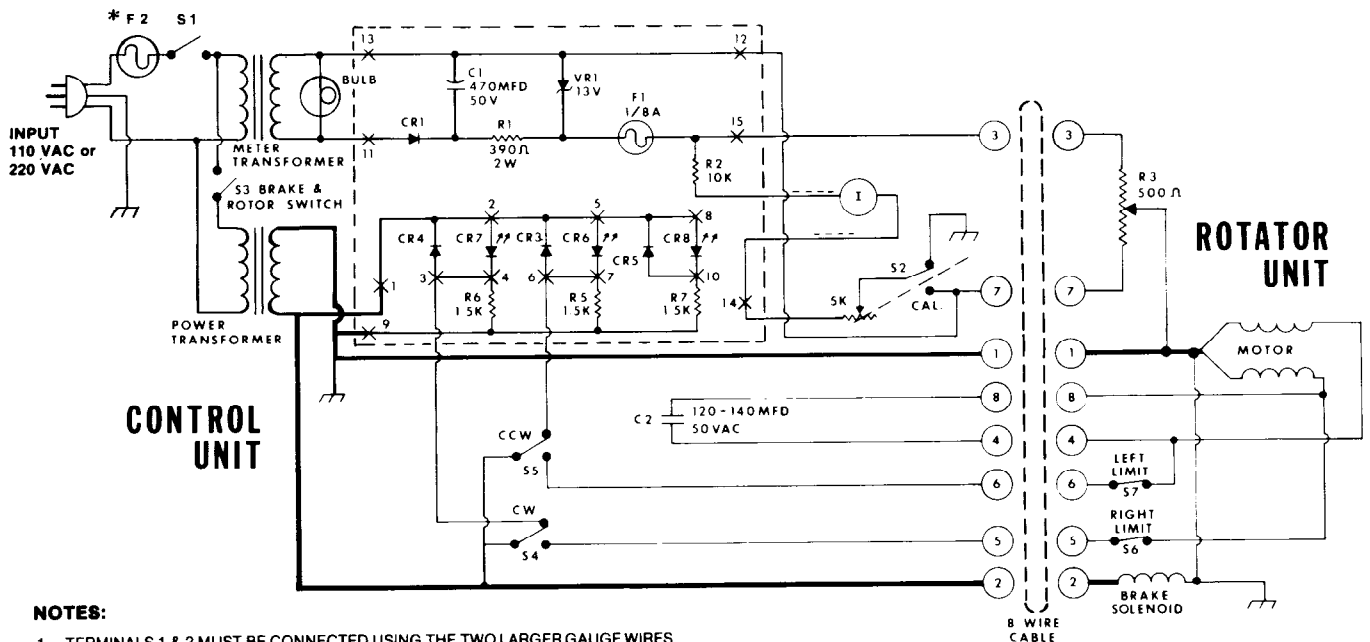
T²X Control Unit Replacement Parts Kits

Item No.	Part No.	Description	Qty
1	51403-02	Control Unit, 220 VAC, complete	1
2	51479-10	Control Unit, 120 VAC, complete	1
3	51480-10	Printed Circuit Board Assembly Kit	1
3a		Capacitor, 470 Mfd., 50V C-1	1
3b		Resistor, 390 ohm 2W R-1	1
3c		Resistor, 10K ohm 1/4W R-2	1
3d		Resistor, 1.5 ohm 1/4W R-5, R-6 & R-7	3
3e		Diode, Zener, 13V 50 MA VR-1	1
3f		Diode, PIV 100V, 1A CR-1, CR-3, CR-4 & CR-5	4
3g		Fuse, 1/8 Amp F-1	1
3h		Diode, Light Emitting, Red CR-6 & CR-7	2
3i		Diode, Light Emitting, Green CR-8	1
3j		Lead Wires	8
4	51437-10	Expandable Parts Kit (110V version)	1
4a		Fuse, 3 Amp, F-2	2
4b		Fuse, 1/8 Amp, F-1	2
4c		Bulb, Meter	2
5	51437-20	Expandable Parts Kit (220V version)	1
5a		Fuse, 1 Amp, Slo-Blo, F-2	2
5b		Fuse, 1/8 Amp, F-1	2
5c		Bulb, Meter	2
6	51492-10	Switch Kit	1
6a		Switch, S-3, S-4 & S-5	3
7	51485-10	Indicator Light Kit	1
7a		Diode, Light Emitting, Red	2
7b		Diode, Light Emitting, Green	1
8	51482-10	Miscellaneous Hardware Kit (110V version)	1
8a		Knob, Calibration	1
8b		Terminal Board (8 Terminals)	1
8c		Screws	2
8d		Lever, Switch for S-3, S-4 & S-5	3
8e		Strain Relief, cable and screw	1
9	51482-20	Miscellaneous Hardware Kit (220V version)	1
9a		Knob, Calibration	1
9b		Terminal Board (8 Terminals)	1
9c		Screws	2
9d		Lever, Switch for S-3, S-4 & S-5	3
9e		Strain Relief, cable clip and screw	1
9f		Washer, Backup	1
10	51481-10	Cover Kit	1
10a		Cover, Top	1
10b		Cover, Bottom	1
10c		Screws	8
10d		Skid Pads	4
11	51441-10	Transformer Kit (Power), 120 VAC	1
12	51442-10	Transformer Kit (Meter), 120 VAC	1
13	51449-10	Transformer Kit (Power), 220 VAC	1
14	51450-10	Transformer Kit (Meter), 220 VAC	1

T²X CONTROL UNIT REPLACEMENT PARTS KITS (cont.)

Item No.	Part No.	Description	Qty
15	51483-10	Capacitor Kit, Motor Start C-2.....	1
16	50861-10	Line Cord Kit, 3-wire, 120 VAC, U.S.	1
17	50798-00	Line Cord Kit, 220 VAC, European	1
18	51499-10	Meter Kit	1
18a		Meter	1
18b		Bulb Holder	1
18c		Mounting Hardware	1
18d		Bezel	1
19	51444-10	Switch Kit, On/Off (S-1) for units with knob-type switch	1
20	51776-10	Switch Kit, On/Off, S-1	1
21	51445-10	Switch Kit, Calibration, S-2	1
22	51446-10	Fuse Holder Kit (for F-2) (110V version)	1
23	51446-20	Fuse Holder Kit (for F-2) (220V version)	1
23a	51484-10	Face Plate Kit	1
24	51448-10	Chassis Kit (110V version)	1
25	51448-20	Chassis Kit (220V version)	1
26	51439-20	Grounding Lug Kit (220V version)	1
26a		Wing Nut, 1/4"-20	1
26b		Nut, hex, 1/4"-20	1
26c		Lockwasher, internal, 1/4"	2
26d		Flatwasher, 1/4"	2
26e		Bolt, 1/4"-20 x 3/4"	1

Hy-Gain reserves the right to change prices at its option. Current prices may be obtained by calling or writing the factory. Please send a stamped, self-addressed envelope.



NOTES:

1. TERMINALS 1 & 2 MUST BE CONNECTED USING THE TWO LARGER GAUGE WIRES OF THE 8 WIRE CABLE.
2. X DENOTES WIRING CONNECTION TO THE P.C. BOARD.
3. ----DENOTES MECHANICAL CONNECTION TO METER

* (F-2 — 3A Fuse, 110V/1A Slo-BlO, 220V)

Figure 8
T²X Schematic

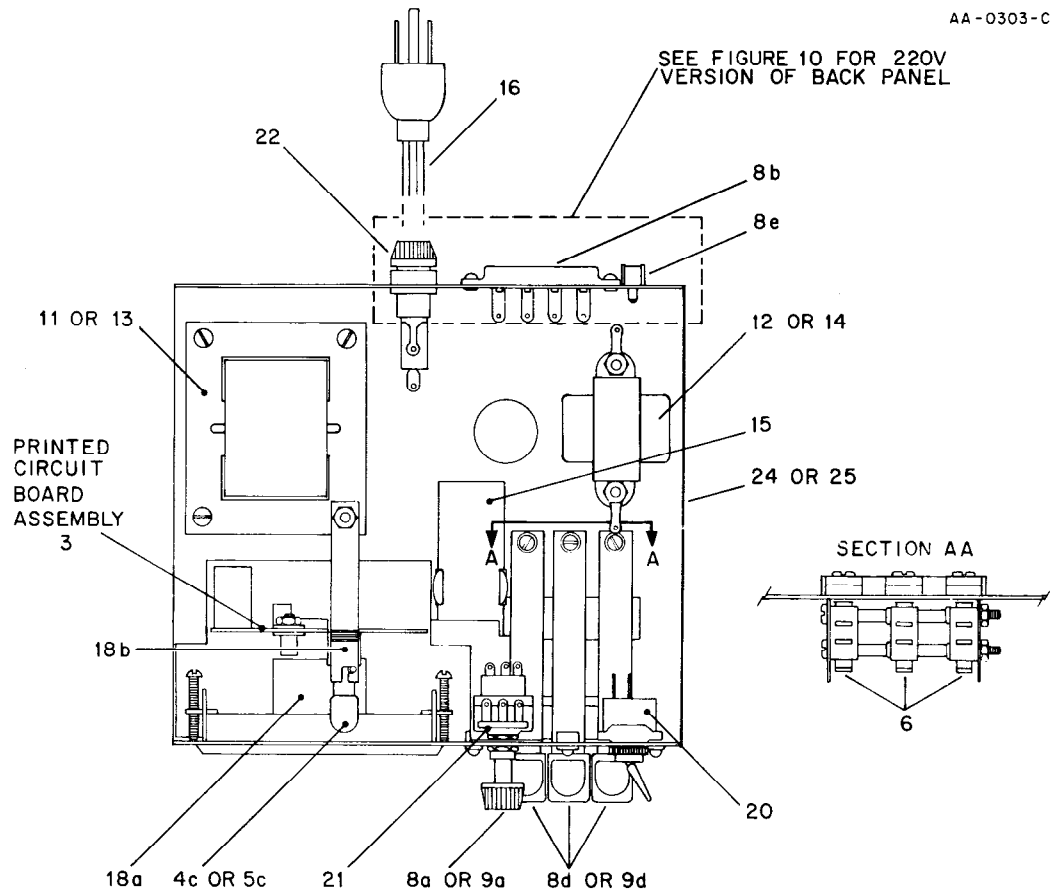


Figure 9
Control Unit - Top View

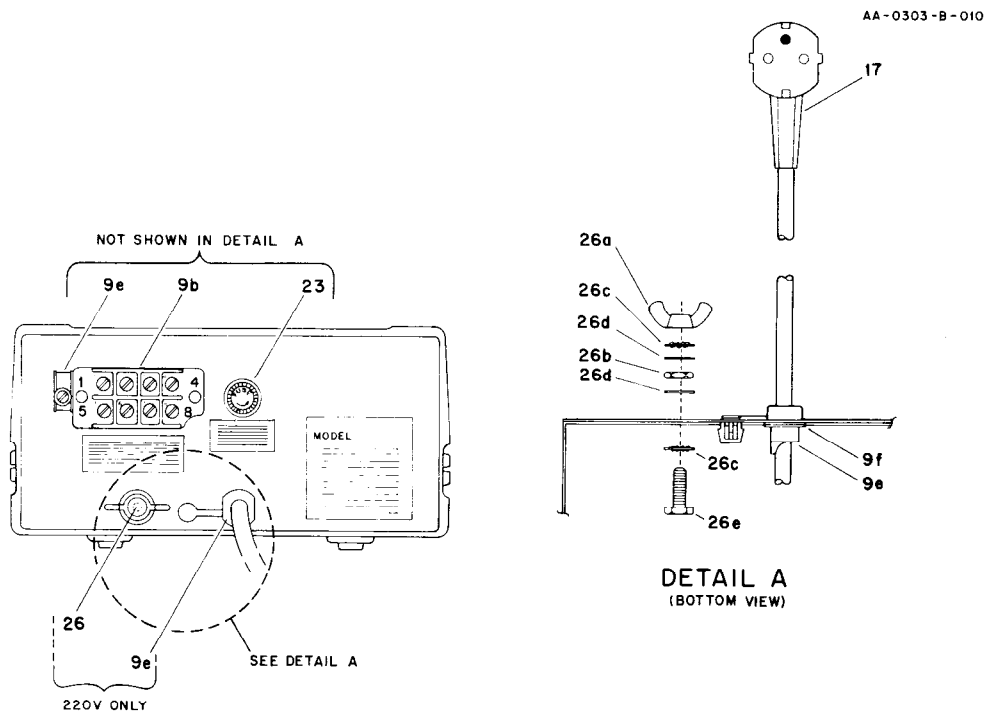


Figure 10
Control Unit - Back View

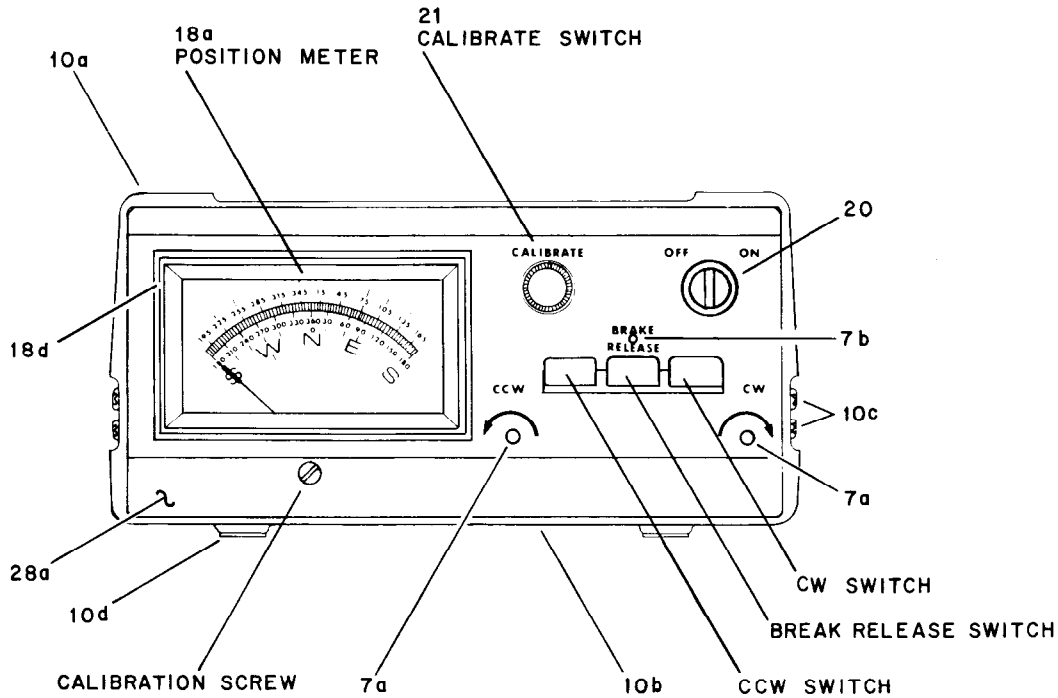


Figure 11
Control Unit - Front Panel

T²X Rotator Replacement Parts Kits

Item No.	Part No.	Description	Qty
27	51486-10	Rotator, complete with hardware	1
28	51487-10	Upper Mast Support Kit (Bell Casting)	1
29	51488-10	Brake Housing Kit (Lower Casting)	1
30	51454-10	Ball Bearing Kit	2
30a		Ball Bearings	49
30b		Bearing Retainer	1
31	51489-10	Ball Bearing Kit	1
31a		Ball Bearings	40
31b		Bearing Retainer	1
32	51490-10	Brake Support Casting Kit	1
33	51456-10	Gear and Pinion Kit	1
33a		Gear and Pinion (1st, 2nd & 3rd from motor)	3
33b		Gear and Pinion (thick pinion, 4th from motor)	1
33c		Small Gear Spacer	1
33d		Large Gear Spacer	1
33e		Washer	3
34	51457-10	Final Spur Gear Kit	1
34a		Final Spur Gear	2
34b		Bushing for Gear	1
35	51494-10	Ring Gear Kit	1
36	50423-10	Stop Arm Kit	1
37	50370-10	Base Casting and Gear Shaft Assembly Kit	1
38	51459-10	Motor Mounting Plate Kit	1
39	51470-10	Motor and Pinion (Brass) Kit	1

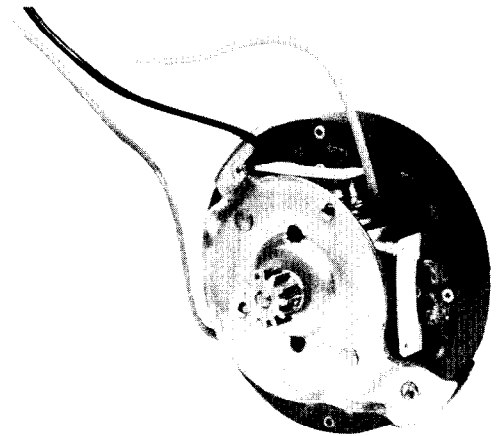
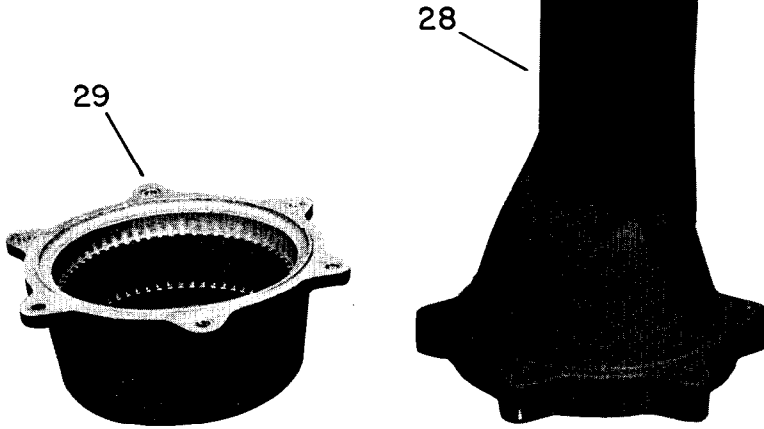
T²X ROTATOR REPLACEMENT PARTS (cont.)

Item No.	Part No.	Description	Qty
40	51461-10	End of Rotation Switch Assembly Kit	1
40a		Switches	2
40b		Bracket	1
41	51460-10	Potentiometer Kit (R-3)	1
42	51462-10	Solenoid (Brake) Kit	1
43	51493-10	Brake Wedge and Hardware Kit	1
43a		Brake Latch	1
43b		Latch Spring	2
43c		Latch Pin	2
43d		Latch Pin Retainer	2
43e		Extension Spring	2
43f		Connecting Links	2
43g		Connecting Link Pin	1
43h		Connecting Link Washer	1
43i		Brake Wedge	1
43j		Brake Wedge Support	1
43k		Solenoid Pin	1
43l		Solenoid Spacer	3
43m		Retaining Pin	2
44	51465-10	Terminal Board Assembly (8 Terminals) Kit	1
44a		Terminal Board	1
44b		Screws	2
45	51495-10	Bolt Kit, Hex Head	1
45a		Bolt, hex head, $\frac{5}{16}$ "-18 x 2.0", stainless steel	6
45b		Nut, hex, $\frac{5}{16}$ "-18, stainless steel	6
45c		Lockwasher	6
46	51422-10	Mounting Hardware Kit	1
46a		Mast Clamp Plated Steel	1
46b		U-Bolt, stainless steel	2
46c		Bolt, hex head, $\frac{5}{16}$ "-18 x 1.62", stainless steel	6
46d		Bolt, hex head, $\frac{5}{16}$ "-18 x 3.5", stainless steel	1
46e		Nut, hex, $\frac{5}{16}$ "-18, stainless steel	5
46f		Lockwasher	11
47	51497-10	Grease, Special Kit (quantity for one overhaul)	1

T²X Rotator Parts Kits Identification

AA-0303-A-011

AA-0303-A-012

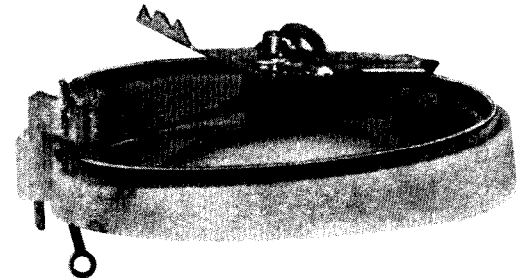
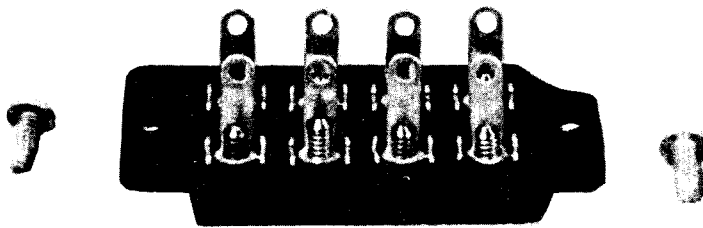


Item No. 28 — Upper Mast Support Kit
 Item No. 29 — Brake Housing Kit (Lower Casting)

Item No. 39 — Motor and Pinion Kit

AA-0303-A-013

AA-0303-A-014

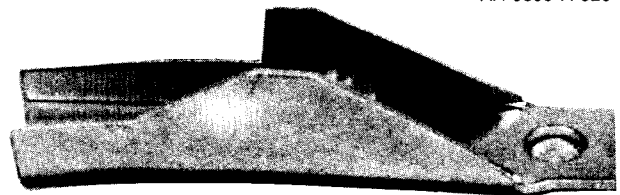
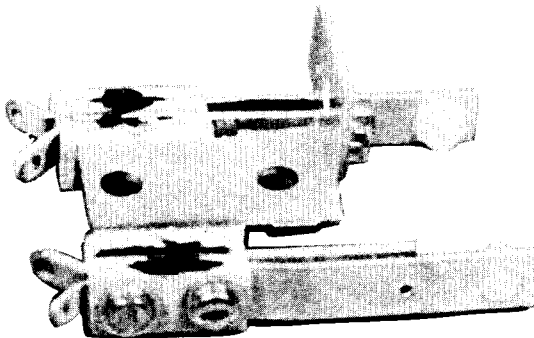


Item No. 44 — Terminal Board Assembly Kit

Item No. 41 — Potentiometer Kit

AA-0303-A-019

AA-0303-A-020

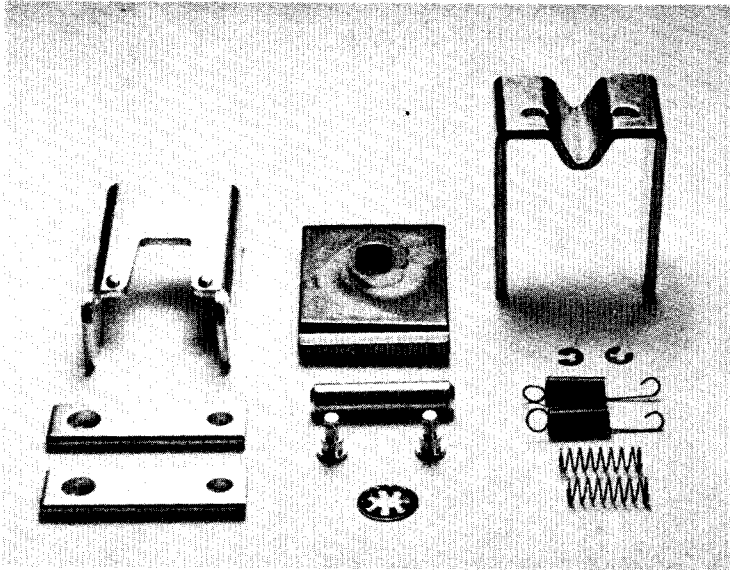


Item No. 40 — End-of-Rotation
 Switch Assembly Kit

Item No. 36 — Stop Arm Kit

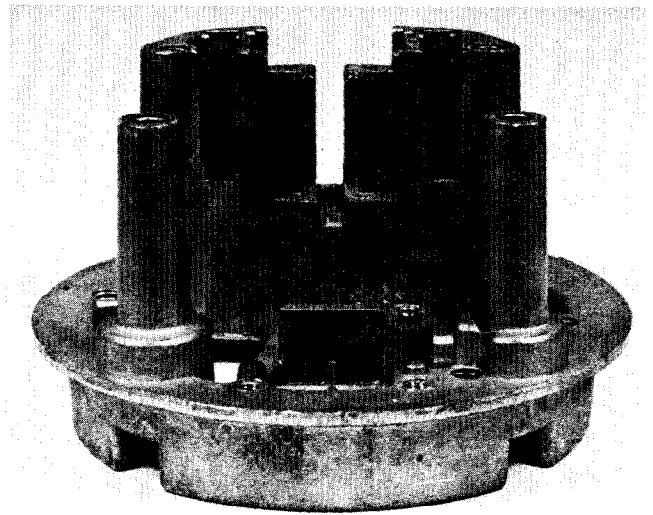
T²X ROTATOR PARTS KITS IDENTIFICATION (cont.)

AA-0303-A-015



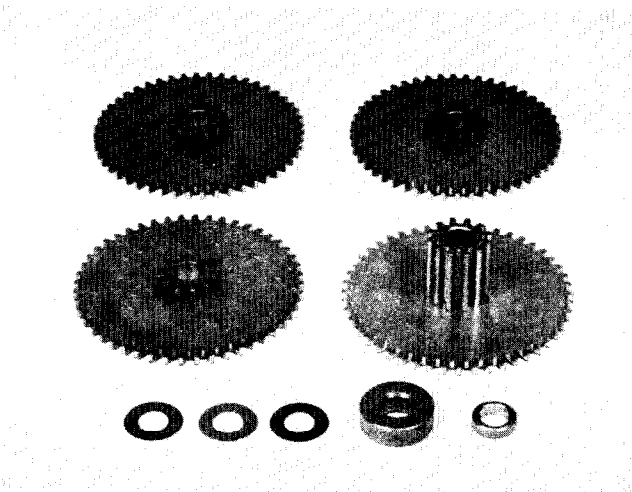
Item No. 43 — Brake Wedge and Hardware Kit

AA-0303-A-016



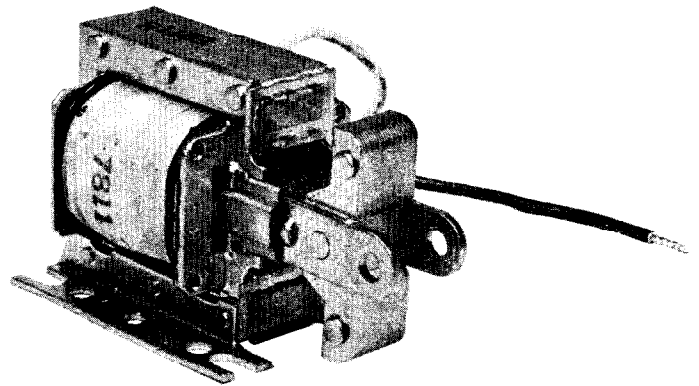
Item No. 32 — Brake Support Casting Kit

AA-0303-A-017



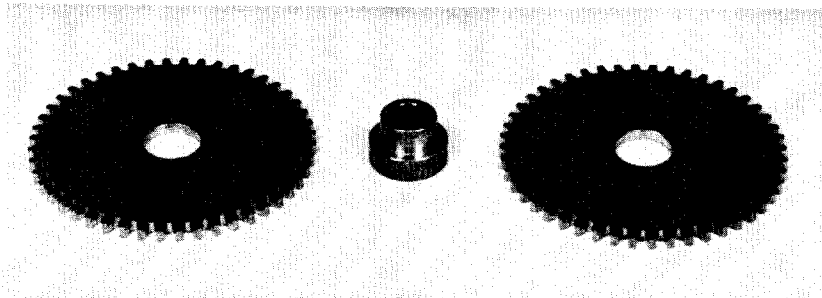
Item No. 33 — Gear and Pinion Kit

AA-0303-A-018



Item No. 42 — Solenoid (Brake) Kit

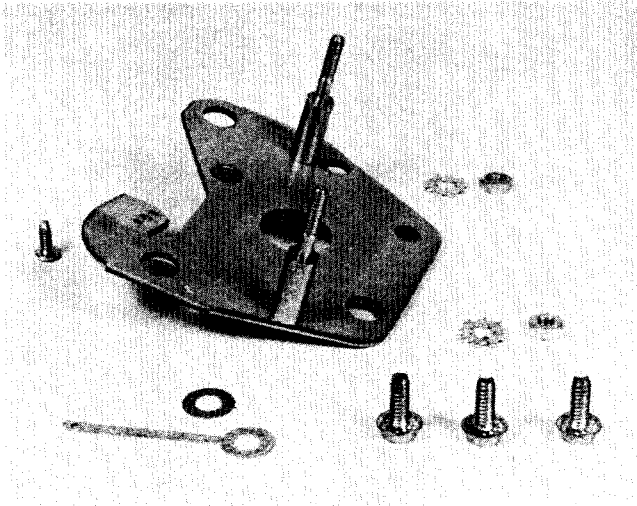
AA-0303-A-022



Item No. 34 — Final Spur Gear Kit

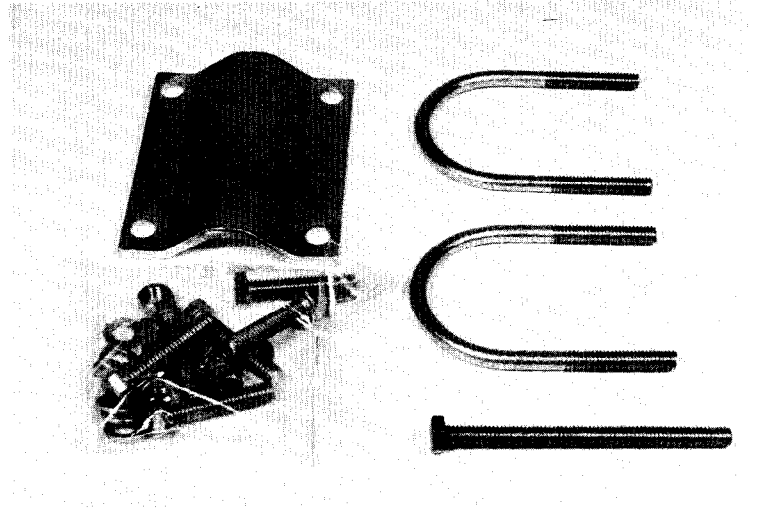
T²X ROTATOR PARTS KITS IDENTIFICATION (cont.)

AA-0303-A-021



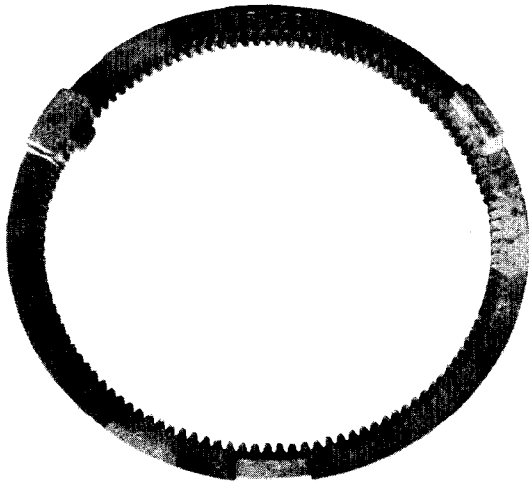
Item No. 38 — Motor Mounting Plate Kit

AA-0303-A-023



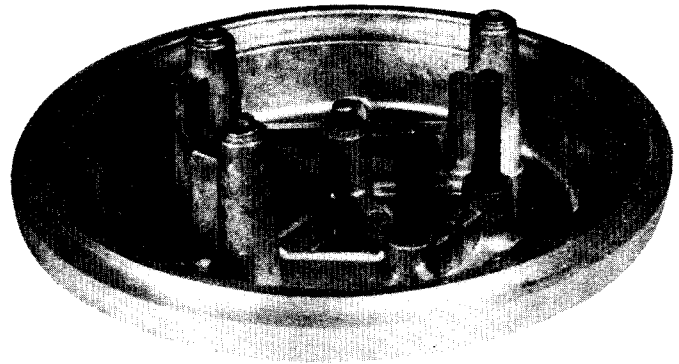
Item No. 46 — Mounting Hardware Kit

AA-0303-A-024



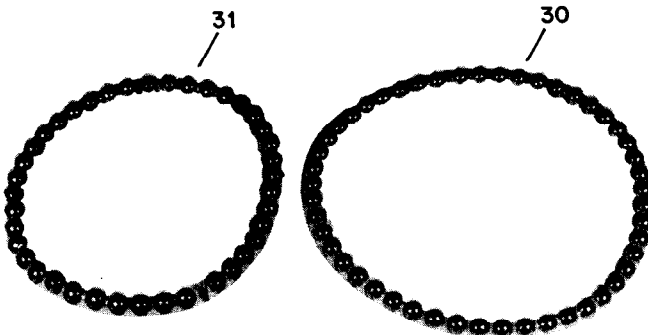
Item No. 35 — Ring Gear Kit

AA-0303-A-025



Item No. 37 — Base Casting and Gear Shaft Assembly Kit

AA-0303-A-026



Item No. 30 — Ball Bearing Kit
Item No. 31 — Ball Bearing Kit

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