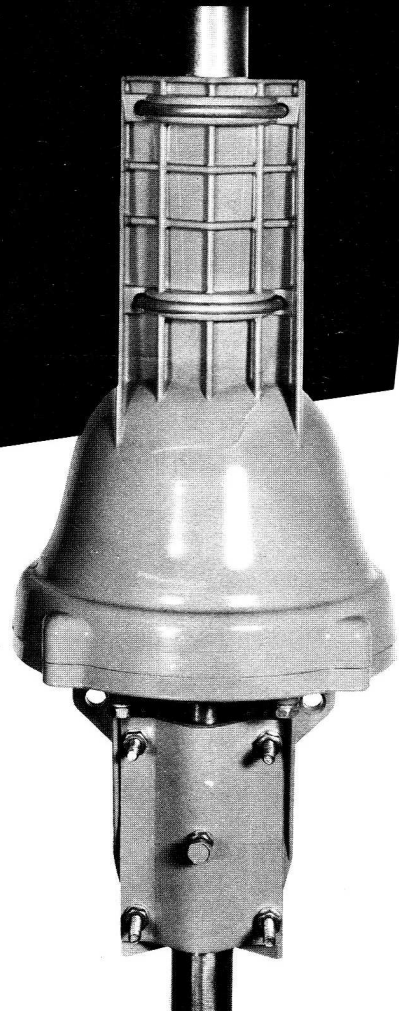


THIS ROTOR IS FOR 220 VAC  
SERVICE. ALL REFERENCES TO  
110 VAC SHOULD BE 220 VAC.

# CDR HAM ROTOR

## *Service Manual*

**MODEL  
TR-44**



**CORNELL-DUBILIER ELECTRONICS**

DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY

Rotor Department

Fuquay-Varina, North Carolina

# Service Manual FOR CDR ROTOR

## MODEL TR-44

**Foreword** On the following pages, you will find information obtained from the Engineering Staff where the CDR Rotors are built, the Service Engineering Group, and from amateurs who have TR-44 Rotors installed. No attempt has been made to detail every possible installation or suggest every maintenance procedure that may be necessary to cover many years of operation. Please feel free to communicate with us at any time that we may be of assistance. Write to:

**CORNELL-DUBILIER ELECTRONICS**  
DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY

**CDR Rotor Department**  
118 E. Jones Street  
Fuquay-Varina, North Carolina

**General** The TR-44 Rotor is designed to support moderately large antenna arrangements and provide for rotation of such antennas through a complete 360 degree range. Position of the antenna is indicated on a meter in the control box.

This rotor is built along the general lines of the original TR-2 and TR-4 rotors which have been used extensively for television reception for many years. The weight of the upper mast and antenna is carried directly in line with the supporting mast. The rotor, radial and thrust bearings, gear train and indicating mechanism are specially built into an elongated bell shaped housing made of aluminum.

### Specifications

Input voltage ..... 115 VAC 60 Cycles (105-125)  
Motor ..... 24 V., 1 $\frac{3}{4}$  Amp., Split phase 10% duty  
Capacitor ..... 185-210 MFD—Electrolytic 10% duty  
Power Transformer ..... 115/26 VAC, 10% duty, Thermal cutout  
Meter ..... DC Milliammeter 0-1 MA  
Meter Scale ..... Direct reading in degrees from North  
(5 degree increments)  
Recommended Cable... Belden #8467 or equivalent. 7 wires  
#18  
Max. Cable Resistance  
for Proper Operation... Not over 1 Ohm (This is about 150 ft.  
#8467 cable)  
Indicating Accuracy... Within 5 degrees of true compass di-  
rection when exactly calibrated  
360° Rotation Time... Approximately 50 seconds  
Control Box Size ..... 5 13/16" wide, 6" deep, 5 1/4" high  
Rotor Dimensions... 8" max. dia. x 17 3/8" high with top and  
bottom mast supports. Less lower  
mast—10 7/8" high  
Weight (Pounds)..... Rotor with top mast support — 8 3/4.  
Lower mast support only—2 1/2. Con-  
trol box complete—5 3/4. Total ship-  
ping weight 19 1/4 lbs. approx.  
Permissible Mast Size... From 7/8" to 2 1/16" diameter  
Mounting Hardware... 1/4" Stainless steel "U" bolts and nuts.

### Checking Control Unit

It is recommended that a prelimi-  
nary check be made on the control  
unit and the rotor itself before  
actual installation to detect possible shipping damage.

To check the control unit, plug it into 110 volt AC power. With a jumper between terminals #1 and #7, operate the control lever to the left slightly. The meter should read full scale. Turning the adjusting control on the rear of the unit should cause some change in the meter deflection. Check for similar operation with the control lever pushed slightly to the right. To check the power circuit, connect an AC voltmeter between terminals 4 and 7 on the rear panel and see that approximately 30 volts is indicated when the control lever is shifted to the extreme right. Connect the same meter between terminals 5 and 7 and see that approximately 30 volts is indicated as the control lever is moved to the extreme left only.

### Checking Rotator

Connect all 7 terminals of the control box to the corresponding 7 terminals of the rotor using the coil of cable obtained for the installation. CAUTION — SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY BURN UP THE POT STRIP IN ROTATOR.

With the rotor in an upright position without the lower mast support assembled, operate rotator by means of control unit lever in both directions.

### Meter Calibration

Run rotator to full left extreme and use zero-center screw to put needle exactly on left limit while holding lever operated. Then run to right extreme and adjust calibrating control on rear to put needle exactly on right limit. Left end adjustment depends only on installation. Right hand adjustment varies with line voltage and must be rechecked periodically if extreme accuracy of indication is desired.

Recheck of calibration requires rotation of antenna to right hand extreme.

### Rotor Installation

The TR-44 rotor is engineered to handle antennas with relatively high wind resistance. Long and trouble-free performance of the rotor with antennas of different types, depends upon making an installation to properly handle the stresses involved.

1. The center-of-gravity and center of wind load force of the antenna should be as close to the top of the rotor casting as possible. One to three feet is practical with most installations. When the array is stacked and an antenna with a boom length exceeding 8 ft. is to be mounted more than 5 ft. above the top of the rotor, use of a heavy duty tower with the rotor mounted inside is mandatory. The antenna support pipe then should be 2 inch O.D. steel with 1/4 inch wall, rotating in a ball-thrust bearing at the top of the tower. The rotor should be mounted inside the tower within 4 feet of this bearing to minimize rotating whip in the tubing. All reliable tower manufacturers will be glad to advise the best method for inside mounting with their product. A rugged mount can be made easily with angle iron and "U" bolts that will fit any tower.

A typical installation requiring this type of mounting would be a medium-sized Tri-band antenna one foot above the top of the tower and a combination six-two meter array mounted 10 feet above.

2. The TR-44 easily mounts on a pipe or top of tower, but certain precautions must be observed to obtain good service. The rotor can be subjected to tremendous leverage forces mounted in this manner, but the thousands of long term successful "top" installations prove its potential feasibility. A careful survey of hundreds of such installations points up several factors. The center-of-gravity and wind loading of the antenna array must be centered over the rotor and not more than 12 inches above it if any part of the antenna array is more than 10 feet from the rotor. The reasoning behind this is simple. The ball-thrust bearing races in the base of the TR-44 are just over 6 inches in diameter. 50 lbs. exerted against a 10 ft. lever will place approximately 2,000 lbs. of "pinch" on these bearings. Each additional foot of leverage or pound of force multiplies this value by a high ratio. Extreme care should be used in any very high, top of clear hill installations. Here the wind forces may be applied at odd angles, such as, a severe up-draft that lifts one side of the antenna array, multiplying leverage many-fold.

Some typical installations that "top" mounting of the TR-44 Rotor can handle in coverage installations would be: Single medium Tri-band 12 inches above top of rotor; stack of a six element 6 meter beam just above rotor with 8 element 2 meter antenna mounted not more than 5 ft. above it; "Box 4" array of four 8 element 2 meter yagis with the center not more than 1 ft. above rotor; and Quads of reasonable size and weight arranged to place the center of gravity inside the rotor.

3. Every effort should be made to eliminate any source of flexure in the mount or antenna. During even moderate breezes, such flexing can set up an oscillating motion that results in thousands of pounds of torque or bending moment. The two degrees of "lost motion" built into every CDR rotor acts as a vibration dampener but can only counteract for moderate swing. After determining proper orientation of rotor and antenna, we suggest that a  $\frac{3}{8}$ " hole be bored through the tapped pilot hole in the upper and lower clamp plates ARU-68—through the support mast—and out through the "V" casting TRA-1 & TRA-44. Then run a  $\frac{3}{8}$ " stainless steel bolt and nut of the proper length, tighten securely, through the whole assembly. This is the only known method of insuring no slip at these two points with a large array. The same treatment should be given any large antenna where it mounts on the support pipe.
4. To summarize: Successful operation of the TR-44 with moderately large antennas is assured if a proper mechanical installation commensurate with the total size of the entire system is made. Please do not attempt another "Easy" 10 ft. by attempting to mount an antenna of any size on top of a  $1\frac{1}{4}$  inch "T.V." mast on top of the rotor—you are just going to pick up pieces after the first wind gust! Do provide a good mechanically solid support for the rotor at the height desired for the antenna; then keep the center of gravity of the array close to the top of the rotor. If there is any doubt about a "Top" mount, then invest in a good inside tower installation; it is an excellent investment.

### Inside Tower Mounts

A cylindrical space of  $8\frac{1}{4}$ " diameter and 12" height will accommodate the TR-44 Rotor bolted to a flat plate without lower mast clamp attached.

ON ANY INSIDE TOWER INSTALLATION, GREAT CARE MUST BE EXERCISED TO GET THE TOP MAST SHIMMED TO EXACT CENTER OF THE ROTOR MAST SUPPORT. The geometry is such that a  $2\frac{1}{16}$ " diameter will be exactly centered. For each  $1/16$ " less diameter used,  $1/32$ " thickness of aluminum must be used around the mast or at least on each side of the V support. To center a 2" O.D. mast, use  $1/32$ " thick shims.

**Balanced Weight** produces only down-thrust on the rotor. With 50 ball bearings operating in accurately machined races, the rotor is capable of handling considerable downward pressure in line with the axis of rotation.

**Unbalanced Weight** creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the top of the rotor. 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 stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

**Wind Pressure** against the boom and elements usually produces a bending force on the mast which causes the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure, the top mast should be as short as possible. In order to distribute the bending stress and prevent fracture of the mast, the TR-44 rotor includes two long, heavy, specially designed steel clamping plates. These are grooved to grip the mast securely. It is recommended that the mast be reinforced in the area where it is clamped by driving a hardwood dowel of proper size into the end of the mast.

**Start-stop Torsion** Torsional or twisting forces must be given special considerations when using the TR-44 Rotor.

The rotating inertia of the antenna in motion must be safely absorbed when the rotor stops. It is essential that all mechanical assemblies making up the antenna array be solidly clamped so that no slipping occurs even under heavy icing conditions. Particular attention must be given to clamping of the boom to the mast, and the masts to the rotor, as the greatest leverage occurs at these points.

**Mechanical Description** The motor drives a train of spur and pinion speed reduction gears which in turn drive the ring gear. The ring gear drives the bell shaped upper mast support, into which the antenna mast is mounted in rigid central alignment.

A boss is cast on the under side and in the center of the cavity of the upper mast support, which engages the serrated edge of the potentiometer arm which is mounted on the top of inner mechanism.

Maximum support and low frictional loss between the rotating upper mast support and the inner mechanism is assured by the use of two groups of 25 steel balls each riding in the bearing races between the two assemblies, and held in special nylon retainers.

Mechanical stops along with electrical limit switches are built into the rotor mechanism to provide accurate and complete 360 degree rotation.

**Circuit Description** The power transformer supplies approximately 30V. AC for operating the motor when the control lever is moved completely to the left or right of the mid-position. Overheating of the transformer from prolonged operation or possible short circuit is prevented by a thermal cut-out switch in the primary winding.

The motor is a two-phase device, the first winding is supplied AC direct from the transformer, while the second has a 100-

130 mfd. capacitor in series in order to shift the phase and provide forward rotational torque. To reverse, the capacitor is switched in series with the first winding, while the second is directly supplied from the transformer. This switching is done by simply moving the control lever from side to side, the center position is off, and cuts the line voltage off the entire unit.

The transformer is energized as the control lever is moved slightly to the left or right of mid-position. It supplies approximately 14 VDC through a capacitor, rectifier and zener diode to the 500 ohm potentiometer in the rotator.

The meter is a high quality DC instrument requiring 1 MA for full scale deflection. It is connected with plus side through the 10K multiplier to the plus side of the pot. The meter circuit is completed through the 5K calibrating control on the rear to the pot arm which is grounded.

Two electrical limit switches in the rotator cut the motor power just before the rotation reaches the extremes. A fuse is included in one side of the supply line. The calibrating control, accessible from the rear, is used to establish exact readings for the particular line voltage present.

## Servicing the Control Unit

Disconnect the AC power source and remove the seven-wire cable. Tag each wire with its number.

Read Resistance	Between Terminals	Switch Lever
11K to 16K	1-2	Center
18K to 25K	1-4*	Right
18K to 25K	1-5*	Left
18K to 25K	1-7*	Center
2700	2-4*	Right
2700	2-5*	Left
2700	2-7*	Center
0	4-7*	Right
0	5-7*	Left

\*plus lead on first terminal indicated

With power cord connected and jumper from terminals #1-7 meter, should read full scale when pot is adjusted.

Read Voltage	Between Terminals	Switch Lever
14VDC	2-7	Right or Left
26VAC	4-7	Right
26VAC	5-7	Left

## Checking the Rotator from the Ground

One may possibly avoid bringing the rotator down from the mast by making electrical checks from the position of the control box. This is done by disconnecting the seven wires from the screw terminals and tagging them carefully #1 through #7 to correspond with the terminal numbers from which they are 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.

Leads of #18 AWG have approximately 0.64 ohm resistance per 100 feet. Use a low resistance ohmmeter to check the values shown in the table below to an accuracy of 10 percent after adding the resistance of the leads involved.

To Check	Resistance Series 1	Resistance Series 2	Between Terminals
1/2 Motor Winding	2.5 ohms*	1.6 ohms*	3 - 7
1/2 Motor Winding	2.5 ohms*	1.6 ohms*	6 - 7
1/2 Motor + Switch	2.5 ohms*	1.6 ohms*	4 - 7
1/2 Motor + Switch	2.5 ohms*	1.6 ohms*	5 - 7
Entire Motor	5 ohms*	3.2 ohms*	3 - 6
Right Limit Switch	0 ohms + leads		3 - 4
Left Limit Switch	0 ohms + leads		5 - 6
Entire Pot Strip	500 ohms		2 - 7
Pot Arm to + End	0 to 500 ohms		1 - 7
Pot Arm to - End	0 to 500 ohms		1 - 2

\* plus leads

## Disassembly of Rotator

1. Remove the bottom mast support to permit the rotator to be set on a flat bench.
2. Remove four screws and carefully raise top casting to ex-

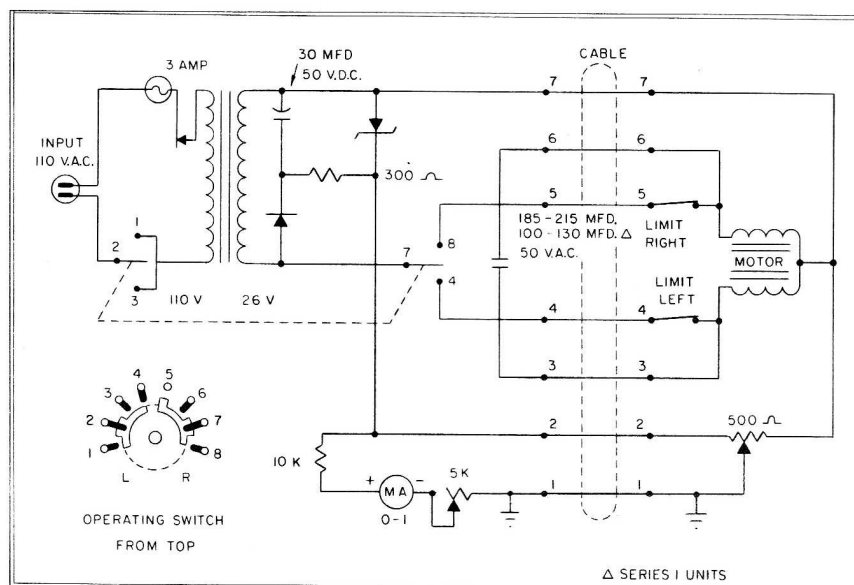


Fig. 1 — Schematic Diagram

pose potentiometer and drive mechanism.

3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. Inspect inside of top housing for small scratches or burned spots on the ribs. These are an indication that a switch blade or connection is rubbing during rotation. See that the pot strip is clean and not burned at either end. See that pot body is secure and that pot arm is clean at the point of contact. Use only fine rouge cloth to polish contact arm. Check limit switch to see if wires are secure and insulation is undamaged. Contacts should be clean. Check for 1/32" clearance between switch blades and motor—particularly alongside of lockwasher under motor fastening. Greater clearance gets switch too close to top bell housing ribs.
5. If the drive ring happens to be near end of rotation, operate the top 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.
6. 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.
7. Remove the drive ring gear from the base housing. 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 higher 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 solid lugs and frame and that there are no faults in the insulation. Pay particular attention to the insulation at the point where the wires are held in metal clips.
9. To remove potentiometer, remove hex nuts. Unsolder leads. Mounting studs are staked to the motor frame. Be sure that the pot strip is clean and that pot arm is not corroded. Use only fine rouge cloth as an abrasive. In replacing the pot be sure the connections are on the side which overhangs the motor.
10. To replace the motor, first remove the pot per Paragraph 9, then unsolder black motor lead if not done in step 9, the red lead from inside left limit switch lug, and the blue lead from inside right limit switch lug. Fastenings holding motor on 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 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 fastening over the slot.
11. When it is necessary to closely inspect or replace gears, it is possible to remove motor, limit switch, pot, and terminal strip without unsoldering. Remove motor fastening from the mounting studs. Work motor up and out, exercising care in pulling leads and terminal strip through the window in the gear housing. Remove plate to expose gears. Carefully note positions for proper replacement.

## Final Reassembly of Rotator

It is assumed in the following instruction that the motor and gear train along with potentiometer and limit switch are likewise assembled and wired and operative.

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 upper spur gear until the inwardly protruding mechanical stop on the ring gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counter-clockwise position against the top brass 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 which is located in the bottom part of the ball 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 flanged 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 lugs on the ring gear must engage the mating lugs in the top housing. This situation will result automatically if the previous instructions have been followed.
6. Determine that the top bearing surface is clean and apply a film of grease on the top ball race and the top bearing assembly. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the retaining ring and apply a light film of grease to the ball race only. Lower the retaining ring into place so that the assembly holes will approximately line up with the threaded holes in the upper housing. Insert the 4 assembly screws and use a heavy screwdriver to completely tighten the 4 assembly screws.
8. It is suggested that all 7 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

## TROUBLE SHOOTING

Field experience has shown that most operational difficulties with the rotor 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 length, and clamping to prevent strain on any single wire, will pay big dividends later in long and trouble-free performance. Put it up right—and leave it up!



Should trouble occur, first follow the suggestion on page four for "Servicing Control Unit" and "Checking Rotator From Ground". Compare resistance values with Schematic Diagram to localize trouble. The following "symptoms" and "treatments" may also be helpful.

### Mechanical Play

To prevent binding under adverse operating conditions, a small amount of play is designed into the rotor. Even a degree or so of rotary play will permit several inches movement at the end of a wide antenna boom, or at the tips of the elements. Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and masts than it is due to actual play in the rotor mechanism.

### Antenna Rotates in Heavy Wind

This is usually a matter of the mast slipping in the support. A false indication of suspected "slipping" can be obtained by comparing meter readings at different times when the beam has not been "rotated officially." Check the nuts on the U bolts that they are tight. Also check that the center bolt in the mast clamp is tight.

### Lack of Power

so that antenna rotation is slow or sluggish. Use method on page four to check motor from ground. Check the capacitor. Check transformer for AC output.

If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of shaft on an inside tower mount. As a last resort, dismantle the rotor to check gears, bearings, etc.

### No Meter Indication

If the instrument transformer is OK and output is not shorted, check for about 14 VDC across terminals #2 and #7 with switch operated. If this is present, check for 500 ohms across these leads to rotor (disconnected at control box). If 500 ohms is present from #2 and #7, see if the reading from #2 to

ground and #7 to ground total 500 ohms. If this is so, connect an auxiliary meter from terminal #7 to ground and see that voltage runs from zero to about 14 VDC as antenna is rotated from left to right extremes.

### No Rotation — No Indication

Either the thermal cutout in the power transformer has opened to protect the motor or capacitor from excessive heat of prolonged operation or there is actually trouble in the circuit. After allowing time for the thermal cutout to restore service, proceed with suggestions above for "lack of power".

### Grounded Leads

Grounds on cable leads can cause completely erroneous readings and even burn out the pot strip. For full explanations, refer to Schematic on page four. Note that a ground on any of the AC leads #3, #4, #5, or #6, can cause the pot to burn out. If lead #2 is grounded, it shorts out part of the pot, 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 it burns out.

### Meter Fluctuation

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 causes of such trouble may be localized by placing a test DC meter across terminals #1 and #7. The test meter will show about 14 VDC.

Where the meters are steady in preceding tests, and there is fluctuation with rotator leads connected, it indicates trouble in the lead wires or rotator itself. Any dirt, grease or corrosion that breaks or interferes with the ground return will not allow any meter movement. In such cases it is necessary to open the rotator per instructions on page four. The ground connection is carried through the potentiometer pivot directly to the frame.

## PARTS AND PRICE LIST

### FOR CONTROL UNIT

[For ordering procedures See Page 8]

Part No	Name	Quantity	Price Each
MCU-178	Control Unit Assembly	1	\$30.00
TRB-67	Motor Capacitor, 185-215 Mfd. 50 VAC	1	3.00
FG-303	Fuse, 3 Amp 3 AG	1	.20
H-334	Silicon Rectifier	1	2.50
H-368	Zener Diode	1	5.00
IT-69	Terminal Strip	2	.10
MCU-5-1	Switch Handle Assembly	1	.50
MCU-103	Wafer Switch	1	1.90
MCU-108-1	Potentiometer, 5K, W.W. 2 Watt	1	1.50
MCU-109	Capacitor, 30 Mfd. 50 VDC	1	1.50
MCU-112	Fuse Holder	1	.40
MCU-116	Potentiometer Knob	1	.25
MCU-127-2	Meter, 0-1 MA, special (North Center Scale)	1	20.00
MCU-148-2	Meter Crystal	1	1.95
MX-82	Control Cabinet	1	3.75
RP-36	Recess Bumper	4	.05
TRA-21	Terminal Board	1	.60
MCU-101	Transformer	1	9.00
W-758	Resistor 300 Ohm, 1 Watt	1	.25
W-759	Resistor 10K Ohms, 1 Watt	1	.25
WM-12	AC Cord	1	.80
ACU-96*	Transformer	1	5.75
TRB-4*	Motor Capacitor, 100-130 Mfd. 50 VAC	1	3.00

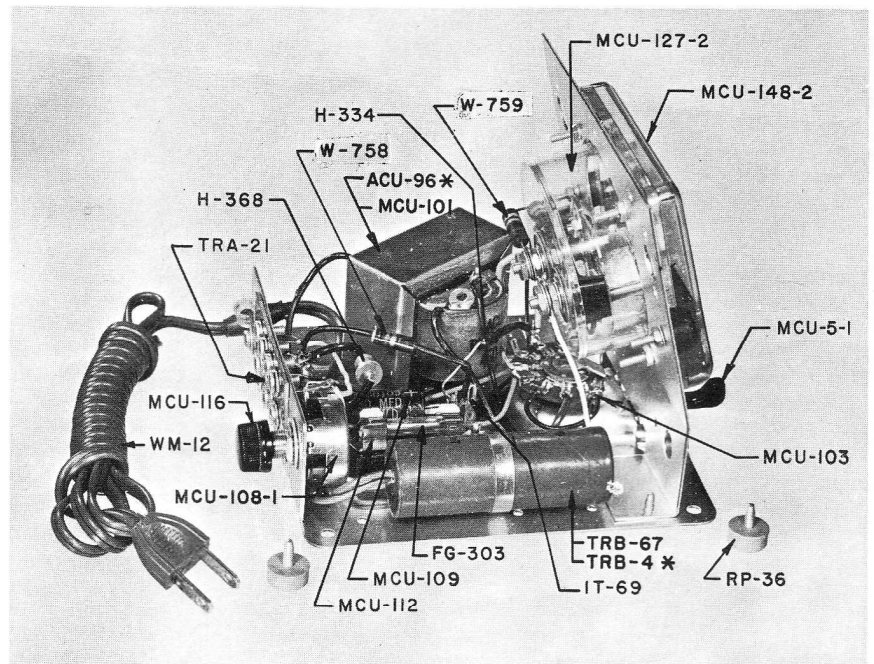


Fig. 2

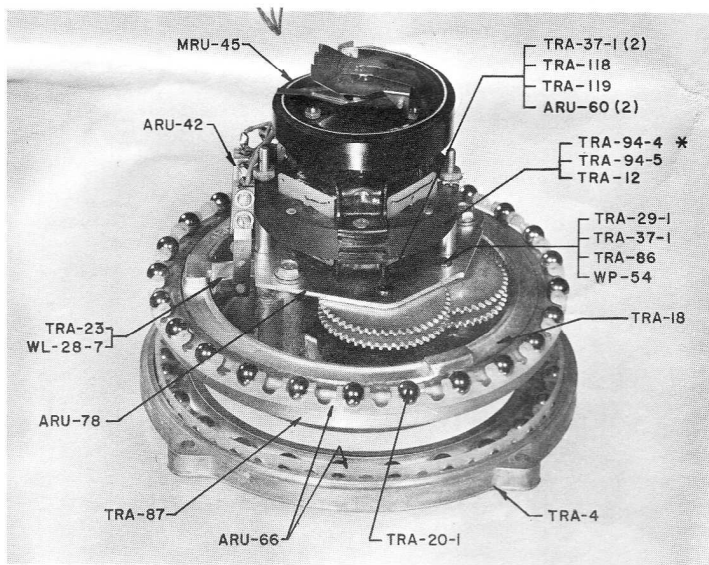


Fig. 3

\* Series 1 Units

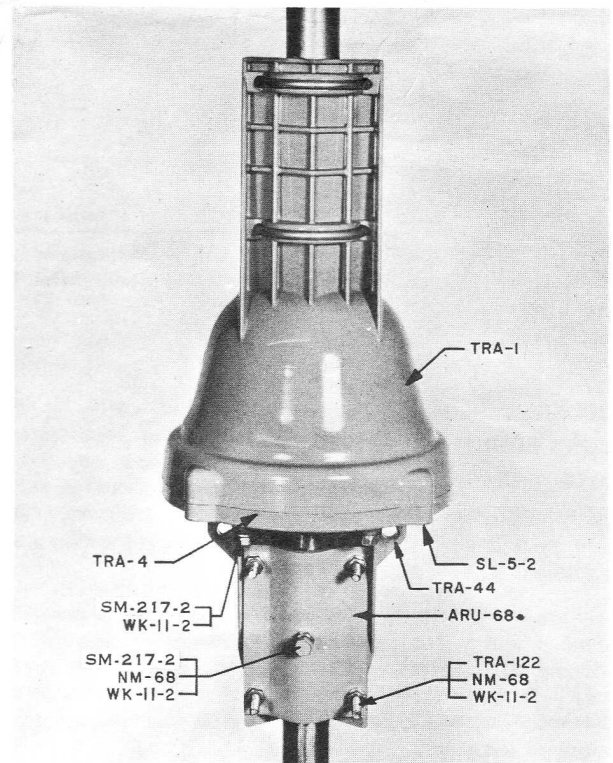


Fig. 4

# PARTS AND PRICE LIST

## FOR TR-44 ROTATOR UNIT (For ordering procedures See Below)

Part No.	Name	Quantity	Price Each
MRU-68	Rotator Unit Assembly	1	\$37.15
ARU-42	End of Rotation Switch Assembly	1	2.75
ARU-60	Final Spur Gear	2	1.75
ARU-66	Ball Retainer	2	.75
ARU-78	Motor Mounting Plate with Studs	1	1.75
MRU-45	Potentiometer Assembly	1	6.75
TRA-1	Upper Mast Support (Bell Casting)	1	8.50
TRA-4	Retaining Ring—Casting	1	1.25
TRA-12	Motor Pinion	1	.40
TRA-18	Ring Gear—Casting	1	1.25
TRA-20-1	Ball Bearings	50	.05
TRA-21	Terminal Board Assembly	1	.60
TRA-23	Stop Lever Assembly	1	.30
TRA-29-1	Small Gear Spacer	1	.10
TRA-37-1	Gear & Pinion (1st, 2nd, & 3rd. from Motor	3	.75
TRA-86	Gear & Pinion (Thick Pinion, 4th. from Motor	1	.90
TRA-87	Base Casting	1	4.00
TRA-94-4	Motor with Potentiometer Mount Attached	1	9.75
TRA-118	Large Gear Spacer	1	.25
TRA-119	Bushing for Final Gear	1	.30
TRA-122	1/4"—20 Stainless U Bolt	4	.40
SL-5-2	# 12—28 x 5/8 Fillister Head Sems Screw	4	.05
SS-64-2	# 6—32 x 3/8" Self Tap Screw	2	.05
WL-28-7	Retainer for Stop Lever Assembly	1	.05
WP-54	Washer	3	.05
TRA-44	Lower Mast Support Assembly	1	4.25
AK-128	Accessory Kit	1	5.00
ARU-68	Clamp Plate	2	.75
NM-68	1/4"—20 Stainless Hex Nut	10	.10
SM-217-2	1/4"—20 x 1 1/4" Hex Machine Screw	6	.05
TRA-122	1/4"—20 Stainless U Bolt	4	.40
WK-11-2	1/4"—Split Ring Lockwasher	14	.05

### Changes Incorporated in Rotator Unit — Series 2

TRA-94-4	Motor with Potentiometer Mount	Omit	
TRA-94-5	Motor with Potentiometer Mount	Add	9.75

### Purchase of Replacement Parts

An adequate stock of parts for the HAM rotor is maintained at our plant. These may be purchased directly at the listed prices or your dealer distribu-

tor will be glad to obtain them for you. Direct factory orders should be addressed: **CDR Rotor Parts Dept., 2070 Maple St., Des Plaines, Illinois.**

Please enclose check or Money Order to cover cost of parts and postage if unit is out of warranty. Requests for warranty replacement parts or service should be directed to the above, giving date of purchase, and a description of the trouble encountered. Authority to return merchandise must be cleared in advance of shipment.

### Warranty

We warrant each new TR-44 rotor in accordance with E.I.A. Standards against defects of material or workmanship for a period of **three months** from the date the rotor is sold to the original purchaser, provided that the WARRANTY SLIP included in the manual has been properly filled out and returned as specified.

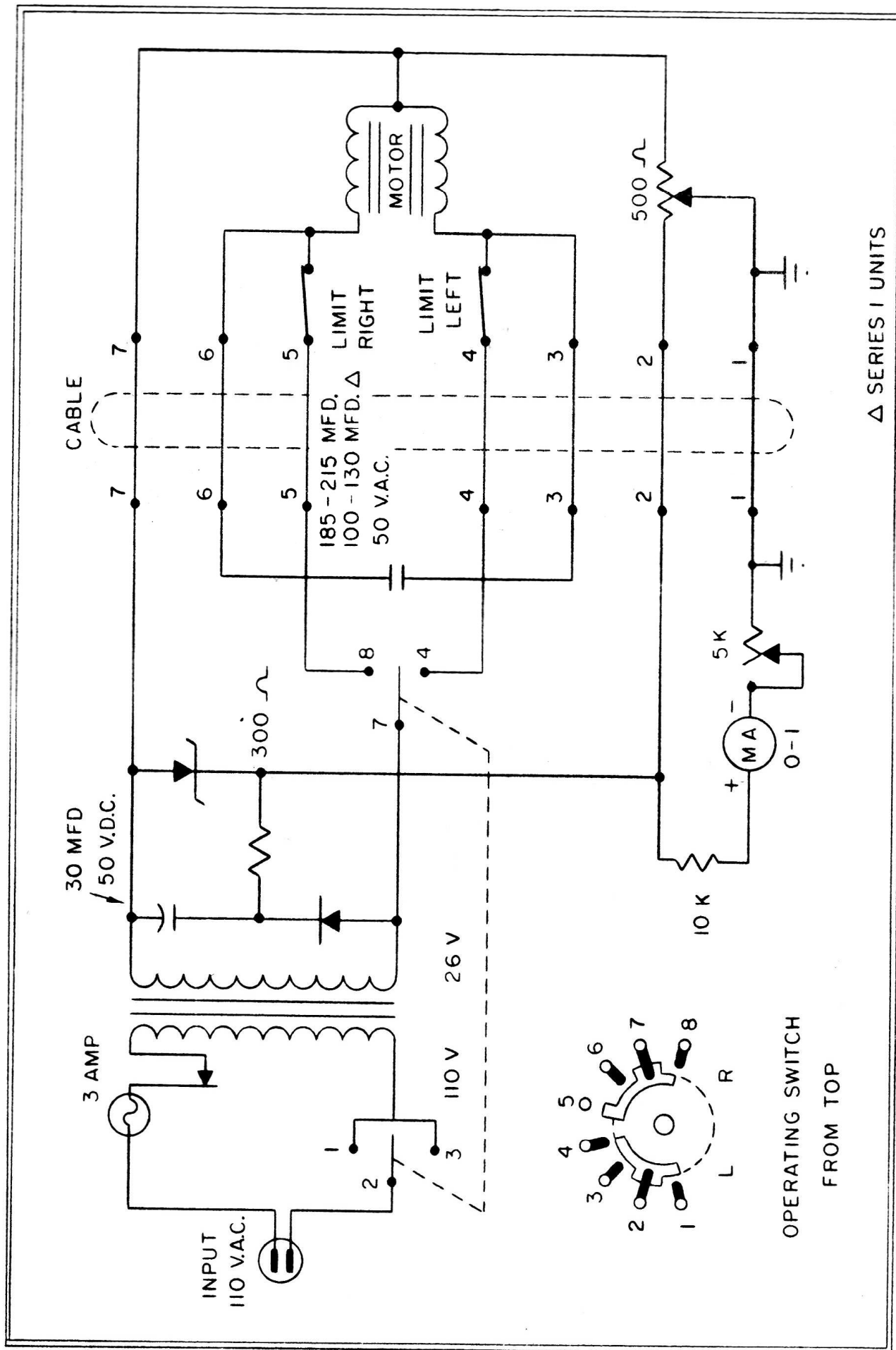
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Δ SERIES 1 UNITS

Fig. 1 — Schematic Diagram